DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET REQUEST
OFFICE OF ENERGY RESEARCH

OVERVIEW

BASIC ENERGY SCIENCES

This country has long recognized the importance of basic research and has considered the federal investment in its scientific base a top national priority. The Basic Energy Sciences (BES) program is an essential component of both the Department and the federal commitment to R&D in the U.S. today. Working with the national laboratories, universities, industry, and other government agencies, the BES program supports research which provides the foundation for new technologies and improvements to existing technologies which are crucial to achieving the goals described in the National Energy Plan.

Basic research is the first link in the chain of events from scientific discovery to technological innovation. Results from BES sponsored research become an integral part of the information base which underpins the nation's nuclear and non-nuclear technologies. In addition to supporting research for the country's technology foundation, BES supported research helps to train our future scientists, and helps us attain our national goals. Better health and quality of life, economic competitiveness, energy, self-sufficiency, and national security are each supported from a strong program in basic research. The research in the BES program is grouped into six major subprogram areas: materials sciences, chemical sciences, applied mathematical sciences, engineering and geosciences, energy biosciences, and advanced energy projects.

In FY 1989, the budget request for the BES program has been split into two parts; one which address the research activities supported by the program which is included in the Energy Supply Research and Development Appropriation; and the second part which addresses all aspects of the operation and construction of the major national user facilities which is a part of a new Basic Research User Facilities Appropriation. This method of budget presentation will enhance the understanding of the funding resources required for research and the funds necessary to operate the national user facilities effectively and efficiently.

The new program, Basic Research User Facilities-Basic Energy Sciences (BRUF-BES), includes the seven major user facilities which are now operating: the High Flux Beam Reactor and National Synchrotron Light Source at Brookhaven National Laboratory, the Combustion Research Facility at Sandia-Livermore, the High Flux Isotope Reactor and the Transuranium Processing Plant at Oak Ridge National Laboratory, the Stanford Synchrotron

Radiation Laboratory at Stanford University, the Intense Pulsed Neutron Source at Argonne National Laboratory and the Los Alamos Neutron Scattering Center at Los Alamos National Laboratory; and one under construction, the 1-2 GeV Synchrotron Light Source at Lawrence Berkeley Laboratory; and one proposed for construction, the 6-7 GeV Synchrotron Radiation Source at Argonne National Laboratory. Each of these facilities is unique in the capabilities which they offer the scientific and engineering community and their success in meeting the nation's research needs has been praised by many high level committees.

The BES program supports research in several ways. The BES program annually supports approximately 1200 individual research projects at over 200 separate institutions with direct support for over 1500 researchers in the physical, biological, and mathematical sciences. These projects are selected on the basis of scientific excellence, relevance to BES' support of DOE long-term goals, and their contribution toward a responsive research program.

BES also is providing advanced state-of-the-art computational support for several Energy Research programs other than Magnetic Fusion Energy [which is directly supported by the National Magnetic Fusion Energy Computer Center (NMFECC)] e.g., High Energy and Nuclear Physics, and Biological and Environmental Research as well as its own program.

The BES strategy continues to be:

- Provide critical knowledge and data by supporting basic research relevant to DOE mission areas;
- Exchange information with other DOE programs, Federal agencies, and the academic and industrial scientific communities;
- Take full advantage of the scientific and industrial communities' identification of needs and opportunities for research in areas likely to be relevant to future energy options;
- Develop trained scientific talent through support of basic research at universities and national laboratories; and
- Promote early applications of the results of basic research.

The Basic Energy Sciences program takes advantage of the research capabilities available at national laboratories, government laboratories, universities, and private research laboratories in the conduct of the program. The national laboratories, with their traditional focus, are especially valuable in doing research which is applicable to a number of energy concepts. The interactions possible are very great because laboratory scientists are frequently involved in many aspects of the applied energy programs. In addition, the stability of the organization and specialized capabilities which exist at the laboratories in many instances are unmatched. Many of the scientists involved in BES research programs are faculty or students at universities. Their research is enhanced through access to special facilities at national laboratories. More than one-third of BES funding supports university-based research. The list of universities receiving support covers almost every state and includes participation by both large and small institutions.

In addition to universities and national laboratories, BES supports research in and maintains ties with industry. Representatives from different industries serve on the BES Advisory Committee; experts from industry participate in the review of research proposals and use the specialized facilities sponsored by BES; industrial scientists participate in program advisory committees at the national laboratories; and industry representatives are invited to attend BES conferences and workshops on special topics.

The FY 1989 request for the Basic Energy Sciences program attempts to address a continuing need for research essential to meeting the long-term goals of the Department and Nation.

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET REQUEST
OFFICE OF ENERGY RESEARCH
(dollars in thousands)
LEAD TABLE
Basic Energy Sciences

Activity	FY 1987	FY 1988	FY 1989 Base	FY 1989 Request	Program Change Request vs Base Dollar	Program Change Request vs Base Percent
Operating Expenses						
Materials Sciences	$118,640	$125,991	$125,991	$134,621	$ + 8,630	+ 7%
Chemical Sciences	79,226	88,218	88,218	93,125	+ 4,907	+ 6%
Applied Mathematical Sciences	38,300	42,450	42,450	42,970	+ 520	+ 1%
Engineering and Geosciences	29,050	31,350	31,350	33,413	+ 2,063	+ 7%
Advanced Energy Projects	12,606	14,300	14,300	14,643	+ 343	+ 2%
Energy Biosciences	16,295	20,250	20,250	20,780	+ 530	+ 3%
Program Direction	4,125	4,500	4,650	4,900	+ 250	+ 5%
Subtotal Operating Expenses	298,242	327,059	327,209	344,452	$ +17,243	+ 5%
Capital Equipment	24,640	25,029	25,029	25,590	+ 561	+ 2
Construction	109,438	85,132	85,132	5,620	-79,512	- 93%
Total	$432,320 a/b/c/	$437,220 a/c/	$437,370 c/	$375,662 c/	$ -61,708	- 14%
Operating Expenses	(298,242)	(327,059)	(327,209)	(344,452)	+17,243	+ 5%
Capital Equipment	(24,640)	(25,029)	(25,029)	(25,590)	+ 561	+ 2%
Construction	(109,438)	(85,132)	(85,132)	(5,620)	-79,512	- 93%
Staffing (FTEs)	62	63	63	63	--	--

Authorization: Section 209, P.L. 95-91.

a/ Total has been reduced by $1,500,000 in FY 1987, and $1,800,000 in FY 1988, as a result of the transfer of Isotopes Production to the Isotope Production and Distribution Funds.
b/ Total has been reduced by $3,728,000 which has been transferred to the SBIR program.
c/ $87,462,000 in FY 1987, $125,555,000 in FY 1988, and $140,483,000 in FY 1989 has been transferred to the Basic Research User Facilities Appropriation.

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

SUMMARY OF CHANGES

Basic Energy Sciences

FY 1988 Appropriation	$ 437,220
Adjustments - Increased personnel costs due to increase in average salary caused partially by change in personnel mix	+ 150
FY 1989 Base	437,370
Operating Expenses	
- Provides for an increase in operating funds to cover cost of living and permit limited expansion in research	+ 10,243
- Provides for expanded research in high temperature superconductivity; combustion and catalysis; oil and gas related research; and high performance materials	+ 7,000
Capital Equipment	
- Provides for equipment needed in support of expanded research identified above	+ 561
Construction	
- Provides funding for ongoing construction o General Plant Projects o Accelerator Improvement Projects	+ 720
- Funding for the Center for Advanced Materials completed in FY 1988	- 7,632
- Makes no provision for continuing funding for Congressional initiated projects	- 72,600
FY 1989 Congressional Budget Request	$ 375,662

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
OFFICE OF ENERGY RESEARCH
(dollars in thousands)

KEY ACTIVITY SUMMARY
BASIC ENERGY SCIENCES

I. Preface: MATERIALS SCIENCES

The Materials Sciences subprogram conducts research aimed at increasing the understanding of materials related phenomena and properties which will contribute to meeting materials needs of present and future energy technologies. The subprogram supports research at DOE laboratories, universities, and to a lesser extent in industry. The laboratory component is the largest and accounts for approximately 75% of the funding. The major laboratory participants are the Ames Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Oak Ridge National Laboratory, Lawrence Berkeley Laboratory, and to a lesser extent Los Alamos, Lawrence Livermore, Pacific Northwest Laboratories, and Sandia Laboratories. The laboratory programs as a whole tend to contain larger groups of scientists, are multidisciplinary, and involve longer-term research projects. Many of the DOE laboratory programs have unique, major facilities which are open to outside users from universities, industry, and other government laboratories. Funding for these facilities is now being budgeted in a new and separate program entitled Basic Research User Facilities-Basic Energy Sciences (BRUF-BES). These facilities are an essential part of the research activities underway in the materials sciences area and funding for this research continues to be requested in the Materials Sciences subprogram. The university component of the program includes top researchers from universities throughout the country. A typical project includes several graduate students in addition to the principal investigator. The projects cover all areas of materials sciences and tend to be narrower in scope and of shorter duration than projects at the laboratories. The funding associated with the university portion of the program is approximately 25%. Most of the the industry supported portion of materials research takes place at smaller businesses through the Small Business Innovation Research Program.

Groups of multidisciplinary researchers work together guided by opportunities within the general goals set forth by the subprogram. Current goals include uncovering the information needed to: develop new or substitute materials; tailor materials properties to satisfy defined requirements; predict materials problems and service life; and improve the theoretical and experimental capability to analyze the fundamental structure of materials. Related to these goals is the support provided for major user facilities which are available to the entire scientific community for research. Coordination among the various materials research efforts within DOE and with other agencies is considered essential. Within DOE this takes place primarily through the Energy Materials Coordinating Committee (EMaCC) and with other agencies through the Committee on Materials (COMAT). Within the Materials Sciences subprogram, research is undertaken in the major areas of metallurgy and ceramics, solid state physics and materials chemistry. Some examples of research accomplishments during the past year include: development of ion-beam smoothing of mirror surfaces to prepare highly reflective surfaces better, quicker and cheaper than conventional or diamond machining; discovery of an enhanced absorption of tritium in metals which results in a new form of embrittlement; successful completion of a new technique using neutrons to determine surface magnetization for the first time and which will be important for examining materials for recording devices; successfully densified ceramic composites without processing flaws using a sinter-forging method which eliminates the expensive machining steps; designed, synthesized and characterized the first organic synthetic metals containing polymeric ions; determined the structure of high temperature superconductors.

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Materials Sciences Research....	$118,640	$125,991	$134,621	+7
Total, Materials Sciences....	$118,640	$125,991	$134,621	+7

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory....	$16,228	$11,158	$17,165	+54
Brookhaven National Laboratory.	9,946	10,436	10,592	+ 1
Lawrence Berkeley Laboratory...	13,291	13,409	13,692	+ 2
Oak Ridge National Laboratory..	25,274	26,444	28,038	+ 6

III. Activity Descriptions

Program Activity	FY 1987	FY 1988	FY 1989
MATERIALS SCIENCES RESEARCH			
Metallurgy and Ceramics Research	Research will proceed on structure of surfaces using added capabilities in electron spectroscopy. Start research on reliability and lifetime of materials important to fossil energy systems. Continue research on ceramics of interest to the advanced engine program, for example the problem of brittleness. Emphasis will be on properties of compound semiconductors. New research on processing of high temperature superconductors and on the preparation of novel and artificially tailored crystals important in all high speed electronic devices. Added emphasis on the cause of radiation induced phase transformations and	Research in processing and characterization of high temperature superconductors will be emphasized as well as new theoretical approaches to study the structure of energy related materials. Research on high strength, high toughness ferritic steels and welds for pressure vessels. Expand work on reliability and lifetime prediction. Maintain emphasis on studies of inert gases in materials which are important to understand embrittlement. Continue emphasis on compound semiconductors started in FY 1987. Properties of the artificially tailored materials will be investigated. Research will continue on studies of radiation	Increased emphasis on processing and understanding structure-property relationships of new high temperature superconductors. Emphasis will continue on theoretical approaches to study the behavior of materials, on reliability and lifetime prediction of materials, on bonding and adhesion at interfaces, and on compound semiconductors. Research will continue on properties of artificially tailored materials, on radiation induced changes in materials, on fracture in extreme conditions, and on advanced energy materials such as high performance alloys, ceramics, and magnetic materials.

III. MATERIALS SCIENCES RESEARCH (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Metallurgy and Ceramics Research (continued)	low temperature radiation effects on fracture of energy materials. Research will emphasize the science of advanced energy materials synthesis and processing. Micromagnetic processes observed during magnetization will be studied to improve the properties of devices such as magnets for motors.	induced changes in materials and fracture of energy materials under extreme conditions of temperature, stress, and hostile environment. Continue research on advanced energy materials synthesis and processing and magnetic materials. Continue research on nondestructive evaluation of materials failures. Research in materials processing will be expanded in structural ceramics and alloys.	
Solid State Physics Research	Expand the use of high energy neutrons. Exploit new techniques employing polarized neutrons from both steady-state reactor and accelerator driven sources. Both are important for characterizing a full range of phenomena in materials. Continue emphasis on energy related research with synchrotron radiation, including new studies on magnetic surfaces and near-surface structures. Research will continue with close contact with experimental programs on materials important in energy systems. Develop new capabilities, especially in relation to new materials. Emphasis will be on improved surface properties through controlled modification of	Continue research in new high temperature superconductors to understand structure and physical properties. Continue research with emphasis on Los Alamos neutron source and new instruments at other locations. Provides for expanded use of synchrotron radiation insertion devices. Supports new study of boron compounds with view toward utility in high temperature applications. Emphasis will be on large-scale computations on energy-related materials systems with regard to materials properties and their temperature behavior. Continue research on surface modification using irradiation. Research will emphasize processes and techniques	Expanded interlaboratory program and new university grants for research on solid state physics of high temperature superconductivity. Use of neutrons and synchrotron radiation for accurate studies of structure, dynamics and electronic configurations of high temperature superconductors. Research emphasizing use of synchrotron radiation, tunneling electron microscopy, ion and molecular beams and other new tools and probes for preparation, characterization and modification of thin films and surfaces. Theoretical research on new materials design. Maintain strength of overall research effort but with some shifts in emphasis and

III. MATERIALS SCIENCES RESEARCH (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Solid State Physics Research (Cont'd.)	materials of promise by irradiation for energy applications. Support for measurements of new properties and characterization of high temperature superconducting materials and optical elements.	important for surface characterization (e.g. photoemission and inverse photoemission). Research in x-ray lithography will be emphasized. Research will expand in processing of ceramic epitaxial films.	support levels to accommodate changing priorities.
Preconstruction R&D	Preconstruction R&D undertaken to begin resolving technical, cost, and schedule issues associated with the decision on a new research reactor at ORNL.	Research and development will continue in support of a DOE decision on a new reactor at ORNL at an accelerated rate as directed by Congress.	Continue research and development necessary to support a DOE decision on a new reactor at ORNL.
Materials Chemistry Research	Continues structural chemistry research and synthesis of new materials with emphasis on the use of neutron scattering and synchrotron radiation. Emphasis will be on research in conducting polymers because of their potential for use in batteries. Program will emphasize energy-related electrical processes, and synthetic high strength materials. Continues program in surface analysis, catalysis, and surface chemistry with use of advanced techniques.	Synthesis of new superconductors will be emphasized and chemical properties of these materials will be measured. Emphasis will be on polymers synthesis of new materials. Program in polymers and electrochemistry to continue with emphasis on electronic and magnetic properties of polymers, and on the design, synthesis, and characterization of new high strength polymers. Continues research on chemical structure, catalysis, and surface chemistry with emphasis in fundamental research on surface wear and friction, especially in theoretical studies. Begin work on	Empahsis will continue in research on new high temperature superconductors with expanded effort in chemical substitution to improve critical parameters. Research started on electrocatalysis using immobilized macromolecules, such as modified enzymes. Continued emphasis on the synthesis of new materials especially using modified or synthetic enzymes to make materials with tailored properties. Research will continue in the electronic and magnetic properties of polymeric and organic materials and on high strength polymers. Base program in chemical

III. MATERIALS SCIENCES RESEARCH (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Materials Chemistry Research (Cont'd)		modified enzymes to make materials with tailored properties. Research in materials processing will be expanded including ceramics composite synthesis.	structure, catalysis, and surface chemistry continues with increased emphasis on structural chemistry at solid-fluid interfaces.
Total, Materials Sciences Research	$118,640	$125,991	$134,621
Total, Materials Sciences Operating Expenses	$118,640	$125,991	$134,621
Percentage Breakdown by Performer			
Laboratory	74%	74%	74%
University	25%	24%	24%
Industrial/Other	1%	2%	2%
Subtotal	100%	100%	100%
Number of Researchers Supported	998	1,010	1,025

I. Preface: CHEMICAL SCIENCES

The Chemical Sciences subprogram supports basic research across a broad front of chemistry and atomic physics necessary for the future development of energy technologies. Research includes photochemistry important to the conversion of light energy to fuels or electricity, chemical physics related to combustion processes, atomic physics important to fusion concepts, heavy element chemistry important to waste management and isotopic separation, organic chemistry as well as heterogeneous and homogeneous catalysis related to coal conversion and the more efficient production of fuels and bulk chemicals, separations and analytical science related to almost every facet of process chemistry and nuclear energy technology, and chemical thermodynamics for predicting physical properties of complex hydrocarbon mixtures. Researchers in the Chemical Sciences continue to make extensive use of the user facilities which are now being budgeted in a separate program titled the Basic Research User Facilities-Basic Energy Sciences (BRUF-BES). However, the research effort supported by the Chemical Sciences subprogram conducted at the major user facilities continues to be funded as part of this subprogram.

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Chemical Sciences Research.....	$79,226	$88,218	$93,125	+6
Total, Chemical Sciences.....	$79,226	$88,218	$93,125	+6

II. B. Major Laboratory and Facility Funding

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Argonne National Laboratory....	$15,700	$16,512	$16,728	+1
Brookhaven National Laboratory.	9,139	10,093	10,349	+3
Lawrence Berkeley Laboratory...	7,145	7,171	7,400	+3
Oak Ridge National Laboratory..	10,038	10,073	10,278	+2

III. Activity Descriptions

Program Activity	FY 1987	FY 1988	FY 1989
CHEMICAL SCIENCES			
Chemical Sciences Research	Continues research in photochemistry with emphasis on understanding initial events in green plant photosynthesis, which will be facilitated by new ultrafast spectroscopic techniques. Basic studies on photocatalytic reactions in homogeneous and heterogeneous systems will continue at current levels.	Research will focus on design of artificial photochemical energy conversion systems. Model compounds tailored for optimum light capture and efficient conversion will be studied. Research in photochemistry, as well as combustion and catalysis related research, are responsive to the Congressionally directed initiative based on the NAS/NRC report "Opportunities in Chemistry."	Theoretical and experimental examinations of the role of solvents in photochemical charge separation phenomena of model compounds designed for efficient conversion will be carried out.

III. CHEMICAL SCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Chemical Sciences Research (Cont'd)	Research will focus on molecular dynamics and spectroscopy in complex fuel systems to provide better combustion diagnostics and understanding of chemical reactivity processes.	Combustion related research will continue. A new effort on reactivity of small metal clusters will provide an atom based understanding of such properties of metals as catalysis, corrosion and electronic behavior.	Emphasis will continue on the dynamics of small combustion related species central to improved models of combustion processes, and on metal cluster chemistry that may underpin an understanding of bulk properties.
	Research to continue on low energy highly charged ions seen in fusion directed plasmas. The cooling of ion beams with electron beams will be explored.	Emphasis will be on studies of interactions between laser beams and accelerator produced ion beams to determine energy transfer cross sections between electrons and ions in excited states. The Kansas State University Ion Collision Physics Facility will begin operation.	Dynamical effects of atomic systems in intense energy fields that occur under high flux conditions of photons, electrons or ions will be studied. The Kansas State University Ion Collision Physics Facility will become completely operational.
	Research to continue on catalytic studies with emphasis on oxide and new bio-catalyst substances for advancing understanding of the reactivity and specificity of catalytic processes. Early stages of oxidation on coal chemical and physical properties will be investigated.	Emphasis will be on research on reactive intermediates, catalytic clusters, oxide catalysts, acid sites and new biocatalytic systems to provide insights into side reactions, catalyst deactivation and new classes of catalysts for converting fossil and biomass resources into fuels.	Research on shape selective oxide catalysts for the energy efficient conversion of paraffinic hydrocarbons to bulk chemicals will be given priority. An initiative on research related to high temperature superconductors will be started. The synthetic chemistry of novel inorganic and organometallic compounds and polymers which can serve as precursors to the new classes of perovskite ceramic superconductors will be examined.

III. CHEMICAL SCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Chemical Sciences Research (Cont'd)	Research to continue on turbulent flame propagation studies to isolate chemically induced turbulence from physical mixing effects. Behavior of supercritical mixtures for energy efficient separations and analytical techniques of complex mixtures to be studied.	Emphasis will be on unified modeling of thermochemistry of turbulent combustion; macro and micro structure modeling of flow fields; ignition and extinction characteristics to increase combustion efficiencies and pollutant control.	Combustion related turbulence research and thermophysical properties of fossil derived mixtures will continue to be emphasized.
	Continues research on the relationship of membrane composition to selectivity, solution chemistry of actinides pertinent to nuclear material processing, and extractants for strategic metals.	Emphasis will be on the study of supercritical fluids as solvents for salts and organic compounds, novel membrane compositions for the efficient separation of gases, and mass transport-enhancing effects of electric and magnetic fields on liquid-liquid extraction systems.	Research to effect direct measurement of heteroatoms in solid matrices such as coal will be carried out. Novel analytical methods for handling polar compounds and direct chromatographic analysis of fossil derived process streams will be explored.
	Research continues on solution chemistry studies and high temperature, high pressure characterization of solid and gaseous actinide compounds important to the isotopic separations of nuclear materials.	Emphasis in FY 1988 will be on solution chemical investigations of the heaviest elements, such as lawrencium. Solid state studies will focus on the characterization of ceramic-like compounds of potential importance to the development of nuclear waste host compounds.	Further research on actinide electronic properties and bonding in high temperature solid state mixed oxides and organoactinides will be performed. Solid state actinide chemistry related to the lanthanide containing high temperature superconducting ceramic materials will be investigated.
Total, Chemical Sciences Research	$79,226	$88,218	$93,125
Total, Chemical Sciences Operating Expenses	$79,226	$88,218	$93,125

III. CHEMICAL SCIENCES (Cont'd)

	FY 1987	FY 1988	FY 1989
Percentage Breakdown by Performer			
Laboratory	66%	66%	66%
University	31%	31%	31%
Industrial/Other	3%	3%	3%
Subtotal	100%	100%	100%
Number of Researchers Supported	847	877	877

I. Preface: APPLIED MATHEMATICAL SCIENCES

Applied Mathematical Sciences has two activities: Mathematical Sciences Research and Energy Sciences Advanced Computation. The objectives of the Mathematical Sciences Research activity are: (1) to expand the knowledge of the fundamental mathematics and computer science principles necessary to model the complex physical phenomena involved in energy production systems and basic sciences, and (2) to explore future computational algorithms and architectures necessary for investigating these mathematical models. The objective of the Energy Sciences Advanced Computation activity is to provide access to the highest quality state-of-the-art supercomputers and relevant software to researchers supported by the Office of Energy Research.

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Mathematical Sciences Research.	$22,367	$23,850	$25,050	+5
Energy Sciences Advanced Computation.....	15,933	18,600	17,920	-4
Total, Applied Mathematical Sciences.....	$38,300	$42,450	$42,970	+1

II. B. Major Laboratory and Facility Funding

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Argonne National Laboratory....	$ 4,230	$ 4,325	$ 4,350	+ 1
Lawrence Berkeley Laboratory...	1,510	1,542	1,675	+ 9
Lawrence Livermore Nat. Lab....	1,200	1,400	1,450	+ 4
Los Alamos National Laboratory.	1,300	1,300	1,490	+ 15
Supercomputer Centers (MFECC & FSU/SCRI).....	15,220	15,500	16,930	+ 9
Jackson State University.....	240	2,000	0	- 100

III. Activity Descriptions

Program Activity	FY 1987	FY 1988	FY 1989
APPLIED MATHEMATICAL SCIENCES			
Mathematical Sciences Research	Continues research in analytical and computational methods for modeling shocks and interfaces in three spatial dimensions and more complex geometries, such as plasma confinement devices, combustion chambers, and oil reservoirs.	Emphasis will be on analytical, computational, and graphical techniques by teams at universities and laboratories for designing complete computational modeling systems.	Level of effort in analytical methods will continue at a stable level but with increased emphasis on geometric and group theoretical studies of supersymmetries.
	Research continued on new graphical diagnostic techniques for quantifying the components of computational models and comparing results with experiments.	Research will focus on optimum analysis and display of scientific data and efficient use of new supercomputer systems.	The current level of effort will be maintained in data analysis, graphical display, and scientific statistics.
	Continued research on the experimental parallel computers at Cal Tech, University of Illinois, and New York University Courant Institute produced promising results for the future of computing.	Focus of research will be on high level languages for new parallel processor computer systems. These languages are used for describing the various algorithms needed to specify exactly the steps required to solve	Continue initiatives begun in FY 1985 on parallel architectures at the projected level. Initiate exploratory projects in supersymmetry and several others in performance evaulation methodology.

III. APPLIED MATHEMATICAL SCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Mathematical Sciences Research (Cont'd)	Also, algorithm research on commercial versions of parallel computers provided exciting results at Argonne, Oak Ridge, Los Alamos and Sandia.	computational models. New algorithms will be incorporated into large scale computational models on the parallel supercomputers.	
Subtotal Mathematical Sciences Research Operations	$22,367	$23,850	$25,050
Energy Sciences Advanced Computation	Continued supercomputer access for ER researchers at the same level as FY 1986. Support for both the NMFECC and the FSU Centers continued. Implementation of network redesign was begun and interagency standards and internetting were studied. File management upgrade continued as scheduled.	Permits lease of Class VII computer system in the last quarter of FY 1988, which will allow ER scientists to address increasingly complex problems. This new machine will be located at the LLNL, and is the primary reason for the increase in funding at this laboratory. Total supercomputer access will improve since the cooperative agreement with FSU will be continued. The file storage system at NMFECC will continue to be supported. The network project will continue.	Continue full operation and access for Class VII supercomputer system by ER research community. Discontinue cooperative agreement with FSU/SCRI in the fifth year. Implementation plans for the Energy Sciences Network (ESNet) project will continue and interconnection to the Federal Research Internet will be initiated.
Subtotal Energy Sciences Advanced Computation Operations	$15,933	$18,600	$17,920
Total Applied Mathematical Sciences Operating Expenses	$38,300	$42,450	$42,970

III. APPLIED MATHEMATICAL SCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Percentage Breakdown by Performer			
Laboratory	42%	42%	69%
University	56%	56%	30%
Industrial/Other	2%	2%	1%
Subtotal	100%	100%	100%
Number of Researchers Supported	156	160	160

I. Preface: ENGINEERING AND GEOSCIENCES

This subprogram supports DOE's central fundamental research activities in engineering and geosciences. The Engineering Research objectives are (1) to improve and advance our knowledge of processes underlying current engineering practice, and (2) to expand knowledge of fundamental concepts for solving anticipated and unforeseen engineering problems in energy technologies. Fundamental research is supported in both traditional engineering disciplines and interdisciplinary areas, especially exploration of advanced analytical and control methods in areas such as thermal hydraulics, materials processing and intelligent systems. The Geosciences Research objective is to develop a quantitative, predictive understanding of the energy related aspects of geological processes. The primary focus is on the geophysics and geochemistry of rock/fluid systems. Current emphasis includes Continental Scientific Drilling (to study underground heat and mass transport), remote sensing of reservoir structures, geochemical migration, and basic geoscience studies of sedimentary formations where oil and gas resources are located.

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Engineering Research.....	$ 13,892	$ 14,845	$ 15,443	+ 4
Geosciences Research.....	15,158	16,505	17,970	+ 9
Total, Engineering and Geosciences.....	$ 29,050	$ 31,350	$ 33,413	+ 7

II. B. Major Laboratory and Facility Funding

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Lawrence Berkeley Laboratory...	$ 2,472	$ 2,410	$ 2,485	+ 3
Los Alamos National Laboratory.	2,793	2,958	3,070	+ 4
Sandia, Albuquerque.....	2,582	2,850	2,964	+ 4

III. Activity Descriptions

Program Activity	FY 1987	FY 1988	FY 1989
ENGINEERING AND GEOSCIENCES			
Engineering Research	Conducted research in the mechanical sciences, including fluid mechanics, heat transfer, solid mechanics, fracture mechanics, and friction. For example, effects of friction were studied on systems operating at very low temperatures and measurements were made of the heat released as a crack propagates in a stressed site of material (a measurement needed to test theories of fracture processes).	In the mechanical sciences, emphasis is being given to applications of thermodynamics to the description of plastic deformations in solids, heat and mass transfer in free convection, and continuation of basic two-phase flow studies such as dry-out and rewetting of surfaces found in energy systems. A new collaborative project on two phase flow is started at MIT/SNL/LANL. Results of recent heat transfer research will help design of fusion reactors.	Advances in the mechanical sciences offer ways for major improvements in energy systems design. New diagnostic and modeling methods for two-phase flows, for example, are replacing empirical correlations with vastly better models based on fundamental understanding. This will help resolve a prime concern with reactor safety codes. Similar studies will be extended to porous media. Major progress can be expected in predicting life-to-crack-initiation of structural components.
	Conducted research on methods for tracking and controlling energy related processes. For example, methods were found for improving the way that machines can make decisions on routine questions, making more	In the systems and control sciences, emphasis is being given to studies of methods for controlling energy production and for improving techniques in chemical process control, programming of parallel	Research in the systems and control sciences will continue to address the fundamental areas of process design and control, nondestructive evaluation, instrumentation for hostile environments, and intelligent

III. ENGINEERING AND GEOSCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
ENGINEERING AND GEOSCIENCES (Cont'd)	effective use of information gathered by such machines with their sensors; and for more cost-effective ways to produce and control plasma in processing of materials.	computers to control intelligent machines, and the use of expert systems in helping such machines handle technical problems resulting from unexpected occurrences. The MIT/INEL collaborative program in plasma diagnostics is broadened to include Stanford University and University of Minnesota.	machines. Studies in the university - INEL collaborative project will include developing efficient control strategies for automated welding processes, and the development of optical techniques for nondestructive system analysis.
	Conducted research in the area of engineering data and analysis, including more energy efficient methods of mixing and stirring fluids, a joint university/industry project on a novel concept for confining chemical processing within a liquid curtain, and various engineering aspects of combustion both in quiescent and turbulent surroundings.	Emphasis is being given to non-linear systems yielding, for example, better analyses of engineering systems containing magnets, certain types of plastic components, and innovative computer memory systems. Studies are also underway in non-imaging optics which have contributed recently to improved fiber optic probes and couplers. Results of studies on random noise in non-linear systems impact simulation of nuclear reactor operation.	Research in the area of engineering data and analysis will continue to address the fundamental areas of combustion processes and the acquisition of thermophysical data for processes and material properties. Provides for expanded research in superconducting materials processing utilizing plasma and other techniques. Additional work would include methodology and optimization related to systems using the new high critical temperature superconductors.
Subtotal Engineering Research	$13,892	$14,845	$15,443
Geosciences Research	Conducted geological and geophysical research on large-scale continental processes, evolution of geologic structures, and properties of earth materials. Efforts continued to relate laboratory experiments to studies conducted "in-situ," either in drill-holes or in mine shafts, in order to enhance predictive capabilities.	Emphasis is being given to advanced seismic and other techniques useful in resource exploration, on rock mechanics and flow studies related to reservoir modeling, and on studies of the physical properties of earth materials and geologic processes.	Provides for increased funding of geological and geophysical research related to sedimentary formations in which oil and gas resources are located. Continues high priority projects in rock mechanics, fluid flow, etc., along lines started earlier.

III. ENGINEERING AND GEOSCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Geosciences Research (Cont'd)	Conducted research on the chemistry of geothermal fluids, rock-water interactions, geochemical transport and organic geochemistry. Special emphasis was given to the development of organic geochemistry and other aspects of the geosciences of long term relevance to fossil fuel resources and the geologic isolation of hazardous wastes.	Emphasis is being given to the geochemistry of the earth's continental crust, the thermodynamics of naturally occurring underground fluids and geochemical transport. The value of drilling projects for enhancing progress in organic geochemistry is being assessed. Geochemical studies are also being undertaken in the developing area of isotope geosciences.	Provides for additional geochemical research on processes in sedimentary formations (e.g., rates of conversion of kerogen to petroleum) while developing further high priority projects in geochemical transport, etc., of even broader applicability, including new isotopic tracer systems.
	Conducted research in the area of energy resource definition and use, including reservoir dynamics and modeling, and studies of thermal regimes by scientific drilling. Drilling was carried out during 1987 at a small crater formed in Long Valley, CA, about 600 years ago.	Emphasis is being given to hydrocarbon resource definition and utilization, including reservoir dynamics and modeling. Additional drilling activities and site studies are planned as part of the Continental Scientific Drilling Program. In particular, a hole of intermediate depth will be drilled at the Valles Caldera in New Mexico through a steam reservoir in which minerals are being deposited.	Provides for completion of the drilling project started in FY 1988 at the Valles Caldera along with associated studies of core and fluid samples. Based on the FY 1988 assessment of scientific drilling in sedimentary formations, initial site studies will be carried out as appropriate. In addition, preliminary site studies preparatory to scientific drilling at Katmai, Alaska, will be undertaken in anticipation of drilling and favorable environmental assessment.
	Conducted research on solar, solar-terrestrial and atmospheric physics and chemistry with emphasis on both direct and diffuse solar radiation. Designs were examined for a low-cost device for energy resource assessment	Emphasis is being given to the relationship between the near space environment of the earth and the upper and middle atmosphere of the earth. The interactions at this interface are poorly known yet they	Provides for continued study of solar-terrestrial atmospheric interactions at the level of effort of prior years, thereby contributing to one of the key energy-related aspects of global geoscience.

III. ENGINEERING AND GEOSCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Geosciences Research (Cont'd)	using radiometric techniques. Studies were carried out as part of the International Solar-Terrestrial Physics Program (ISTP) and contributed to the Geosphere-Biosphere Global Geoscience Initiative (IGBP).	surely relate to the cyclic U.S. droughts and the 22-year solar cycle which has a major impact on U.S. energy concerns.	
Subtotal Geosciences Research	$15,158	$16,505	$17,970
Total Engineering and Geosciences Operating Expenses	$29,050	$31,350	$33,413
Percentage Breakdown by Performer			
Laboratory	53%	53%	53%
University	39%	39%	39%
Industrial/Other	8%	8%	8%
Subtotal	100%	100%	100%
Number of Researchers Supported	269	284	310

I. Preface: ADVANCED ENERGY PROJECTS

The objective of the Advanced Energy Projects (AEP) subprogram is to explore the feasibility of novel, energy-related concepts, as they evolve from basic research. Such concepts are at an early stage of scientific definition and, therefore, would not qualify for support by technology programs. Because they are new and untried, those concepts invariably represent a high risk; to qualify for support they must also have the potential for an eventual high payoff of a magnitude sufficient to open new vistas in the Nation's technology posture. Muon-catalyzed fusion, an unexplored approach to controlled fusion totally different from either magnetic or inertial fusion can serve as just one of many examples. An area of major programmatic attention is the transfer of successful projects to proper technology programs; such transfers are effected every year, and several already have led to major development programs both in the Government and in private industry.

I. Preface: ADVANCED ENERGY PROJECTS (Cont'd)

The principal mode of operation for this interdisciplinary subprogram is to support individual projects for a limited time only; it differs from other subprograms in that it supports new and novel research projects. The spectrum of projects supported is very broad, encompassing, for example, new sources of electromagnetic radiation, new methods of better fossil fuels utilization, totally new approaches to controlled fusion (including muon-catalyzed fusion) and unconventional approaches to the utilization of high temperature superconductors. Close contact is maintained with other DOE technology programs to ensure proper coordination. Projects are selected on the basis of unsolicited proposals received from researchers at universities, industrial laboratories (especially small R&D companies) and national laboratories.

A separate activity within AEP is the Heavy Ion Fusion Accelerator Research (HIFAR) program. HIFAR conducts research and development on the heavy-ion, induction linear accelerator method to assess its suitability as a "driver" for electric power plants based on the principle of inertial confinement fusion. In this approach to fusion, output from the driver is used to compress small pellets of fuel to the extent that energy-producing thermonuclear reactions occur. (The other driver contenders, lasers and light-ion accelerators, are being developed elsewhere within DOE.)

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Advanced Energy Projects.....	$ 12,606	$ 14,300	$ 14,643	+ 2
Total, Advanced Energy Projects.....	$ 12,606	$ 14,300	$ 14,643	+ 2

II. B. Major Laboratory and Facility Funding

Lawrence Berkeley Laboratory...	$ 4,203	$ 5,100	$ 5,033	- 1
Los Alamos National Laboratory.	3,570	2,328	2,368	+ 2

III. Activity Descriptions

Program Activity	FY 1987	FY 1988	FY 1989
ADVANCED ENERGY PROJECTS			
Advanced Energy Projects	Work continued on the exploration of novel concepts that could open new horizons in energy-related	Continued emphasis will be on the development of very bright laser-type x-ray sources and the evaluation of	As is the case every year, new highly nonconventional energy-related concepts, as they emerge, will be

III. ADVANCED ENERGY PROJECTS (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Advanced Energy Projects (Cont'd)	applications. New records were broken in the performance of laboratory-scale x-ray lasers. The trend is towards shorter wavelengths (needed in most of the important applications) and higher brightness. In the field of muon-catalyzed fusion, a set of crucial experiments were performed to elucidate the promise of this fusion method.	their applications, with the potential for a significant amount of technology transfer. Efforts on muon-catalyzed fusion will continue. Further studies of key physics parameters will be performed, building upon recent experimental results.	explored for their technical feasibility. Continued emphasis will be on concepts for very bright laser-type x-ray sources and their applications, especially in the area of x-ray laser holography and microscopy, where significant technology transfer to the private sector is expected. A highly unconventional approach to energy storage will be further pursued. Muon-catalyzed fusion will be further explored for its potential as an alternative to other fusion schemes.
Heavy Ion Fusion Accelerator Research	Completed MBE-4 assembly. Installed beam diagnostics. Operated experiment and characterized acccelerator module performance. Conducted beam amplification tests and assessed results. Explored the relationship between accelerator tolerances and beam transport with single beam apparatus. Documented the system assessment. Completed initial phase of advanced accelerator concept studies, incorporating results from single beam and MBE-4 tests. Updated accelerator design and cost codes for sub-scale applications. Continued injector fabrication. Installed electrical components needed to operate injector	Planned activities in Heavy Ion Fusion Accelerator Research are to conduct comprehensive MBE-4 test series; to operate experiments at design specifications, document results and critically review; to complete accelerator parameter studies, review estimates and compare with experimental test results. Design codes will be used to identify and assess the accelerator concepts and techniques needed to adequately test the major beam physics and accelerator technology issues. Injector development will continue. These experiments and accelerator design studies will establish a basis for proceeding with a detailed design of an accelerator experiment to minimally meet the HIFAR program objective.	The Heavy Ion Fusion Accelerator Research program will be continued to complete and document existing major research activities within the program; emphasis will be placed on maximizing the scientific return on the sizable investment in the existing HIFAR experimental apparatus.

III. ADVANCED ENERGY PROJECTS (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Advanced Energy Projects (Cont'd)	at one-half power. Each of these activities provides additional insight for identifying accelerator design options and concepts to optimize the performance/cost ratio for a driver.		
Total Advanced Energy Projects Operating Expenses	$12,606	$14,300	$14,643
Percentage Breakdown by Performer			
Laboratory	81%	80%	80%
University	11%	10%	10%
Industrial/Other	8%	10%	10%
Subtotal	100%	100%	100%
Number of Researchers Supported	137	143	145

I. Preface: ENERGY BIOSCIENCES

The Energy Biosciences subprogram is structured to provide the basic microbiological and plant sciences information necessary for DOE's efforts in generating the background for enhancing the renewable resource base, for microbiological transformation of renewable organic materials such as lignocellulosics in the production of fuels and chemicals, and for other energy relevant biological systems applications. Research is undertaken to uncover basic understanding of biological principles, mechanisms and organisms in order to implement genetic manipulation or other biotechnology operations relevant to long range DOE objectives. Some investigations are designed with the objective of wedding contemporary plant biology with state-of-the-art powerful chemical-physical techniques and thinking to achieve better understanding of mechanisms. The program fills a significant need in the federal research network by the support of biological areas not served adequately or, in some cases, not at all, by other programs.

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Energy Biosciences.....	$ 16,295	$ 20,250	$ 20,780	+ 3
Total, Energy Biosciences....	$ 16,295	$ 20,250	$ 20,780	+ 3

II. B. Major Laboratory and Facility Funding

Brookhaven National Laboratory.	$ 1,019	$ 1,135	$ 1,320	+ 16
Lawrence Berkeley Laboratory...	1,130	1,100	1,320	+ 20
Michigan State University.....	2,183	2,400	2,450	+ 2

III. Activity Descriptions

Program Activity	FY 1987	FY 1988	FY 1989
Energy Biosciences	Continued long-term ongoing efforts on basic research with energy relevance with some changing emphases to include additional research on microbial breakdown of lignin, synthesis, structure and function of plant complex carbohydrates, data requisite to development of genetic transformation of structures involved in photosynthesis, genetics and biochemistry of fermentative orphan microbes, and other topics of high priority. The partial implementation of an integrated multidisciplinary effort on the biochemical structural characterization of plant and microbial complex carbohydrates was accomplished. Enhanced program of basic bio-conversion of woody	Emphasis will continue on the core programs of Energy Biosciences in plant and microbial sciences. This includes topics already identified in which work is already in progress. Some of these include studies on lignin and cellulose biosynthesis and microbial degradation of these biopolymers, metabolic regulation of biosynthetic pathways in plants, photosynthesis, development of genetic systems in anaerobic microorganisms, organelle genetics in plants, and others. The full implementation will be completed of a plant and microbial complex carbohydrate center, initiated earlier, dedicated to research, training and service to the research	The level allows continuation of the base program in plant and microbial sciences with internal adjustments of the program based on turnover of projects. Some additional activity in plant biochemistry related to regulation of synthesis of lignin and polysaccharides may be expected. The multidisciplinary plant science activity will continue. Depending on the results of FY 1988, areas such as complex carbohydrates, rhizosphere dynamics and other high priority plant science studies will be continued.

III. ENERGY BIOSCIENCES (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Energy Biosciences (Cont'd)	materials was begun at Oregon Graduate Center by Congressional direction ($1.2 million). Testing and early groundwork was done on computerized structural data base on carbohydrates.	community. The effort will address those high priority needs identified in carbohydrate research. A computerized carbohydrate data base to be fully implemented. In addition, a number of new projects in protein engineering, molecular mapping of plant genetic information and biochemistry of plants and microorganisms are anticipated. Continue program at Oregon Graduate Center in response to Congressional direction ($1.7 million).	
Total Energy Biosciences Operating Expenses	$16,295	$20,250	$20,780
Percentage Breakdown by Performer			
Laboratory	15%	15%	15%
University	81%	81%	81%
Industrial/Other	4%	4%	4%
Subtotal	100%	100%	100%
Number of Researchers Supported	180	200	215

I. Preface: PROGRAM DIRECTION

This subprogram provides the Federal staffing resources and associated funding required to develop, direct, and administer a complex and broadly diversified program for mission-oriented research to provide the fundamental scientific and engineering base on which the Nation's future energy, defense, and technology options depend.

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Program Direction.....	$ 4,125	$ 4,500	$ 4,900	+ 9
Total, Program Direction...	$ 4,125	$ 4,500	$ 4,900	+ 9

III. Activity Description

Program Activity	FY 1987	FY 1988	FY 1989
Program Direction	Provided funds for salaries, benefits, and travel for 62 full-time equivalents (FTE's) in the Office of Basic Energy Sciences, the Scientific Computing Staff, and related program and management support staff. Ongoing activities included assessing the scientific needs and priorities of the program; planning to meet those needs; technical review of proposals from laboratories and universities; and monitoring the progress of ongoing university contracts, laboratory programs, and construction projects, as well as responding to the many day-to-day requirements involving budget, procurement and other management support activities. Staff supported R&D for the next generation of facilities (1-2 GeV and 6-7 GeV Synchrotrons and Advanced Neutron Source) needed to continue U.S. leadership in key scientific areas,	Provides funds for salaries and related costs of 63 FTE's. Provides for the normal increased personnel costs such as within-grade and merit increases, impact of the 1987 pay raise, and the increased agency contribution to the Federal Employees Retirement System (FERS). Staff will continue to support program workload as in FY 1987 with expected increases in the number of proposals reviewed; in liaison with industry in such areas as superconductivity, semi-conductors, and oil and gas geosciences; and in facilities support as R&D and construction activities increase on major scientific facilities. ($4,335)	Provides funds for salaries, benefits, and travel related to continuation of 63 FTE's. Provides for normal increased salary costs including impact of the FY 1988 pay raise. Adequate support becomes even more critical for R&D and construction activities associated with major new scientific facilities and to meet associated environment, safety and health responsibilities. This request provides continued support for other expanded research areas and to respond to the Administration's initiatives to increase the coordination and cooperation of research between government, university, and industry scientists in areas crucial to U.S. technology leadership, such as superconductivity. This level provides the management capability to ensure a continued sound program of basic research. ($4,485)

III. PROGRAM DIRECTION (Cont'd)

Program Activity	FY 1987	FY 1988	FY 1989
Program Direction (Cont'd)	supported numerous university construction projects, and participated in meetings and provided support to the newly established Basic Energy Sciences Advisory Committee. Also managed the DOE-wide SBIR program and the Magnetic Fusion Energy Computer Network. ($3,652)		
	Provided program support such as electronic information and communications services, printing and binding, and contractual services for such things as the SBIR program. ($473)	Continues a variety of program support services similar to those required in FY 1987. Also includes contractual support for technical writing and editing and to assist with the environment, safety and health workload required by current regulations and directives. ($165)	Continues the variety of program support services required in FY 1988. In addition, provides entire contractual support to the SBIR program. ($415)
Total, Program Direction	$4,125	$4,500	$4,900

I. Preface: CAPITAL EQUIPMENT

Capital equipment is needed to support the research in each of the subprograms in the Basic Energy Sciences program. In addition, Argonne and Ames are funded for general purpose equipment through BES for the purpose of providing all the DOE programs at ANL with this type of equipment. Much of the research in the BES program involves experiments at extremes of temperature and pressure and requires unprecedented levels of resolution. Reliable, precise measurements under such conditions challenge the current state-of-the-art, and as improvements are made in instruments and equipment, it is important to benefit from them in a timely fashion. The quality of individual research projects and effective experiments at the major facilities depends on the availability of new state-of-the-art equipment and instrumentation, and on replacement of older, obsolete equipment.

II. A. Summary Table

Program Activity	FY 1987	FY 1988	FY 1989	% Change
Capital Equipment.....	$ 24,640	$ 25,029	$ 25,590	+ 2

II. B. Major Laboratory and Facility Funding

Argonne National Laboratory....	$ 6,615	$ 6,443	$ 6,235	- 3
Brookhaven National Laboratory.	1,944	1,725	1,730	-
Lawrence Berkeley Laboratory...	4,496	3,950	3,325	- 16
Oak Ridge National Laboratory..	4,796	3,619	3,334	- 8

III. Activity Descriptions

Program Activity	FY 1987	FY 1988	FY 1989
Capital Equipment	Replacements and new major equipment used for energy research in the various subprograms; these include electron microscopes, neutron spectrometers, nuclear magnetic resonance spectrometers, lasers, molecular beam equipment and computer equipment and peripherals. General purpose equipment requirements for Ames and ANL were met.	Equipment needs will be accommodated at the FY 1987 level. Replacement and acquisition of new equipment required in each of the subprograms will continue to ensure that optimum research results can be obtained and properly analysed. General purpose equipment requirements for Ames and ANL will continue to be met.	Equipment needs will be accommodated at the FY 1988 level. Replacement and acquisition of new equipment required in each of the subprograms will continue to ensure that optimum research results can be obtained and properly analysed. General purpose equipment requirements for Ames and ANL will continue to be met.
Total, Capital Equipment	$24,640	$25,029	$25,590

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

CONSTRUCTION PROJECTS

Basic Energy Sciences

IV. Construction Project Summary

Project No.	Project Title	Total Prior Year Obligations	FY 1988 Request	FY 1989 Request	TEC
89-R-401	Accelerator Improvement Projects	XXX	0	720	720
89-R-400	General Plant Projects	XXX	0	4,900	4,900
88-R-400	General Plant Projects	XXX	4,900	0	4,900
84-ER-112	Center for Advanced Materials	32,618	7,632	0	40,250
	Prior Year Projects	0	72,600	0	0
Total, Basic Energy Sciences Construction		XXX	$ 85,132	$ 5,620	XXX

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY CONSTRUCTION PROJECT SUMMARY

Basic Energy Sciences

IV. B. Plant Funded Construction Project

1. Project title and location: 89-R-401 Accelerator and reactor improvements and modifications, various locations

Project TEC: $ 720
Start Date: 2nd Qtr. FY 1989
Completion Date: 3rd Qtr. FY 1991

2. Financial Schedule:

Fiscal Year	Appropriated	Obligations	Costs
1989	$ 720	$ 720	$ 375
1990	0	0	310
1991	0	0	35

3. Narrative:

(a) This project provides for additions and modifications to accelerator and reactor facilities, which are supported by the Basic Energy Sciences program. Since program priorities and needs change, the projects described below indicate the most likely projects to be funded. A continuing evaluation, however, is necessary to ensure that those projects with the greatest productivity are funded. Two projects at the Brookhaven National Laboratory are requested to incorporate improvements at the High Flux Beam Reactor and the National Synchrotron Light Source.

(b) The following are the projected items of work to be performed at the various locations. Since needs and priorities may change, other projects may be substituted for the examples listed below, and some of these may be located on non-Government owned property.

National Synchrotron Light Source

Component hardware replacements and additions to achieve improved orbit stability by elimination of noise sources and to provide active feedback systems.

High Flux Beam Reactor

New state-of-the-art instrumentation to provide improved reliability and maintainability, such as control rod position indicators, primary system instrumentation, and on-line secondary water tritium monitors.

Holifield Heavy Ion Research Facility

Provide for improvements to the Holifield Heavy Ion Research Facility (HHIRF) and the EN-tandem facility by providing a high quality electron target for ion-electron collisions research.

FY 1988 funding of $ 720,000 is requested to permit the timely improvements to these national user facilities.

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
OFFICE OF ENERGY RESEARCH
(dollars in thousands)

KEY ACTIVITY CONSTRUCTION PROJECT SUMMARY

Basic Energy Sciences

IV. B. Plant Funded Construction Project

1. Project title and location: 89-R-400 General plant projects

Project TEC: $ 4,900
Start Date: 1st Qtr. FY 1989
Completion Date: 4th Qtr. FY 1990

2. Financial schedule:

		Costs			
Fiscal Year	Obligations	FY 1987	FY 1988	FY 1989	After FY 1989
Prior Year Projects	3,877	15	0	0	0
FY 1987 Projects	3,150	2,319	731	100	0
FY 1988 Projects	4,900	0	3,390	1,510	0
FY 1989 Projects	4,900	0	0	3,500	1,400

3. Narrative:

(a) This project is required to provide for minor new construction, other capital alterations and additions, and for buildings and utility systems. Where applicable, the request also includes the cost of installed capital equipment integral to a subproject. Funding of this type is essential for maintaining the productivity and usefulness of Department-owned facilities. Since it is difficult to detail this type of project in advance, a continuing evaluation of requirements and priorities may be expected to result in additions, deletions, and changes in the currently planned subproject. At Argonne, BES is the funding program for all the laboratory's GPP.

(b) The currently estimated distribution of FY 1988 funds by office is as follows:

Argonne National Laboratory	$ 3,700
Ames Laboratory	500
Notre Dame Radiation Laboratory	100
Sandia National Laboratories	400
Stanford Synchrotron Radiation Laboratory	200
Total project cost	$ 4,900

FY 1989 General Plant Projects (GPP) are miscellaneous minor new construction projects of a general nature, the total estimated costs of each will not exceed $1,200,000. These projects are necessary to provide for the continuing requirement to maintain the facilities in a good state of repair, to adapt the facilities to new or improved production or service techniques, to effect economics of operations and to reduce or eliminate health, fire, and security problems.

(c) FY 1989 funding of $4,900,000 is requested to meet essential requirements of each of the above mentioned locations.

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET SUBMISSION
CONSTRUCTION PROJECT DATA SHEETS
ENERGY SUPPLY RESEARCH AND DEVELOPMENT - PLANT AND CAPITAL EQUIPMENT
BASIC ENERGY SCIENCES
(Tabular dollars in thousands. Narrative material in whole dollars.)

1. Title and location of project: Accelerator and Reactor Improvements and Modifications, various locations

2. Project No.: 89-R-401

3. Date A-E work initiated: 2nd Qtr. FY 1989

3a. Date physical construction starts: 3rd Qtr. FY 1989

4. Date Construction ends: 3rd Qtr. FY 1991

5. Previous cost estimate: none
Date:

6. Current cost estimate: $ 720
Less amount for PE&D: 0
Net cost estimate: $ 720
Date: January 1988

7. Financial Schedule

Fiscal year	Authorizations	Appropriations	Obligations	Costs
1989	$ 720	$ 720	$ 720	$ 375
1990	0	0	0	310
1991	0	0	0	35

8. Brief Physical Description of Project

This project provides for additions and modifications to accelerator and reactor facilities, which are supported by the Basic Energy Sciences program. Since program priorities and needs change, the project described below indicate the most likely project to be funded. A continuing evaluation, however, is necessary to ensure that those projects with the greatest productivity are funded. One project at Oak Ridge National Laboratory is requested to incorporate improvements at the Holifield Heavy Ion Research Facility (HHIRF).

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Accelerator and Reactor Improvements and Modifications, various locations

2. Project No.: 89-R-401

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

The following are the projected items of work to be performed. Since needs and priorities may change, other projects may be substituted for the examples listed below, and some of these may be located on non-Government owned property.

Holifield Heavy Ion Research Facility (HHIRF)

This project will provide for improvements to the Holifield Heavy Ion Research Facility (HHIRF) and the EN-tandem facility by providing a high quality electron target for ion-electron collisions research. Initially, the electron target will be housed adjacent to the EN-tandem; subsequently, it will be located in the new atomic physics addition to the HHIRF. Electron target components will include items such as an electron gun, solenoids, toroids, an electron collector, high voltage power supplies, magnet power supplies, vacuum chambers, valves, vacuum pumps, vacuum gauges, bake-out system, and a high voltage platform and support system.

10. Details of Cost Estimate

Holifield Heavy Ion Research Facility.....	720

11. Method of Performance

Design, engineering and inspection will be performed by Oak Ridge National Laboratory. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts and subcontracts awarded on the basis of competitive bidding.

DEPARTMENT OF ENERGY
FY 1989 CONGRESSIONAL BUDGET SUBMISSION
CONSTRUCTION PROJECT DATA SHEETS
ENERGY SUPPLY RESEARCH AND DEVELOPMENT - PLANT AND CAPITAL EQUIPMENT
BASIC ENERGY SCIENCES

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

1. Title and location of project: General Plant Projects

2. Project No.: 89-R-400

3. Date A-E work initiated: 1st Qtr. FY 1989

3a. Date physical construction starts: 2nd Qtr. FY 1989

4. Date construction ends: 4th Qtr. FY 1990

5. Previous cost estimate: None
Date:

6. Current cost estimate: $4,900
Date: January 1988

7. Financial Schedule:

Fiscal Year	Obligations	FY 1987	FY 1988	FY 1989	FY 1990
Prior Year Projects	$ 3,877	$ 15	$ 0	$ 0	$ 0
FY 1987 Projects	3,150	2,319	731	100	0
FY 1988 Projects	4,900	0	3,390	1,510	0
FY 1989 Projects	4,900	0	0	3,500	1,400

8. Brief Physical Description of Project

This project is required to provide for minor new construction, other capital alterations and additions, and for buildings and utility systems. Where applicable, the request also includes the cost of installed capital equipment integral to a subproject. Funding of this type is essential for maintaining the productivity and usefulness of Department-owned facilities. Since it is difficult to detail this type of project in advance, a continuing evaluation of requirements and priorities may be expected to result in additions, deletions, and changes in the currently planned subproject. In general, the estimated funding for each location is preliminary in nature, and is intended primarily to indicate the relative magnitude of the requirements. No significant R&D program is anticipated as a prerequisite for design and construction of the subprojects under construction.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: General Plant Projects — 2. Project No.: 89-R-400

8. Brief Physical Description of Project (continued)

The currently estimated distribution of FY 1988 funds by office is as follows:

Argonne National Laboratory	$ 3,700
Ames Laboratory	500
Notre Dame Radiation Laboratory	100
Sandia National Laboratories	400
Stanford Synchrotron Radiation Laboratory	200
Total project cost	$ 4,900

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

The following are examples of the major items to be performed at the various locations. Since needs and priorities may change, other projects may be substituted for the examples listed below, and some of these may be located on non-Government owned property.

Argonne National Laboratory..... $ 3,700

The Argonne National Laboratory FY 1988 General Plant Projects (GPP) are miscellaneous minor new construction projects of a general nature, the total estimated costs of each will not exceed $1,200,000. These general plant projects are necessary to provide for the continuing requirement to maintain the facilities in a good state of repair, to adapt the facilities to new or improved production or service techniques, to effect economics of operations and to reduce or eliminate health, fire, and security problems.

1. Upgrade Laboratory Electric Service, Building 223
2. Site-Wide Caulking and Tuck Pointing
3. Replace Hot Water Heaters, Buildings 205, 206, 208
4. Replace AC Units, Buildings 202, 214
5. ATLAS Experimental Hall Addition, Building 203
6. Cooling Tower R4 Replacement, Building 203
7. Replace Exterior Doors and Jambs, Site-Wide
8. Replace Exhaust Systems, Wing A, Building 203
9. Replace Cooling Tower, Building 202, G & H Wings
10. Replace Fan Coil Units and Pumps, Building 213

1. Title and location of project: General Plant Projects — 2. Project No.: 89-R-400

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

Of the total request of $3,700,000 for GPP at the Argonne National Laboratory, approximately 50 percent will be used for plant rehabilitation and approximately 50 percent will be used for upgrading and programmatic projects.

Ames Laboratory..... $ 500

The projects involve: Upgrading HVAC System, Metallurgy Building (basement and first floor areas), Motor Control Center for Spedding Hall, replace Applied Sciences Center Roofs, and miscellaneous small programmatic projects. The projects described will be constructed on the Ames Laboratory, non-Government owned property.

Notre Dame Radiation Laboratory..... $ 100

Requirements include the expansion of the accelerator area to provide space for additional pieces of experimental apparatus to be added to the pulse radiolysis facility, and to prepare for eventual replacement of the present accelerator. The projects described will be constructed on the Notre Dame Radiation Laboratory, non-Government owned property.

Sandia National Laboratories..... $ 400

The Combustion Research Facility (CRF) at Sandia National Laboratories, Livermore (SNLL) has a continuing need for General Plant Project (GPP) funds for upgrading or the construction of facilities as required to meet expanding or changing programmatic goals. Many experiments, both active and proposed, at the CRF have greatly impacted the available laboratory space and facilities. Some experiments have become increasingly complex and consequently require larger laboratory space than is currently available to them. The GPP funding in this request will provide additional laboratory space with appropriate modifications to suit individual experimental situations.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: General Plant Projects 2. Project No.: 89-R-400

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

Stanford Synchrotron Radiation Laboratory..... $ 200

Requirements include minor modifications and additions necessary to support the optimum use of the laboratory research capabilities. These improvements are necessary to maintain the capital investment at the site and to accommodate the continuous changes to the physical site necessitated by the evolving SSRL research program. Examples include upgrading of chemistry lab/darkroom, construction of parking lot, and relocation of computer facility. The projects described will be constructed at the Stanford University, non-Government owned property.

10. Details of Cost Estimate

See description, item 8. The estimated costs are preliminary and, in general indicate the magnitude of each program. These costs included engineering, design, construction and inspection.

11. Method of Performance

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