DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT

OVERVIEW

BASIC ENERGY SCIENCES

The Basic Energy Sciences (BES) program supports research that is crucial to achieving the goals of the Department of Energy and those described in the Energy Policy Act of 1992 and in the High Performance Computing Act of 1991 (Public Law 192-104). In the pursuit of its research goals, the BES program designs, constructs, and operates large complex scientific facilities and makes them available to the scientific community at large. Thus, the main activities in BES are to conduct energy-related research, to provide the necessary scientific facilities for this research to DOE and other users, and to support an information technology infrastructure for collaborative research. The research funded by the BES program utilizes the expertise of the national laboratories, universities, industry, and other government agencies.

Results from BES sponsored research become an integral part of the information base that underpins the nation's energy technology development. The BES program strengthens the nation's science and engineering foundation by training future scientists and providing improved environmental quality, better health and quality of life, economic competitiveness through the transfer of information and technology, energy self-sufficiency, and national security. The BES program is also at the forefront in the development of computational science as a new paradigm of research, complementing theory and experimentation. The research in the BES program is grouped into six major subprogram areas: Materials Sciences, Chemical Sciences, Engineering and Geosciences, Advanced Energy Projects, Energy Biosciences, and Applied Mathematical Sciences.

Much of the research sponsored by the BES program is driven by information needs that are currently limiting existing energy technologies. The link between basic research and applications, however, is typically not confined to any single energy or technological problem, but has applications to a number of technologies. For example, a new or improved heat transfer device may be applied to fossil, nuclear, solar or geothermal energy systems. Advances in high temperature superconducting materials also may be applied to a number of energy technologies, such as more efficient motors, generators, power transmission lines and transportation systems. These improvements will have tremendous economic and energy savings. Each of the subprograms in BES support research projects with similarly broad applications across a range of energy technologies. Whether attempting to burn coal cleaner or more cheaply, or to find ways to reduce the overall volume or hazards from wastes, nuclear or non-nuclear, solutions will ultimately depend on advances in basic research and the applications of those advances to energy technologies. The BES research program annually supports approximately 1,400 individual research projects at over 200 separate institutions, with direct support for over 4,000 investigators and 2,300 graduate students in the physical, biological, and mathematical sciences. These projects are selected on the basis of scientific excellence, relevance to support of DOE long-term goals, and their contribution to the goals of the Energy Policy Act of 1992.

The BES program operates unique facilities that are available to a wide array of user groups. These major facilities account for a significant amount of the BES budget requirement. In general, facility costs have risen by an amount greater than the cost of living. These higher costs can be attributed to higher utility costs, safeguards, safety requirements, and higher user demands, as well as the cost of cutting-edge equipment. At the seven major user facilities funded by the BES program, the number of users grew to over 4,000 from industry, academia and Federal laboratories in FY 1993. These facilities are the High Flux Beam Reactor and the National Synchrotron Light Source at Brookhaven National Laboratory, the Combustion Research Facility at Sandia National Laboratories, Livermore, the High Flux Isotope Reactor and the Radiochemical Engineering Development Center at Oak Ridge National Laboratory, the Stanford Synchrotron Radiation Laboratory at the Stanford Linear Accelerator Center, the Intense Pulsed Neutron Source at Argonne National Laboratory and the Advanced Light Source at Lawrence Berkeley Laboratory.

The BES program supports research facilities for a number of top U.S. universities and U.S. corporations (e.g., IBM, AT&T, Exxon, GM). These users sponsor major research teams in areas such as catalysis, electronics, polymers, and biomedicine. Results from these research efforts, including user facility based research funded in the Biological and Environmental Research program, are important not only to those institutions, but also to the Department. At the neutron sources, major companies and universities are doing research in structural biology and in superconductivity; research is also supported that evaluates radiative effects on materials important to fission, fusion, and radioactive waste

technology. At the High Flux Isotope Reactor, important and unique isotopes are produced.

The strategic plan for BES has as its principal goals:

o Focus the research effort on energy related activities, especially those identified in the Energy Policy Act of 1992 and emphasize a multidisciplinary approach with participation of several subprograms, as appropriate.

o Completion of advanced scientific facilities for the nation and safe and productive operation of the BES facilities.

o Development of energy-related National challenge applications for the National Information Infrastructure.

o Enhance the balanced approach to BES activities between research and facilities through growth in both areas where opportunities exist.

o Enhancement of math and science education - the BES program provides support for about 2,300 graduate students and 2,000 academic professors and post-doctoral researchers.

o Promote information and technology transfer.

The BES program support can be divided into two distinct but related components: research; and facility operations, design and construction. Research is supported at national laboratories, universities and other institutions. Approximately one-fourth of BES funding supports university-based research directly. The list of universities receiving support covers almost every state and includes participation by both large and small institutions. The facility component supports the operation of seven major user facilities. In addition, the FY 1995 facility request provides for the continuation of construction of an advanced x-ray radiation light source at ANL. All activities related to an advanced research reactor, the Advanced Neutron Source, needed by the Department and the Nation appear in a separate budget.

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.

In order to make further progress in certain fields, more advanced facilities are required. Three facilities have been identified by the scientific community as being the most critical to the future needs of the Department's Basic Energy Sciences program: the Advanced Light Source, located at the Lawrence Berkeley Laboratory, the 6-7 GeV Synchrotron Radiation Source located at the Argonne National Laboratory, and the Advanced Neutron Source (ANS), to be located at Oak Ridge National Laboratory.

The Department has developed performance measures for the results of its basic research activities. General performance measures of program outputs for basic research include such metrics as the number of scientists supported, the number of students earning advanced degrees, the number of scientific publications in peer-reviewed journals, the number of awards from professional organizations, and the number of citations in scientific publications. Metrics for the transfer of new knowledge to a technology application include the number of cooperative agreements with industry, the number of projects resulting in support from a DOE Energy Technology program, the number of invention records and patents, and the number of industry users at the major scientific user facilities. For construction projects, metrics can include costs and schedule milestones completed against approved project baselines. These performance measures are easily tabulated, commonly used, and begin to provide a framework for evaluating program efficiency. However, the most descriptive indicators in this area are qualitative rather than quantitative measures. In order to measure outcomes, or program effectiveness, the impact of the research outputs must be assessed in terms of the quality of the new knowledge gained, its usefulness to technology development, and its longer-term benefit to society. Although there are limited and expensive methods for evaluating the quality of science through peer-review metrics, no metric exists that can accurately measure science's impact on technology and society.

Overview - BASIC ENERGY SCIENCES (Cont'd)

The following summary highlights the Basic Energy Sciences program encompassed within the FY 1995 request:

o The research program would be held to approximately the same level of effort as in FY 1994. Within the base program request, research will continue to emphasize new areas started in FY 1993, including materials synthesis and processing associated with advanced materials and processing activities, biotechnology activities, nonautomotive battery research, and advanced manufacturing activities.

o The seven major user facilities would be operated at a level that would make them available to users at approximately the FY 1994 level. The Manual Lujan, Jr., Neutron Scattering Center (MLNSC) facility will be closed in FY 1994.

o The Advanced Light Source (LBL) would operate at close to capacity and the 6-7 GeV Synchrotron Radiation Source (ANL) would continue to be constructed with minimal effect on schedule.

o The High Performance Computing Research Centers, at Oak Ridge National Laboratory and Los Alamos National Laboratory, will both operate prototype computational systems providing support to approximately eight grand challenge class computational energy projects and the National Energy Research Supercomputer Center at Lawrence Livermore National Laboratory will begin work to transition a prototype massively parallel computing system into a production environment.

o The overall budget for Accelerator and Reactor Improvements and Modifications, General Plant Projects, and Capital Equipment are proposed at slightly less than the FY 1994 level to address the high priority needs of the program.

This budget request provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands. Narrative in whole dollars.)

LEAD TABLE

Basic Energy Sciences

Activity	FY 1993 Adjusted		FY 1994 Appropriation	FY 1994 Adjustment	FY 1995 Request
Operating Expenses					
Materials Sciences	$273,282	a/	$276,985	-$5,328	$274,221
Chemical Sciences	163,630	a/	169,000	-2,717	162,013
Engineering and Geosciences	36,456		37,900	-710	36,837
Advanced Energy Projects	10,972		11,400	-206	11,085
Energy Biosciences	25,447		26,700	-51	25,957
Applied Mathematical Sciences	83,902		106,200	-2,538	109,367
Program Direction	8,400		9,400	0	9,900
Subtotal Operating Expenses	602,089		637,585	-11,550	629,380
Capital Equipment	45,440		44,880	0	41,537
Construction	204,333		119,500	0	70,379
Subtotal, Basic Energy Sciences	851,862		801,965	-11,550	741,296
Adjustment	-14,275	b/	-----	-----	-----
Total Program	$837,587	c/d/	$801,965	-$11,550	$741,296

a/ Reflects $1,000,000 ($500,000 in Materials Sciences and $500,000 in Chemical Sciences) Internal Reprogramming from Nuclear Energy to Basic Energy Sciences for the purchase of research materials collection isotopes (93-R-4).

b/ Amount of general reduction for use of prior year balances assigned to this program. The total will be taken at the Appropriation level.

c/ Excludes $8,838,000 which has been transferred to the SBIR program.

d/ Reflects program specific general reduction of $49,000,000 and general reduction for use of prior year balances of $14,275,000.

	FY 1993 Adjusted	FY 1994 Appropriation	FY 1994 Adjustment	FY 1995 Request
Summary				
Operating Expenses	$588,724	$637,585	-$11,550	$629,380
Capital Equipment	44,930	44,880	0	41,537
Construction	203,933	119,500	0	70,379
Total Program	$837,587	$801,965	-$11,550	$741,296
Staffing (FTEs)				
Headquarters	67	76	0	75
Field	5	6	0	7
Total	72	82 e/	0	82

e/ Revised request.

Authorization: Section 209, P.L. 95-91, "Department of Energy Organization Act"

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

SUMMARY OF CHANGES

Basic Energy Sciences

FY 1994 Request	$ 801,965
- Adjustment	- 11,550
FY 1994 Adjusted	$ 790,415

Operating Expenses

Materials Sciences ..... + 2,564
Increased funding is provided for the 6-7 GeV to continue research and development and to begin commissioning of the storage ring ($+10,900). Reduced funding is provided to continue ongoing research ($-2,819) and operation of major user facilities ($-3,217). The Manuel Lujan, Jr., Neutron Scattering Center will be shutdown in FY 1994; therefore no funds are provided ($-2,300).

Chemical Sciences ..... - 4,270
Reduced funding provided for continuation of the operation of major user facilities ($-1,019) and for ongoing research ($-3,251).

Engineering and Geosciences ..... - 353
Reduced funding provided for ongoing research activities.

Advanced Energy Projects ..... - 109
Reduced funding provided for ongoing research activities.

Energy Biosciences ..... - 692
Reduced funding provided for ongoing research activities.

Applied Mathematical Sciences ..... + 5,705
Provides for prototype system upgrades at one High Performance Computing Research Center (+906). Provides for transitioning of massively parallel processor prototypes into the supercomputer access program production environment, increased energy sciences network capability, and information infrastructure technology activities ($+4,799).

Program Direction ..... + 500
Funds provided for support of staff needed to monitor and manage program.

Capital Equipment ..... - 3,343
Core equipment funding is reduced slightly impacting research, environmental safety and health, and facility needs ($-1,927). Equipment funding in support of the 6-7 GeV Synchrotron Radiation Source is also reduced consistent with reduced capital equipment needs associated with the construction project data sheet ($-1,916). Increased funding in support of capital equipment needs associated with High Performance and Computing Communication activities ($+500).

Construction ..... - 49,121
Continues support for all ongoing construction projects: 6-7 GeV Synchrotron Radiation Source ($-48,621), Accelerator Improvement Projects ($0) and General Plant Projects ($-500).

FY 1995 Congressional Budget Request ..... $ 741,296

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FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(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 behavior which addresses the materials needs for safe, reliable, and environmentally acceptable energy technologies including fusion, fission, fossil, solar, geothermal, conservation, and waste containment. 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 36 percent 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 National Laboratory, Lawrence Livermore National Laboratory, Pacific Northwest Laboratory, Idaho National Engineering Laboratory, National Renewable Energy Laboratory, and Sandia National Laboratories. The laboratory research programs as a whole tend to contain larger groups of scientists, are multidisciplinary, involve longer-term research projects and tend to be co-sited with DOE-funded technology programs. Many of the DOE laboratory programs have unique, major facilities which are open to outside users from universities, industry, and other government laboratories. The university component of the program includes top researchers from universities throughout the country. A typical project may include graduate students and post-doctoral associates 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. About 15 percent of the funding is associated with the university portion of the program. Most of the industry supported portion of materials research takes place at smaller businesses through the Small Business Innovation Research program. Due to the unique, expensive, and specialized nature of the user facilities, the largest participation of industry researchers occurs at these facilities. As long as the research conducted by industry is available to the scientific community and is of interest to DOE, there is no charge imposed on the industry groups for the use of these facilities. Funding for the facilities portion of the Materials Sciences budget is about 49 percent.

The National Science and Technology Council's Committee on Civilian Industrial Technology (NSCT/CCIT) coordinates materials R&D activities throughout the Federal government. Participating agencies include: Department of Energy, National Science Foundation, Department of Defense, Department of Commerce-National Institute of Standards and Technology, National Aeronautics and Space Administration, Department of Transportation, Department of Health and Human Services-National Institutes of Health, Environmental Protection Agency, Department of Agriculture, and Department of Interior-Bureau of Mines. The Division of Materials Sciences, Office of Basic Energy Sciences, has the lead role in coordinating and integrating the input from approximately twenty different Department of Energy program offices to NSCT/CCIT. Also, interagency coordination and planning is carried out through topical coordination groups under the NSTC/CCIT in areas such as structural ceramics, superconductivity, etc.

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 that improve performance or efficiency in energy systems; to tailor materials properties to satisfy defined requirements such as improved corrosion resistance in fossil energy systems or radiation resistance in fission and fusion systems; to predict materials problems and service life to improve safety and reliability of components in energy systems; and to improve the theoretical and experimental capability to analyze the fundamental structure and behavior 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 NSCT/CCIT. Within the Materials Sciences subprogram, research is undertaken in the major areas of metallurgy, ceramics, solid state physics, and materials chemistry.

Some examples of research accomplishments during the past year include: discovery of a novel type of rubbery solid electrolyte that exhibits both high ionic conductivity and mechanical flexibility and is promising for lightweight batteries for transportation applications; the non-destructive mapping of the residual stress in a complex multipass welds that are necessary for safety and environmental protection, by

I. Materials Sciences (Cont'd)

neutron diffraction techniques; the development of a new class of semiconductor structures for the high efficiency generation of laser light; the simulation of a complex sheet metal forming problem including texture evolution by massively parallel computer simulation; the demonstration that precipitates in an oxide superconductor form strong flux pinning centers; the development of a simple and inexpensive glazing technique to improve the fracture toughness of superconducting liquid level sensors; the preparation of boron nitride films exhibiting a diamond crystal structure and hardness greater than diamond by means of ion-assisted pulsed laser deposition; the discovery that microscopic cavities within silicon provide exceptionally effective traps for metallic impurities and improve the semiconducting behavioral parameters for silicon; the discovery that helium bubbles diffuse through solid aluminum containing traces of lead or indium 100 times faster than through pure solid aluminum; the development of a new family of toughened whisker reinforced structural ceramics for high temperature applications requiring superior load carrying capacity and toughness; the successful electron beam welding of a thick section of a steel that is the material of choice in coal fired power plants; the achievement of the highest room temperature ductility ever achieved in the intermetallic compound nickel aluminide, which will enhance the ability to fabricate this material; the development of a new surface force apparatus, the Interfacial Forces Microscope, for the quantitative measurement of the mechanical relaxation of monomolecular organic film; the development of a process called electroincineration, which is the rapid and complete electrochemical oxidation of toxic family of organic waste materials to harmless by-products; small-angle neutron scattering measurements of the magnetic flux vortex lattice in the high temperature superconductors; the observation of layer-by-layer epitaxial growth of gallium arsenide crystals using time-revolved X-ray scattering experiments at Stanford Synchrotron Radiation Laboratory; the development of fundamental understanding a theory which predicts interplanar expansion or contraction of metallic surface layers; the development of a new technique called diffraction EXAFS in which the chemical environment of different lattice sites in a crystal can be determined, even though these different lattice sites are occupied by the same element; the discovery of isotopically enriched diamond monochrometers for use in handling extremely high power loads generated by third generation light sources; and research supported by the Division of Materials Sciences has led to 45 Cooperative Research and Development Agreements with industrial matching funds of over $45 million.

II. A. Summary Table: Materials Sciences

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Materials Sciences Research	$ 138,521	$ 141,153	$ 138,334	- 2
Facilities Operations	134,761	130,504	135,887	+ 4
Total, Materials Sciences	$ 273,282	$ 271,657	$ 274,221	+ 1

II. B. Major Laboratory and Facility Funding

AMES LAB	$ 9,525	$ 9,539	$ 9,255	- 3
ARGONNE NATIONAL LAB (EAST)	$ 60,659	$ 77,360	$ 87,853	+ 14
BROOKHAVEN NATIONAL LAB	$ 51,018	$ 50,026	$ 49,489	- 1
IDAHO NATIONAL ENGINEERING LAB	$ 408	$ 312	$ 303	- 3
LAWRENCE BERKELEY LAB	$ 38,400	$ 38,067	$ 36,996	- 3
LAWRENCE LIVERMORE NATIONAL LAB	$ 2,183	$ 2,059	$ 1,997	- 3
LOS ALAMOS NATIONAL LABORATORY	$ 12,705	$ 9,036	$ 6,714	- 26
OAK RIDGE NATIONAL LAB	$ 44,776	$ 22,185	$ 21,520	- 3
PACIFIC NORTHWEST LAB	$ 2,870	$ 3,068	$ 2,977	- 3
SANDIA NATIONAL LABORATORIES	$ 7,949	$ 7,947	$ 7,709	- 3

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

Program Activity	FY 1993	FY 1994	FY 1995
Materials Sciences			
Materials Sciences Research	Metallurgy and Ceramics Research - Continued effort on understanding processing-structure- property relationships in ceramic superconductors. Continued efforts on theoretical approaches to high performance metals and ceramics, and structure-behavior relationships. Continued efforts in safety and reliable performance of materials, including corrosion resistant materials, surface modification to improve friction and wear, modeling of near-net shape fabrication processes for complex materials systems, welding and joining of materials, materials for radiation environments, synthesis of photovoltaic materials, and high temperature structural ceramics.	Metallurgy and Ceramics Research - Continue effort on understanding synthesis-processing-structure-property relationships in ceramic superconductors. Increased thrusts in safety and reliable performance of materials. Continue efforts on corrosion resistant materials, surface modification to improve friction and wear, modelling of near-net shape fabrication processes for complex materials systems, welding and joining of metallic and ceramic materials, materials for radiation environments, synthesis and processing of photovoltaic materials, and high temperature structural ceramics.	Metallurgy and Ceramics Research - Continue effort on understanding synthesis-processing-structure-property relationships in ceramic superconductors. Sustain thrusts in safety and reliable performance of materials. Continue efforts on surface modification to improve friction and wear, modelling of near-net shape fabrication processes for complex materials systems, welding and joining of metallic and ceramic materials, materials for radiation environments, synthesis, processing and behavior of photovoltaic materials, and high temperature structural ceramic composites. Increased thrusts of synthesis and processing of metals and ceramics, aqueous corrosion, and high-temperature gaseous corrosion and erosion.
	Solid State Physics Research - Continued high priority research within the DOE mission, and largely unique to DOE, such as neutron scattering and synchrotron radiation. Constant effort on the physics of high-temperature superconductivity. Continued efforts on the physics of radiation effects. Continued efforts in surface and interface science, magnetic materials, theory of atomically complex materials, and characterization of complex materials. Within the Advanced Materials and Processing Program (AMPP) there was greater emphasis on the synthesis and processing of new materials, especially magnetic and superconducting materials. Progress was made on the development of new beamlines for the new light sources at the Advanced Light Source at LBL and	Solid State Physics Research - Continuation of high priority research within the DOE mission especially in neutron scattering and synchrotron light sources. Continued efforts in the physics of high-temperature superconductivity, radiation effects, and the development of novel characterization methods. Continued efforts on the physics of surfaces and interfaces. Enhanced emphasis on new materials with energy-related properties. Enhanced emphasis in magnetic and photovoltaic materials. Enhanced effort to develop beamlines for ALS and APS.	Solid State Physics Research - Continuation of high priority research within the DOE mission especially in neutron scattering and synchrotron light sources. Continued efforts in the physics of high-temperature superconductivity and radiation effects at the same level, and the development of novel characterization methods. Continued efforts on the physics of surfaces and interfaces. Continued emphasis on new materials with energy-related properties. Continued emphasis on thrusts in magnetic and photovoltaic thin film materials.

III. Materials Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Materials Sciences Research (Cont'd)	the 6-7 GeV Synchrotron Radiation Source at ANL.		
	Materials Chemistry Research - Continued emphasis on synthesis and characterization of novel organic and inorganic materials with a focus on novel inorganic materials, organic superconductors (such as doped buckeyballs), synthetic metals, high strength polymers, polymeric electrolytes, preceramic material and novel materials synthesized using biological processes. There was continued emphasis on the materials chemistry of macromolecules at interfaces. Continued emphasis on biomolecular materials, catalysts, organic ferromagnets and organic superconductors, materials derived from small clusters, polymers and tribology. Continued emphasis on the synthesis and processing of new materials under the AMPP initiative in order to identify new materials with new or improved properties.	Materials Chemistry Research - Continued emphasis on research in materials chemistry of high priority to the Department including synthesis and characterization of novel organic and inorganic superconductors and magnetic materials, synthetic metals, surfaces and interfaces, polymers and materials synthesized by biological processes. New programs will be developed in the synthesis of biomolecular materials, novel ferromagnets, superconductors, and synthetic metals. There will be an enhanced effort to provide beamline support for the ALS and APS.	Materials Chemistry Research - Continued emphasis on research in materials chemistry of high priority to the Department including synthesis and characterization of nanoscale materials based on novel cluster chemistry, organic ferromagnets, novel organic/inorganic superconductors, synthetic metals, surface chemistry of interfaces, polymers and materials synthesized by biological processes. Continued emphasis on understanding friction, lubrication, and corrosion. Programs will be developed in the synthesis of biomolecular materials, novel ferromagnets, and synthetic metals.
	EPACT:	EPACT:	EPACT:
	EPACT Section 2201 "National Advanced Materials Initiative:"	EPACT Section 2201 "National Advanced Materials Initiative:"	EPACT Section 2201 "National Advanced Materials Initiative:"
	The Basic Energy Sciences program conducts research related to the goals of EPACT in the area of advanced materials. However, BES is not responsible for the reporting requirements identified in EPACT, Section 2201.	The Basic Energy Sciences program conducts research related to the goals of EPACT in the area of advanced materials.	The Basic Energy Sciences program conducts research related to the goals of EPACT in the area of advanced materials.

III. Materials Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Materials Sciences Research (Cont'd)		INVESTMENT:	INVESTMENT:
		Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	Funding in the amount of $4,068,000 has been transferred to the SBIR program.	Funding in the amount of $4,002,000 has been budgeted for the SBIR program.	Funding in the amount of $5,484,500 has been budgeted for the SBIR program.
	$ 138,521	$ 141,153	$ 138,334
Facilities Operations	Continued support for major facilities in the Materials Sciences subprogram. Increased support for commissioning and operation of the Advanced Light Source (LBL) and R&D and commissioning of components of the 6-7 GeV Synchrotron Radiation Source (ANL). Workshops leading to the development of a conceptual design of a pulsed spallation neutron source were deferred. (For more detail on Facilities Operations see the Major User Facilities section following the Construction section.)	Continues support for major facilities in the Materials Sciences subprogram with increases and funds for first full year of operation for the Advanced Light Source (LBL). Provides increases needed for R&D and commissioning of components of the 6-7 GeV Synchrotron Radiation Source (ANL). Begin workshops and meetings leading to a conceptual design of a pulsed spallation neutron source. (For more detail on Facilities Operations see the Major User Facilities section following the Construction section.)	Continues support for major facilities in the Materials Sciences subprogram. Provides increases needed for R&D and commissioning of components of the 6-7 GeV Synchrotron Radiation Source (ANL). (For more detail on Facilities Operations see the Major User Facilities section following the Construction section.)
	Preconstruction research and development support of ANS continues for environmental impact statement, preliminary safety analysis report, and probabilistic risk assessment for the ANS.	Funding for ANS budgeted in a separate decision unit.	Funding for ANS budgeted in a separate decision unit.

III. Materials Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Facilities Operations (Cont'd)	EPACT: EPACT Section 2203(a)(2)(a) "Supporting Research and Technical Analysis": Provides funds for operation of user facilities to provide special scientific and research capabilities to serve the research needs of the Nation's universities, industry, private laboratories, Federal laboratories, and others.	EPACT: EPACT Section 2203(a)(2)(a) "Supporting Research and Technical Analysis:" Provides funds for operation of user facilities to provide special scientific and research capabilities to serve the research needs of the Nation's universities, industry, private laboratories, Federal laboratories, and others. INVESTMENT: Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	EPACT: EPACT Section 2203(a)(2)(a) "Supporting Research and Technical Analysis": Provides funds for operation of user facilities to provide special scientific and research capabilities to serve the research needs of the Nation's universities, industry, private laboratories, Federal laboratories, and others. INVESTMENT: Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	$ 134,761	$ 130,504	$ 135,887
Materials Sciences	$ 273,282	$ 271,657	$ 274,221

DEPARTMENT OF ENERGY
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ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

I. Preface: Chemical Sciences

The Chemical Sciences subprogram supports a broad range of basic research in chemistry and atomic physics necessary for future development of energy technologies. Major program efforts are in photochemistry important for the efficient conversion of solar energy to fuels or electricity; chemical physics related to combustion processes and improved utilization of fossil fuels; atomic physics related to fusion energy; heavy element chemistry related to nuclear waste management; a broad program in homogeneous and heterogeneous catalysis related to coal conversion and improved processes for the commercial production of chemicals; separations and analytical sciences related to virtually all process chemistry and nuclear energy technology; and chemical thermodynamics to assist in predicting physical and chemical properties of hydrocarbon fuels. Basic research in molecular sciences that will lead to innovative approaches to waste management and environmental cleanup is supported.

Recent examples of research results that may have significant technological impact may be cited as follows. Novel metal coated alumina foam monolith catalysts have been discovered which give high conversion and selectivity in the partial oxidation of methane to synthesis gas (carbon monoxide and hydrogen) or methanol. Gallium arsenide particles with diameters of about fifty angstroms and a narrow size distribution have been synthesized. Such particles could be the basis for new nonlinear optical devices and solar photocatalysts. A new sensitive diagnostic tool for molecular and atomic species which is suitable for applications in engines has been developed from collaborative research involving scientists supported by the Division of Chemical Sciences and the former Office of Conservation and Renewable Energy. A microchemical analytical procedure has been developed which has been applied to the analysis of the chemical contents of a single red blood cell. Single cell analysis could be used for disease characterization before the gross manifestations of the disease becomes apparent. Also, drug studies can now be carried out at a single cell level rather than testing a living organism for the pharmacological effects of the test compound.

II. A. Summary Table: Chemical Sciences

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Chemical Sciences Research	$ 106,796	$ 108,342	$ 106,923	- 1
Facilities Operations	56,834	57,941	55,090	- 5
Total, Chemical Sciences	$ 163,630	$ 166,283	$ 162,013	- 3

II. B. Major Laboratory and Facility Funding

	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
AMES LAB	$ 3,659	$ 3,759	$ 3,709	- 1
ARGONNE NATIONAL LAB (EAST)	$ 16,564	$ 16,080	$ 16,080	0
BROOKHAVEN NATIONAL LAB	$ 18,020	$ 17,759	$ 17,468	- 2
IDAHO NATIONAL ENGINEERING LAB	$ 315	$ 315	$ 315	0
LAWRENCE BERKELEY LAB	$ 8,337	$ 8,278	$ 7,362	- 11
LOS ALAMOS NATIONAL LABORATORY	$ 996	$ 1,033	$ 1,069	+ 3
OAK RIDGE NATIONAL LAB	$ 45,096	$ 44,701	$ 43,301	- 3
PACIFIC NORTHWEST LAB	$ 6,800	$ 6,590	$ 6,590	0
SANDIA NATIONAL LABORATORIES	$ 8,125	$ 8,037	$ 7,794	- 3

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

Program Activity	FY 1993	FY 1994	FY 1995
Chemical Sciences			
Chemical Sciences Research	The research program is aimed at providing a molecular level understanding of solvent dynamics and electron transfer necessary for development of improved solar photochemical energy conversion schemes and devices. Related research on natural photosynthesis and photoelectrochemistry has also received emphasis. Other areas including hot atom chemistry and radiation chemistry were given lower priority.	Work continues to focus on solvent dynamics, electron transfer, and short-lived phenomena. Progress in these technical areas is necessary for more efficient conversion of solar energy into other useful energy forms. Also necessary to achieve these long term goals is planned research on dye-sensitized semiconductor photoelectrodes, heterogeneous photocatalysis, and new organometallic precursors for electronic materials.	Support for research that will enhance molecular level understanding related to solar photochemical energy conversion will be maintained. Increased emphasis will be placed upon novel semiconductor structures as well as organic semiconducting and electrically conducting polymers of import to solar photochemical energy conversion.
	Critical to improved understanding of combustion processes is a thorough base in chemical reactivity. The dynamics and kinetics of simple combustion related reactions were given highest priority. Modeling efforts were also continued. The Combustion Research Facility (CRF) continued as a major site devoted to combustion science. Research in the fundamentals related to environmental restoration and waste management was enhanced. The areas of focus were the liquid-solid interface which is important to understanding the	Critical to the Energy Policy Act of 1992 is an understanding, on the molecular level, of combustion processes. The proposed funding levels permit high priority programs in chemical dynamics and kinetics of simple reactions including the reaction dynamics of hot molecules and surface combustion chemistry to continue. The CRF continues as a major site devoted to a broad program in combustion related chemical physics. Cluster research, a new area of molecular science, continues because it has	The majority of the nation's energy arises from combustion and research related to combustion continues as a high priority program within the Chemical Sciences subprogram. Research related to chemical dynamics and kinetics of simple reactions of combustion interest will continue with high priority. Research of lower priority will be reduced in favor of combustion related work so as to maintain the strength and viability of the DOE combustion research effort. Emphasis will be placed on theoretical

III. Chemical Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Chemical Sciences Research (Cont'd)	reactivity and to control or prevent transport of hazardous chemicals and species in the environment. Research on properties and reactivity of clusters, both metal and semiconductor, continued since these are important in the long-term for improved catalysts and understanding materials.	potential for improved understanding of catalysis and the behavior of materials. Interaction with the technology programs related to combustion and environmental restoration is being continued.	and experimental characterization of clusters, a unique form of matter, as a function of their composition, size, structure, and bonding.
	The atomic physics effort continued with an enhanced focus upon properties of low-temperature plasmas. The recommendations of the workshops supported by the Chemical Sciences Division on "Future Research Opportunities in Atomic, Molecular, and Optical Physics" formed the long-range basis for the program.	The budget request is consistent with the report on "Future Research Opportunities in Atomic, Molecular, and Optical Physics" and the program provides support for efforts consonant with those areas listed. Specifically, approaches to the study of high energy density systems and energy-loss processes are being emphasized. Experimental and theoretical efforts in multi-electron excitation and ionization will improve understanding of the fusion process, light-matter interactions, and collision phenomena. Programs in atomic and plasma physics for advanced energy concepts related to many industrial and consumer needs are included. The plasma physics activity is being coordinated with Energy Research's Fusion Energy program. An area of emphasis is on accurate characterization of chemical processes taking place in plasmas including surface phenomena and interactions between complex species found in plasmas.	Research consistent with the report "Future Research Opportunities in Atomic, Molecular, and Optical Physics" will be maintained. A new emphasis will be in the area of low-temperature plasma physics which have the potential of significant impact on materials processing.

III. Chemical Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Chemical Sciences Research (Cont'd)	Materials precursor chemistry based on new synthetic processes for the molecular design of advanced materials was increased. High priority research in the heterogeneous catalysis programs and coal chemistry research continued to be emphasized. Other efforts were reduced. General program directions established in FY 1992 continued.	The catalysis research includes work on oxide and photoelectric catalysis, modification of shape selective oxide catalysts, and work to extend the conversion of paraffinic hydrocarbons to chemicals with significant energy efficiency, which includes work with renewable feedstocks. This activity is coordinated with other more applied catalysis programs in DOE through ongoing discussions.	All program elements will continue. Synthetic and mechanistic chemistry of novel inorganic and organometallic precursors to advanced materials, which are important to new ceramics, catalysts, semiconductors and other technologically important materials, will be enhanced. In addition, nanoscale synthesis of particles (quantum dots) and surface clusters, which may lead to new photovoltaic materials and new catalysts for the control of reactions important to alternative fuels and industrial chemicals, will be undertaken.
	Phase equilibria in chemical engineering sciences emphasized simulations and theory of modeling adsorption of simple fluids in porous media. Research on physically based predictive turbulence models was protected. A basic research program in the area of batteries for non-automotive applications was started. Particular emphasis was placed on improving battery size, weight, life, and recharge cycles. The initiative involved researchers from industry, universities, and National Laboratories and emphasized consortia and technology transfer.	In chemical engineering sciences, research on combustion related turbulence and phase equilibria of complex mixtures, experimental and theoretical, and physically based predictive models is being protected. The basic research program on advanced batteries is being expanded to include research on aspects of fuel cells. This research is being coordinated with other appropriate applied program elements in DOE.	In chemical engineering sciences, research on the theoretical modeling of phase equilibria and thermophysical properties related to efficient processing will be strengthened, including modeling of turbulent flames related to reduction of environment pollutants in combustion processes. The advanced battery research program will continue at the FY 1994 level.
	Improvements and innovations in analytical methods were continued and efforts to improve the understanding of separation processes were emphasized. This included studies of the design of ion-specific complexing agents in selective hydrometallurgical separations processes and research on the energy and process efficiencies of vapor-liquid separations.	Actinide separations research needed to underpin the development of new processes for dealing with environmental and hazardous wastes continues. Biotechnology related analytical research on macromolecules is being protected. Program directions established in FY 1993 continued.	The chemical properties and structure of interfaces, as determined by laser ablation, atomic force microscopy and molecular imaging of ceramic and other inorganic materials, important to the development of new and improved analytical methods and separation techniques will be emphasized.

III. Chemical Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Chemical Sciences Research (Cont'd)	Studies of the characteristics of electronic bonding at high pressure and the behavior of the actinide elements in superconducting phases was emphasized in solid state heavy element chemistry. Research on the electronic structures of the actinide elements in aqueous solution as it pertains to analyses and species characterization at environmental concentrations was augmented.	Emphasis is on solid state heavy element chemistry related to superconducting materials, environmental and hazardous waste related activities and lanthanide chemistry.	In the heavy element chemistry program, the study of the effect of f-electrons in superconducting materials, including the effects of magnetic fields on superconducting electrons, important to understanding superconductivity in actinide and lanthanide mixed metal oxides will be enhanced as will research on actinide chemistry in near neutral solutions since it is important to improved understanding of actinide transport under environmental conditions.
		INVESTMENT:	INVESTMENT:
		Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	Funding in the amount of $2,436,000 has been transferred to the SBIR program.	Funding in the amount of $2,447,000 has been budgeted for the SBIR program.	Funding in the amount of $3,240,500 has been budgeted for the SBIR program.
	$ 106,796	$ 108,342	$ 106,923
Facilities Operations	Support is provided to major user facilities which are available to the entire scientific community. The facilities operated at slightly below the improved level set in FY 1991 because of inflation. Improvements in safety, management, and operations at the facilities continued at the FY 1992 level. Increasing requirements in quality assurance and conduct of operations were addressed in the context of a constrained budget. (For more detail on Facilities Operations see the Major User Facilities section following the Construction section.)	Support is provided to major user facilities which are available to the entire scientific community. The facilities continue to operate at the level set in FY 1993 adjusted for inflation. Improvements in safety, management, and operations at the facilities are being continued. Increasing requirements in quality assurance and conduct of operations are being addressed to the extent possible. (For more detail on Facilities Operations see the Major User Facilities section following the Construction section).	Support is provided to major user facilities which are available to the entire scientific community. The facilities will continue to operate at approximately the level set in FY 1994. Improvements in safety, management, and operations at the facilities will be continued. Increasing requirements in quality assurance and conduct of operations will be addressed to the extent possible. (For more detail on Facilities Operations see the Major User Facilities section following the Construction section).

III. Chemical Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Facilities Operations (Cont'd)	EPACT: EPACT Section 2203(a)(2)(a) "Supporting Research and Technical Analysis": Provides funds for operation of user facilities to provide special scientific and research capabilities to serve the research needs of the Nation's universities, industry, private laboratories, Federal laboratories, and others.	EPACT: EPACT Section 2203(a)(2(a) "Supporting Research and Technical Analysis": Provides funds for operation of user facilities to provide special scientific and research capabilities to serve the research needs of the Nation's universities, industry, private laboratories, Federal laboratories, and others. INVESTMENT: Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	EPACT: EPACT Section 2203(a)(2)(a) "Supporting Research and Technical Analysis": Provides funds for operation of user facilities to provide special scientific and research capabilities to serve the research needs of the Nation's universities, industry, private laboratories, Federal laboratories, and others. INVESTMENT: Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	$ 56,834	$ 57,941	$ 55,090
Chemical Sciences	$ 163,630	$ 166,283	$ 162,013

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

I. Preface: Engineering and Geosciences

This subprogram provides DOE's principal cross-cutting research activities in the engineering and geosciences disciplines. The research builds foundations for creation and development of technologies contributing to progress in the areas of respecting the environment, securing future energy supplies, and increasing energy efficiency. Payoffs from the research include added domestic sources of liquid and gaseous fuels, improved waste clean-up and management, reduction of capital needs for energy production and distribution, and addition of highly skilled personnel to the U.S. work force in energy-related specialties.

Engineering research serves as a conduit between basic science and applications-oriented research and development with the goals of maintaining leadership in engineering and stimulating job growth while protecting the environment. The engineering activity aims are (1) to improve and advance our knowledge of processes underlying current engineering practice, and (2) to expand the store of fundamental concepts for solving anticipated and unforeseen engineering problems in energy technologies. To meet those objectives, the program focuses on supporting individual investigators and small groups of researchers addressing the foundations of energy related engineering. Topics addressed include fundamentals important to increasing energy efficiency, to identifying potential new energy production and utilization processes, to advanced manufacturing science, and to maintaining high environmental standards. Examples include multiphase flows (important to energy production and to waste management), instrumentation and control systems (important to intelligent systems for material processing and synthesis of high quality manufactured products, and for bioprocessing of fuels and energy-related wastes), and issues such as reliability and useful life prediction of aging energy production and distribution systems (important for economy, safety and environmental considerations). An increasing fraction of the effort features joint research projects involving two or more participating institutions, among National Laboratories, universities and industry, making the resources of the Government more productive and more responsive to its citizens and businesses.

Geosciences research extends the foundation for efficient and economic utilization of the Earth's energy resources. Geosciences research also extends the technology base necessary for understanding the geodynamics of environmentally contaminated sites, for developing innovative remediation technologies, and for predicting the potential environmental impact of future energy technologies. The programmatic emphasis is on geologic fluids flowing in, and interacting with, porous and fractured geologic media. Better predictive capabilities will greatly improve the technical basis for energy and environmental policy. The emphasis on fundamental aspects of the problem will insure that the resulting new understanding will be equally applicable to evaluation of environmentally contaminated DOE and industrial sites. The Geosciences program will contribute to important new federal efforts related to oil and gas resources through research emphasizing fundamental aspects of geophysical identification and assessment of fluid-bearing reservoirs in the subsurface.

II. A. Summary Table: Engineering and Geosciences

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Engineering Research	$ 16,673	$ 17,000	$ 16,875	- 1
Geosciences Research	19,783	20,190	19,962	- 1
Total, Engineering and Geosciences	$ 36,456	$ 37,190	$ 36,837	- 1

II. B. Major Laboratory and Facility Funding

	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
ARGONNE NATIONAL LAB (EAST)	$ 811	$ 816	$ 680	- 17
BROOKHAVEN NATIONAL LAB	$ 384	$ 349	$ 350	0
IDAHO NATIONAL ENGINEERING LAB	$ 2,294	$ 2,002	$ 2,317	+ 16
LAWRENCE BERKELEY LAB	$ 2,472	$ 2,404	$ 2,132	- 11
LAWRENCE LIVERMORE NATIONAL LAB	$ 2,025	$ 1,740	$ 1,750	+ 1
LOS ALAMOS NATIONAL LABORATORY	$ 2,730	$ 1,827	$ 1,812	- 1
OAK RIDGE NATIONAL LAB	$ 2,350	$ 2,561	$ 2,600	+ 2
PACIFIC NORTHWEST LAB	$ 1,079	$ 792	$ 807	+ 2
SANDIA NATIONAL LABORATORIES	$ 2,255	$ 1,971	$ 1,996	+ 1

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

Program Activity	FY 1993	FY 1994	FY 1995
Engineering and Geosciences			
Engineering Research	In mechanical sciences, the available funds provided for research on the behavior of structural materials, such as the relationship between elastic and plastic properties of a single crystal and an aggregate of the same material. Studies of multiply fractured solids showed that competing complex interactions between the cracks often cancel out, allowing a simple theory to account for the changes in elastic properties of such solids. In the area of advanced manufacturing, twelve three-year predoctoral fellowships were awarded for training future engineering faculty in modern competitive manufacturing methods. Further, research on mitigation of effects of vibrations in machine tools was initiated. Studies of thermal instabilities in superconducting magnets identified the low temperature friction properties of bonding materials necessary to prevent the onset of those instabilities.	Studies of aging and its mitigation in energy related structures continue, with special attention being paid to a better understanding of the effects of advanced materials processing on the eventual mechanical properties and performance of the structural components. Those studies include the application of advances in the theories of dynamical systems to modeling the aging of structures. The search for simplified, but realistic models of complex processes such as fluid-flow induced vibrations in heat exchangers and chemically driven pattern formation continues. Conditions for maintaining the stability and effectiveness of liquid films for rapid heat removal are under study. Support is provided for research on advanced manufacturing.	In mechanical sciences support will be maintained for research on advanced manufacturing technologies, providing for the maintenance of predoctoral fellowships addressing basic energy-related problems in integrated manufacturing. Research on multiphase flows will continue, as will work on new concepts in radiative heat transfer. Further improvements in understanding causes and evolution of damage in and subsequent failure of structures will be pursued. Special attention will be paid to the effects of periodic and random thermomechanical loadings on the longevity of energy related structures. Researchers will be strongly encouraged to extend their contracts with industry and thereby enhance technology transfer.

III. Engineering and Geosciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Engineering Research (Cont'd)	In the control systems and instrumentation segment, the application of neural nets and fuzzy logic to the control of bioprocesses was initiated. Novel instrumentation techniques have permitted the maintenance of the required nonequilibrium conditions governing the rapid production of high quality wear resistant coatings. Recent advances in chemical process control methods have been applied to coating processes and immediately utilized by a major office supplies manufacturer (at its cost), resulting in up to five-fold improvement in product quality and a corresponding decrease in waste. Research on mobile intelligent machines has resulted in a new steering system which simplifies robot maneuvering in confined spaces.	In the area of control systems and instrumentation, under the Advanced Materials and Processing activities, there is an increasing research effort on appropriate instrumentation, diagnostics, and relevant process control methods. Studies of propagation of solitons in fiber optics, a means for wide-band data transfer and communication, are proceeding as is research on high critical temperature superconducting devices. Chemical process engineering research is increasingly directed toward bioprocessing problems. Topics in autonomous intelligent machines include related issues in the fundamentals of advanced manufacturing, and agile manufacturing such as research on heterogeneous distributed computing systems.	Studies in the area of control systems and instrumentation will continue with the development of diagnostics and instrumentation for advanced materials processing, and for bioprocessing of fuels and energy related wastes. Further effort will be exerted in the general field of intelligent machines, and in particular use of video signals will be explored for the control and precise positioning of end effectors on robotic arms. Research on novel approaches to measuring properties of fluid mixtures such as environmentally sound refrigerants will continue.
	Progress in the area of engineering data and analysis includes further gain in understanding the behavior of slurries, dense suspensions, and flows in porous media. Efforts in applying magnetic resonance imaging as noninvasive diagnostics have proved particularly useful in eliciting the phenomena occurring in those flows. In another study, new insights into preventing undesirable component segregation in solidifying metal alloys have been gained. Application of the principles of deterministic chaos clarified how very viscous fluids are broken up and dispersed by the flow of less viscous liquids. Other studies of nonlinear systems further confirmed the side-by-side occurrence of ordered and chaotic regions in the same setup.	In engineering data and analysis, research continues on transport of energy through random media, contributing among other things to improved models of cloud cover in global climate studies. Concepts from the field of aerodynamics are applied to new ways of depositing hard coatings on soft substrates. Support continues for the University-National Laboratory collaborative research on plasma processing of materials. Possible direct communication paths among members of bacterial colonies are studied together with the effect such paths may have on adaptive control systems for bioprocessing. A joint University-National Laboratory project continues to characterize the rheological and transport properties of dense suspensions alongside related individual research projects. Utilization of DOE experimental and	Research topics in engineering data and analysis will include characterization of mixtures of fluids important to secondary and tertiary oil recovery, novel approaches to a better understanding of turbulent flows, and extension of methods for modeling hysteresis in a wide range of engineering systems. Theories of wave propagation in nonuniform media will be applied to improving the design methods for nonimaging optical systems, such as solar collectors, area illumination systems, and various related consumer products. Non-linear methods for control of chaos in manufacturing processes will be exploited.

III. Engineering and Geosciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Engineering Research (Cont'd)		computational facilities by outside engineering researchers is strongly encouraged.	
	EPACT:	EPACT:	EPACT:
	EPACT Section 2202 "National Advanced Manufacturing Technologies Initiative":	EPACT Section 2202 "National Advanced Manufacturing Technologies Initiative":	EPACT Section 2202 "National Advanced Manufacturing Technologies Initiative:"
	The Basic Energy Sciences program conducts research related to the goals of EPACT in the area of advanced manufacturing technologies. However, BES is not responsible for the reporting requirements identified in EPACT, Section 2202.	The Basic Energy Sciences program conducts research related to the goals of EPACT in the area of advanced manufacturing technologies.	The Basic Energy Sciences program conducts research related to the goals of EPACT in the area of advanced manufacturing technologies.
		INVESTMENT:	INVESTMENT:
		Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	Funding in the amount of $248,000 has been transferred to the SBIR program.	Funding in the amount of $252,000 has been budgeted for the SBIR program.	Funding in the amount of $337,500 has been budgeted for the SBIR program.
	$ 16,673	$ 17,000	$ 16,875
Geosciences Research	Progress continued on acquiring fundamental data on properties and behavior of geologic materials. New data on thermodynamic and transport properties of solids and fluids are being obtained by researchers at DOE laboratories and academic institutions. Mechanical behavior of rocks and minerals under stress provides key information on the origin and nature of fractures in rocks, which control reaction and interaction of fluids with rocks and minerals. Two researchers	The appropriation provides for an effective research program on mineral-fluid interactions. Research will emphasize the use of advanced instrumentation and capabilities for time- and space-resolved studies of mineral reactions in the presence of geologic fluids. Use of synchrotron radiation facilities at Stanford and Brookhaven provide a foundation for future use of new capabilities at the Advanced Photon Source. At the Advanced Photon Source, beam-line	The request provides for maintaining an effective research program in research on basic properties of rocks, minerals, and geologic fluids. It will provide for continued support of analytical instrumentation for geosciences research on mineral-fluid interactions at the Advanced Photon Source to complement separate NSF-supported geosciences research at this facility. There will be a reduced level of effort in Solar-Terrestrial Interactions and in research directed toward an

III. Engineering and Geosciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Geosciences Research (Cont'd)	supported by this program were elected to membership in the National Academy of Sciences this year.	instrumentation is being provided through a research consortium and in collaboration with the National Science Foundation.	understanding of high- pressure-high temperature geologic processes.
	Earthquakes and volcanoes involve large scale earth processes which dramatically impact the face of the earth and the energy systems on which civilization is based. Current research on volcanic and tectonic regimes emphasizes those which are currently active or have been active in the recent past. A comprehensive project-by-project review of the entire Geosciences program was completed using an external peer review process. This involved more than 125 scientists (not supported by the program) from government, industry and university research labs.	The Interagency Continental Scientific Drilling Program is evolving to a broader research program involving the dynamics of continental systems. The theme of the cooperative interagency (NSF, USGS, DOE) effort is to develop approaches which provide a base for treating dynamic aspects of continental evolution as a whole, rather than as a collection of disparate disciplinary efforts. Research themes will include effects of catastrophic events such as meteorite impacts on the face of the earth, potential volcanic events, and large earthquakes.	The request provides for continuing basic research emphasizing dynamical behavior of the Earth's continental crust. Emphasis on the Interagency Continental Scientific Drilling Program will decline in favor of a broader program on Continental Dynamics. Research will continue to focus on active processes which can be examined by scientific drilling, surface observations, and by geophysical imaging. The research program is actively coupled to research programs in NSF and the USGS through established coordination mechanisms.
	Accessing the hidden resources of the earth requires both direct and indirect scrutiny. Indirect observations, such as geophysical imaging, coupled with surface-based methods provide the models which can be tested by direct observation. Direct observation requires drilling, sampling, and in situ measurements. Techniques and methods developed and tested in the Scientific Drilling Program can be used in the commercial sector to increase the Nation's energy resource base.	Special emphasis is being given to cross-cutting basic research which provides new knowledge on the origin, migration, and entrapment of hydrocarbons in the context of exploration and production for natural gas resources. Much of this research is carried out at the universities and laboratories involving direct collaboration with industry via industry-funded consortia. Research programs emphasize fundamental problems of subsurface flow of fluids such as detection and characterization, and involves modeling and direct field observations.	The request provides for a strong and continuing program in geophysical imaging and analysis of fluid transport in geologic media. Seismic and electromagnetic methods will continue to form the core of the research program. Special attention will be given to innovative methods in non-linear seismology which offer promise in terms of controlling the nature and direction of acoustic beams. Scale-dependent (space and time) transport properties in fluid-bearing reservoirs will be an area of strong interest. Geosciences research will contribute to the Domestic Natural Gas and Oil Initiative through participation in the Advanced Computational Initiative. Research areas include fundamental aspects of geophysical identification and

III. Engineering and Geosciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Geosciences Research (Cont'd)			assessment of gas and oil reservoirs. ($3,000)
	Nuclear and chemical wastes are byproducts of energy resource use and the Nation's defense efforts. Geologic disposal in engineered systems provides a possible means of disposal if isolation of toxic or hazardous substances from mankind can be assured. Basic information from the geosciences is essential to determine viability of potential geologic disposal methods. Data on both long-term natural processes, the base-line, and the effects of anthropogenic intervention are needed. Development of sound predictive computational models which rest on an understanding of natural and perturbed geologic systems is a program goal.	The appropriation provides for a continued strong program directed toward providing the basic scientific data necessary for prediction of long-term stability of the interaction of natural and anthropogenic material under conditions found in the earth's crust. Characterization of potential disposal sites for radioactive and chemical wastes rests heavily on non-penetrative geophysical interrogation, a theme in the research program dealing with geophysical imaging. Basic research in mineralogy and geochemistry provides knowledge on the geologic stability of engineered hosts for long-term isolation of toxic and hazardous constituents from mankind.	The request will also provide for continuing research in geophysical imaging applicable to assessment and characterization of potential waste disposal sites. It provides for geochemical and mineralogical studies for understanding and predicting consequences and effects of disposal of hazardous and radioactive wastes in the geologic environment. Geophysical research will shift toward definition of basic research needs associated with monitoring active and closed waste disposal sites. This effort will be closely integrated with the research themes involving restoration of the environment and fundamental properties of geologic materials.
	Past practices of the Department and the energy industry have led to undesirable environmental degradation. Development of effective mitigation strategies rests on a firm understanding of the interaction of anthropogenic substances such as man-made waste with the rocks, soils, minerals and fluids of the earth crust.	Fundamental data on transport processes in the geologic milieu represent a core component of this program. Interaction of minerals and natural or anthropogenic fluids is critical in assessing the potential for release, or capture, of hazardous constituents which are presently in the geologic environment.	The request provides for a base program in the interaction of rocks and minerals of the Earth's crust with ground water and contaminated fluids. Research will emphasize transport and reaction in porous and fractured rocks, and high-resolution electro-magnetic imaging.

III. Engineering and Geosciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Geosciences Research (Cont'd)	Researchers at Brookhaven National Laboratory are providing fundamental data on x-ray computed microtomographic images of drill hole samples, with resolution at better than the 10 micron level, to researchers at Mobil Exploration and Production Technology Center in Dallas who are in turn collaborating with researchers at Los Alamos National Laboratory (supported by the Fossil Energy Program in DOE) in using the data to assess opportunities for enhancing oil recovery. This serves as an example of how informal research interaction results in transfer of knowledge and technology.	Researchers at DOE laboratories will continue to take advantage of opportunities resulting from close coupling of basic and applied research activities at the operating level. This effort will be enhanced through strengthened interaction of researchers at DOE laboratories and universities reflected in multi-institutional research proposals. It is anticipated that such activities will result in new Cooperative Research and Development Agreements and other less formal methods of transferring technology.	Using basic knowledge developed in the research program to strengthen the Nation's economic position will continue to be a theme of the research activity. Opportunities will be sought to encourage basic research partnerships with participating researchers at DOE laboratories and universities and in industry laboratories. The research program will continue to interact with university-industry research consortia through support of research grants awarded on a competitive basis.
		INVESTMENT:	INVESTMENT:
		Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	Funding in the amount of $295,000 has been transferred to the SBIR program.	Funding in the amount of $300,000 has been budgeted for the SBIR program.	Funding in the amount of $399,000 has been budgeted for the SBIR program.
	$ 19,783	$ 20,190	$ 19,962
Engineering and Geosciences	$ 36,456	$ 37,190	$ 36,837

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

I. Preface: Advanced Energy Projects

The Advanced Energy Projects (AEP) subprogram provides support to establish the feasibility of novel, energy related ideas. The ideas can be stimulated in many ways, but usually arise from advances in basic research or from novel exploratory energy concepts that do not readily fit into an existing program area. The AEP subprogram spans the Department's energy mission. The high risk associated with an AEP project is properly balanced by a high payoff for the Nation's energy posture if the project is successful. Projects are typically supported at a level of $300,000 per year for a period of three years. Although funding profiles can vary among projects in the AEP subprogram, the three year budget period is considered the maximum. Following AEP support, it is expected that each concept will be sufficiently established and, if promising, will attract further funding from other sources to realize its full potential. The AEP subprogram does not support either ongoing, evolutionary research or large scale demonstration projects. Projects are selected on the basis of proposals submitted by universities, industrial organizations, non-profit research institutions or private individuals. The AEP subprogram also considers ideas or concepts submitted by researchers at national laboratories. Equal consideration is given to all submissions.

II. A. Summary Table: Advanced Energy Projects

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Advanced Energy Projects	$ 10,972	$ 11,194	$ 11,085	- 1
Total, Advanced Energy Projects	$ 10,972	$ 11,194	$ 11,085	- 1

II. B. Major Laboratory and Facility Funding

ARGONNE NATIONAL LAB (EAST)	$ 2,345	$ 1,400	$ 1,380	- 1
BROOKHAVEN NATIONAL LAB	$ 440	$ 0	$ 0	0
LAWRENCE BERKELEY LAB	$ 452	$ 600	$ 595	- 1
LOS ALAMOS NATIONAL LABORATORY	$ 950	$ 757	$ 750	- 1
OAK RIDGE NATIONAL LAB	$ 835	$ 795	$ 790	- 1
LAWRENCE LIVERMORE NATIONAL LAB	$ 116	$ 701	$ 695	- 1

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

Program Activity	FY 1993	FY 1994	FY 1995
Advanced Energy Projects			
Advanced Energy Projects	Provides funds for converting basic research findings into applications that, if successful, would improve the Nation's energy economy. Existing projects making satisfactory progress were continued toward completion. These projects were in areas that include radioactive waste treatment using an aqueous biphasic extraction method, ultrafast molecular electronic devices, solar detoxification of aquatic systems, magnet replicas using high-temperature superconductors, high band-gap photovoltaic materials for a two-step fission energy conversion, synthesis of ceramic composite powders, a biocatalytic approach to the production of alternate fuels and feedstocks, and synthesis of plastics from renewable oils.	Provides funds to explore the feasibility of a sufficient number of new concepts that could contribute to the Nation's energy economy. Funds are also available to continue and complete existing projects as planned. These projects include the exploration of renewable polymers from plant sources of monomers, solar detoxification of aquatic systems with porous photocatalysts and ultrafast molecular electronic devices. Subprogram activities will be coordinated with DOE technology development programs to identify emerging areas of mutual interest. Research will be emphasized in high-leverage areas within the Department's energy mission such as new approaches for producing alternate feedstocks and fuel and novel processing techniques of advanced materials for energy conversion, energy generation, or transportation.	Provides funds to initiate seven to ten new projects. It is expected that these projects would emphasize new areas of opportunity for the Department. Areas viewed as promising include smart materials, catalytic antibodies, self-reinforcing materials, thermoelectric materials for heating and refrigeration, "clean" alternatives for cars, and alternate methods for removal of metals from coal. Existing projects in the portfolio will be continued toward completion, provided they remain promising. Subprogram activities will continue to be coordinated with the Department's technology development programs to identify areas of mutual benefit.
		INVESTMENT:	INVESTMENT:
		Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	Funding in the amount of $163,000 has been transferred to the SBIR program.	Funding in the amount of $165,000 has been budgeted for the SBIR program.	Funding in the amount of $222,000 has been budgeted for the SBIR program.
	$ 10,972	$ 11,194	$ 11,085
Advanced Energy Projects	$ 10,972	$ 11,194	$ 11,085

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

I. Preface: Energy Biosciences

Concerns about national energy supply, environmental conditions, and United States competitiveness all highlight the need to concentrate efforts on the development of alternate fuel and chemical resources and related biotechnologies as one important facet of the Nation's science policy. The research focus of the Energy Biosciences (EB) subprogram is to understand the mechanisms of how plants produce biomass and the mechanisms of microbiological transformation of abundant biomass into usable forms. Currently, a major obstacle to the development of new biotechnologies is the meager biological information base from which to devise new processes and applications. The EB subprogram is designed to fill this critical information gap by the support of research in the plant and microbiological sciences. The program supports developing fundamental understanding at the genetic, biochemical and physiological levels of the diverse and extraordinary capabilities of organisms to metabolically produce chemical compounds. Whereas the goal of this research is to achieve improved supplies of fuels, chemicals and materials, information useful in bioremediation also results. The EB subprogram specifically focuses on the major classes of plant compounds such as carbohydrates and lipids, how they are produced, how they function in the organism, how they are degraded, and what opportunities exist for their biological modification. Applications to energy problems can be expected in the mid- to long-term time (seven or more years) scale. However, some EB program generated information is rapidly transferred to industry. For example, in the past year one Energy Biosciences' investigator was able to show that it is possible to transfer genes from bacteria to plants that can synthesize a compound that could be used as a biodegradable plastic. This resulted in a patent. An industrial firm is now working on this patent and others have shown interest.

The exploitation of biochemical transformations and other capabilities applied to energy matters requires investment in fundamental research. The rapid growth of biomedically oriented biotechnology is the dividend from substantial previous basic research investments in the biomedical area. A similar investment in plant and nonmedical microbiological research will produce comparable applications. The ability to genetically manipulate many organisms is growing more rapidly than our basic knowledge of the traits to be manipulated, i.e., there is a major gap in our understanding about the biochemical and physiological basis of important characteristics, e.g., yield in plants, biochemical pathways to valuable products, etc. This deficiency of knowledge is a major obstacle to achieving more energy-related biotechnologies. The U.S. biotechnology industry tracks basic research progress closely and promptly exploits information that is generated, unlike some other segments of industry. That is, technology transfer is not a significant problem in this area.

The primary goal of the program is the potential biological solution of energy problems addressed at the fundamental level. These include photosynthesis, methanogenesis, fermentations, genetics of anaerobic organisms and numerous others. The program interacts and coordinates with several other programs within DOE as well as USDA and NSF programs and participates with those agencies to support plant science collaborative research and training on common objectives. Where feasible, interactions with industry are promoted. The Energy Biosciences program is currently one of the active components in the development of a unified DOE biotechnology activity through the BioEnergy Coordinating Committee (BECC) of DOE.

The Energy Biosciences program, while diverse in scope, has many components that are strongly interrelated and integrated. The program may be partitioned into: 1) fundamental aspects of primary biological production, consisting of research on plant and microbial photosynthesis, growth and development in plants, host-pathogen relationships and plant physiological processes, all of which ultimately affect productivity. 2) conversions of primary biological energy products, a category that covers basic research in microbial fermentations, defining plant metabolism and its regulation, nitrogen fixation, structure and function of plant cell walls, and other topics, all of which determine the nature and amount of the end products available as fuels and chemicals. The research also contributes to understanding the origins of products that constitute parts of natural systems and cycles. 3) enabling biotechnology research, consisting of studies on the genetics of orphan microorganisms with possible roles in biotechnology, the mechanisms of genetic expression in plants, critical data base development, plus others that feed into building the framework on which to base biosystems relating to energy matters.

I. Energy Biosciences (Cont'd)

The budget request for FY 1995 fits well within the stated high priority mission topics of the Department. The research and other activities all have the objectives of promoting the Nation's biotechnological capabilities to produce alternate fuels, generate renewable products that can replace petroleum derived chemicals, improve the environment by devising means of ridding waste via biological activities, plus other advantageous procedures. The research activities are consistent with objectives defined by biotechnological, environmental and other program areas.

II. A. Summary Table: Energy Biosciences

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Energy Biosciences	$ 24,871	$ 26,649	$ 25,957	- 3
Total, Energy Biosciences	$ 24,871	$ 26,649	$ 25,957	- 3

II. B. Major Laboratory and Facility Funding

BROOKHAVEN NATIONAL LAB	$ 1,045	$ 1,079	$ 1,126	+ 4
LAWRENCE BERKELEY LAB	$ 1,060	$ 1,038	$ 1,075	+ 4
LOS ALAMOS NATIONAL LABORATORY	$ 135	$ 135	$ 140	+ 4
NATIONAL RENEWABLE ENERGY LAB	$ 150	$ 139	$ 140	+ 1

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

Program Activity	FY 1993	FY 1994	FY 1995
Energy Biosciences			
Energy Biosciences	Research was conducted to pursue much needed fundamental understanding that will serve as the basis for future energy related biotechnologies. The Energy Biosciences subprogram is expected to play multiple roles in relation to various specific DOE missions and national initiatives. Principally, the program generates and feeds basic information into activities identified with the Energy Policy Act of 1992.	Existing research efforts will be sustained, plus provide some flexibility to initiate new research projects in advanced materials and processing and biotechnology. Effectively, the increase will permit technical advances to be made in underpinning the biological production of novel energy-related materials using plants.	The current program will be sustained at approximately the FY 1994 level of effort. New projects relating to various topics in plant and microbial sciences will be initiated. The Energy Biosciences program is the source of ideas and information relating to several components of the biotechnology industry, most notable of which are alternate fuels and other petroleum substituting procedures, along with bioremediation activities. It is important to realize that all of the efforts that are conducted by the Energy Biosciences program are consistent with the objectives of developing new biotechnology applications. There is also a relation to advanced materials with respect to defining new biomaterials and how these may be synthesized. The crucial point is that considerable fundamental research needs to be supported in order to achieve the development of future technologies. Interestingly, other countries are now investing more heavily in these fields in the expectation of major industrial dividends.
	To realize the tantalizing prospects of plant biotechnologies, as a significant resource for fuels, chemicals and other materials for the future, more understanding is necessary. Research on the partitioning of products synthesized in plants, the regulation and control of metabolic steps and the movement and storage of energy-rich compounds was conducted. The Energy Biosciences area of primary biological production focused on these activities and the continued efforts to define the	The important efforts within the category of primary biological production consisting of photosynthesis and other research related to plant productivity will be maintained. Some examples of specific topic areas include pursuing the formation of lignin and its role in plant rigidity. The ability of both plants and microbes to synthesize biodegradable plastic materials will be investigated.	The important efforts within the category of primary biological production consisting of studying regulation of plant growth and development and other key topics will be continued.

III. Energy Biosciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Energy Biosciences (Cont'd)	specific opportunities to enhance the photosynthetic solar conversion process, into various useful products.		
	Projects in the Energy Biosciences area of conversion of primary biological energy products were continued, with an emphasis on the important acquisition of additional knowledge of metabolic capabilities in plants and microorganisms. Such knowledge can lead to the use of organisms to produce fuels, industrial chemicals and entirely new biologically synthesized materials. The synthesis of the major components of plant cell walls (the principal component of biomass), cellulose, hemicellulose and lignin are examples of poorly understood metabolic pathways. Further, greater understanding of the metabolic capabilities of microorganisms affords potential development of new modes of product processing. The uptake of minerals by plant systems was studied to provide insights to possible environmental benefits.	The program's activities in the metabolic diversity of microorganisms will be emphasized as well as studies on the structure of plant cell walls which form the basis for the production of novel biomolecular materials.	The program's activities will continue at approximately the FY 1994 level. A number of new projects relating to plant and microbial biochemistry pathways including plant cell wall structure and biosynthesis will be initiated. These projects closely relate to building the base for new biotechnologies.
	The way plants react to environmental signals, temperature changes, chemicals and others is a major problem in determining growth and development patterns as well as biosynthetic routes. This area received more attention. Another area of emphasis was the efforts to utilization of biological systems in the synthesis of novel catalysts and polymeric molecules.	The investigations falling within the category of enabling biotechnology research, such as studies on the regulation of genetic expression in plants and microbes as well as other types of investigations that help to provide the basis for new biotechnologies will be sustained.	Research will continue at the FY 1994 level of effort. In addition, new projects dealing with genetic mechanisms of plant and unusual microorganisms will replace some current projects. That is, some turnovers will occur.

III. Energy Biosciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Energy Biosciences (Cont'd)	Joint programs with other agencies, such as the plant science research and training collaboration, with USDA and NSF continued.	Joint programs with other agencies, such as the plant science collaborative research, with USDA and NSF will be continued.	The efforts relating to the Department of Energy/National Science Foundation/Department of Agriculture Joint Program on Collaborative Research in plant science collaborative research will be maintained. The Department of Energy role will be critical in this increasingly interesting and productive program. The program is often quoted as a model system for coordinating multiagency activities and programs. Other activities will include development of research areas jointly with other DOE programs.
	Fellowships were continued in certain key, important, but underrepresented topic areas, including microbial metabolism and physiology, plant biochemistry, and other topic areas whose lack of expertise delays biotechnology development.	There will be continued support of a limited number of post doctoral fellowships (and potential graduate student fellowships) in certain key, important, but underrepresented topic areas, including microbial metabolism and physiology, plant biochemistry, and other topic areas whose lack of expertise delays both biotechnology development and scientific advancement..	The program will continue to support fellowships and other training activities that are critical to furthering biotechnology development in the nation. Some of the funding will be used for development of a much needed substantial training program in microbial physiology. This will be a part of a multiagency effort to fill an important training gap.
		INVESTMENT:	INVESTMENT:
		Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	Provides funding for continuation of advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.
	Funding in the amount of $379,000 has been transferred to the SBIR program.	Funding in the amount of $390,000 has been budgeted for the SBIR program.	Funding in the amount of $519,000 has been budgeted for the SBIR program.
	$ 24,871	$ 26,649	$ 25,957
Energy Biosciences	$ 24,871	$ 26,649	$ 25,957

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

I. Preface: Applied Mathematical Sciences

The Applied Mathematical Sciences (AMS) subprogram mission is to improve the ability of the Department to solve scientific and engineering problems which are critical to its mission, through research and development in and applications of advanced mathematical, computational, computer, and communications sciences and information technologies and, as authorized, to meet the requirements of the High Performance Computing Act of 1991. The Office of Scientific Computing, Office of Energy Research, manages this diverse and forefront AMS subprogram which spans the spectrum of activities from fundamental research to technology development. The AMS subprogram, through the Mathematical, Computational, and Computer Sciences Research (MCCSR) Activity, supports fundamental research and educational programs in critical areas needed by all DOE program components. The AMS subprogram, through the Advanced Computation, Communications Research, and Associated Activities (ACCRA) Activity provides leading edge information technology infrastructure support for researchers funded by the Office of Energy Research, including implementation of large scale high performance computing system prototypes for computational research, supercomputer access for over 4,000 researchers nationwide, and the Energy Sciences Network (ESNet) activities.

To fulfill this mission, the AMS subprogram seeks to:

o Ensure access by Energy Researchers to continually improve mathematical, computational, and computer science techniques and methods through appropriate investments in basic long range applied mathematics, computational, and computer science research;

o Ensure an adequate supply of appropriately trained computational scientists and engineers to support the scientific research and Energy Policy Act requirements of the Department, and the national security, and economic competitiveness needs of the United States;

o Ensure the availability of and continuing improvements to a nationwide high performance computing, communications and information technology infrastructure which supports the requirements of Energy Researchers for collaboration and advanced resources;

o Ensure the availability from United States sources of high performance computing hardware and software resources and technology advances which enable the solution of critical scientific and engineering problems for the Office of Energy Research, the Department of Energy, and the Nation;

o Ensure effective industrial involvement in the Office of Energy Research, the effective transfer of knowledge and technology in high performance computing, communications, and information technologies from government-sponsored research to United States industry, and the effective diffusion of these technologies into energy related applications.

Because of this mission and the computationally intensive nature of energy related applications and problems, the Department of Energy, perhaps more than any other agency, depends for its mission accomplishment on advancements in computational techniques and computer and networking technologies. As a result, DOE has a long history of computational research and development, with strong industrial and university cooperation. The Department's Applied Mathematical Sciences subprogram was initiated in the early nineteen fifties at the suggestion of John von Neumann to enhance understanding of the use of digital computers in nuclear applications. Consequently, the Department has been prominent in maintaining the United States leadership in high performance computing and communications, in encouraging, and even providing, innovation in HPCC and other information technologies, and in supporting United States economic, scientific, and technological competitiveness and productivity through its extensive use of these technologies.

The unique contribution and value of the Department's AMS subprogram results from the Department's role as a pioneer in the use of supercomputers

I. Applied Mathematical Sciences (Cont'd)

for numerical simulation of complex systems that reduce substantially the cost of experimentation and testing and that also reduce the adverse effects on the environment. Because of this experience, the Department of Energy is playing a major role in the multiagency High Performance Computing and Communications and the National Information Infrastructure Programs, both in its program initiatives and in program management. The High Performance Computing Research Centers, at Oak Ridge National Laboratory and Los Alamos National Laboratory, will both operate prototype computational systems providing support to approximately eight grand challenge class computational energy projects and the National Energy Research Supercomputer Center at Lawrence Livermore National Laboratory will begin work to transition a prototype massively parallel computing system into a production environment.

Applied Mathematical Sciences will participate in the Domestic Natural Gas and Oil Initiative through the Advanced Computational Initiative. The work will be focused on fundamental research on applied mathematics of seismic phenomena, modeling of reservoir dynamics, flow of gases and liquids in heterogeneous media, and transport of contaminants.

Equally important, as noted above, this program includes research and development in advanced communications which offers to radically transform the way in which all Americans work. Accordingly, the National Research and Education Network component of the High Performance Computing and Communications Program is considered to be the prototype for a national information infrastructure which will improve our abilities to manage energy demand and will greatly assist in our efforts to reduce our dependence on energy imports through telecommuting and other means that substitute electronic communications for physical transport of people and goods.

II. A. Summary Table: Applied Mathematical Sciences

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Mathematical, Computational, and Computer Sciences Research	$ 41,405	$ 51,590	$ 52,496	+ 2
Advanced Computation, Communications, and Associated Activities	42,497	52,072	56,871	+ 9
Total, Applied Mathematical Sciences	$ 83,902	$ 103,662	$ 109,367	+ 6

II. B. Major Laboratory and Facility Funding

AMES LAB	$ 6,645	$ 5,835	$ 5,835	0
ARGONNE NATIONAL LAB (EAST)	$ 5,365	$ 7,338	$ 7,338	0
LAWRENCE BERKELEY LAB	$ 3,538	$ 6,310	$ 6,310	0
LAWRENCE LIVERMORE NATIONAL LAB	$ 26,577	$ 36,339	$ 39,839	+ 10
LOS ALAMOS NATIONAL LABORATORY	$ 10,295	$ 11,780	$ 9,780	- 17
OAK RIDGE NATIONAL LAB	$ 11,261	$ 10,895	$ 11,095	+ 2
SANDIA NATIONAL LABORATORIES	$ 3,505	$ 3,678	$ 2,678	- 27

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

Program Activity	FY 1993	FY 1994	FY 1995
Applied Mathematical Sciences			
Mathematical, Computational, and Computer Sciences Research	Basic Research and Human Resources (BRHR) research in analytical and numerical methods will continue to pursue fundamental research in areas important for understanding the physical, chemical, and biological processes related to energy production, use, and conservation. Basic research in this area will also investigate parallel numerical algorithms, matching algorithms to computer architectures, and theory of parallel computing complexity as part of the HPCC program. BRHR will also provide additional support for expanded computational science education programs.	Basic Research and Human Resources (BRHR) research in analytical and numerical methods will continue to pursue fundamental research in areas important for understanding the physical, chemical, and biological processes related to energy production, use, and conservation. Basic research in this area will also investigate parallel numerical algorithms, geometry, and adaptive mesh techniques as part of the HPCC program. HPCC educational programs will continue at current levels of effort.	Basic Research and Human Resources (BRHR) research in analytical and numerical methods will continue to pursue fundamental research in areas important for understanding the physical, chemical, and biological processes related to energy production, use, and conservation. Basic research in this area will also investigate parallel numerical algorithms, geometry, and adaptive mesh techniques as part of the HPCC program. HPCC educational programs will continue with increased emphasis on programs for women and minorities.
	High Performance Computing Systems (HPCS) research will continue in performance measurements of parallel architectures, parallel systems technology development, and prototype hardware evaluation of big performance computing systems.	High Performance Computing Systems (HPCS) research will continue at a reduced level in performance measurements of parallel architectures, parallel systems technology development, and prototype hardware evaluation of high performance computing systems, including an IBM SP2 system at Argonne National Laboratory. HPCS will continue support at HPCRCs.	High Performance Computing Systems (HPCS) research will continue at a reduced level in performance measurements of parallel architectures, parallel systems technology development, and prototype hardware evaluation of high performance computing systems. HPCS will continue support for small and full scale prototype systems at HPCRCs.
	Advanced Software Technology and Algorithms (ASTA) research in applications and computational sciences will continue to emphasize the computational "grand challenge" problems, including computational fluid and combustion dynamics, global climate modeling, structural biology, materials properties and condensed matter physics, quantum chromodynamics, numerical tokamak, enhanced oil recovery, and groundwater transport modeling applications. HPCC funding support will provide for minimal growth	Advanced Software Technology and Algorithms (ASTA) research will continue in computational "grand challenges," computational techniques, and software tools and components research areas. The scope of applications research support and software components research will be focused on high leverage areas such as distributed environments and software tools for parallel systems. In addition, the "grand challenges" projects will be reviewed and evaluated for scientific progress to focus on	Advanced Software Technology and Algorithms (ASTA) research will continue in computational "grand challenges," computational techniques, and software tools and components research areas. The scope of applications research support and software components research will be focused on high leverage areas such as distributed environments and software tools for parallel systems. In addition, the "grand challenges" projects will be reviewed and evaluated for scientific progress to focus on

III. Applied Mathematical Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Mathematical, Computational, and Computer Sciences Research (Cont'd)	in these existing "grand challenge" collaborations. ASTA software research will also emphasize data management technologies, distributed computing environments, future generation data storage systems and visualization techniques.	priority energy applications to accommodate planned growth in the other collaborations.	priority energy applications to prioritize funding for these collaborations. Participation in the Domestic Natural Gas and Oil Initiative. ($1,000)
	EPACT:	EPACT:	EPACT:
	EPACT Section 2028 "Telecommuting Study":	EPACT Section 2028 "Telecommuting Study":	EPACT Section 2028 "Telecommuting Study":
	In response to the Energy Policy Act charge to DOE, the Office of Scientific Computing has commissioned two studies on telecommuting. The National Academy of Sciences has been tasked with convening a panel of technology, sociology and transportation experts to examine the promise of telecommuting as a viable method of reducing travel, thus reducing emissions and consumptions of fuel. The OSC has also teamed with the Office of the Assistant Secretary for Policy, Planning and Program Evaluation to commission a more technical treatise of telecommuting technologies and capabilities and to augment the study produced by the Department of Transportation on the current state of telecommuting. Two DOE laboratories (LBL and ORNL) are working on this task and have enlisted the aide of respected telecommuting researchers and experts. ($350)	The two telecommuting studies initiated in FY 1993 will be completed and their results published. The results will be used by DOE, and we expect other agencies, in determining future activities and research that can be undertaken in this area. ($100)	Since the two studies initiated in FY 1993 will be completed in FY 1994 the studies will not require any additional funding. ($0)
		INVESTMENT:	INVESTMENT:
		Funds are provided for the HPCC activities included in the President's FY 1994 Economic Investment Package.	Funds are provided for continuation of the HPCC activities included in the President's FY 1994 Economic Investment Package.

III. Applied Mathematical Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Mathematical, Computational, and Computer Sciences Research (Cont'd)	Funding in the amount of $618,000 has been transferred to the SBIR program.	Funding in the amount of $759,000 has been budgeted for the SBIR program.	Funding in the amount of $1,050,000 has been budgeted for the SBIR program.
	$ 41,405	$ 51,590	$ 52,496
Advanced Computation, Communications, and Associated Activities	Continue funding for Cray Research, Inc., C-90 supercomputer implementation at the National Energy Research Supercomputer Center (NERSC) and for the HPCC Research Centers initiated as part of the HPCC program. Continue funding for supercomputer software tools for improved access to HPCC systems. Continue funding for the FSU/SCRI cooperative agreement.	Continue funding for Cray Research, Inc., C-90 supercomputer installed in FY 1992 at the National Energy Research Supercomputer Center (NERSC). Continue support for installed, full scale prototype HPCS at the HPCRCs. Continue funding for supercomputer software tools for improved access to HPCC and mass storage systems. Continue funding for the FSU/SCRI cooperative agreement.	Continue funding for Cray Research, Inc., C-90 supercomputer installed in FY 1992 at the National Energy Research Supercomputer Center (NERSC). Continue operational support for installed, full scale prototype HPCS at the HPCRCs. Introduce massively parallel system into the Energy Research supercomputer access program. Continue funding for supercomputer software tools for improved access to HPCC and mass storage systems.
	Begin upgrade and evolution of Energy Sciences Network (ESNet) as part of the HPCC NREN project, including T3 implementation (45 megabits per second), packetized remote conferencing technology development and distributed applications network support. Maintain gigabit network research at current level.	Continue T3 (45 megabit) capability upgrades for the ESNet sites. Continue gigabit network research concentrating on multi-protocol support, interprocess communications techniques, and distributed computing technologies, e.g., those which enable telecommuting.	Complete T3 (45 megabit) capability upgrades for the ESNet sites. Continue gigabit network research concentrating on multi-protocol and multicast technologies, high speed interprocess communications techniques, and distributed computing technologies, e.g., those which enable information infrastructure applications. Participation in the Domestic Natural Gas and Oil Initiative. ($2,000)
	No activity.	INVESTMENT: Funds are provided for the HPCC activities included in the President's FY 1994 Economic Investment Package.	INVESTMENT: Funds are provided for continuation of the HPCC activities included in the President's FY 1994 Economic Investment Package.
	Funding in the amount of $631,000 has been transferred to the SBIR program.	Funding in the amount of $763,000 has been budgeted for the SBIR program.	Funding in the amount of $1,138,000 has been budgeted for the SBIR program.

III. Applied Mathematical Sciences (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Advanced Computation, Communications, and Associated Activities (Cont'd)	$ 42,497	$ 52,072	$ 56,871
Applied Mathematical Sciences	$ 83,902	$ 103,662	$ 109,367

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

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 and scientific user facilities for the scientific and engineering community. The Nation's future energy, defense, and technology options depend on long-range research supported by this program. This staff administers a basic research program which helps us attain our national goals, i.e., better health and quality of life, economic competitiveness, energy self-sufficiency, and national security. The staff annually monitors and evaluates approximately 1,400 individual research projects at over 200 separate institutions.

II. A. Summary Table: Program Direction

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Program Direction.....	$ 8,400	$ 9,400	$ 9,900	+ 5
Total, Program Direction	$ 8,400	$ 9,400	$ 9,900	+ 5

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

Program Activity	FY 1993	FY 1994	FY 1995
Program Direction	Provided funds for salaries, benefits, and travel related to 72 full-time equivalents (FTEs) in the Office of Basic Energy Sciences, the Office of Scientific Computing, and for related program and management support staff in the Headquarters and field. ($5,966) Funded staff for the Office of Basic Energy Sciences activities which 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. Provided program management to meet the National research goals supporting the country's energy-related technology foundation. Provided staff support for basic research, R&D, and facilities needed to continue U.S. leadership in key scientific areas and for numerous university construction projects. Managed increased research program activities which include, for example, manufacturing related engineering, materials processing, atomic physics, and energy biosciences. Managed preconstruction R&D for the Advanced Neutron Source (ANS), and supported construction of advanced scientific facilities, especially the 6-7 GeV Synchrotron Radiation Source, and supported numerous current user facilities. Provided ES&H oversight of large research facilities and construction projects. Interacted with other agencies and helped maintain world leadership in science and technology. Supported the Basic Energy Sciences Advisory Committee, and managed the DOE-wide SBIR program.	Provide funds for salaries, benefits, and travel for a revised level of 82 FTEs, an increase of four over the FY 1994 budget. ($7,665) Continue program management as in FY 1993. Staff will continue to meet National research goals supporting the country's energy-related technology foundation. Staff will continue to support labor-intensive awards of university grants in growing programs, monitor contractor management and accountability, and oversee project management, especially for the 6-7 GeV Synchrotron Radiation Source. Continue interaction with other DOE organizations to oversee increased activities on the ANS, support current user facilities, and ensure ES&H compliance. Manage ongoing research program activities. Continue to interact with other agencies and help maintain world leadership in science and technology. Continue to support the Basic Energy Sciences Advisory Committee and manage the DOE-wide SBIR program.	Provide funds for salaries, benefits, and travel to continue 82 FTEs. Provides for four additional FTEs over the FY 1994 budget and pay increases resulting, for example, from locality pay and normal within-grade increases. ($8,385) Continue to provide program direction and oversight of efforts to meet National research goals supporting the country's energy-related technology foundation. Continue to monitor contractor oversight and accountability and project management. Continue interaction with other DOE organizations to oversee activities on the ANS, support current user facilities, and ensure ES&H compliance. Manage ongoing research program activities. Continue to interact with other agencies and help maintain world leadership in science and technology. Continue to support the Basic Energy Sciences Advisory Committee and manage the DOE-wide SBIR program.

III. Program Direction (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Program Direction (Cont'd)	Funded staff for the Office of Scientific Computing. Activities included policy and program planning, representation on interagency coordinating councils, management of research and development projects in mathematical and computational sciences, management of ER supercomputer centers and management of Energy Sciences Network (ESNet) development and operations. Supported the National Science and Technology Council (NSTC) high performance computing and communications (HPCC) program, requiring increased interaction among five Federal agencies with a major goal of transfer of technology to U.S. industry. Managed and coordinated the National Research and Education Network (NREN). Supported and coordinated multidisciplinary research collaborations with other ER program areas. Supported new efforts in telecommunications networking, computational science and hardware architectural research.	Continue FY 1993 projects and program management activities with an increase of one FTE over the FY 1994 budget level. Also continue to support the NSTC HPCC activities. Support increased workload involving interagency computer network research and infrastructure program management and coordination of NREN. Provide focused expertise and specific program management experience to manage increased proposals and new research projects. Enhance contractor oversight and accountability, and support Energy Policy Act of 1992 requirements in the area of telecommuting. Support the Administration's new program in Information Infrastructure Technology and Applications (IITA).	Continue to support all FY 1994 program areas and the interagency NSTC HPCC program at the revised FY 1994 FTE level which includes one additional FTE over the FY 1994 budget. Support continued interagency computer network research and infrastructure program management and coordination of NREN. Manage proposals and research projects, including oversight of a massively parallel computing system and development of a program in IITA. Continue contractor oversight and accountability, and support Energy Policy Act of FY 1992 requirements in the area of telecommuting.
	Provided program and management support in the areas of budget and finance, personnel administration, acquisition and assistance, policy coordination, information resources management, and construction management support.	Continue to provide program and management support as in FY 1993 with an increase of two FTEs over the FY 1994 budget to reflect reallocation of Office of Energy Research resources.	Continue to provide program and management support as in FY 1994 with a decrease of one FTE from the revised FY 1994 level and a net increase of one over the FY 1994 budget.
	Provided contract management oversight at Chicago Operations Office for construction of the 6-7 GeV Synchrotron Radiation Source, a multimillion dollar project.	Support the 6-7 GeV Synchrotron Radiation Source with one additional FTE over the FY 1994 budget. Handle all the procurements, safety and environmental oversight, and project management activities related to that project, with increased emphasis on preparation for commissioning.	Provide two additional FTEs above the FY 1994 budget, including one also required in FY 1994, for increased technical and clerical support to the 6-7 GeV Synchrotron Radiation Source.

III. Program Direction (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Program Direction (Cont'd)	Provided a variety of program support such as electronic information and communications services, printing and binding, and contractual services, for example, for ES&H support, the SBIR program, and Automated Office Support Systems (AOSS) workstations. ($2,434)	Continue at a reduced level the variety of program support required in FY 1993. ($1,735)	Continue at a reduced level the variety of program support required in FY 1994. ($1,515)
	$ 8,400	$ 9,400	$ 9,900
Program Direction	$ 8,400	$ 9,400	$ 9,900

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

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, general purpose equipment at Argonne and Ames is funded through BES. Studies done both by the Department and by the laboratories continue to stress the importance of modernization in order to take advantage of technologically more efficient and safe instruments and equipment. Much of the research in the BES program involves experiments at extremes of temperatures 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: Capital Equipment

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Capital Equipment	$ 45,440	$ 44,880	$ 41,537	- 7
Total, Capital Equipment	$ 45,440	$ 44,880	$ 41,537	- 7

II. B. Major Laboratory and Facility Funding

AMES LAB	$ 1,574	$ 1,443	$ 1,443	0
ARGONNE NATIONAL LAB (EAST)	$ 15,910	$ 12,799	$ 10,883	- 15
BROOKHAVEN NATIONAL LAB	$ 4,028	$ 3,852	$ 3,852	0
IDAHO NATIONAL ENGINEERING LAB	$ 310	$ 263	$ 263	0
LAWRENCE BERKELEY LAB	$ 7,063	$ 8,645	$ 8,645	0
LAWRENCE LIVERMORE NATIONAL LAB	$ 1,539	$ 1,253	$ 1,253	0
LOS ALAMOS NATIONAL LABORATORY	$ 825	$ 1,511	$ 1,511	0
OAK RIDGE NATIONAL LAB	$ 7,331	$ 5,501	$ 5,501	0
PACIFIC NORTHWEST LAB	$ 1,605	$ 1,036	$ 1,036	0
SANDIA NATIONAL LABORATORIES	$ 1,906	$ 2,136	$ 2,136	0

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

Program Activity	FY 1993	FY 1994	FY 1995
Capital Equipment			
Capital Equipment	Continued core equipment funding at about the same dollar level as FY 1992. Emphasis continued in areas which require ES&H attention and in areas which have high priority in the research program. Increasing equipment requirements at the major user facilities continued to receive attention and funding. General purpose equipment requirements for Ames and ANL continued to be funded at the FY 1992 level. Provided increases for both the 6-7 GeV Synchrotron Radiation Source to maintain project schedule and the 1-2 GeV Synchrotron Radiation Source to support initial operations. Capital equipment in support of the High Performance Computing and Communications program was enhanced.	Continues core equipment funding at the FY 1993 level. Emphasis will continue in areas which require ES&H attention and in areas which have high priority in the research programs. Equipment requirements at the major user facilities will continue to be met. General purpose equipment requirements for Ames and ANL will continue to be funded at the FY 1993 level. Acquisition of a field emission gun electron microscope, located at Lawrence Berkeley Laboratory, with a point-to-point resolution limit of about one Angstrom (TEC - $1.5M). Continues support of the High Performance Computing and Communications activities.	Continues core equipment funding at slightly below the FY 1994 level. Emphasis will continue in areas which require ES&H attention and in areas which have high priority in the research programs. Basic equipment requirements at the major user facilities will continue to be met. General purpose equipment requirements for Ames and ANL will continue to be funded at the FY 1994 level. Supports research experiments, workstations, small networking equipment, supercomputer peripheral items and associated items in conjunction with the High Performance Computing and Communications activities.
	No activity.	INVESTMENT: Funds are provided for the HPCC activities included in the President's FY 1994 Economic Investment Package.	INVESTMENT: Funds are provided for continuation of the HPCC activities included in the President's FY 1994 Economic Investment Package.
	$ 45,440	$ 44,880	$ 41,537
Capital Equipment	$ 45,440	$ 44,880	$ 41,537

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

BASIC ENERGY SCIENCES

I. Preface: Construction

Construction is needed to support the research in each of the subprograms in the Basic Energy Sciences program. Experiments necessary in support of basic research require that state-of-the-art facilities be built or existing facilities modified to meet unique research requirements. Reactors, radiation sources, and neutron sources are among the expensive, but necessary, facilities required. The budget for the BES program includes funding for the construction and modification of these facilities.

II. A. Summary Table: Construction

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Construction	$ 109,533	$ 119,500	$ 70,379	- 41
Congressionally Directed Projects	94,800	0	0	0
Total, Construction	$ 204,333	$ 119,500	$ 70,379	- 41

II. B. Major Laboratory and Facility Funding

AMES LAB	$ 1,130	$ 835	$ 520	- 38
ARGONNE NATIONAL LAB (EAST)	$ 100,007	$ 110,600	$ 61,979	- 44
BROOKHAVEN NATIONAL LAB	$ 4,153	$ 4,000	$ 4,200	+ 5
LAWRENCE BERKELEY LAB	$ 1,558	$ 1,500	$ 1,800	+ 20
OAK RIDGE NATIONAL LAB	$ 1,033	$ 600	$ 1,000	+ 67
SANDIA NATIONAL LABORATORIES	$ 180	$ 180	$ 100	- 44

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

Program Activity	FY 1993	FY 1994	FY 1995
Construction			
Construction	Provides necessary funds to continue all projects underway in FY 1992, except for the 1-2 GeV and the Solid State Research Facility which were completed. EPACT: EPACT Section 2203(a)(2)(c) "Supporting Research and Technical Analysis": Provides funds for the construction of the Advanced Photon Source at the Argonne National Laboratory. ($96,407)	Provides necessary funds to continue at the approved schedule all projects underway in FY 1993. EPACT: EPACT Section 2203(a)(2)(c) "Supporting Research and Technical Analysis": Provides funds for the construction of the Advanced Photon Source at the Argonne National Laboratory. ($107,000) INVESTMENT: Provides funding for advanced materials and processing activities included in the President's FY 1994 Economic Investment Package.	Provides necessary funds to continue at the approved schedule all projects underway in FY 1994. EPACT: EPACT Section 2203(a)(2)(c) "Supporting Research and Technical Analysis": Provides funds for the construction of the Advanced Photon Source at the Argonne National Laboratory. ($58,379) INVESTMENT: No activity.
	$ 109,533	$ 119,500	$ 70,379
Congressionally Directed Projects	Funding provided for Congressionally directed projects.	No activity.	No activity.
	$ 94,800	$ 0	$ 0
Construction	$ 204,333	$ 119,500	$ 70,379

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

MAJOR USER FACILITIES

1. Preface: Major User Facilities

The major facilities discussed below are used to conduct forefront research in materials, chemistry, biology, medicine, and in the applied sciences using lasers and high fluxes of neutrons or photons. These facilities are unique in their ability to probe the structure and properties of important energy related phenomena. In view of the expensive and unique character of these facilities, scientists from all parts of the Nation travel to these facilities to conduct their research, including researchers from government laboratories, industry, universities, and DOE contractors. In addition to currently operating facilities, recommendations from national committees and DOE committees have identified needs for advanced facilities in order to conduct leading edge research. Funds have been included for those facilities requiring Nuclear Regulatory Commission certificates of compliance as directed by 10 CFR 170 and 171. This budget request includes funds to upgrade the major scientific facilities including two new synchrotron radiation sources and a new neutron source. This request includes construction funding in FY 1995 for the 6-7 GeV Synchrotron Radiation Source and operation of the 1-2 GeV Synchrotron Radiation Source. The new neutron source, the Advanced Neutron Source, is budgeted under a separate decision unit. Summarized below is a list of each of these facilities, as well as a description of the activities underway in FY 1993, FY 1994 and FY 1995 to provide for their operation and maintenance. Funding for these facilities is included as part of the budget request in the Materials Sciences and Chemical Sciences subprograms.

The National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory is a unique user-oriented facility for advanced research with synchrotron radiation. At NSLS a wide range of research techniques are used by chemists, solid-state physicists, metallurgists, engineers and biologists for basic and applied studies. This is a forefront, dedicated facility which is used for vacuum ultra-violet and X-ray spectroscopy and X-ray scattering. This facility now serves over 3,200 users per year.

The High Flux Beam Reactor (HFBR) at Brookhaven National Laboratory produces high flux neutron beams used for research in a variety of fields. Neutrons are used as probes by nuclear and solid-state physicists, chemists, and biologists. This 27 year old research reactor has been a pacesetting facility and continues to be an important research tool. During FY 1993, the facility was shut down for part of the year to allow for safety improvements. When fully utilized, this facility will serve nearly 200 users.

The Intense Pulsed Neutron Source (IPNS) at Argonne National Laboratory is a dedicated user facility for advanced research with pulsed neutrons serving the physics, materials, chemical, and life sciences research communities. About 200 user scientists conduct experiments each year.

The High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory is a multipurpose reactor which is used for the production of isotopes, and also used for materials sciences, nuclear chemistry, and radiation damage research. The isotopes are important to the research, medical, and industrial community. Many of these isotopes can only be produced at the HFIR reactor. When fully utilized about 100 users are involved with research at the facility. The Radiochemical Engineering Development Center is a companion facility to the HFIR and was built to recover the transuranium elements from irradiated targets from the reactor.

The Stanford Synchrotron Radiation Laboratory (SSRL) at Stanford University is a national facility funded to permit the utilization of synchrotron radiation for basic and applied research in chemistry, physics, biology, and materials sciences. The operation of this facility has been dependent on the operation of the High Energy Physics electron injector. FY 1993 was the first full year of operations dedicated to synchrotron radiation, independent of High Energy Physics. When fully utilized about 500 users are involved in research at the facility. With some new beamlines being commissioned, increased scientific activity is expected.

The Manuel Lujan, Jr., Neutron Scattering Center (MLNSC) (formerly LANSCE) at Los Alamos National Laboratory will be shut down in FY 1994 because Los Alamos Meson Physics Facility operations are being terminated; therefore, no FY 1995 funding is requested for this facility.

I. Major User Facilities (Cont'd)

The Combustion Research Facility (CRF) at Sandia National Laboratories, Livermore provides a unique capability to outside users from industry, university, and laboratory scientists for combustion research. The focus of the laboratory is on laser diagnostics of combustion systems, but a variety of burner systems and special facilities are available, including those for research on coal combustion and internal combustion engines. About 30 experiments involving about 60 scientists are expected to be operational in FY 1995.

The Advanced Light Source (ALS) at Lawrence Berkeley Laboratory, previously called the 1-2 GeV Synchrotron Radiation Source, is a third generation synchrotron radiation facility for intense beams of light in the UV and soft x-ray regions of the spectrum. Research will include atomic and molecular structure, corrosion, surface phenomena, chemical dynamics, imaging of biological structures, x-ray lithography, and catalysis. Operation of the user program at the ALS began in the last quarter of FY 1993.

Funding in FY 1995 is requested to continue research and development activities associated with the 6-7 GeV Synchrotron Radiation Source (ANL). For the 6-7 GeV facility, funds provided are for R&D and testing of components with increases needed to begin commissioning of the storage ring.

Funding for the Advanced Neutron Source is budgeted for in a separate decision unit.

II. A. Summary Table: Major User Facilities

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
National Synchrotron Light Source	$ 23,616	$ 24,712	$ 24,323	- 2
High Flux Beam Reactor	23,633	23,927	22,362	- 7
Intense Pulsed Neutron Source	6,719	6,690	6,986	+ 4
High Flux Isotope Reactor	26,259	26,818	25,255	- 6
Radiochemical Engineering Development Center	7,636	7,818	7,363	- 6
Stanford Synchrotron Radiation Laboratory	13,736	14,273	13,605	- 5
Manuel Lujan, Jr. Neutron Scattering Center	5,765	2,300	0	-100
Combustion Research Facility	4,379	4,473	4,287	- 4
Advanced Light Source	22,496	23,239	21,896	- 6
6-7 GeV Synchrotron Radiation Source	36,647	54,000	64,900	+ 20
Pulsed Spallation Neutron Source	150	195	0	-100
Advanced Neutron Source	20,559	0	0	0
Total, Major User Facilities	$ 191,595	$ 188,445	$ 190,977	+ 1

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

Program Activity	FY 1993	FY 1994	FY 1995
Major User Facilities			
National Synchrotron Light Source	Continues operations at a slightly lower level than FY 1992. Reduction in operations and user support necessary to absorb the full effect of any cost of living increases.	Continue operations with an increase to support a larger number of users. Provide upgrades in experimental systems.	Continue operations at approximately the FY 1994 level. Begin operation of small gap undulator and begin construction of elliptically polarized wiggler.
	$ 23,616	$ 24,712	$ 24,323
High Flux Beam Reactor	Continues operations at a slightly lower level than FY 1992. Reduction in operations and user support necessary to absorb the full effect of any cost of living increases.	Continue operations with an increase to support a larger number of users.	Continue operations at approximately the FY 1994 level. Continue thermal hydraulic tests for 60 megawatt operation. Improve powder diffractometer and neutron reflectometer.
	$ 23,633	$ 23,927	$ 22,362
Intense Pulsed Neutron Source	Continues operations at a slightly lower level than FY 1992. Reduction in operations and user support necessary to absorb the full effect of any cost of living increases.	Enhance operations (5 additional weeks) with an increase to support a larger number of users.	Continued enhancement of operations with an increase to support a larger number of users.
	$ 6,719	$ 6,690	$ 6,986
High Flux Isotope Reactor	Continues operations at a slightly lower level than FY 1992.	Continues operations at FY 1993 level with full attention given to ES&H upgrades.	Continues operations at approximately the FY 1994 level with full attention given to ES&H upgrades and spent fuel cask issues.
	$ 26,259	$ 26,818	$ 25,255
Radiochemical Engineering Development Center	Continues operations at a slightly lower level than FY 1992. Reduction in operations and user support necessary to absorb the effect of any cost of living increases.	Continues operations at approximately the FY 1994 level with full attention given to ES&H upgrades.	Continues operations at approximately the FY 1994 level with full attention given to ES&H upgrades.

III. Major User Facilities (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Radiochemical Engineering Development Center (Cont'd)	$ 7,636	$ 7,818	$ 7,363
Stanford Synchrotron Radiation Laboratory	Continues operations at a slightly lower level than FY 1992. Reduction in operations and user support necessary to absorb the full effect of any cost of living increases.	Continues operations at FY 1993 level (approximately 6 months for users). Improvements to the SPEAR ring will be initiated.	Improvements to the SPEAR ring initiated in FY 1994 will be completed. Operation of the SPEAR ring will continue at approximately the FY 1994 level.
	$ 13,736	$ 14,273	$ 13,605
Manuel Lujan, Jr. Neutron Scattering Center	Continues operations at a slightly lower level than FY 1992. Reduction in operations and user support necessary to absorb the full effect of any cost of living increases. Users will be expected to transfer experiments to other facilities by FY 1994.	Provides for shutdown of facility.	No activity.
	$ 5,765	$ 2,300	$ 0
Combustion Research Facility	Continues operations at a slightly lower level than FY 1992. Reduction in operations and user support necessary to absorb the full effect of any cost of living increases.	Continues operations at the FY 1993 level. Strengthened programs in chemical kinetics and dynamics will accommodate more users.	Continues operations at approximately the FY 1994 level. Provides additional capability in combustion related chemical dynamics and kinetics at the CRF to accommodate more users from industrial laboratories.
	$ 4,379	$ 4,473	$ 4,287
Advanced Light Source	Increases support for commissioning and starts operation of the Advanced Light Source.	Provides support for first full year of operation of the Advanced Light Source.	Continues operation of the Advanced Light Source at approximately the FY 1994 level.
	$ 22,496	$ 23,239	$ 21,896

III. Major User Facilities (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
6-7 GeV Synchrotron Radiation Source	Increases support for commissioning and testing and research and development to support construction of 6-7 GeV Synchrotron Radiation Source.	Continues research and development, commissioning and testing of components with increases to accelerate R&D needed to support construction of the 6-7 GeV Synchrotron Radiation Source.	Continues research and development and testing of components with increases needed to begin commissioning of the storage ring.
	$ 36,647	$ 54,000	$ 64,900
Pulsed Spallation Neutron Source	Support efforts leading to a conceptual design of a pulsed spallation source.	Continue to support efforts leading to a conceptual design of a pulsed spallation source.	No activity.
	$ 150	$ 195	$ 0
Advanced Neutron Source	Preconstruction research and development support of ANS continues with additional funds for environmental impact statement, preliminary safety analysis report, and probabilistic risk assessment for the ANS.	Funding for the ANS is budgeted for in a separate decision unit.	Funding for the ANS is budgeted for in a separate decision unit.
	$ 20,559	$ 0	$ 0
Major User Facilities	$ 191,595	$ 188,445	$ 190,977

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

IV. A. Construction Project Summary

	Project Title	Previous Obligations	FY 1993 Adjusted	FY 1994 Enacted	FY 1995 Request	Unappropriated Balance	TEC
GPE-400	General Plant Projects	$ XXX	$ 5,500	$ 5,000	$ 4,500	$ 0	$ 4,500*
95-E-305	Accelerator and Reactor Improvements and Modifications, various locations	XXX	0	0	7,500	0	7,500
94-E-305	Accelerator and Reactor Improvements and Modifications, various locations	XXX	0	7,500	0	0	7,500
93-E-305	Accelerator and Reactor Improvements and Modifications, various locations	XXX	7,626	0	0	0	7,626
89-R-402	6-7 GeV Synchrotron Radiation Source Argonne National Laboratory Argonne, Illinois	205,392	96,407	107,000	58,379	0	467,178
	Congressionally Directed Projects	XXX	94,800	0	0	0	0
	Total, Basic Energy Sciences	$ XXX	$204,333	$119,500	$ 70,379	$ 0	$ XXX

* TEC of FY 1995 GPP B/A request only.

IV. B. Construction Funded Project Descriptive Summary

1. Project Title and Location: GPE-400 General Plant Projects, Various Locations — TEC: $ 4,500, TPC: $ 4,500

Start Date: 2nd Qtr. FY 1995 — Completion Date: 4th Qtr. FY 1996

2. Financial Schedule (Federal Funds):

		Costs				
Fiscal Year	Obligations	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997
Prior Year Projects	XXXXX	3,014	1,800	0	0	0
1993 Projects	5,500	1,100	2,200	2,200	0	0
1994 Projects	5,000	0	1,000	2,000	2,000	0
1995 Projects	4,500	0	0	900	1,800	1,800

3. Narrative: 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 subprojects.

The currently estimated distribution of FY 1995 funds by office is as follows:

Ames Laboratory	$ 520
Argonne National Laboratory	3,600
Notre Dame Radiation Laboratory	30
Sandia National Laboratories	100
Stanford Linear Accelerator Center (SSRL)	250
Total project cost	$ 4,500

FY 1995 General Plant Projects (GPP) are miscellaneous minor new construction projects of a general nature. The total estimated costs of each will not exceed $2,000,000. 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.

4. Total Project Funding (BA):

	Prior Years	FY 1993	FY 1994	FY 1995 Request
Construction	$XXXXX	$5,500	$5,000	$4,500

IV. B. Construction Funded Project Descriptive Summary

1. Project Title and Location: Project 95-E-305 Accelerator and Reactor Improvements and Modifications, Various Locations — TEC: $ 7,500 TPC: $ 7,500

Start Date: 3rd Qtr. FY 1995 Completion Date: 3rd Qtr. FY 1997

2. Financial Schedule (Federal Funds):

Fiscal Year	Appropriation	Obligations	Costs
1995	$ 7,500	$ 7,500	$ 1,500
1996	0	0	3,000
1997	0	0	3,000

3. Narrative: 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, one project is requested for facility improvements at the Stanford Synchrotron Radiation Laboratory, one project is requested at the Oak Ridge National Laboratory for improvements to the High Flux Isotope Reactor, and one project at Lawrence Berkeley Laboratory is requested for improvements at the Advanced Light Source.

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
Consistent with the increased user requirements at the NSLS, several additions and improvements are proposed at the facility including: design and construction of a special vacuum changer; stabilize the vuv and x-ray orbits; upgrade the vuv transport, septum and kicker; and provide new power supplies to the x-ray insertion quadrupoles.

High Flux Beam Reactor
Several reactor additions and improvements are necessary to ensure the continued safe and reliable operation of this facility. Specifically in FY 1995, several projects are proposed including: to replace or refurbish the HFBR 2400 volt ac electrical distribution circuit breakers and for the design and fabrication of shielding and shield casks.

Stanford Synchrotron Radiation Laboratory
Provides for improvements to the Stanford Synchrotron Radiation Laboratory necessary to meet changing research activities underway. The capabilities at this laboratory are an essential part of several BES research efforts, and to meet these unique requirements, modifications and improvements are necessary. SPEAR power supplies, isolation valves, and a positron kicker are among the types of improvements necessary at this laboratory.

High Flux Isotope Reactor
Provides for necessary safety improvements identified for the High Flux Isotope Reactor (HFIR) facilities and systems, to assure compliance with DOE orders and applicable standards, codes and regulations.

Advanced Light Source

Provides for a third-harmonic radio frequency cavity system for the storage ring, an advanced storage ring optical diagnostic system, accelerator control systems upgrades, and additional sector valves for the storage ring vacuum system.

4. Total Project Funding (BA):

	FY 1995 Request
Construction	$ 7,500

IV. B. Construction Funded Project Descriptive Summary

1. Project Title and Location: Project 89-R-402 6-7 GeV Synchrotron Radiation Source
Argonne National Laboratory
Argonne, Illinois

TEC: $467,178
TPC: $811,922

Start Date: 3rd Qtr. FY 1990 Completion Date: 1st Qtr. FY 1997

2. Financial Schedule (Federal Funds):

Fiscal Year	Appropriated	Adjustments	Obligations	Costs
1989	$ 6,000	$ 0	$ 6,000	$ 5,633
1990	40,000	- 560 a/	39,440	15,916
1991	70,000	- 408 b/	69,592	37,347
1992	90,360	0	90,360	88,044
1993	110,407	-14,000 c/	96,407	117,504
1994	107,000	0	107,000	105,708
1995	58,379	0	58,379	88,143
1996	0	0	0	8,883

3. Narrative: Argonne National Laboratory is constructing a new-generation 6-7 GeV synchrotron radiation source. This facility is important for the Department's research program and will serve as a national resource for the conduct of research by industry, government, and university scientists. This facility will produce unprecedentedly brilliant x-ray beams to serve the research needs of virtually all scientific disciplines and many technological fields, e.g., physics, chemistry, materials and surface science, biology, and medicine. Users will include scientists, engineers, and graduate students from universities, industry, and research laboratories throughout the United States.

The facility as currently envisaged will consist of a large storage ring containing as many as 34 insertion devices to give intense beams of hard x-rays. The injection and booster systems will be designed to inject positrons into the storage ring at the design energy of 7 GeV. Beam currents as high as 100 milliamperes and lifetimes of at least 10 hours are anticipated. Most importantly, the lowest possible beam emittance will be sought to give the highest brilliance x-ray source by a factor of 10,000 over any in existence. This facility will impact heavily on the fields of physics, materials, chemistry, biology and medicine, and many technologies. Determination of bulk and surface structure will be performed with greater resolution and accuracy. Microprobe characterization will allow impurity detection in the parts per billion range. The high brilliance will make possible inelastic x-ray scattering which is an essentially unexplored field. Investigating time-dependent phenomena in biological membranes and in photosynthetic processes will be possible, as will observing the motion of atoms in protein systems. Angiography and analysis of tumor diseases will be advanced through non-invasive and very fast x-ray diagnostics without, or with the minimal use of, dyes or drugs. Topography will be extended to time-resolved studies of plastic deformation and fracture. All of these investigations are made possible by the photon energy, time-structure, intensity, and unusual brilliance of the radiation source. Other experiments important to national security needs would also be undertaken.

4. Total Project Funding (BA):

	Prior Years	FY 1993	FY 1994	FY 1995 Request	To Complete
Construction	$205,392	$96,407	$107,000	$58,379	$ 0
Capital Equipment	6,800	9,000	5,816	3,900	7,084
Operating Expenses	68,375	36,647	54,000	64,900	88,222

a/ Reflects sequestration of funds for FY 1990.
b/ Application of a portion of the FY 1991 general reduction of $4,111,000.
c/ Application of a portion of the FY 1993 programmatic general reduction of $49,000,000.

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST

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

Basic Energy Sciences

1. Title and Location of Project: General Plant Projects

2a. Project No. GPE-400
2b. Construction Funded

3a. Date A-E Work Initiated, (Title I Design Start Scheduled): 1st Qtr. FY 1995

3b. A-E Work (Title I & II) Duration: Months vary per project

4a. Date Physical Construction Starts: 2nd Qtr. FY 1995

4b. Date construction ends: 4th Qtr. FY 1996

5. Previous Cost Estimate: None

6. Current Cost Estimate: $4,500
TEC -- $4,500
TPC -- $4,500

7. Financial Schedule (Federal Funds):

		Costs				
Fiscal Year	Obligations	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997
Prior Year Projects	$ XXXXX	$ 3,014	$ 1,800	$ 0	$ 0	$ 0
1993 Projects	5,500	1,100	2,200	2,200	0	0
1994 Projects	5,000	0	1,000	2,000	2,000	0
1995 Projects	4,500	0	0	900	1,800	1,800

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

1. Title and Location of Project: General Plant Projects

2a. Project No. GPE-400
2b. Construction Funded

8. Brief Physical Description of Project (Continued)

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 subprojects. 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.

The currently estimated distribution of FY 1995 funds by laboratory is as follows:

Ames Laboratory	$ 520
Argonne National Laboratory	3,600
Notre Dame Radiation Laboratory	30
Sandia National Laboratories	100
Stanford Linear Accelerator Center (SSRL)	250
Total project cost	$ 4,500

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.

Ames Laboratory ..... $ 520

Includes funds to maintain the research capability at the Ames Laboratory, to adapt the facilities to changes required to meet new and improved production techniques, to effect economies of operations, and to reduce or eliminate health, fire, safety or environmental problems. The major projects are the development building HVAC system, handicapped access modification and Spedding Hall office renovations. The highest priorities will be selected based on the laboratory and DOE assessment of existing environmental, health, and safety needs at the laboratory. The projects described above will be constructed on the Ames Laboratory, non-Government owned property.

1. Title and Location of Project: General Plant Projects

2a. Project No. GPE-400
2b. Construction Funded

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

Argonne National Laboratory..... $ 3,600

The Argonne National Laboratory FY 1995 General Plant Projects (GPP) are miscellaneous minor new construction projects of a general nature (such as safety upgrades, fire protection upgrades, and shower and lavatory upgrades). The total estimated costs of each will not exceed $2,000,000. These general plant projects are required to provide for minor new construction and additions, and upgrades 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 and in meeting its requirements for safe and reliable facilities operation. Since it is difficult to detail this type of project in advance, a continuing evaluation of requirements and priorities may be expected to result in additions, deletions, and modifications to the currently planned subprojects. No significant R&D program is anticipated as a prerequisite for design and construction of the subprojects under construction. The highest priority projects will be selected as needs are identified in FY 1995.

Notre Dame Radiation Laboratory..... $ 30

The Radiation Laboratory is housed in the Radiation Research Building, a Government-owned building located on non-Government-owned land on the campus of the University of Notre Dame. The areas to be modified are within or attached to the Radiation Research Building. The Radiation Research Building was constructed in 1962 to standards then prevailing, and suitable access for people in wheelchairs or otherwise handicapped was not incorporated into the design. To provide safe access, the laboratory intends to construct a wheelchair ramp to permit access to the north doors of the building, which are closest to available laboratory parking spaces. In addition, a men's and a women's restroom within the laboratory will each be converted for handicapped access.

Sandia National Laboratories..... $ 100

The Combustion Research Facility (CRF) at Sandia National Laboratories, Livermore (SNL/L) has a continuing need for General Plant Project (GPP) funds for upgrading or the construction of facilities as required to meet expanding or continuously changing programmatic goals and to meet identified environmental, health, and safety requirements. This project will provide funding to modify laboratory space and facilities in the CRF Laboratory Complex. Modifications will be needed to accommodate the many active and proposed combustion research experiments whose needs continuously change and have become increasingly complex because of the technological advances in combustion research. Additional modifications are mandated for environmental, safety and health needs that have evolved since the original facility was designed in 1977.

1. Title and Location of Project: General Plant Projects	2a. Project No. GPE-400 2b. Construction Funded

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

Stanford Linear Accelerator Center (SSRL)..... $ 250

Requirements include minor modifications and additions necessary to support the optimum use of the laboratory research capabilities and to meet identified environmental, health, and safety requirements. These improvements are necessary to maintain the capital investment at the site, to keep the backlog of projects from growing, and to accommodate the continuous changes to the physical makeup of the site necessitated by the evolving SSRL research projects. Examples include upgrading of laboratory space, modifications to roads and parking areas, and relocation of experimental equipment at the facility. The projects described will be constructed on 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.

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST

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

Basic Energy Sciences

1. Title and Location of Project: Accelerator and Reactor Improvements and Modifications, various locations

2a. Project No. 95-E-305
2b. Construction Funded

3a. Date A-E Work Initiated, (Title I Design Start Scheduled): 1st Qtr. FY 1995

3b. A-E Work (Title I & II) Duration: Months vary per project

4a. Date Physical Construction Starts: 3rd Qtr. FY 1995

4b. Date Construction Ends: 3rd Qtr. FY 1997

5. Previous Cost Estimate: None

6. Current Cost Estimate: $ 7,500
TEC -- $ 7,500
TPC -- $ 7,500

7. Financial Schedule (Federal Funds):

Fiscal Year	Appropriation	Obligations	Costs
1995	$ 7,500	$ 7,500	$1,500
1996	0	0	3,000
1997	0	0	3,000

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 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, one project is requested at the Stanford Linear Accelerator for facility improvements at the Stanford Synchrotron Radiation Laboratory, one project is requested at the Oak Ridge National Laboratory for improvements to the High Flux Isotope Reactor, and one project is requested at the Lawrence Berkeley Laboratory for improvements at the Advanced Light Source.

1. Title and Location of Project: Accelerator and Reactor Improvements and Modifications, various locations	2a. Project No. 95-E-305 2b. Construction Funded

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

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.

a. National Synchrotron Light Source (BNL)..... $ 1,600

Consistent with the increased user requirements at the NSLS, several additions and improvements are proposed at the facility including: design and construction of a special vacuum chamber; stabilize the vuv and x-ray orbits; upgrade the vuv transport, septum and kicker; and provide new power supplies to the x-ray insertion quadrupoles.

b. High Flux Beam Reactor (BNL)..... $ 2,600

Several reactor additions and improvements are necessary to ensure the continued safe and reliable operation of this facility. Specifically in FY 1995, several projects are proposed: to replace or refurbish the HFBR 2400 volt ac electrical distribution circuit breakers and for the design and fabrication of shielding and shielded casks.

c. Stanford Synchrotron Radiation Laboratory (SLAC)..... $ 500

This project will provide for improvements at the Stanford Synchrotron Radiation Laboratory necessary to meet changing research activities underway. The capabilities at this laboratory are an essential part of several BES research efforts, and to meet these unique requirements, modifications and improvements are necessary. SPEAR power supplies, isolation valves, and a positron kicker are among the types of improvements necessary at this laboratory.

1. Title and Location of Project: Accelerator and Reactor Improvements and Modifications, various locations	2a. Project No. 95-E-305 2b. Construction Funded

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

d. High Flux Isotope Reactor (ORNL)..... $ 1,000

The purpose of this project is to improve the safety of the HFIR and to assure compliance with DOE orders and with applicable standards, codes and regulations. Current instrumentation used in three systems for monitoring and controlling reactor power level is "original HFIR" and is far out of date. Due to their age, these instrumentation systems are difficult to maintain because of the non-availability of spare parts and services, and calibration is inaccurate and subject to excessive drifting. Funding is being provided to replace them.

e. Advanced Light Source (LBL)..... $ 1,800

This accelerator and reactor improvement and modification project would provide a third-harmonic rf cavity system for the storage ring to provide enhanced control of electron beam bunch length, an advanced storage ring optical diagnostic system to study stored electron beam stability and bunch length, accelerator control system upgrades, and additional sector valves for the storage ring vacuum system that will allow individual sectors to be brought up to atmospheric pressure without compromising the vacuum in neighboring sectors.

10. Details of Cost Estimate

a. Engineering, design, and inspection and component assembly and installation.....	$ 7,500
Total line item cost.....	$ 7,500

11. Method of Performance

Design, engineering and inspection will be performed by Brookhaven National Laboratory, Stanford Synchrotron Radiation Laboratory, Oak Ridge National Laboratory, and Lawrence Berkeley 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 1995 CONGRESSIONAL BUDGET REQUEST
(Changes from FY 1994 Congressional Budget Request are denoted with a vertical line in left margin.)

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

Basic Energy Sciences

1. Title and Location of Project: 6-7 GeV Synchrotron Radiation Source
Argonne National Laboratory
Argonne, Illinois

2a. Project No. 89-R-402
2b. Construction Funded

3a. Date A-E Work Initiated (Title I Design Start Scheduled): 2nd Qtr. FY 1989

3b. A-E Work (Titles I & II) Duration: 48 months

5. Previous Cost Estimate:
Total Estimated Cost (TEC) -- $467,178
Total Project Cost (TPC) -- $811,922

4a. Date Physical Construction Starts: 3rd Qtr. FY 1990

4b. Date Construction Ends: 1st Qtr. FY 1997

6. Current Cost Estimate:
TEC -- $467,178
TPC -- $811,922

7. Financial Schedule (Federal Funds):

Fiscal Year	Appropriation	Adjustments	Obligations	Costs
1989	$ 6,000	$ 0	$ 6,000	$ 5,633
1990	40,000	- 560 a/	39,440	15,916
1991	70,000	- 408 b/	69,592	37,347
1992	90,360	0	90,360	88,044
1993	110,407	-14,000 c/	96,407	117,504
1994	107,000	0	107,000	105,708
1995	58,379	0	58,379	88,143
1996	0		0	8,883

a/ Reflects sequestration of funds for FY 1990.
b/ Application of a portion of the FY 1991 general reduction of $4,111,000.
c/ Application of a portion of the FY 1993 programmatic general reduction of $49,000,000.

1. Title and Location of Project:	6-7 GeV Synchrotron Radiation Source Argonne National Laboratory Argonne, Illinois	2a. Project No. 89-R-402 2b. Construction Funded

8. Brief Physical Description of Project

The DOE has selected Argonne National Laboratory to design and build a new generation 6-7 GeV synchrotron radiation source. This facility is important for the Department's research program and will serve as a national resource for the conduct of research by industry, government, and university scientists. This facility will be located at the Argonne National Laboratory and will produce unprecedentedly brilliant x-ray beams to serve the research needs of virtually all scientific disciplines and many technological fields, e.g., physics, chemistry, materials and surface science, biology, and medicine. Users will include scientists, engineers, and graduate students from universities, industry, and research laboratories throughout the United States.

The accelerator complex will consist of a 200 MeV electron accelerator, a positron production target, a positron linac, a positron accumulator ring, an injector synchrotron to accelerate positrons to 6-7 GeV, and a positron storage ring. The storage ring will be housed in an annular building and will provide space for 69 experimental beamlines and related equipment. Funding for an initial complement of beamlines is included in this construction project. The injector synchrotron will be housed in a separate, but related, structure. The complex will also include: offices; general and special purpose laboratories; clean room laboratories; and miscellaneous service operations areas. Provisions are included for site access roads, parking, service utilities, and miscellaneous site amenities.

The central lab/office building will contain laboratories, administrative offices, library and technical areas with an associated multiuse meeting facility.

The following is a brief physical description of the project facilities:

TECHNICAL COMPONENTS: The major system components for the production and injection of positrons are of conventional design. The storage ring, with approximately a 1100-meter circumference and 40 6-meter-long straight sections, is so designed that the positron beam size and position at each insertion device can be tuned independently for optimal performance. Storage ring magnets are of conventional design; however, a novel and highly effective vacuum system is proposed. The storage ring will operate at an energy (6-7 Gev) which will assure that 20 keV x-rays can be effectively obtained from an undulator in the fundamental mode.

1. Title and Location of Project:	6-7 GeV Synchrotron Radiation Source Argonne National Laboratory Argonne, Illinois	2a. Project No. 89-R-402 2b. Construction Funded

8. Brief Physical Description of Project (Continued)

Of the 40 straight sections, 6 will be occupied by accelerator equipment. Thus a total of 34 straight sections are available for insertion devices (undulators and wigglers). In addition, 35 photon beams from bending magnets (BM) can be provided. The initial complement of beamlines included directly in the project are based on three different types of radiation sources. Additional beamlines, as provided through Collaborative Access Teams (CAT's), are also expected to be ready at commissioning.

CONVENTIONAL FACILITIES: The central laboratory/office building is a conventionally designed building with structural steel framing, concrete floor slabs, and an architectural metal exterior curtain wall with insulated glass windows. The office/laboratory section is composed of two connected four story buildings with mechanical penthouses. An adjacent building houses a multipurpose meeting facility designed for seminars and user meetings. The accelerator control center is located in a two story building attached to the experimental hall building near the central laboratory/office building.

The heating, ventilation and air-conditioning systems are generally variable volume, constant temperature air supply systems providing standard temperature and humidity conditions. Computer rooms and laboratory clean rooms have separate specialized air-handling systems. The building's fire-protection system consists of smoke-detectors, sprinkler systems, and alarm-controlled zones electronically interlocked with Argonne's site-wide fire and security system. Utility systems are conventional, interconnecting with Argonne's existing site-wide utility system.

Conventional facilities buildings for injection consist of the linear accelerator/klystron gallery wing, the synchrotron injection wing, the synchrotron extraction wing, and the synchrotron ring tunnel.

(1) The linear accelerator/klystron gallery building is a long, narrow structure having an outer shell similar to a prefabricated metal building and joined on one side by a reinforced concrete and earth-shielded linear accelerator tunnel. The klystron gallery is an open bay with concrete floor slab, steel frame, and metal panel walls.

(2) The synchrotron injection wing is similar to a prefabricated metal building. Appropriate shielding is provided by concrete blocks.

1. Title and Location of Project:	6-7 GeV Synchrotron Radiation Source Argonne National Laboratory Argonne, Illinois	2a. Project No. 89-R-402 2b. Construction Funded

8. Brief Physical Description of Project (Continued)

(3) The synchrotron extraction tunnel is located below the rf/extraction ring. Appropriate shielding is provided by concrete walls and roof.

(4) The synchrotron enclosure is a box shaped reinforced concrete structure fully covered with earth berms which provide approximately two feet of cover over the top and having sloped sides.

The experimental hall/storage ring building is an annular shaped, metal clad building having an average radius of 600 feet, and is approximately 28 feet high and 85 feet wide. Steel columns and 120 roof beams provide a clear span for experimental beamline installation. A concrete "storage ring" shielding enclosure is located within the building near the inner wall. This enclosure has approximately 3-foot thick reinforced concrete walls and roof slab. The inside height is 9 feet and the width varies between about 9 and 21 feet in a sawtooth pattern.

The experimental hall building has separate air-handling units and air-distribution units creating multiple zones to provide heat and air-conditioning. The storage ring enclosure is air-conditioned and exhausted to the extent necessary to remove equipment-generated heat only. All utilities are distributed to the building from the utility support building.

An emergency/service vehicle tunnel, 14 foot head clearance, is provided under the building for infield access. A pedestrian tunnel also connects central laboratory/office building to the control room, crosses the experimental hall, and connects the rf/extraction and injector buildings.

An rf/extraction building, located above the synchrotron extraction tunnel, will house storage-ring magnet power supplies and radio frequency (rf) equipment for the synchrotron and the storage ring. ~~The four laboratory/office modules~~ Consistent with user needs, at least four laboratory/office modules will be constructed. These are similar metal-framed one-story buildings with insulated metal exterior panels and concrete floor slabs. These buildings are spaced at intervals around the outside of the experimental hall/storage ring building and each contains offices, laboratories, conference areas, service support spaces, and truck air-lock access to facilitate delivery of technical components.

1. Title and Location of Project:	6-7 GeV Synchrotron Radiation Source Argonne National Laboratory Argonne, Illinois	2a. Project No. 89-R-402 2b. Construction Funded

8. Brief Physical Description of Project (Continued)

The utility support facility houses central mechanical and electrical equipment supporting the accelerator components and conventional facilities. It is a single-story, conventional metal-framed structure similar to a prefabricated metal building, with reinforced concrete floor slab. The facility has an overhead truck access door.

SITE IMPROVEMENTS: The completed project will occupy approximately 80 acres of relatively level, open land on the Argonne site. A standard perimeter road encircling the entire complex will provide access to all quadrants and interconnect with Argonne's road system. The project center and the four office/laboratory modules will have paved parking facilities. Emergency and service access to the infield area of the experimental hall/storage ring will be via a 16-foot wide vehicle tunnel.

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

Over the past 20 years, synchrotron radiation emitted by circulating electron or positron beams has emerged as a very powerful and versatile source of vacuum ultraviolet light and x-rays, and a very powerful tool for probing the structure of matter and for studying various physical processes. Several synchrotron radiation facilities with different designs and characteristics are now in regular operation in this country, the most recent additions being the 0.8 GeV and 2.5 GeV rings of the National Synchrotron Light Source at Brookhaven National Laboratory.

In October of 1983, an ad hoc committee was convened by the Department of Energy, Office of Basic Energy Sciences, with the charter to "solicit and evaluate ideas from synchrotron-radiation providers and users as to the future opportunities and technical needs for synchrotron-radiation based research." The committee had a membership of 17 scientists actively pursuing research using synchrotron radiation. The finding of the committee, briefly stated, is that the present research and development programs in materials science, physics, biology, and chemistry using

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

synchrotron radiation can be greatly benefitted by the availability of two additional facilities in the U.S. The one with the higher priority is a high-energy storage ring capable of providing fundamental undulator radiation in the x-ray region of the spectrum up to 20 keV, with an early 1990 target date for full operation. Such a storage ring requires an electron or positron beam of energy around 6-7 GeV. Both should be insertion device (undulator and wiggler) based machines designed to accommodate a large number of such insertion devices.

The recommendation by the Committee was later studied and endorsed by the Major Materials Facilities Committee of the National Academy of Sciences and the top priority for the 6 GeV facility was strongly reaffirmed. This high priority national need was reaffirmed in the National Research Council (Brinkman) report - "Physics through 1990's" - and by the Stehle subcommittee of the DOE Energy Research Council Advisory Board.

During 1986 a National task group recommended that the synchrotron energy should be increased from the previously specified value of 6 GeV in order to provide wider tunability of x-rays from undulator sources. Based on the report of that task group, 7 GeV has been chosen as the standard operating energy of the synchrotron. This document addresses the proposed construction of this new synchrotron radiation facility. This new facility would consist of a large storage ring containing as many as 34 insertion devices to give intense beams of hard x-rays. The injection and booster systems will be designed to inject positrons into the storage ring at the design energy of 7 GeV. Beam currents as high as 100 milliamperes and lifetimes of at least 10 hours are anticipated. Most importantly, the lowest possible beam emittance would be sought to give the highest brilliance x-ray source by a factor of 10,000 over any in existence. This facility would impact heavily on the field of physics, materials, chemistry, biology and medicine, and many technologies. Determination of bulk and surface structure will be performed with greater resolution and accuracy. Microprobe characterization will allow impurity detection in the parts per billion range. The high brilliance will make possible inelastic x-ray scattering which is an essentially unexplored field. Investigating time-dependent phenomena in biological membranes and in photosynthetic processes will be possible, as will observing the motion of atoms in protein systems. Angiography and analysis of tumor diseases will be advanced through non-invasive and very fast x-ray diagnostics without, or with the minimal use of, dyes or drugs. Topography will be extended to time-resolved studies of plastic deformation and fracture. All of these investigations are made possible by the photon energy, time-structure, intensity, and unusual brilliance of the radiation source. Other experiments important to national security can also be undertaken.

1. Title and Location of Project:	6-7 GeV Synchrotron Radiation Source Argonne National Laboratory Argonne, Illinois	2a. Project No. 89-R-402 2b. Construction Funded

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

Research and development funding will be used to refine the lattice design of the storage ring, design and test new radio-frequency cavity systems, advance vacuum technology and surface cleaning techniques, develop insertion devices, and investigate beamline components that must handle greater x-ray intensities than at existing sources.

Reliability, stability, and flexibility are emphasized in the accelerator, storage ring, and beamline designs. Specifically, the storage ring can accommodate all types of insertion devices with all tuning conditions desired by the users.

10. Details of Cost Estimate

		Total Cost
a.	1. Engineering, design, and inspection	$ 61,735
	2. Construction management costs	11,910
b.	Construction costs	
	1. Technical components	209,571
	2. Conventional facilities	136,632
	Subtotal	419,848
c.	Contingency	47,330
	Total line item cost	$467,178

11. Method of Performance

Customary accepted practice will be followed. Design of the conventional facilities will be performed under a CPFF architect/engineer contract awarded in accordance with established DOE approved procedures. The design of technical components will be performed by the Laboratory. To the extent feasible, construction and other procurements will be by means of fixed price contracts awarded on the basis of competitive bidding.

1. Title and Location of Project: 6-7 GeV Synchrotron Radiation Source
Argonne National Laboratory
Argonne, Illinois

2a. Project No. 89-R-402
2b. Construction Funded

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

	Prior Years	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	Total
a. Total project funding									
1. Total facility costs									
(a) Line item (Sec. 10).....	21,549	37,347	88,044	117,504	105,708	88,143	8,883	0	467,178
(b) Expense funded equipment.	0	0	0	0	0	0	0	0	0
(c) Inventories.....	0	0	400	4,000	2,900	1,300	0	0	8,600
Total direct cost.....	21,549	37,347	88,444	121,504	108,608	89,443	8,883	0	475,778
2. Other project costs									
(a) R&D necessary to complete construction...	26,798	14,332	17,265	21,626	14,932	7,500	0	0	102,453
(b) Other project related costs.....	0	0	6,115	11,021	36,168	56,100	80,900	7,322	197,626
(c) Capital equipment.....	3,800	1,500	1,500	9,000	5,816	3,900	7,084	0	32,600
(d) Conceptual design costs..	3,465	0	0	0	0	0	0	0	3,465
Total other project costs.....	34,063	15,832	24,880	41,647	56,916	67,500	87,984	7,322	336,144
Total project cost (TPC) (Items 1 & 2).....	55,612	53,179	113,324	163,151	165,524	156,943	96,867	7,322	811,922

b. Related annual funding a/ (estimated live of project: 20 years)

1. Facility operating costs b/.....	$61,000
2. Programmatic research	19,000
3. ES&H Costs.....	6,100
4. Maintenance Costs c/.....	2,000
5. Capital equipment related to programmatic research.....	2,625
6. Accelerator improvements.....	4,725
Total related annual funding.....	$95,450

a/ Estimated costs in thousands escalated to 1997-year dollars.
b/ Annual operating costs which begin in 1997 include operations effort, utility, and administrative costs.
c/ Maintenance cost estimated at 2.5% of annual operating cost in FY 1997, building to 7% by FY 2000.

1. Title and Location of Project:	6-7 GeV Synchrotron Radiation Source Argonne National Laboratory Argonne, Illinois	2a. Project No. 89-R-402 2b. Construction Funded

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

a. Total project funding

1. Total facility costs

(a) Construction line item - No narrative required

(b) Inventories

The spare parts inventory consists of specialized technical components which are not readily available "off the shelf" and have long lead times for procurement. These components include items such as rf accelerating cavities, klystrons, magnets, and beam diagnostic apparatus.

2. Other project costs

(a) R&D necessary to complete construction.

These costs represent the R&D necessary to assure the best possible performance of the facility, to optimize conceptual engineering designs, and to develop the quality assurance plans for the testing of all hardware. The R&D plan includes: accelerator physics, including optimization of the current lattice and studies of alternative lattices, tracking with component errors and misalignments, nonlinear effects of the lattice and insertion devices, and vacuum chamber impedances; component prototyping and testing; designs for insertion devices and beamline components; detector development; and reexamination of the designs for the conventional facilities.

(b) Related annual funding

These costs provide support for staff, utilities, management, start-up, commissioning, and pre-operations R&D for the APS. This support starts in FY 1992 with the commissioning of the linac and continues in FY 1993 through FY 1996, to include the Positron Accumulator Ring, the Booster Synchrotron, the Storage Ring and beamlines. In late FY 1996, the monthly cost profile for the APS should be the same as for a fully operational APS.

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT

OVERVIEW

ADVANCED NEUTRON SOURCE (ANS)

Neutrons are extremely useful to study the structure and dynamics of materials, to produce certain isotopes, to understand radiation effects, and for other research. Because they are uncharged, neutrons can penetrate deeply into materials, and interact with the nuclei of atoms; thus, they afford a unique capability to study materials. From neutron scattering experiments, it is possible to obtain detailed information on a microscopic scale of the position of atoms in a material, and the manner in which these atoms move as the result of thermal excitations. Because the neutron possesses a magnetic moment, the location of atomic-scale magnetic moments can be obtained. The structural and magnetic information obtained by neutron experiments is essential to the understanding of materials and has been instrumental in the creation of new materials. Of particular importance is the impact made by neutron research on polymers and biological materials. The use of neutron scattering to investigate the microscopic characteristics and structures of polymers has increased exponentially in the past decade, and this trend continues at the present time. Neutrons, by virtue of their capability to determine accurately the position of hydrogen in macromolecular structures, provide unique methods to study the structure and function of, for example, receptor molecules in biological systems. These latter studies are, in turn, vital to the understanding of disease and human genetics. Neutrons are also needed to make transuranic and other isotopes which find important uses in such diverse areas as medical applications, aircraft radiography, residual stress analysis, the study of impurities and dopants in semiconductors, and the inspection of a variety of components of industrial equipment. Neutrons are also used for irradiation studies of materials for fusion and fission reactors, materials analysis, and nondestructive evaluation of materials.

Over the past two decades, a considerable erosion in the strength of the U.S. neutron capability has occurred relative to other industrialized countries. The two major U.S. high-flux reactors, the High Flux Beam Reactor at Brookhaven National Laboratory and the High Flux Isotope Reactor at Oak Ridge National Laboratory, were both constructed in the 1960's. The High Flux Beam Reactor was optimized for neutron scattering. The High Flux Isotope Reactor was optimized for isotope production; however, it also provides several scattering beamlines and facilities for materials irradiation. Both of these reactors will approach the end of their useful lifetimes in the next decade. Since the 1960's, no new high-flux beam research reactor has been constructed in the U.S. In Europe, the situation is different. Major reactor facilities were constructed in 1971 and 1980 in France, and in 1982 and 1991 in Germany.

The strategy for the development of new, advanced research reactor facilities, which serve a broad scientific community in the investigation of the structure of matter, resulted from an evaluation by the National Research Council's Major Materials Facilities Committee. In 1984, this Committee recommended an advanced steady-state neutron facility. This recommendation was reaffirmed in 1985 by the Energy Research Advisory Board; in 1987 by the National Research Council's Physics Review Panel, the Energy Research Advisory Board's Physics Review Panel, and the Basic Energy Sciences Advisory Committee; in 1989 by the National Research Council's Materials Science and Engineering Committee; and in 1990 again by the Basic Energy Sciences Advisory Committee. More recently, in 1993, the Basic Energy Sciences Advisory Committee's Panel on Neutron Sources provided the following recommendation:

"Recommendation 1: Complete the design and construction of the Advanced Neutron Source according to the schedule proposed by the project."

The Advanced Neutron Source is an experimental facility designed to meet the Nation's need for an intense steady-state source of neutrons, as described above. The facility will be based on a new research reactor that will have the most intense neutron beams in the world,

exceeding its closest competitor by a factor of 5 to 10. The Advanced Neutron Source would replace both the High Flux Beam Reactor and the High Flux Isotope Reactor, provide increased research capability, and provide increased assurance of worker and public safety. The Advanced Neutron Source is designed to meet the programmatic needs of the Department of Energy in condensed matter physics, chemistry, biological sciences, materials science, polymer science, isotope production, and materials irradiation. In addition, it will function as a national facility open to researchers from universities, national laboratories, and industry. Based on the experience in Europe, it is anticipated that the Advanced Neutron Source will serve over 1,000 researchers per year.

The Advanced Neutron Source is a Presidential investment initiative for the Department of Energy.

The FY 1995 request provides $12,300,000 for continued research and development of the Advanced Neutron Source, as well as $1,000,000 for capital equipment. Construction funding of $26,700,000 is requested to initiate Title I design.

The performance measure for the Advanced Neutron Source will be milestones completed against approved project baselines for cost, schedule and performance.

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands. Narrative in whole dollars).

LEAD TABLE

Advanced Neutron Source

Activity	FY 1993 Estimate a/	FY 1994 Request	FY 1994 Adjustment	FY 1995 Request
Operating Expenses	$0	$17,000	$0	$12,300
Capital Equipment	0	0	0	1,000
Construction	0	0	0	26,700
Total	$0	$17,000	$0	$40,000
Summary				
Operating Expenses	0	17,000	0	12,300
Capital Equipment	0	0	0	1,000
Construction	0	0	0	26,700
Total Program	$0	$17,000	$0	$40,000
Staffing (FTE's)	(Included in Basic Energy Sciences Program Direction)			

Authorization: Section 209, P.L. 95-91, "Department of Energy Organization Act"

a/ ANS was budgeted as part of the Basic Energy Sciences program in FY 1993 ($21,419,000).

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(dollars in thousands)

SUMMARY OF CHANGES

Advanced Neutron Source

FY 1994 Appropriation	$ 17,000
Operating Expenses	- 4,700

Supports continuing research and development to provide the technical foundation for the Advanced Neutron Source, the development of an Environmental Impact Statement and safety and regulatory compliance.

Capital Equipment	+ 1,000

Provides funds for equipment associated with the natural circulation test facility, the safety test facility, vessel fracture tests, and circulation loop tests.

Construction	+ 26,700

Construction funds are being requested to initiate Title I design.

FY 1995 Congressional Budget Request	$ 40,000

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

ADVANCED NEUTRON SOURCE RESEARCH, DEVELOPMENT AND OPERATIONS

I. Preface: Advanced Neutron Source Research, Development and Operations

The Advanced Neutron Source research and development (R&D) program provides support for research and development to further the design and provide the technical foundation for the ANS and its technical systems. The program currently has a strong focus on the design, fabrication, and testing of the fuel elements for the reactor. Also included are corrosion testing and analyses of potential fuel elements, the neutronic and thermal hydraulic design of the reactor core, and reactor kinetics studies. Specific experiments will be carried out such as the irradiation of aluminum in the High Flux Isotope Reactor and the development of a materials data base for reactor system components. Continued modelling and testing of components and concepts for sources of cold (long wavelength) neutron beams will be undertaken. Efforts to refine designs and concepts for scientific instruments and beam guides will be continued. Shielding calculations, design of reactor protection systems and sensor development will be carried out. Various activities such as thermal hydraulics testing, materials certification, and blockage to support the safety analysis will also be carried out.

This budget supports essential research and development, the development of an environmental impact statement, activities necessary for reactor safety and regulatory compliance, a study of low-enriched uranium fuel options for the ANS, advanced conceptual design studies, and activities necessary to update the baseline documentation.

II. A. Summary Table: Advanced Neutron Source Research, Development and Operations

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Advanced Neutron Source Research, Development and Operations	$ 0	$ 17,000	$ 12,300	- 28
Total, Advanced Neutron Source Research, Development and Operations	$ 0	$ 17,000	$ 12,300	- 28

II. B. Major Laboratory and Facility Funding

OAK RIDGE NATIONAL LAB	$ 0	$ 14,792	$ 12,300	- 17
ARGONNE NATIONAL LAB (EAST)	$ 0	$ 960	$ 0	-100
BROOKHAVEN NATIONAL LAB	$ 0	$ 200	$ 0	-100

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

Program Activity	FY 1993	FY 1994	FY 1995
Advanced Neutron Source Research, Development and Operations	This activity was funded in the Basic Energy Sciences program.	The FY 1994 research and development (R&D) program will be a continuation of designs, tests, and modelling of ANS components to provide further results prior to ANS construction. Activities in FY 1994 will include fuel element R&D such as the irradiation of the second miniplate in the reflector region of the High Flux Isotope Reactor facility. Upper and lower fuel elements without uranium in fuel plates will be fabricated for use in core flow tests. Dynamic tests of some reactor core elements, the control rods, and the reflector shutdown rods will be carried out. A study will be undertaken to examine the impact on the ANS performance goals if low or medium-enriched fuel is used rather than the highly enriched fuel used for the design. The study will build on existing information using currently developed fuels and focus on low (20%) and medium (35%) enriched fuel. Continue work on Environmental Impact Statement.	Continue research and development leading to the construction of the Advanced Neutron Source. Complete corrosion tests under irradiation conditions at the High Flux Isotope Reactor. Fabricate dummy prototype core for flow tests. Begin operation of a natural circulation core facility. Continue effort on preliminary safety analysis report, Phase 2 of the Level 1 Probabilistic Risk Assessment and Phase 1 of the Level 2 Probabilistic Risk Assessment. Continue work on safety analysis report. Continue work on Environmental Impact Statement. Continue work on the fabrication of fuel elements for use in ANS critical experiments. Cold source tests will be performed. The current ANS design is based on a core fueled with highly enriched (93%) uranium fuel. Modification of the core design to incorporate low enriched uranium fuel will be considered based on: the results of the FY 1994 study on the feasibility of fueling with medium or low enriched uranium; and the cost effectiveness of such a modification. If fueling the reactor with existing low enriched uranium fuel would result in an unacceptable degradation of performance, the DOE will consider initiating a research program to attempt to develop a low enriched uranium fuel option that would meet necessary performance standards. It is recognized that changing the current design could result in an increase to the total project cost. The cost to develop a new fuel has not been incorporated into the current estimate.

III. Advanced Neutron Source Research, Development and Operations (Cont'd):

Program Activity	FY 1993	FY 1994	FY 1995
Advanced Neutron Source Research, Development and Operations (Cont'd)	EPACT:	EPACT:	EPACT:
	EPACT Section 2203(a)(2)(d) "Supporting Research and Technical Analysis":	EPACT Section 2203(a)(2)(d) "Supporting Research and Technical Analysis":	EPACT Section 2203(a)(2)(d) "Supporting Research and Technical Analysis":
	This activity was funded in the Basic Energy Sciences program in FY 1993.	Provides funds to further develop the design and provide the technical foundation for the Advanced Neutron Source.	Provides funds to further develop the design and provide the technical foundation for the Advanced Neutron Source.
	This activity was funded in the Basic Energy Sciences program.	Funding in the amount of $251,000 has been budgeted for the SBIR program.	Funding in the amount of $246,000 has been budgeted for the SBIR program.
	$ 0	$ 17,000	$ 12,300
Advanced Neutron Source Research, Development and Operations	$ 0	$ 17,000	$ 12,300

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

CAPITAL EQUIPMENT

I. Preface: Capital Equipment

The ANS has specific capital equipment requirements in support of the research and development efforts on the many technical system components and for the engineering design of scientific instruments and systems which will exploit the neutron beams. Included are equipment to support control rod element testing and evaluation, the design and cold source component and loop tests, natural circulation test, transient low flow testing, and reactor component tests.

II. A. Summary Table: Capital Equipment

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Capital Equipment	$ 0	$ 0	$ 1,000	>999
Total, Capital Equipment	$ 0	$ 0	$ 1,000	>999

II. B. Major Laboratory and Facility Funding

OAK RIDGE NATIONAL LAB	$ 0	$ 0	$ 1,000	>999

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

Program Activity	FY 1993	FY 1994	FY 1995
Capital Equipment	This activity was funded in the Basic Energy Sciences program.	No activity.	Funds are for equipment associated with the natural circulation test facility, the safety test facility, vessel fracture tests, and circulation loop tests. Other equipment supports the research and development on components and engineering design of instruments and systems of the Advanced Neutron Source.
	EPACT:	EPACT:	EPACT:
	EPACT Section 2203(a)(2)(d) "Supporting Research and Technical Analysis":	No activity.	EPACT Section 2203(a)(2)(d) "Supporting Research and Technical Analysis":
	This activity was funded in the Basic Energy Sciences program in FY 1993.		Provides funds to equipment needs associated with the design of the Advanced Neutron Source. ($1,000)
	$ 0	$ 0	$ 1,000
Capital Equipment	$ 0	$ 0	$ 1,000

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT
(dollars in thousands)

KEY ACTIVITY SUMMARY

CONSTRUCTION

I. Preface: Construction

The Advanced Neutron Source will be designed and constructed to meet national experimental needs for an intense, steady-state source of neutrons. The Advanced Neutron Source research complex will be built around a new reactor with a fission power of approximately 330 megawatts.

The core is comprised of two right circular cylindrical elements which are coaxially aligned, separated on the vertical axis, and offset in radius such that unheated coolant enters each element. The core volume is approximately 67 liters. The core is positioned in a replaceable core pressure boundary tube which constitutes a section of the primary coolant loop piping. Surrounding the core pressure boundary tube is a reflector tank of heavy water, approximately 3 meters in diameter, which serves as a neutron reflector and moderator for the reactor and experimental systems. Materials irradiation and transuranic production targets are located inside the core pressure boundary tube near the core while beam tubes and other irradiation facilities are located in the reflector tank. For further moderation of neutrons to very low energies, the reflector tank will also contain two "cold sources." Each cold source is a helium-cooled cryostat containing a liquid deuterium moderator and serves as a source of cold neutrons.

There are four major buildings planned for the Advanced Neutron Source complex. The central structure is an approximately 60-meter-diameter cylindrical, domed reactor containment building. This building houses the reactor itself, with the first floor dedicated to beam and irradiation experiments, the second floor divided between experimental facilities and reactor operations, and a high bay floor dedicated to reactor operations. Adjacent to the reactor building is a reactor support building. This structure houses other large reactor equipment and the general support equipment which need not be located in the reactor building. Also connected to the reactor building is the guide hall. This structure, outside of the reactor containment, is dedicated to beam experiments and will be equipped with an initial complement of advanced instruments for neutron scattering. The fourth building in the complex is an office building, serving both the extensive user community and the reactor operations staff. A number of state-of-the-art experimental systems will be provided to make use of the intense neutron beams from the Advanced Neutron Source. These would include beam transport systems, monochrometers, sample chambers, detectors, and the necessary electronics.

II. A. Summary Table: Construction

Program Activity	FY 1993 Enacted	FY 1994 Enacted	FY 1995 Request	% Change
Construction	$ 0	$ 0	$ 26,700	>999
Total, Construction	$ 0	$ 0	$ 26,700	>999

II. B. Major Laboratory and Facility Funding

OAK RIDGE NATIONAL LAB	$ 0	$ 0	$ 26,700	>999

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

Program Activity	FY 1993	FY 1994	FY 1995
Construction	No activity.	No activity.	Provides necessary funds to begin Title I design of the Advanced Neutron Source.
	INVESTMENT/EPACT: EPACT Section 2203(a)(2)(d) "Supporting Research and Technical Analysis": No activity.	No activity.	INVESTMENT/EPACT: EPACT Section 2203(a)(2)(d) "Supporting Research and Technical Analysis": Provides funds to begin Title I design of the Advanced Neutron Source ($26,700).
	$ 0	$ 0	$ 26,700
Construction	$ 0	$ 0	$ 26,700

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
(Changes from FY 1994 Congressional Budget Request are denoted with a vertical line in left margin.)

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

IV. A. Construction Project Summary

Project No.	Project Title	Previous Obligations	FY 1993 Adjusted	FY 1994 Request	FY 1995 Request	Unappropriated Balance	TEC
94-E-308	Advanced Neutron Source	$ 0	$ 0	$ 0	$ 26,700	$ 2,191,973	$ 2,218,673
	Total, Advanced Neutron Source	$ 0	$ 0	$ 0	$ 26,700	$ 2,191,973	$ 2,218,673

IV. B. Construction Funded Project Descriptive Summary

1. Project Title and Location: Project 94-E-308 Advanced Neutron Source
Oak Ridge National Laboratory
Oak Ridge, Tennessee

TEC: $2,218,673
TPC: $2,883,263

Start Date: 3rd Qtr. FY 1997 Completion Date: 4th Qtr. FY 2003

2. Financial Schedule (Federal Funds):

Fiscal Year	Appropriated	Obligations	Costs
1995	$ 26,700	$ 26,700	$ 26,700
1996	97,000	97,000	82,950
1997	202,060	202,060	146,707
1998	358,700	358,700	287,965
1999	512,790	512,790	482,820
2000	515,540	515,540	556,055
2001	338,030	338,030	402,614
2002	145,400	145,400	201,687
2003	22,453	22,453	31,175

3. Narrative: The Advanced Neutron Source will be a new reactor facility planned to meet national experimental needs for an intense, steady-state source of neutrons. It will be open for use by scientists from universities, industry, and other Federal laboratories. The Advanced Neutron Source research complex will be built around a new reactor with a fission power of approximately 330 megawatts.

There are five major buildings for the Advanced Neutron Source complex. The central structure is an approximately 60-meter-diameter cylindrical, domed reactor containment building. This building houses the reactor itself, with lower floors dedicated to beam and irradiation experiments and a high bay floor dedicated to reactor operations. The second floor is divided between experimental facilities and reactor operations. Adjacent to the reactor building is a reactor support building. This structure houses other large reactor equipment and the general support equipment which need not be located in the reactor building. Also connected to the reactor containment building is the guide hall. This structure, outside of reactor containment, is dedicated to cold neutron beam experiment use. The fourth building in the complex is an office building, serving both the extensive user community and the reactor operations staff. The fifth building is dedicated to operations support functions with other ancillary structures associated with facility operations located in proximity to the basic five building complex. A number of state-of-the-art experimental systems will be provided to make use of the intense neutron beams from the Advanced Neutron Source. These would include beam transport systems, monochrometers, sample chambers, detectors, and the necessary electronics.

4. Total Project Funding (BA):

	Prior Years	FY 1993	FY 1994	FY 1995 Request	To Complete
Construction	$ 0	$ 0	$ 0	$26,700	$2,191,973
Capital Equipment	4,500	860	0	1,000	25,266
Operating Expenses	60,376	20,559	17,000	12,300	522,729

DEPARTMENT OF ENERGY
FY 1995 CONGRESSIONAL BUDGET REQUEST
(Changes from FY 1994 Congressional Budget Request are denoted with a vertical line in left margin.)

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

Advanced Neutron Source

1. Title and Location of Project:	Advanced Neutron Source Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

SIGNIFICANT CHANGES

- TEC increased from $2,139,329,000 to $2,218,673,000 primarily because of a one year delay in the project's start date and the application of full overhead burdened rates as directed by the DOE Chief Financial Officer for FY 1995 construction projects. Other cost changes have also been incorporated to reflect the results of value engineering studies, responses to review committee recommendations on thermal-hydraulics and reactor safety topics, incorporation of modifications arising from inputs from the positron users community, and updated escalation factors.

- TPC increased from $2,748,900,000 to $2,883,263 primarily because of a one year delay in the project's start date, the application of full overhead burdened rates as directed by the DOE Chief Financial Officer for FY 1995 construction projects, and reevaluation of the R&D program to reflect incorporation of review committee recommendations on thermal-hydraulics and reactor safety topics. The basic change within the TPC is a redistribution of "Other Project Costs." That redistribution reflects the modified costs and schedule estimates associated primarily with R&D tasks, especially those associated with reactor safety topics.

DEPARTMENT OF ENERGY
FY 1995 INTERNAL REVIEW BUDGET

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

Advanced Neutron Source 1/

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1. Title and Location of Project: Advanced Neutron Source (ANS)
Oak Ridge National Laboratory (ORNL)
Oak Ridge, Tennessee

2a. Project No. 94-E-308
2b. Construction Funded

3a. Date A-E Work Initiated, (Title I Design Start Scheduled): 1st Qtr. FY 1995

3b. A-E Work (Title I, II, III) Duration: 104 months

5. Previous Cost Estimate:
Total Estimated Cost (TEC) -- $2,139,329
Total Project Cost (TPC) -- $2,748,900

4a. Date Physical Construction Starts: 3rd Qtr. FY 1997

4b. Date Construction Ends. 4th Qtr. FY 2003

6. Current Cost Estimates:
TEC: $2,218,673
TPC: $2,883,263

7. Financial Schedule (Federal Funds):

Fiscal Year	Appropriations	Obligations	Costs
1995	26,700	26,700	26,700
1996	97,000	97,000	82,950
1997	202,060	202,060	146,707
1998	358,700	358,700	287,965
1999	512,790	512,790	482,820
2000	515,540	515,540	556,055
2001	338,030	338,030	402,614
2002	145,400	145,400	201,687
2003	22,453	22,453	31,175

1/ The Office of Energy Research is the sponsoring (funding) office while the Office of Nuclear Energy will be responsible for project management and execution.

1. Title and Location of Project:	Advanced Neutron Source (ANS) Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

8. Brief Physical Description of Project

The Advanced Neutron Source (ANS) is a new experimental facility planned to meet the national need for an intense, steady-state source of neutrons. It will be open to use by scientists from universities, from industry, and from other federal laboratories. The ANS will be equipped with an initial complement of advanced instruments for neutron scattering and nuclear physics research, with isotope production facilities, and ~~materials irradiation~~ with facilities for the study of materials in high radiation fields.

The facility will be built around a new research reactor of unprecedented flux [2/] that will have the most intense beams of steady-state neutrons in the world--a minimum of five to ten times higher than the current world leader at the Institute Laue-Langevin (ILL) in Grenoble, France. Combining the higher source flux with ~~and~~ improved experimental instruments ~~and detectors~~ will create a useful neutron flux that is at least ten times and, for certain experiments, more than one hundred times, higher than is now available in the United States. ~~When fully instrumented~~ There will be three times as many scattering instruments as there are at either of the present high-flux reactors so that the scientific output can be much more than 10 times greater than that at the High Flux Isotope Reactor (HFIR) at Oak Ridge and the High Flux Beam Reactor (HFBR) at Brookhaven together. The potential also exists for the development of entirely new lines of scientific research based on the advanced capabilities that will be available in the ANS facilities.

In addition to meeting the DOE programmatic needs, this will be a national facility with an open user policy attractive to scientists from universities, other national laboratories, and industry. It is anticipated that the ANS would be used by approximately 1000 different individuals each year for neutron scattering experiments in solid state physics, chemistry, metallurgy, ceramics, polymers, colloids, biology, and nuclear physics. In addition, a wide community of isotope and materials irradiation users will also be supported both on-site and throughout the world.

The primary objectives in the design of the site and buildings for the ANS are to provide a protective containment structure for the reactor, to provide the optimal ~~instruments~~ facilities for utilization of neutron beams and irradiation facilities ~~studies~~, and to address the mix of needs associated with the user community, the operations staff, security, contamination control, noise, etc.

[2/] The conceptual design reactor core is based on high enriched (93%) uranium fuel.

1. Title and Location of Project:	Advanced Neutron Source (ANS) Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

8. Brief Physical Description of Project (Continued)

The objectives stated above are being met with a ~~four~~ five major building concept. The central structure is an approximately 60 m (200 ft.) diameter cylindrical, domed, reactor containment building. This building houses the reactor itself, with lower floors dedicated to beam and irradiation experiments, and a high bay floor dedicated to reactor operations. The entire primary cooling circuits are located in cell banks in reactor containment. Adjacent to the containment building is a reactor support building. This structure houses other large reactor and general support equipment which need not be located in containment.

Also connected to the reactor containment building ~~dome~~ is the guide hall. This structure, outside of reactor containment, is dedicated to cold neutron beam experiment use. The fourth building in this complex is an office building, serving both the extensive user community and the permanent staff. The fifth building is dedicated to operations support functions with other ancillary structures associated with facility operations ~~will be~~ located in proximity to the basic ~~four~~ five building complex.

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

All studies of U. S. facilities used for conducting research in neutron scattering and other fields of materials science have shown the facilities do not have state-of-the-art capabilities. The most significant studies supporting this finding were the Seitz/Eastman committee of the National Academy on Major Materials Facilities (1984) and the DOE Energy Research Advisory Board (1985). Both recommended an immediate start on development and design work for a new advanced steady state neutron source. More recently (1993) the Basic Energy Sciences Advisory Commission (BESAC) Panel on Neutron Sources concluded the ANS was the Panel's highest priority for rapid construction.

The purpose of the ANS project is to provide a research reactor with unsurpassed facilities ~~capability~~ for scientific experiments. The ANS will provide for very greatly enhanced neutron scattering research in condensed matter physics, chemistry, biology, materials science, and polymer science. It will also replace and enhance the High Flux Isotope Reactor's capabilities for production of transuranium elements, for irradiation test facilities and abundant fast neutrons required for fusion reactor materials research and development.

1. Title and Location of Project:	Advanced Neutron Source (ANS) Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

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

If the proposed facilities are ~~ANS is~~ not supported, the United States will not have facilities capable of performing state-of-the-art research and will fall further behind the Europeans, whose existing reactors are superior to those in the U.S. Further, existing major U.S. reactors (HFIR, HBFR) are expected to be retired in the next decade. The specific impact for not supporting this request is an increase in the likelihood that the U.S. will be without any of these research capabilities and will not be able to preserve a minimum level of U.S. competitiveness in the areas based on this important area of research.

The scope of this project is defined by the requirements for neutron flux and ~~materials~~ irradiation facilities consistent with the recommendations contained in the studies mentioned earlier. This requires the design and construction of a new research reactor and supporting experimental facilities to meet the defined national need for an intense, steady-state source of neutrons.

10. Details of Cost Estimate a/

	Item Cost	Total Cost
a. Design and Management Costs		$ 524,988
1. Engineering, design, and inspection at approximately 20% of items c through f below (Design, Drawings, and Specifications $200,878)	$ 254,339	
2. Construction management at approximately 5% of item c through f below)	62,665	
3. Project management at approximately 9% of items c through f below	112,142	
4. Regulatory Compliance	95,842	
b. Land and land rights		0
c. Construction costs		1,153,077
1. Improvements to land	25,737	
2. Building costs	32,405	
3. Other structures	10,265	
4. Special facilities	1,062,931	
5. Outside utilities	21,739	

a/ The conceptual design report was issued June 1992 and updated in April 1993, Title I design begin October 1994.

1. Title and Location of Project:	Advanced Neutron Source (ANS) Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

10. Details of Cost Estimate (continued)

	Item Cost	Total Cost
d. Standard equipment		15,448
e. Major computer items		79,217
f. Removal cost less salvage		0
g. Design and project liaison, testing, checkout and acceptance		51,277
Subtotal		1,824,007
h. Contingency at approximately 21.6% of above costs		394,666
i. Total line item cost (Section 12.a.1.(a))		2,218,673
j. Non-Federal Contribution		0
Net Federal total estimated costs (TEC)		$2,218,673

11. Method of Performance

~~The ORNL Management and Operating contractor will subcontract for the services of a Prime Contractor, teamed with an Architect Engineer for the balance of plant, a Reactor Manufacturer for reactor systems, and a Construction Manager.~~ The ORNL Management and Operating Contractor will provide overall project management, design and procurement of the experiment systems, and will subcontract to the commercial nuclear industry for the services of an Industry Team for design and management integration. The Industry Team will be led by a Prime Contractor teamed with an Architect-Engineer for the balance-of-plant design, a Reactor Manufacturer for reactor systems design, and a Construction Manager for construction, installation, equipment procurement, test and preoperational support. To the extent feasible, construction and procurement will be accomplished by fixed-priced subcontracts awarded on the basis of competitive bidding.

1. Title and Location of Project: Advanced Neutron Source (ANS)
Oak Ridge National Laboratory (ORNL)
Oak Ridge, Tennessee

2a. Project No. 94-E-308
2b. Construction Funded

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

	Prior Years	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	TOTAL
a. Total project funding											
1. Total facility costs											
(a) Line item (Sec. 10).....	0	26,369	82,356	145,843	286,762	481,176	554,101	400,714	200,226	30,308	2,207,855
(b) Expense funded equipment											
(c) Inventories.....							a/				
(d) DOE site office support subcontractors.....	0	331	594	864	1,203	1,644	1,954	1,900	1,461	867	10,818
Total direct cost.....	0	26,700	82,950	146,707	287,965	482,820	556,055	402,614	201,687	31,175	2,218,673
2. Other project costs											
(a) R&D necessary to complete construction.....	43,816	9,869	44,482	40,781	31,884	19,640	7,116	6,020	5,211	5,731	214,550
(b) Conceptual design costs.....	51,881										51,881
(c) Site characterization....	790										790
(d) NEPA documentation.....	1,304	2,365	825								4,494
(e) Other project related costs.....	49	32	1,809	8,121	17,796	19,194	47,576	56,829	89,009	120,323	360,738
(f) DOE site office support subcontracts.....	95	34	52	43	45	48	53	56	59	26	511
(g) Capital equipment not related to construction.	5,360	1,000	4,611	5,397	5,939	3,732	1,863	1,244	1,240	1,240	31,626
Total other project Costs.....	103,295	13,300	51,779	54,342	55,664	42,614	56,608	64,149	95,519	127,320	664,590
Total project cost (TPC).....	103,295	40,000	134,729	201,049	343,629	525,434	612,663	466,763	297,206	158,495	2,883,263

a/ Value of Heavy Water (D_2O) (assumed to be supplied in this year from existing government stocks) not included.

1. Title and Location of Project:	Advanced Neutron Source (ANS) Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

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

	TOTAL
b. Related annual funding (Estimated Life: 40 Years) a/	
1. Facility operating costs	$ 89,490
2. Programmatic operating expenses directly related to the facility	39,272
3. Capital equipment not related to construction but related to the programmatic effort in the facility	901
4. GPP or other construction related to the programmatic effort in the facility	0
5. Utility costs	22,785
6. Accelerator reactor improvement modifications (ARIM)	2,680
7. Other costs	0
Total related annual funding	$155,128 b/

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

a. Total project funding

1. Total facility costs

(a) Line item

The estimated costs for this data sheet are for providing Title I and II design, inspection and construction of the ANS facility.

a/ Estimated costs in thousands escalated to 2004-year dollars.
b/ These costs will be offset by savings from closing down HFIR and HFBR. The annual operating costs of these facilities escalated to 2004 dollars is $74,675,000.

1. Title and Location of Project:	Advanced Neutron Source (ANS) Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

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

(b) Expense funded equipment

No narrative required.

(c) Inventories

No narrative required.

2. Other Project Costs

(a) R&D necessary to complete construction

A research and development program is needed to confirm several design bases related primarily to the reactor core performance and safety analysis, system control concepts, cold source designs, and neutron guides, beam tubes, and instruments. Several of these development tasks require long time durations to resolve detailed life cycle characteristics and the timely coupling of development results into the design is a major factor in detailed task planning. A detailed R&D plan has been prepared which defines each specific task and the interface requirements and timing relationships to the ANS project.

(b) Conceptual design costs

Costs are included for preparation of the conceptual design documentation and for ~~one~~ two years of advanced conceptual design prior to the start of Title I design in FY ~~1994~~ 1995.

(c) Site Characterization

Preliminary characterization of the reference ANS site on the Oak Ridge Reservation was started in FY 1990 and continued into FY 1994.

1. Title and Location of Project:	Advanced Neutron Source (ANS) Oak Ridge National Laboratory (ORNL) Oak Ridge, Tennessee	2a. Project No. 94-E-308 2b. Construction Funded

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

(d) NEPA Documentation Costs

Costs shown include preparation of a Phase I Environmental Report and the work required on the Environmental Impact Statement.

(e) Other project related costs

Costs in this category include one-third of the full complement of instruments which are not included in the line item, safety program and management support for the R&D program (item (a) above) and for buildup of the operations staff participation in the design, construction, and test and checkout phases of the project.

(f) DOE site office support

Subcontractor support costs for the DOE-Oak Ridge project office are included in this item.

(g) Capital equipment not related to construction but related to the programmatic effort in the facility

Estimated costs are to provide test facilities for use in development of cold sources, evaluation of core flow blockage, natural convection cooling and flow induced vibration of components. In addition, equipment and facilities supporting structural testing of the fuel elements as well as reactor control components evaluation and major equipment items evaluation is required.

b. Related annual funding:

1. Facility operating costs

The annual facility operating costs expressed in FY ~~2003~~ 2004 dollars include all operations, Quality Assurance and support staff ~~and the annual utility costs~~.

1. Title and Location of Project: Advanced Neutron Source (ANS)
Oak Ridge National Laboratory (ORNL)
Oak Ridge, Tennessee

2a. Project No. 94-E-308
2b. Construction Funded

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

2. Programmatic operating expenses directly related to the facility

The costs included in this category are those related to support for the users of the ANS facility.

3. Capital equipment not related to construction but related to the programmatic effort in the facility.

Costs included are intended to reflect probable replacement parts for capital equipment ~~with moving parts~~.

4. GPP or other construction related to the programmatic effort in the facility

No narrative required.

5. Utility costs

Costs shown cover all estimated utility requirements for the facility.

6. Other costs

No narrative required.