Advanced Scientific Computing Research

Program Mission

The mission of the Advanced Scientific Computing Research (ASCR) program is to foster and support fundamental research in advanced scientific computing – applied mathematics, computer science, and networking and provide the high performance computational and networking tools that enable DOE to succeed in its science, energy, environmental quality, and national security missions. The importance of advanced scientific computing to the missions of the Department was clearly stated in the "Scientific Discovery through Advanced Computing," (SciDAC) report, which was delivered to Congress in March 2001:

> *"Advanced scientific computing is key to accomplishing the missions of the U.S. Department of Energy (DOE). It is essential to the design of nuclear weapons, the development of new energy technologies, and the discovery of new scientific knowledge. All of the research programs in DOE's Office of Science … have identified major scientific questions that can only be addressed through advances in scientific computing."*

Strategic Objectives

SC5: To enable advances and discoveries in DOE science through world-class research in applied mathematics, computer sciences, networks and computational sciences and through the distributed operation of high performance, scientific computing and network facilities; and to deliver, in FY 2006, a suite of specialized software tools for DOE scientific simulations that take full advantage of terascale computers and high speed networks.

SC7-5: Provide major advanced scientific user facilities where scientific excellence is validated by external review; average operational downtime does not exceed 10% of schedule; construction and upgrades are within 10% of schedule and budget; and facility technology research and development programs meet their goals.

Program Strategic Performance Goals and Targets

SC5-1: Build leading research programs in focused disciplines of applied mathematics, computer science, and network and collaboratory research important to national and energy security to spur revolutionary advances in the use of high performance computers and networks. (Mathematical, Information and Computational Sciences subprogram)

Performance Indicator

Invited presentations at major national and international conferences.

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Initiated project to understand the advantages and issues associated with lightweight kernel operating systems rather than full kernels for the compute nodes of extreme-scale scientific computers. [Met Goal]	Complete the development of the Cougar lightweight kernel for clusters of Alpha processor-based computers and begin the assessment of scalability and performance for selected applications. (SC5-1)	Complete the definitive analysis of the advantages and issues associated with lightweight kernel operating systems rather than full kernels for the compute nodes of extreme-scale scientific computers, resolving a critical issue for the future of high performance computers in the U.S. (SC5-1)
Supported the Computational Science Graduate Fellowship Program with the successful appointment of 20 new students to support the next generation of leaders in computational science for DOE and the Nation. [Met Goal]	Appoint 20 new students to the Computational Science Graduate Fellowship Program to develop the next generation of leaders in computational science for DOE and the Nation. (SC5-1)	Appoint 20 new students to the Computational Science Graduate Fellowship Program to develop the next generation of leaders in computational science for DOE and the Nation. (SC5-1)

SC5-2: Create the *Mathematical and Computing Systems Software* and the *High Performance Computing Facilities* that enable Scientific Simulation and Modeling Codes to take full advantage of the extraordinary capabilities of terascale computers, and the *Collaboratory Software Infrastructure* to enable geographically-separated scientists to effectively work together as a team as well as provide electronic access to both facilities and data. (Mathematical, Information and Computational Sciences subprogram)

Performance Indicator

Software released to applications teams.

Performance Standards

As discussed in the Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Operated facilities, including the National Energy Research Scientific Computing Center (NERSC) and ESnet, within budget while meeting user needs and satisfying overall SC program requirements where, specifically, NERSC delivered 3.6 Teraflop capability at the end of FY 2001 to support DOE's science mission. [Exceeded Goal]	Achieve operation of the IBM-SP computer at 5.0 Teraflop "peak" performance. These computational resources will be integrated by a common high performance file storage system that facilitates interdisciplinary collaborations. (SC5-2) Migrate the users with the largest allocations to the IBM-SP from the previous generation Cray T3E. (SC5-2)	Begin installation of next generation NERSC computer, NERSC-4, that will quadruple the capability available to solve leading edge scientific problems. (SC5-2)
		Initiate at least 8 competitively selected interdisciplinary research teams to provide computational science and applied mathematics advances that will accelerate biological discovery in microbial systems and develop the next generation of computational tools required for nanoscale science based on peer review, in partnership with the Biological and Environmental Research and Basic Energy Sciences programs, respectively, of submitted proposals. (SC5-2)

SC7-5: Provide advanced scientific user facilities where scientific excellence is validated by external review; average operational downtime does not exceed 10% of schedule; construction and upgrades are within 10% of schedule and budget; and facility technology research and development programs meet their goals. (Mathematical, Information and Computational Sciences subprogram)

Performance Indicator

Percent unscheduled downtime.

Performance Standards

As discussed in the Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Maintained and operated facilities, including NERSC and ESnet, so the unscheduled downtime on average is less than 10 percent of the total scheduled operating time. [Met Goal]	Maintain and operate facilities, including NERSC and ESnet, so the unscheduled downtime on average is less than 10 percent of the total scheduled operating time. (SC7-5)	Maintain and operate facilities, including NERSC and ESnet, so the unscheduled downtime on average is less than 10 percent of the total scheduled operating time. (SC7-5)
Initiated the review of ASCR high performance computing facilities by the Advanced Scientific Computing Advisory Committee (ASCAC). [Met Goal]	Deliver preliminary report of ASCAC review of ASCR high performance computing facilities. (SC7-5)	Complete the review of ASCR high performance computing facilities by the Advanced Scientific Computing Advisory Committee (ASCAC) and implement action plans to respond to recommendations. (SC7-5)

Significant Accomplishments and Program Shifts

The major thrust of the research efforts supported by the ASCR program is to establish the mathematics and computer science foundations and develop the specialized software tools needed to effectively utilize rapidly-evolving, high-performance computing and networking hardware to enable new scientific discoveries across the research portfolio of the Office of Science. Advances in microelectronics continue to fuel dramatic performance improvements in computing and networking technologies. However, commercial market needs and expectations, which are driving those improvements, are dramatically different from the needs and the expectations of the researchers being supported to advance DOE science. Consequently, the DOE and other Federal agencies whose missions depend on high-performance, scientific computing, must make research investments to adapt high-performance computing and networking hardware into tools for scientific discovery. The importance of these tools to the DOE Office of Science mission and the fundamental differences between business, personal and scientific requirements are illustrated by the following examples:

- Intermetallic compounds, such as iron-manganese-cobalt (Fe-Mn-Co), have properties that would be attractive in a wide variety of applications including, transportation, data storage and computer read/write heads. Before many of these applications can be realized, an important fundamental feature to understand is the degree of "exchange bias," which is responsible for the novel magnetic properties of these materials. Scientifically, the "exchange bias" arises when an antiferromagnetic layer such as FeMn pins the orientation of the magnetic moment of an adjacent ferromagnetic layer such as Cobalt. A calculation performed during the summer of 2001 showed, for the first time, that the magnetic structure of the FeMn layer adjacent to the cobalt layer of atoms was fundamentally different from the magnetic structure of pure FeMn material. This dramatic discovery provides important scientific insight into the properties of magnetic materials and suggests that the "design" of materials with unusual magnetic properties may be fostered through supercomputer simulations. Here are some features of the calculation:
  - The researchers performed a simulation of two layers of Fe-Mn-Co containing 2,016 atoms. (About 15,000 atoms would be needed to accurately model all features of this intermetallic material.) In order to predict the magnetic behavior in the interface region, approximately 30 trillion operations (i.e. additions, subtractions, multiplications and divisions) are required for each atom. Furthermore, 48 megabytes (MB) of memory were needed to store critical

data for each atom. The entire calculation required approximately 100 gigabytes (GB) of memory and 60 quadrillion (60×10^{15}) operations to complete.

  - To put this in context, a 1GHz desktop workstation would need its memory upgraded by a factor of 1500 to perform this calculation, which would take one year to finish. A more realistic comparison can be made by comparing a run on NERSC-3 with a run on a previous generation supercomputer a Cray T3E (NERSC-2). Using 644 processors on the T3E, the code ran at 347 Gflops and required 2 days to complete. Using 2176 processors on the IBM-SP (NERSC-3) the code achieved 2460 Gflops and required only 6.6 hours to complete.

- Scientific simulations to meet Office of Science missions frequently involve accessing large data files on the order of millions to billions of megabytes (MB) in size. These data files are being generated by measurements, experiments, and simulations at many locations around the world. Reliable access to these data requires investments in high-speed high-bandwidth networks, and in robust, efficient network software. To highlight the special features of these requirements, the supercomputing conference series initiated a Network Bandwidth Challenge in 2000, in which researchers were invited to demonstrate their ability to maximize network performance for their application. In both 2000 and 2001, the first prize for optimal use of the network went to a DOE laboratory-led application. In 2001, the prize-winning application was based on an interactive, scientific simulation running at two separate supercomputers. The results of the simulation were sent to the conference floor over the network and visualized at a sustained network performance level of 3.3 gigabits per second, or approximately 1,000 times faster than commercially available DSL.

- A national consortium of climate scientists, computer scientists and applied mathematicians, including DOE researchers, is developing the Coupled Parallel Climate Model (PCM), a terascale simulation code to assist the U.S. National Assessment effort in global climate change. The PCM code is unique in combining atmospheric, ocean, and sea-ice models into a tightly coupled terascale simulation. The PCM code must be run many times with varying assumptions on environmental conditions to create an ensemble of results that, in the aggregate, provides the capability of predicting trends in global climate change. Today's largest supercomputers and software tools can reliably produce results with about 300 km resolution, which is adequate for simulating global effects, such as the jet stream and the temperature profile of the earth. Next generation supercomputer hardware and software tools will be required to perform simulations on a 50 km resolution or less. This will allow accurate simulation of regional effects, such as complex topography and the influence of rivers and streams.

The ASCR program builds on several decades of leadership in high performance computing and many pioneering accomplishments, such as the establishment of the first national supercomputer center in 1974. The principles that guide the integration of these efforts will be discussed in more detail in the MICS subprogram narrative. Building on this long history, principal investigators have received recognition through numerous prizes, awards, and honors. A list of FY 2001 accomplishments and awards is given below.

ACCOMPLISHMENTS

Mathematical, Information and Computational Sciences

- *Babel Language Interoperability: Component Technology for Scientific Software.* Computer scientists at Lawrence Livermore National Laboratory, in collaboration with members of the Common Component Architecture working group, have developed a language interoperability tool that supports the re-use of scientific libraries across multiple programming languages that are prevalent in high end applications. Previously, application developers often could not re-use existing software libraries if the library and the application were written in different programming languages. Using LLNL's language interoperability tool, called Babel, library writers may now deliver libraries that can be called from any of the standard scientific languages, including Fortran 77, C, C++, and Python. Support for Java and Fortran 90 is under development.
- *Hypre: Conceptual Interfaces Provide Access to State-of-the-art Linear Solvers.* A valuable new approach for describing linear systems of equations to linear solver libraries can be described as so-called "physics-based" or "conceptual" interfaces. Unlike traditional matrix-based interfaces used in most libraries, conceptual interfaces are more natural for application users and provide the additional information (e.g., the description of a computational grid) necessary for exploiting powerful linear solver algorithms such as geometric multigrid. Researchers at the Lawrence Livermore National Laboratory, for the first time, developed a Fast Adaptive Composite algorithm through a stand alone linear solver library, eliminating the need for users to "roll their own," as is the case presently. As a bonus, this interface also provides access to standard matrix-based solvers such as Incomplete Factorizations (ILU), Sparse Approximate Inverse methods, and Algebraic Multigrid (AMG), without requiring user code changes.
- *Pushing Collaboration beyond the Desktop.* Researchers at the Argonne National Laboratory continue to push technology to enable scientific collaborations with the Access Grid. The Access Grid is the ensemble of resources that can be used to support group-to-group human interaction across the grid. It consists of multimedia display, presentation and interactions environments, interfaces to grid middleware, and interfaces to visualization environments; and it supports large-scale distributed meetings, collaborative work sessions, seminars, lectures, tutorials and training. More than fifty Access Grid "nodes" -- including cameras, microphones and speakers, and multiple computers for audio and video -- have been installed worldwide.
- Novel Computer Interface and Visualization Environment Transferred to Industry. The 3D human-computer interface and visualization environment known as FLIGHT developed by researchers at the Sandia National Laboratories has been commercialized by Novint Technologies. This software represents several "firsts:"

    - First effort to integrate the sense of touch, with real-time graphics interaction.
    - First human interface totally based on 3D interaction tools. Three patents have been submitted.
    - First Trans-Atlantic virtual collaborative environment to interact with force feedback immersively. This work was presented as an invited application at the 2nd International Grid booth at INET'2000.

- *A Lucky Catch: The Oldest, Most Distant Type Ia Supernova Confirmed by Supercomputer Analysis at NERSC.* An exploding star dubbed SN 1997ff, caught once on purpose and twice by accident by NASA's Hubble Space Telescope, is the oldest and most distant Type Ia supernova ever seen, according to a recent analysis performed at the Department of Energy's National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory. Scientists from the Lawrence Berkeley National Laboratory and the Space Telescope Science Institute that studied the distant supernova, used an IBM SP supercomputer to perform the analysis at NERSC, a world-class, 5 Teraflop, unclassified supercomputing center. By digitally subtracting images from the same region of space taken on two different dates, the researchers were able to isolate a supernova event and unravel much of the uncertainty associated with the observed data. As a result of their simulations, these researchers determined that the supernova was of Type Ia at a redshift of 1.7, and was first observed eight days after it exploded.

- *Fast Visualization of Vector Fields Using Color Mapping.* Researchers at the Sandia National Laboratory have developed two new techniques for visualizing two-dimensional vector fields that use color mapping to depict the flow direction. These approaches are fast because unlike conventional flow visualization techniques such as streamlines, they are completely local and require very little computation. This is especially significant for very large data sets where detection of small complex features is desired in real time. These approaches use the viewer's inherent ability to recognize and understand complex color patterns.
- *Twelve Companies Adopt Argonne Lab/USC Globus ToolkitTM as Standard Grid Technology Platform.* The open source Globus Toolkit™ developed by USC's Information Sciences Institute (ISI) and Argonne National Laboratory has become the de-facto international standard in the burgeoning field of grid computing as twelve leading computer vendors and software providers in the U.S. and Japan announced in November 2001, that they will port and/or support the product. Grid computing is a technology that uses the Internet as basic wiring to let people share computing, storage, data, programs, and other resources, just like the electric power grid allows people and energy companies to share generators of all kinds. The goal is to allow anyone with a computer to effectively integrate instruments, displays, and computational and information resources over a variety of computer platforms.
- *NERSC completes acquisition of new supercomputer.* The Department of Energy's National Energy Research Scientific Computing (NERSC) Center at Lawrence Berkeley National Laboratory has accepted and placed into full service its NERSC-3/Phase 2 system. In June 2001, this 5 Teraflop supercomputer system was number two on the "Top 500" list of the most powerful supercomputers in the world. The system meets, or exceeds, all major, original performance specifications. In FY 2002, its first full year of operation, NERSC-3 will provide the DOE Office of Science research community with 45,000,000 massively parallel processing (MPP) hours for simulations, which is almost a factor of two times the computational capability of the Center one year ago.

AWARDS

Mathematical, Information and Computational Sciences

- *R&D 100 Award*. An R&D 100 award was made to the to the University of Tennessee and Oak Ridge National Laboratory for developing the Performance Application Programming Interface (PAPI). PAPI specifies an application programming interface for accessing hardware performance counters available on most modern microprocessors. PAPI exploits these hardware counters to provide users with precise, high-resolution information on the number and timing of operations performed during software execution, on accesses to the memory hierarchy, on the status of instruction pipelines, and on all the aspects of software execution that must be analyzed when tuning software for high performance.

- *NERSC User Honored by American Physical Society Award for Work in Computational Physics.* Alex Zunger, a physicist at DOE's National Renewable Energy Laboratory in Colorado and a NERSC user, has been named the 2001 recipient of the prestigious Rahman Award by the American Physical Society. The award is presented annually to an individual for "outstanding achievement in computational physics research." Zunger was cited for his "pioneering work on the computational basis for first-principles electronic theory of solids." The Institute for Scientific Information has listed Zunger as one of the most-cited physicists worldwide.
- *Electronic Notebook Recognized for Innovation.* The Electronic Notebook software, enote v1.10, developed by the Oak Ridge National Laboratory and first released in 1999 received an Energy 100 Award in January 2001. These awards recognized the top 100 discoveries and innovations from the Department of Energy that have resulted in improvements for American consumers between 1973 and 2000. Enote provides an easy to use electronic lab notebook that has the look and feel of a scientist's paper notebook, but with additional digital features.

Laboratory Technology Research

- *R&D 100 Award - A New Catalyst Material to Treat Vehicle Exhaust Emissions.* Pacific Northwest National Laboratory (PNNL), in collaboration with Delphi Automotive Systems and Ford Research Laboratory, has developed a zeolite-Y-based-catalyst material for plasma-catalysis engine exhaust treatment that has been shown to remove nearly 90% of Nox, with a cost to fuel efficiency of less than 5%. Unlike other possible catalytic systems, this system is not harmed by sulfur impurities and requires no major design changes to vehicles or fuel infrastructure.
- *Federal Laboratory Consortium (FLC) Award for Excellence in Technology Transfer - Development of High-Temperature Superconducting Wires.* Oak Ridge National Laboratory (ORNL), in collaboration with Minnesota Mining and Manufacturing (3M), has developed a new route to the fabrication of high-temperature superconducting (HTS) wires for high power applications. These HTS materials have tremendous potential for greatly improved energy efficiency in a number of power applications related to the utilization of electrical energy. For example, these materials should produce superconducting transmission lines capable of 2-5 times the power transfer into urban areas, without need for additional rights-of-way and without significant losses to resistance.
- The 2001 Thomas Young Medal and Prize from the Instititute of Physics to a group leader in the Solid State Division of ORNL (awarded in 2001).

PROGRAM SHIFTS

In FY 2003, the MICS subprogram of ASCR will continue its components of the collaborative program across the Office of Science to produce the scientific computing, networking and collaboration tools that DOE researchers will require to address the scientific challenges of the next decade. This program was described in the March 2000 report to Congress entitled, "Scientific Discovery through Advanced Computing," (SciDAC). These activities build on the historic strength of the Department of Energy's Office of Science in computational science, computer science, applied mathematics, and high-performance computing and in the design, development, and management of large scientific and engineering projects and scientific user facilities.

In FY 2003, ASCR will enhance its investments in Advanced Computing Research Testbeds to provide additional specialized capabilities to SciDAC applications research teams that demonstrate significant opportunities for new scientific discovery. The partnership with the Biological and Environmental Research program initiated in FY 2001 in the areas of advanced mathematical, modeling and simulation techniques for biological systems will be expanded. New research will be undertaken to characterize the inventory of multiprotein molecular machines found in a subset of DOE-relevant microbes and organisms with nucleated cells (eukaryotes) and to simulate functional diversity. Results from these investigations are expected to impact clean energy, environmental cleanup, and carbon sequestration efforts. ASCR's contributions to this partnership will consist of developing the underlying mathematical understanding and computational tools that are needed for the analysis and simulation of these biological processes. Finally, in FY 2003, ASCR will initiate a new partnership with the Basic Energy Sciences program in the area of computational nanoscale science, engineering and technology. This partnership is an integral part of the Nanoscale Science, Engineering and Technology initiative in the Office of Science that is led by the Basic Energy Sciences program. The first goal of this initiative is to establish a fundamental scientific understanding of structures and interactions at the nanoscale. For example, it is known that when sample size, grain size, or domain size shrink to the nanoscale, collective phenomena can have a significant influence on local physical properties and may differ dramatically from the corresponding properties in bulk material. The principal missions of the Department of Energy (DOE) in science, energy, defense, and environment will benefit greatly from developments in these areas. Nanoscale synthesis and assembly methods will result in significant improvements in solar energy conversion; more energy-efficient lighting; stronger, lighter materials that will improve efficiency in transportation; greatly improved chemical and biological sensing; use of low-energy chemical pathways to break down toxic substances for environmental remediation and restoration; and better sensors and controls to increase efficiency in manufacturing. ASCR's contributions to this partnership will consist of developing the specialized computational tools for nanoscale science.

A Federally-chartered advisory committee was established for the Advanced Scientific Computing Research program in FY 2000 and is charged with providing advice on: promising future directions for advanced scientific computing research; strategies to couple advanced scientific computing research to other disciplines; and the relationship of the DOE program to other Federal investments in information technology research. This advisory committee will play a key role in evaluating future planning efforts for research and facilities.

Interagency Environment

The research and development activities supported by the MICS subprogram are coordinated with other Federal efforts through the Interagency Principals Group, chaired by the President's Science Advisor, and the Information Technology Working Group (ITWG). The ITWG represents the evolution of an interagency coordination process that began under the 1991 High Performance Computing Act as the High Performance Computing, Communications, and Information Technology (HPCCIT) Committee. DOE has been a key participant in these coordination bodies from the outset and will continue to coordinate its R&D efforts closely through this process.

In FY 1999, the President's Information Technology Advisory Committee (PITAC) recommended significant increases in support of basic research in: Software; Scalable Information Infrastructure; High End Computing; Socio-Economic and Workforce Impacts; support of research projects of broader scope; and visionary “Expeditions to the 21st Century” to explore new ways that computing could benefit our world.

Although the focus of the enhanced DOE program is on solving mission critical problems in scientific computing, this program will make significant contributions to the Nation’s Information Technology Basic Research effort just as previous DOE mission-related research efforts have led to DOE’s leadership in this field. In particular, the MICS subprogram will place emphasis on software research to improve the performance of high-end computing as well as research on the human-computer interface and on information management and analysis techniques needed to enable scientists to manage, analyze and visualize data from their simulations, and develop effective collaboratories. DOE’s program, which focuses on the information technology research needed to enable scientists to solve problems in their disciplines, differs from the National Science Foundation’s portfolio, which covers all of information technology. In addition, DOE’s focus on large teams with responsibility for delivering software that other researchers can rely on differs from NSF’s single investigator focus.

Scientific Facilities Utilization

The ASCR program request includes $28,244,000 in FY 2003 to support the National Energy Research Scientific Computing (NERSC) Center, which is ASCR’s component of the SC-wide Scientific Facilities Initiative that started in FY 1996. This investment will provide computer resources for about 2,400 scientists in universities, federal agencies, and U.S. companies. It will also leverage both federally and privately sponsored research, consistent with the Administration’s strategy for enhancing the U.S. National science investment. The proposed funding will enable NERSC to maintain its role as one of the Nation’s premier unclassified computing centers, which is a critical element in the success of many SC research programs. Research communities that benefit from NERSC include structural biology; superconductor technology; medical research and technology development; materials, chemical, and plasma sciences; high energy and nuclear physics; and environmental and atmospheric research.

Workforce Development

The R&D Workforce Development mission is to ensure the supply of computational and computer science and Ph.D. level scientists for the Department and the Nation through graduate student and postdoctoral research support. In FY 2003, this program will support approximately 800 graduate students and post doctoral investigators, of which 500 will be supported at Office of Science user facilities.

ASCR will continue the Computational Science Graduate Fellowship Program with the successful appointment of 20 new students to support the next generation of leaders in computational science.

Funding Profile

(dollars in thousands)

	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Current Appropriation	FY 2003 Request
Advanced Scientific Computing Research					
Mathematical, Information, and Computational Sciences	151,647	155,050	-650	154,400	166,625
Laboratory Technology Research	9,649	3,000	0	3,000	3,000
Subtotal, Advanced Scientific Computing Research	161,296	158,050	-650	157,400	169,625
General Reduction	0	-650	650	0	0
Total, Advanced Scientific Computing Research	161,296 [a] [b]	157,400	0	157,400	169,625

Public Law Authorization:

Public Law 95-91, "Department of Energy Organization Act"

Public Law 103-62, "Government Performance and Results Act of 1993"

[a] Excludes $3,990,000 which was transferred to the SBIR program and $239,000 which was transferred to the STTR program.

[b] Excludes $225,000 which was transferred to the Science Safeguards and Security program in an FY 2001 reprogramming.

Funding by Site

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Albuquerque Operations Office					
Los Alamos National Laboratory	5,727	2,855	5,020	+2,165	+75.8%
Sandia National Laboratories	4,656	4,767	3,889	-878	-18.4%
Total, Albuquerque Operations Office	10,383	7,622	8,909	+1,287	+16.9%
Chicago Operations Office					
Ames Laboratory	2,151	1,991	1,625	-366	-18.4%
Argonne National Laboratory	14,077	11,246	8,573	-2,673	-23.8%
Brookhaven National Laboratory	2,130	1,199	542	-657	-54.8%
Fermi National Accelerator Laboratory	120	226	60	-166	-73.5%
Princeton Plasma Physics Laboratory	190	340	0	-340	--
Chicago Operations Office	28,161	12,060	7,240	-4,820	-40.0%
Total, Chicago Operations Office	46,829	27,062	18,040	-9,022	-33.3%
Oakland Operations Office					
Lawrence Berkeley National Laboratory	65,807	51,325	53,223	+1,898	+3.7%
Lawrence Livermore National Laboratory	4,898	6,587	3,068	-3,519	-53.4%
Stanford Linear Accelerator Center	315	502	234	-268	-53.4%
Oakland Operations Office	4,316	1,781	960	-821	-46.1%
Total, Oakland Operations Office	75,336	60,195	57,485	-2,710	-4.5%
Oak Ridge Operations Office					
Oak Ridge Inst. For Science and Education	349	100	99	-1	-1.0%
Oak Ridge National Laboratory	22,545	11,251	10,496	-755	-6.7%
Thomas Jefferson National Accelerator Facility	50	0	0	0	--
Oak Ridge Operations Office	60	0	0	0	--
Total, Oak Ridge Operations Office	23,004	11,351	10,595	-756	-6.7%
Richland Operations Office					
Pacific Northwest National Laboratory	4,616	3,738	1,003	-2,735	-73.2%
Washington Headquarters	1,128	47,432	73,593	+26,161	+55.2%
Total, Advanced Scientific Computing Research	161,296 [a] [b]	157,400	169,625	+12,225	+7.8%

[a] Excludes $3,990,000 which was transferred to the SBIR program and $239,000 which was transferred to the STTR program.

[b] Excludes $225,000 which was transferred to the Science Safeguards and Security program in an FY 2001 reprogramming.

Site Description

Ames Laboratory

Ames Laboratory is a Multiprogram Laboratory located on 10 acres in Ames, Iowa. The MICS subprogram at Ames Laboratory conducts research in computer science and participates on one of the SciDAC teams. The LTR subprogram at Ames conducts research in the physical, chemical, materials, mathematical, engineering, and environmental sciences through cost-shared collaborations with industry.

Argonne National Laboratory

Argonne National Laboratory (ANL) in Argonne, Illinois, is a Multiprogram Laboratory located on a 1,700 acre site in suburban Chicago. ANL has a satellite site located in Idaho Falls, Idaho. The MICS subprogram at ANL conducts basic research in mathematics and computer science, as well as research in advanced computing software tools and collaboratory tools. ANL also participates in several scientific application and collaboratory pilot projects as well as supporting an advanced computing research testbed and participates on a number of the SciDAC teams. The testbed at ANL focuses on a large cluster of Intel-based compute nodes with an open source operating system based on LINUX, this cluster has been given the name of "Chiba City." The LTR subprogram at ANL conducts research motivated by practical energy payoffs through cost-shared collaborations with industry. The areas emphasized in the research portfolio are chemistry of ceramic membranes, separations technology, near-frictionless carbon coatings, and advanced methods for magnesium production.

Brookhaven National Laboratory

Brookhaven National Laboratory (BNL) is a Multiprogram Laboratory located on a 5,200 acre site in Upton, New York. The MICS subprogram at BNL participates on one of the SciDAC teams. The LTR subprogram at BNL conducts research motivated by practical energy payoffs through cost-shared collaborations with industry. The areas emphasized in the research portfolio are materials for rechargeable lithium batteries, sensors for portable data collection, catalytic production of organic chemicals, and DNA damage responses in human cells.

Fermi National Accelerator Laboratory (Fermilab)

Fermilab is located on a 6,800-acre site about 35 miles west of Chicago, Illinois. The LTR subprogram at Fermilab conducts research in areas such as superconducting magnet research, design and development, detector development and high-performance computing through cost-shared collaborations with industry.

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory (LBNL) is a Multiprogram Laboratory located in Berkeley, California. The Laboratory is on a 200 acre site adjacent to the Berkeley campus of the University of California. The MICS subprogram at LBNL conducts basic research in the mathematics and computer science, as well as research in advanced computing software tools and collaboratory tools. LBNL participates in several scientific application and collaboratory pilot projects and participates on a number of the SciDAC teams. LBNL manages the Energy Sciences Network (ESnet). ESnet is one of the world's most effective and progressive science-related computer networks that provides worldwide access and communications to Office of Science (SC) facilities. In 1996, the National Energy Research

Scientific Computing Center (NERSC) was moved from the Lawrence Livermore National Laboratory to LBNL. NERSC provides a range of high-performance, state-of-the-art computing resources that are a critical element in the success of many SC research programs. The LTR subprogram at LBNL conducts research motivated by practical energy payoffs through cost-shared collaborations with industry. The areas emphasized in the research portfolio are molecular lubricants for computers, advanced material deposition systems, screening novel anti-cancer compounds, and innovative membranes for oxygen separation.

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory (LLNL) is a Multiprogram Laboratory located on an 821 acre site in Livermore, California. The MICS subprogram at LLNL involves significant participation in the advanced computing software tools program as well as basic research in applied mathematics and participates on a number of the SciDAC teams.

Los Alamos National Laboratory

Los Alamos National Laboratory (LANL) is a Multiprogram Laboratory located on a 27,000 acre site in Los Alamos, New Mexico. The Mathematical Information and Computational Sciences (MICS) subprogram at LANL conducts basic research in the mathematics and computer science and in advanced computing software tools. LANL also participates in several scientific application and collaboratory pilot projects and participates on a number of the SciDAC teams.

Oak Ridge Institute for Science and Education

Oak Ridge Institute for Science and Education (ORISE) is located on 150 acres in Oak Ridge, Tennessee. ORISE provides support for education activities funded within the ASCR program.

Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is a Multiprogram Laboratory located on a 24,000 acre site in Oak Ridge, Tennessee. The MICS subprogram at ORNL conducts basic research in the mathematics and computer science, as well as research in advanced computing software tools and collaboratory tools. ORNL also participates in several scientific application and collaboratory pilot projects and participates on a number of the SciDAC teams. ORNL also supports Advanced Computing Research Testbeds (ACRTs) focused on the evaluation of leading edge research computers from Compaq and IBM including significant interactions with SciDAC applications teams. The LTR subprogram at ORNL conducts research motivated by practical energy payoffs through cost-shared collaborations with industry. The areas emphasized in the research portfolio are high temperature superconducting wires, microfabricated instrumentation for chemical sensing, and radioactive stents to prevent reformation of arterial blockage.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) is a Multiprogram Laboratory located on 640 acres at the Department's Hanford site in Richland, Washington. The MICS subprogram at PNNL conducts basic research in the mathematics and computer science, as well as research in advanced computing software tools and collaboratory tools. PNNL also participates in several scientific application pilot projects and participates on a number of the SciDAC teams. The LTR subprogram at PNNL conducts research motivated by practical energy payoffs through cost-shared collaborations with industry. The areas emphasized in the research portfolio are mathematical simulations of glass production, interactions of biological polymers with model surfaces, and characterization of microorganisms in environmental samples.

Princeton Plasma Physics Laboratory

The Princeton Plasma Physics Laboratory (PPPL), a laboratory located in Plainsboro, New Jersey, is dedicated to the development of magnetic fusion energy. The LTR subprogram at PPPL conducts research in areas that include the plasma processing of semiconductor devices and the study of beam-surface interactions through cost-shared collaborations with industry.

Sandia National Laboratories

Sandia National Laboratories (SNL) is a Multiprogram Laboratory, with a total of 3,700 acres, located in Albuquerque, New Mexico, with sites in Livermore, California, and Tonopah, Nevada. The MICS subprogram at SNL conducts basic research in mathematics and computer science, as well as research in advanced computing software tools and collaboratory tools. SNL also participates in several scientific application and collaboratory pilot projects and participates on a number of the SciDAC teams.

Stanford Linear Accelerator Center

The Stanford Linear Accelerator Center (SLAC) is located at the edge of Silicon Valley in California about halfway between San Francisco and San Jose on 426 acres of Stanford University land. The LTR subprogram at SLAC conducts research in areas such as advanced electronics, large-scale ultra-high vacuum systems, radiation physics and monitoring, polarized and high-brightness electron sources, magnet design and measurement, and controls systems through cost-shared collaborations with industry.

Thomas Jefferson National Accelerator Facility

The Thomas Jefferson National Accelerator Facility (TJNAF) is a basic research laboratory located on a 200 acre site in Newport News, Virginia. The LTR subprogram at the TJNAF conducts research in such areas as accelerator and detector engineering, superconducting radiofrequency technology, speed data acquisition, and liquid helium cryogenics through cost-shared collaborations with industry.

All Other Sites

The ASCR program funds research at 71 colleges/universities located in 24 states supporting approximately 117 principal investigators. Also included are funds for research awaiting distribution pending completion of peer review results.

A number of Integrated Software Infrastructure Centers will be established at laboratories and/or universities. Specific site locations will be determined as a result of competitive selection. These centers will focus on specific software challenges confronting users of terascale computers.

Mathematical, Information, and Computational Sciences

Mission Supporting Goals and Objectives

The Mathematical, Information, and Computational Sciences (MICS) subprogram is responsible for carrying out the primary mission of the ASCR program: discovering, developing, and deploying advanced scientific computing and communications tools and operating the high performance computing and network facilities that researchers need to analyze, model, simulate, and — most importantly — predict the behavior of complex natural and engineered systems of importance to the Office of Science and to the Department of Energy.

- A key feature of the ASCR program is that the approach to accomplishing the Program Strategic Performance Goals is integrated through the management of the MICS subprogram. Computing and networking requirements of the Office of Science far exceed the current state-of-the-art; and the requirements far exceed the tools that the commercial marketplace will deliver. The MICS subprogram must not only support basic research in the areas listed above, but also the development of the results from this basic research into software usable by scientists in other disciplines and partnerships with users to test the usefulness of the research. These partnerships with the scientific disciplines are critical because they provide rigorous tests of the usefulness of current advanced computing research, enable MICS to transfer the results of this research to scientists in the disciplines, and help define promising areas for future research. This integrated approach is critical for MICS to succeed in providing the extraordinary computational and communications tools that DOE's civilian programs need to carry out their missions. It is important to note that these tools have applications beyond the Office of Science; to the NNSA and the private sector after these tools have been initially discovered and developed by the MICS subprogram.

In addition to its research activities, the MICS subprogram supports the operation of supercomputer and network facilities that are available to researchers working on problems relevant to DOE's scientific missions 24 hours a day, 365 days a year.

In FY 2003, the MICS subprogram will continue its components of the collaborative SciDAC program across the Office of Science to produce the scientific computing, networking and collaboration tools that DOE researchers will require to address the scientific challenges of the next decade. The MICS components include investments in scientific computing research and networking and collaboration research that are complemented by investments in computing and networking facilities. In addition, in FY 2003, MICS will increase its efforts in computational biology and in computational nanoscience.

The specific details of the MICS investment strategy are described below in the detailed program justification section of this budget. However, it is important to understand that all of those individual program elements are pieces in a puzzle whose overall goal is to enable scientists to use computing and collaboration technologies as tools for scientific discovery. Thus, the way the individual elements fit together and complement each other is critical because a scientist needs all of these pieces to succeed. A weakness in any one element, or weakness in the way the elements are integrated, are barriers to the scientist's success. The three sections below provide the background for MICS subprogram investments in Scientific Computing Research, High Performance Networking, Middleware and Collaboratory Research, and High Performance Computing and Networking Facilities.

Scientific Computing Research Investments

In scientific computing, the key measure of success in translating peak computing power into science is the percent of peak performance that is delivered to an application over the *entire* calculation. In the early to mid-1990's on computers such as the Cray Research C-90, many scientific codes realized 40% to 50% of the peak performance of the supercomputer. In contrast, on today's parallel supercomputers, scientific computing codes often realize only 5% to 10% of "peak" performance, and this fraction could decrease as the number of processors in the computers grow.

This phenomenon is a direct result of the fact that the speed of memory systems and the speed of interconnects between processors is increasing much more slowly than processor speed. For many scientific applications these factors dominate the performance of the application. Two types of solutions are available to the computer hardware designer in addressing the mismatch of speed between the components: (1) clever hierarchical arrangements of memory with varying speeds and software to find data before it is needed and move it into faster memory, closer to the processor that will need it; and (2) techniques to increase parallelism, for example, by using threads in the processor workloads or by combining parallel data streams from memory or disks. Current technology forecasts indicate a doubling or quadrupling in the numbers of layers in the memory hierarchy, and a 100- to 1000-fold increase in the amount of parallelism in disk and tape systems to accommodate the relative increase in the mismatch between processor speed and memory, disk and tape speeds in the next five years.

One result of this increasing complexity of high-performance computer systems is the importance of the underlying systems software. Operating systems, compilers, runtime environments, mathematical libraries, and end-user applications must all work together efficiently to extract the desired high performance from these systems.

In addition to the challenges inherent to managing the required level of parallelism, technology trends and business forces in the U.S. computer system industry have resulted in radically reduced development and production of high-end systems necessary for meeting the most demanding requirements of scientific research. In essence, the U.S. computer industry has become focused on the computer hardware and software needs of business applications, and little attention is paid to the special computational needs of the scientific community. Therefore, to achieve the performance levels required for agency missions and world leadership in computational science, large numbers of smaller commercial systems must be combined and integrated to produce terascale computers. Unfortunately, the operating systems software and tools required for effective use of these large systems are significantly different from the technology offered for the individual smaller components. Therefore, new enabling software must be developed if scientists are to take advantage of these new computers in the next five years.

The following are specific examples of *computer science* research challenges:

- Efficient, high-performance operating systems, compilers, and communications libraries for high-end computers.
- Software to enable scientists to store, manage, analyze, visualize, and extract scientific understanding from the enormous (terabyte to petabyte) data archives that these computers will generate.

- Software frameworks that enable scientists to reuse most of their intellectual investment when moving from one computer to another and make use of lower-level components, such as runtime services and mathematical libraries, that have been optimized for the particular architecture.
- Scalable resource management and scheduling software for computers with thousands of processors.
- Performance monitoring tools to enable scientists to understand how to achieve high performance with their codes.

In addition to these computer science challenges, significant enhancements to the MICS applied mathematical research activity are required for the Department to satisfy its mission requirements for computational science. Over the history of computing, improvements in algorithms have yielded at least as much increase in performance as has hardware speedup. Large proportions of these advances are the products of the MICS applied mathematics research activity. In addition to improving the speed of the calculations, many of these advances have dramatically increased the amount of scientific understanding produced by each computer operation. For example, a class of mathematical algorithms called "fast multipole algorithms," was discovered for a number of important mathematical operations required to process 1,000 datapoints by a factor of 1,000; 10,000 datapoints by a factor of 10,000; and so on. Another example of how powerful these methods can be is that they enable a scientist to process 10,000 datapoints in the time that it would have taken to process 100 using earlier techniques, or 1,000,000 datapoints in the time older techniques would have needed to process 1,000. The requirements of scientific domains for new algorithms that can scale to work effectively across thousands of processors and produce the most science in the fewest number of computer operations drives the need for improved mathematical algorithms and the supporting software libraries that must be made available for ready use by domain scientists. In this area of research the MICS applied mathematics activity is the core of the nationwide effort.

The MICS subprogram will address these challenges by continuing the competitively selected partnerships (based on solicitation notices to DOE national laboratories and universities) focused on discovering, developing, and deploying to scientists key enabling technologies that were initiated in FY 2001. These partnerships, which are called Integrated Software Infrastructure Centers, must support the full range of activities from basic research through deployment and training because the commercial market for software to support terascale scientific computers is too small to be interesting to commercial software providers. These centers play a critical role in providing the software infrastructure that will be used by the SciDAC applications research teams. The management of these centers will build on the successful experience of the MICS subprogram in managing other community software research efforts as a part of its High Performance Computing and Communications program, as well as on the lessons learned in important programs supported by Defense Advanced Research Projects Agency (DARPA) such as Project Athena at MIT, the Berkeley UNIX Project, and the initial development of the Internet software and the Internet Activities Board (IAB). These Integrated Software Infrastructure Centers will have close ties to key scientific applications projects to ensure their success.

The efforts initiated in FY 2001 address the important issues of understanding and developing the tools that applications developers need to make effective use of machines that will be available in the next several years.

The MICS activities that respond to these challenges are described later in the Detailed Program Justification section of the MICS subprogram budget under the headings:

- Applied Mathematics,
- Computer Science, and
- Advanced Computing Software Tools.

High Performance Networking, Middleware and Collaboratory Research Investments

Advances in network capabilities and network-enabled technologies now make it possible for large geographically distributed teams to effectively collaborate on the solution of complex problems. It is now becoming possible to effectively harness and integrate the collective capabilities of large geographically distributed computational facilities, data archives, and research teams. This new capability is especially important for the teams using the major experimental facilities, computational resources, and data resources supported by DOE because all of the necessary resources are not available at one location.

- Significant research is needed to augment the capability and performance of today's networks, including the Internet, in order to develop high-performance network infrastructures that support distributed high-end data-intensive applications and secure large-scale scientific collaboration. The requirements of high-performance networks that support distributed data-intensive computing and scientific collaborations on a national and international scale are very different than the requirements of the current commercial networks where millions of users are moving small web pages. The MICS-supported research on high-performance networks includes research on high-performance protocols, network-aware operating system services, advanced network coprocessors, network measurement and analysis, and traffic models of large single flows.
- Research is also needed for the development and testing of high-performance middleware needed to seamlessly couple scientific applications to the underlying transport networks. These include high-performance middleware such as advanced security services for grid computing, ultra-high-speed data transfer services, services to guarantee Quality of Service (QoS) for delay sensitive applications, and grid resources discovery. These high-performance middleware provide the scalable software components needed to integrated distributed data archives, high performance disk caches, visualization and data analysis servers, authentication and security services, computational resources, and the underlying high-speed network networks into a scalable and secure scientific collaborative environment.

The MICS subprogram will address these challenges through an integrated program of fundamental research in networking and collaboratory tools, partnerships with key scientific disciplines, and advanced network testbeds.

Specific responses to these challenges are described in the Detailed Program Justification section of the MICS subprogram budget under the headings:

- Networking,
- Collaboratory Tools, and
- National Collaboratory Pilot Projects.

Enhancements to High Performance Computing and Networking Facilities

To realize the scientific opportunities offered by advanced computing, enhancements to the Office of Science's computing and networking facilities are also required. The MICS subprogram supports a suite of high-end computing resources and networking resources for the Office of Science:

- **Production High Performance Computing Facilities.** The National Energy Research Scientific Computing Center (NERSC) provides high performance computing for investigators supported by the Office of Science. NERSC provides a spectrum of supercomputers offering a range of high performance computing resources and associated software support.
- **Energy Sciences Network (ESnet).** ESnet provides worldwide access to Office of Science facilities, including light sources, neutron sources, particle accelerators, fusion reactors, spectrometers, high-end computing facilities and other leading-edge instruments and facilities.
- **Advanced Computing Research Testbeds.** These testbeds provide advanced computational hardware for testing and evaluating new computing hardware and software. These testbeds are providing specialized computational resources to support SciDAC applications teams in FY 2002. In FY 2003, this activity will be enhanced to provide specialized computing resources to SciDAC application teams.

Current production supercomputing resources provided less than half of the resources that were requested last year. The pressure on production facilities will only increase in future years as more applications become ready to move from testing the software to using the software to generate new science. In addition, as the speed of computers increases, the amount of data they produce also increases. Therefore, focused enhancements to the Office of Science's network infrastructure are required to enable scientists to access and understand the data generated by their software. These network enhancements are also required to allow researchers to have effective remote access to the experimental facilities that the Office of Science provides for the Nation.

The MICS subprogram activities that respond to these challenges are described later in the Detailed Program Justification section of the MICS subprogram budget under the headings:

- National Energy Research Scientific Computing Center (NERSC),
- Advanced Computing Research Testbeds, and
- Energy Sciences Network (ESnet).

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Mathematical, Computational, and Computer Sciences Research	57,434	70,315	78,620	+8,305	+11.8%
Advanced Computation, Communications Research and Associated Activities	94,213	80,139	83,782	+3,643	+4.5%
SBIR/STTR	0	3,946	4,223	+277	+7.0%
Total, Mathematical, Information, and Computational Sciences	151,647	154,400	166,625	+12,225	+7.9%

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
Mathematical, Computational, and Computer Sciences Research	**57,434**	**70,315**	**78,620**
■ **Applied Mathematics**	**27,110**	**32,000**	**24,634**

Research is conducted on the underlying mathematical understanding and numerical algorithms to enable effective description and prediction of physical systems. Research in applied mathematics is critical to the DOE's mission because improved mathematical techniques enable large computational simulations. As discussed earlier in the MICS subprogram overview, improvements in mathematical algorithms are responsible for greater improvement in scientific computing capabilities than the increases in hardware performance. This activity supports research at DOE laboratories, universities, and private companies at a level similar to previous years. Many of the projects supported by this activity are partnerships among researchers at universities and DOE laboratories. The program supports research in a number of areas including: ordinary and partial differential equations, including numerical linear algebra, iterative methods and preconditioners, sparse solvers, and dense solvers; fluid dynamics, including compressible, incompressible and reacting flows, turbulence modeling, and multiphase flows; optimization, including linear and nonlinear programming, interior-point methods, and discrete and integer programming; mathematical physics; control theory, including differential-algebraic systems, order reduction, queuing theory; shock wave theory systems, multipole expansions, mixed elliptic-hyperbolic problems, including hyperbolic and wavelet transforms; dynamical systems, including chaos-theory and control, and bifurcation theory; programming; and geometric and symbolic computing, including minimal surfaces and automated reasoning systems.

The FY 2003 budget continues the FY 2001 increased level of funding for the Computational Sciences Graduate Fellowship program. In addition, the FY 2003 budget includes a $2,000,000 increase to support basic research in applied mathematics focused on developing the mathematical understanding and techniques needed for our partnership with the Biological and Environmental

	(dollars in thousands)	
FY 2001	FY 2002	FY 2003

Research program. This partnership focuses on understanding microbes that address DOE energy and environmental needs through a research program on the leading edge of biology. The research will offer new ways to solve environmental challenges related to DOE's missions, including toxic waste cleanup, new clean energy sources and global climate stabilization through carbon sequestration. New research in applied mathematics is needed to support this partnership because the needs of biologists include areas of mathematical research such as graph theory, combinatorics, control theory, and advanced statistics research that are not supported by the existing program.

FY 2003 funding for the competitively selected Integrated Software Infrastructure Centers (ISICs) partnerships focused on algorithms and mathematical libraries for critical DOE applications on terascale computers, which had previously been under this activity, has been transferred to the Advanced Computing Software Tools activity, along with the FY 2003 funding for the ISICs that had previously been under the Computer Science activity. This transfer enables a clearer discussion of these activities and a clearer relationship to the ASCR Program Strategic Performance Goals.

Performance will be measured in a number of ways. Efforts in applied mathematics will be evaluated on an ongoing basis for their leadership and significant contributions to the worldwide applied mathematics effort using measures including a number of awards, significant advances, and invited participation and membership on organizing and program committees of major national and international conferences (SC5-1; SC5-2). The Computational Science Graduate Fellowship Program will appoint 20 new students to develop the next generation of leaders in computational science for DOE and the Nation (SC5-1).

	FY 2001	FY 2002	FY 2003
■ **Computer Science**..	**20,941**	**21,051**	**19,000**

Research in computer science to enable large scientific applications is critical to DOE because its unique requirements for high performance computing significantly exceed the capabilities of computer vendors' standard products. Therefore, much of the computer science to support this scale of computation must be developed by DOE. This activity supports research in two general areas: the underlying software to enable applications to make effective use of computers with hundreds or thousands of processors as well as computers that are located at different sites; and large scale data management and visualization under circumstances where the underlying resources and users are geographically distributed. The first area includes research in protocols and tools for interprocessor communication and parallel input/output (I/O) as well as tools to monitor the performance of scientific applications and advanced techniques for visualizing very large-scale scientific data. Researchers at DOE laboratories and universities, often working together in partnerships, carry out this research.

FY 2003 funding for the competitively selected Integrated Software Infrastructure Centers (ISICs) partnerships focused on computer science research for critical DOE applications on terascale computers, which had previously been under this activity, has been transferred to the Advanced Computing Software Tools activity, along with the FY 2003 funding for the ISICs that had previously been under the Applied Mathematics activity. This transfer enables a clearer discussion

(dollars in thousands)		
FY 2001	FY 2002	FY 2003

of these activities and a clearer relationship to the ASCR Program Strategic Performance Goals.

Performance in computer science will be measured through peer review and regularly scheduled external expert reviews of ongoing projects, production of significant research results, and the adaptation of results and knowledge by other researchers supported by the Office of Science (SC5-1; SC5-2).

	FY 2001	FY 2002	FY 2003
■ **Advanced Computing Software Tools**	**4,421**	**8,473**	**20,256**

This research uses the results of fundamental research in applied mathematics and computer science to develop an integrated set of software tools that scientists in various disciplines can use to develop high performance applications (such as simulating the behavior of materials). These tools, that provide improved performance on high-end systems, are critical to the ability of scientists to attack the complex scientific and engineering problems that can only be solved with high-end computing systems.

In FY 2003, support for all the competitively selected Integrated Software Infrastructure Centers, competitively selected in FY 2001 under SciDAC, to address critical computer science and systems software issues for terascale computers is described in this activity for clarity. FY 2003 funding for basic research in computer science focused on problem solving environments for scientific computing, portable runtime systems, and other basic research in software components, which was previously included in this activity has been transferred to the computer science activity in order to more clearly characterize the research.

The ISICs funded under this activity focus on: structured and unstructured mesh generation for large simulations and high performance tools for solving partial differential equations on parallel computers; tools for analyzing the performance of scientific simulation software that uses thousands of processors; the development of data management and visualization software capable of handling terabyte scale data sets extracted from petabyte scale data archives, and software for managing computers with thousands of processors; and software component technology to enable rapid development of efficient, portable, high performance parallel simulation software.

These Integrated Software Infrastructure Centers are a critical component in DOE's strategy for SciDAC. The ISICs differ from the other activities in this program element because they are responsible for the entire lifecycle of the software that they develop. From the experience gained with end user application scientists applying previous software tools, it has become clear that to promote wide usage across the scientific community, the tools must also be reliable, documented, and easy to use. In addition, users of the tools need the tools to be maintained so that the tools continue to be available, have bugs fixed, etc. Since many of the tools needed in the high performance arena have no commercial market, the Integrated Software Infrastructure Centers initiated in FY 2001 will provide a means for focused investment to deploy these tools to the scientific community.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

Performance will be measured through peer review and regularly scheduled external expert reviews of ongoing projects, production of significant research results, and the adaptation of results and knowledge by other researchers in the Office of Science (SC5-1; SC5-2). In addition, these ISICs will undergo a progress review to ensure effective coupling between the ISICs and between the ISICs and application teams in the MICS Scientific Applications Pilot Projects efforts and in the SciDAC teams funded by the other programs in the Office of Science (SC5-2).

	FY 2001	FY 2002	FY 2003
■ **Scientific Applications Pilot Projects**..................................	**4,962**	**8,791**	**14,730**

This research is a collaborative effort with disciplinary computational scientists to apply the computational techniques and tools developed by MICS supported research to basic research problems relevant to the mission of SC. This effort tests the usefulness of current advanced computing research, transfers the results of this research to the scientific disciplines, and helps define promising areas for future research. The FY 2003 funding for this activity will allow the continuation of the pilot projects that were competitively selected in FY 2001. These pilot projects are tightly coupled to the Integrated Software Infrastructure Centers (described above in advanced computing software tools) to ensure that these activities are an integrated approach to the challenges of terascale simulation and modeling that DOE faces to accomplish its missions. These partnerships include areas such as design of particle accelerators with the High Energy and Nuclear Physics (HENP) program; plasma turbulence in tokamaks with the Fusion Energy Sciences (FES) program; global climate change with the Biological and Environmental Research (BER) program; and combustion chemistry with the Basic Energy Sciences (BES) program. The increase in funding in this program activity will focus on expanding our partnership with BER and establishing a new partnership with BES. This expansion of the partnership with BER includes an increase of approximately $3,000,000 in FY 2003, which further develops the computational research infrastructure needed to study microbial communities that may have applications to clean energy, environmental cleanup, and carbon sequestration and especially underlying mathematical understanding and computational tools that are needed for the analysis and simulation of these biological processes. The new partnership with the BES program includes approximately $3,000,000 for computational nanoscale science engineering and technology. This partnership is an integral part of the Nanoscale Science, Engineering and Technology initiative in the Office of Science, that is led by the BES program. These new research teams will focus on using high performance computers to answer fundamental questions such as the emergence of collective phenomena -- phenomena that emerge from the interactions of the components of the material and whose behavior thus differs significantly from the behavior of those individual components. In some cases, collective phenomena can bring about a large response to a small stimulus -- as seen with colossal magnetoresistance, the basis of a new generation of recording memory material. Collective phenomena are also at the core of the mysteries of such materials as the high-temperature superconductors, one of the great outstanding problems in condensed matter physics. All of these new projects will be selected through open, peer reviewed competitive processes.

	FY 2001	FY 2002	FY 2003
	(dollars in thousands)		

Performance will be measured through peer review, external expert reviews of ongoing projects, production of significant research results, and the adaptation of results and knowledge by other researchers supported by the Office of Science (SC5-2).

	FY 2001	FY 2002	FY 2003
Advanced Computation, Communications Research, and Associated Activities	**94,213**	**80,139**	**83,782**

	FY 2001	FY 2002	FY 2003
■ **Networking**	**7,507**	**7,066**	**7,066**

Research is needed to develop high-performance networks that are capable of supporting distributed high-end computing and secure large-scale scientific collaboration. High performance networks enable scientists to collaborate effectively and to have efficient access to distributed computing resources such as tera-scale computers, experimental scientific instruments, and large scientific data archives. This research is carried out at national laboratories and universities. It focuses in areas such as high-performance transport protocols for high-speed networks; scalable techniques for measuring, analyzing, and controlling traffic in high performance networks; network security research to support large-scale scientific collaboration; advanced network components to enable high-speed connections between terascale computers, large scientific data archives, and high-speed networks; and research on high-performance "middleware." Middleware is a collection of network-aware software components that scientific applications need in order to couple efficiently to advanced network services and make effective use of experimental devices, data archives, and terascale computers at different locations. In all of these cases, the network and middleware requirements of DOE significantly exceed those of the commercial market.

Performance will be measured through peer review, external expert reviews of ongoing projects, production of significant research results, and the adaptation of results and knowledge by other researchers supported by the Office of Science and other Federal Agencies (SC5-1; SC5-2).

	FY 2001	FY 2002	FY 2003
■ **Collaboratory Tools**	**5,915**	**5,527**	**5,527**

This research uses the results of fundamental research in computer science and networking to develop an integrated set of software tools to support scientific collaborations. This includes enabling scientists to remotely access and control facilities and share data in real time, and to effectively share data with colleagues throughout the life of a project. These tools provide a new way of organizing and performing scientific work that offers the potential for increased productivity and efficiency and will also enable broader access to important DOE facilities and data resources by scientists and educators across the country. It is particularly important to provide for efficient, high-performance, reliable, secure, and policy-aware management of large-scale data movement. This research includes an effort to develop a set of essential middleware services required to support large-scale data-intensive collaboratory applications. This research also includes an effort to research, develop, and integrate the tools required to support a flexible, secure, seamless collaboration environment that supports the entire continuum of interactions between collaborators. The goal is to seamlessly allow collaborators to locate each other, use asynchronous and synchronous messaging, share documents, progress, results, applications and

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

hold videoconferences. There is also research for developing and demonstrating an open, scalable approach to application-level security in widely distributed, open network environments that can be used by all the collaboratory tools as well as by the advanced computing software tools whenever access control and authentication are issues. Finally, another example of research in collaboratory tools is the development of a scientific annotation middleware system that will provide significant advances in research documentation and data pedigree tracking. Researchers access the system through a notebook interface as well as through components embedded in other software systems. It will provide more complete, effective and efficient ways to document scientific work.

Performance will be measured through peer review, and regularly scheduled external expert reviews of ongoing projects, production of significant research results, and the adaptation of results by other researchers supported by the Office of Science and other Federal Agencies (SC5-2).

	FY 2001	FY 2002	FY 2003
■ **National Collaboratory Pilot Projects**	**8,245**	**10,857**	**10,857**

This program is intended to test, validate, and apply collaboratory tools in real-world situations in partnership with other DOE programs. The competitively selected partnerships involve national laboratories, universities, and U.S. industry. It is important to continue to demonstrate and test the benefits of collaboratory tools technology in order to promote its widespread use and enable more effective access to the wide range of resources within the Department, from light sources to terascale computers to petabyte data storage systems. The partnerships that were initiated in FY 2001 focus on developing user environments where collaboration is ubiquitous and distributed computing is seamless and transparent for DOE mission applications. The Particle Physics Data Grid is developing middleware infrastructure to support High Energy Physics and Nuclear Physics (HENP) communities, and to enable grid-enabled data-management ("manipulation") and analysis capabilities "at the desk of every physicist." It is building one unified system that will be capable of handling the capture, storage, retrieval and analysis of particle physics experiments at the five most critical research facilities, a key collaboratory issue being the highly distributed access to, and processing of, the resulting data by a worldwide research community. In another community, the Earth System Grid II developing a virtual collaborative environment linking distributed centers, models, data, and users that will facilitate exchange among climatologists all over the world and provide a badly needed platform for the management of the massive amounts of data that are being generated. Development of this and similar concepts is essential for rapid, precise, and convincing analysis of short- and long-term weather patterns, particularly in the period when increasing pollution introduces changes that may affect us for generations to come. The National Fusion Collaboratory is centered on the integration of collaborative technologies appropriate for widely dispersed experimental environments and includes elements of security, distributed systems, and visualization. All three of these pilot collaboratories will rely on the DOE Science Grid to provide the underpinnings for the software environment, the persistent grid services, that make it possible to pursue innovative approaches to scientific computing through secure remote access to online facilities, distance collaboration, shared petabyte datasets and large-scale

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

distributed computation. This level of funding will permit the continuation of the efforts funded in FY 2001.

Performance will be measured through peer review, and regularly scheduled external expert reviews of ongoing projects, production of significant research results, and the adaptation of results by other researchers supported by the Office of Science (SC5-2).

	FY 2001	FY 2002	FY 2003
■ **National Energy Research Scientific Computing Center (NERSC)**	**34,361**	**28,244**	**28,244**

NERSC, located at LBNL, provides high performance computing for investigators supported by the Office of Science. The Center serves 2,400 users working on about 700 projects; 36 percent of users are university based, 59 percent are in National Laboratories, 4 percent are in industry, and 1 percent in other government laboratories. NERSC provides a spectrum of supercomputers offering a range of high performance computing resources and associated software support. The two major computational resources at NERSC are a 512 processor Cray T3E computer and a 2,944 processor IBM SP computer whose installation was completed in late FY 2001 following a fully competitive procurement process. The FY 2003 funding will support the operation of the IBM-SP computer at about 5.0 teraflops "peak" performance. These computational resources will be integrated by a common high performance file storage system that facilitates interdisciplinary collaborations. Related requirements for capital equipment, such as high-speed disk storage systems, archival data storage systems, and high performance visualization hardware, and general plant projects (GPP) funding are also supported. FY 2003 capital equipment requirements continue at the same level as in FY 2002. The competitive process for upgrading hardware (NERSC-4) is underway. The target date for the installation of NERSC-4 Phase I hardware is mid FY 2003. Expected performance will be greater than 10 teraflops.

Performance will be measured in a number of ways. Hardware performance is determined by computing the percentage of time the machine is actually available to users, which excludes scheduled downtime for maintenance, etc. This will be 90 percent or more of the total scheduled operating time. In FY 2001, the measured operating time lost to unscheduled downtime on systems at NERSC ranged from 0 percent to 1.34 percent. Overall performance of the center is measured by user surveys that will continue to show a high degree of satisfaction with the services at NERSC and annual reports that will continue to demonstrate production of world-class science being done at the facility. NERSC will be operated within budget while meeting user needs and satisfying overall SC program requirements (SC5-2; SC7-5)

	FY 2001	FY 2002	FY 2003
■ **Advanced Computing Research Testbeds (ACRTs)**	**20,057**	**11,657**	**15,300**

This activity supports the advanced computational hardware testbeds that play a critical role in testing and evaluating new computing hardware and software, especially with regard to their applicability to scientific problems. Current testbeds are located at Argonne National Laboratory (IBM/ Intel Cluster); and ORNL (Compaq-Alpha technology and IBM Power –4 technology). These testbeds represent the evolution of Advanced Computing Research Facilities that supported the computational requirements of the scientific application partnerships that were completed in

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

FY 2000. Support for the Nirvana Blue Computer Testbed at LANL was phased out in FY 2001. This activity also supports the distributed high performance storage system (HPSS) testbed collaboration between ORNL and LBNL. Because many of the issues to be investigated only appear in the computer systems at significantly larger scale than the computer manufacturers' commercial design point, these testbeds must procure the largest scale systems that can be afforded and develop software to manage and make them useful. In addition, the ACRTs, taken together, must have a full range of computer architectures to enable comparison and reduce overall program risk. These all involve significant research efforts, often in partnership with the vendors to resolve issues including operating system stability and performance, system manageability and scheduling, fault tolerance and recovery, and details of the interprocessor communications network. Therefore, these systems are managed as research programs and not as information technology investments. The additional funding in this program element will enhance the ability of these testbeds to provide specialized computational resources to support SciDAC applications teams in FY 2003.

Performance will be measured by the importance of the research that results from these testbeds as viewed by publications in the scientific literature, the ASCR Advisory Committee and external reviews and the demand for access to these facilities by the nationwide computer and computational science communities (SC5-2; SC7-5)

	FY 2001	FY 2002	FY 2003
■ **Energy Sciences Network (ESnet)**	**18,128**	**16,788**	**16,788**

ESnet is a high-performance network infrastructure that supplies the DOE science community with capabilities not available on current commercial networks or the commercial Internet. It provides national and international high-speed access to the DOE and to the Office of Science research facilities, including: advanced light sources; neutron sources; particle accelerators; fusion reactors; spectrometers; supercomputers; Advanced Computing Research Testbeds (ACRTs); and other leading-edge science instruments and facilities. ESnet provides the communications fabric that interconnects geographically distributed research facilities and large-scale scientific collaboration. It supplies the critical infrastructure that links DOE researchers worldwide and forms the basis for advanced experimental research in networking, collaboratory tools, and distributed data-intensive scientific applications testbeds such as the national collaboratory pilot projects. For day-to-day operation, DOE employs ESnet management at LBNL, who contracts with commercial vendors for advanced communications services including Asynchronous Transfer Mode (ATM), Synchronous Optical Networks (SONET) and Dense Wave Division Multiplexing (DWDM). In addition, LBNL ESnet management is responsible for the interfaces between the network fabric it provides and peering arrangements with other Federal, education and commercial networks, international research network connections, and the University Corporation for Advanced Internet Development (UCAID) Abilene network that provides high performance connections to many research universities. The FY 2003 funding will support the continued operation of ESnet and will meet capital equipment needs to upgrade high-speed network routers, ATM switches, and network testing equipment.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

Performance will be measured in several ways. The operating time lost due to unscheduled ESnet downtime in FY 2003 will be less than 10 percent of the total scheduled possible operating time. In FY 2001, the measured operating time lost to unscheduled downtime on ESnet was 3 percent of total scheduled operating time. In FY 2003, ESnet will operate within budget while meeting user needs and satisfying overall SC program requirements. Network enhancements will improve researchers access to high performance computing and software support, and enhance scientific opportunities by enabling scientists to access and understand greater amounts of scientific data and benefit DOE and scientific research (SC5-2; SC7-5).

	FY 2001	FY 2002	FY 2003
SBIR/STTR	**0**	**3,946**	**4,223**

In FY 2001, $3,748,000 and $225,000 were transferred to the SBIR and STTR programs, respectively. The FY 2002 and FY 2003 amounts are the estimated requirement for the continuation of the SBIR and STTR programs.

	FY 2001	FY 2002	FY 2003
Total, Mathematical, Information, and Computational Sciences	**151,647**	**154,400**	**166,625**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Mathematical, Computational, and Computer Sciences Research	
■ **Applied Mathematics.** Provides an increase to the Applied Mathematics program element to support research in applied mathematics for biological problems plus a small enhancement to the Computational Science Graduate Fellowship program ($2,366,000). The new research in applied mathematics will focus on the mathematics needed by biologists to understand microbes and include areas of mathematical research such as graph theory, combinatorics, control theory, and advanced statistics research. Funding for the ISICs previously included in the Applied Mathematics program element is transferred to the Advanced Computing Software Tools program element (-$9,732,000). This transfer more clearly identifies the special role of the ISICs and clarifies the budget description.	-7,366

	FY 2003 vs. FY 2002 ($000)
■ **Computer Science.** Transfers funding for the ISICs previously included in the Computer Science program element to the Advanced Computing Software Tools program element (-$7,051,000). Transfers funding for basic research in computer science focused on problem solving environments for scientific computing, portable runtime systems, and other basic research in software components, which was previously included in the Advanced Computing Software Tools program element to the Computer Science program element ($5,000,000). These transfers more clearly identify the special role of the ISICs and clarify the budget description..	-2,051
■ **Advanced Computing Software Tools.** Transfers funding for the ISICs previously included in the Applied Mathematics ($9,732,000) and Computer Science ($7,051,000) program elements to the Advanced Computing Software Tools program element. Transfers funding for basic research in computer science focused on problem solving environments for scientific computing, portable runtime systems, and other basic research in software components, which was previously included the Advanced Computing Software Tools program element (-$5,000,000) to the Computer Science program element. These transfers more clearly identify the special role of the ISICs and clarifies the budget description….	+11,783
■ **Scientific Application Pilot Projects.** Provides additional funding to double the number of pilot projects in the partnership with BER on computational biology, and to enable a number of new partnerships with BES focused on computational nanoscience. The new, competitively selected research teams in the partnership with BER will focus on the computational tools that are needed for the analysis and simulation of biological processes such as protein folding and gene regulation. The new, competitively selected research teams in the partnership with BES will focus on using high performance computers to answer fundamental questions in nanoscale science such as the emergence of collective phenomena............................	+5,939
Advanced Computation, Communications Research, and Associated Activities	
■ **Advanced Computing Research Testbed.** Provides an increase in this program element to establish a minimal high-performance computing capability for Topical Applications, providing an architecture tailored to a class of applications within the SciDAC research portfolio to produce new science, including required upgrades to ESnet infrastructure...	+3,643
SBIR/STTR	
■ Increase in SBIR/STTR due to increase in operating expenses.	+277
Total Funding Change, Mathematical, Information, and Computational Sciences	+12,225

Laboratory Technology Research

Mission Supporting Goals and Objectives

The mission of the Laboratory Technology Research (LTR) subprogram is to support high-risk research that advances science and technology to enable applications that could significantly impact the Nation's energy economy. LTR fosters the production of research results motivated by a practical energy payoff through cost-shared collaborations between the Office of Science (SC) laboratories and industry. Therefore, the LTR subprogram is responsible for one of the ASCR Program Strategic Performance Goals:

An important component of the Department's strategic goals are to ensure that the United States maintains its leadership in science and technology. LTR is the lead program in the Office of Science for leveraging science and technology to advance understanding and to promote our country's economic competitiveness through cost-shared partnerships with the private sector.

The National Laboratories under the stewardship of the Office of Science conduct research in a variety of scientific and technical fields and operate unique scientific facilities. Viewed as a system, these ten laboratories — Ames Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Fermi National Accelerator Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Princeton Plasma Physics Laboratory, Stanford Linear Accelerator Center, and Thomas Jefferson National Accelerator Facility — offer a comprehensive resource for research collaborations. The major component of the LTR research portfolio consists of investments at these laboratories to conduct research that benefits all major stakeholders — the DOE, the industrial collaborators, and the Nation. These investments are further leveraged by the participation of an industry partner, using Cooperative Research and Development Agreements (CRADAs). Another LTR subprogram component provides funding to the Office of Science national laboratories to facilitate rapid access to the research capabilities at the SC laboratories through agile partnership mechanisms including personnel exchanges and technical consultations with small business. The LTR subprogram currently emphasizes four critical areas of DOE mission-related research: advanced materials processing and utilization, nanotechnology, intelligent processes and controls, and energy-related applications of biotechnology.

Funding Schedule

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Laboratory Technology Research	9,649	2,921	2,921	0	--
SBIR/STTR	0	79	79	0	--
Total, Laboratory Technology Research..	9,649	3,000	3,000	0	--

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Laboratory Technology Research	**9,649**	**2,921**	**2,921**

This activity supports research to advance the fundamental science at the Office of Science (SC) laboratories toward innovative energy applications. Through CRADAs, the SC laboratories enter into cost-shared research partnerships with industry, typically for a period of three years, to explore energy applications of research advances in areas of mission relevance to both parties. The research portfolio consists of 12 projects and emphasizes the following topics: advanced materials processing and utilization, nanotechnology, intelligent processes and controls, and energy-related applications of biotechnology. Efforts underway include the exploration of (1) new cast steels with microstructures and mechanical properties better than comparable cast alloys, to provide an improved critical component material for higher efficiency steam and gas turbine technology for electric power generation; (2) radiative carrier recombination in group-III nitride thin films, to optimize the performance of GaN-based high-brightness Light Emitting Diodes for applications in energy-efficient lighting; and (3) molecular structures of new classes of hydroporphyrin photosensitizers for use with light and oxygen to destroy cancerous cells and tissues. A small but important component of this activity provides industry, particularly small businesses, with rapid access to the unique research capabilities and resources at the SC laboratories. These research efforts are usually supported for a few months to quantify the energy benefit of a specific problem posed by industry. Recent projects supported the development of: (1) an economically-viable duplex chromium nitride near-frictionless carbon film capable of providing extreme wear resistance and reduced friction to sliding engine and drive train components in advanced diesel engines; (2) a detailed understanding of the interplay between platinum/cadmium zinc telluride interfacial chemistry and radiation detector performance for applications such as finding new cancer locations; and (3) an ion source for producing negative heavy ions for ion implantation in the semiconductor industry, which will eliminate toxic gas.

Performance in this activity will be measured through merit-based peer and on-site reviews.

	FY 2001	FY 2002	FY 2003
SBIR/STTR	**0**	**79**	**79**

In FY 2001, $242,000 and $14,000 were transferred to the SBIR and STTR programs, respectively. The FY 2002 and FY 2003 amounts are the estimated requirement for the continuation of the SBIR and STTR program.

	FY 2001	FY 2002	FY 2003
Total, Laboratory Technology Research	**9,649**	**3,000**	**3,000**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
There are no significant funding changes.	

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	0	1,000	1,000	0	--
Capital Equipment (total)	5,213	5,130	6,250	+1,120	+21.8%
Total, Capital Operating Expenses	5,213	6,130	7,250	+1,120	+18.3%

Major Items of Equipment (TEC $2 million or greater)

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp- riations	FY 2001	FY 2002	FY 2003	Accept- ance Date
Distributed Visualization Server – LBNL	2,500	0	2,500	0	0	FY 2001
Total, Major Items of Equipment		0	2,500	0	0	

Energy Research Analyses

Program Mission

The mission of the Energy Research Analyses (ERA) program is to provide the capabilities needed to evaluate the scientific excellence, relevance, and international leadership of the Office of Science basic science research programs; to advance the understanding of how the Office of Science contributes to DOE and national mission goals; and to contribute to the effective management of the department's science enterprise.

Strategic Objective

SC-8: Ensure efficient SC program management of research and construction projects through a re-engineering effort by FY 2003 that will support world class science through systematic improvements in SC's laboratory physical infrastructure, security, and ES&H.

Progress toward accomplishing this Strategic Objectives will be measured by a Program Strategic Performance Goal, Indicators and Annual Targets, as follows:

Program Strategic Performance Goals

SC8-1: By FY 2007, develop best in class evaluation tools and methods, science management practices, and communication capabilities that enable Office of Science basic research programs to meet critical DOE and national mission requirements.

Performance Indicators

Number and quality of evaluation techniques adopted by SC.

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Launched several research management studies to identify: 1) best practices in benchmarking, 2) best practices to administer public science communication, 3) effective use of quantitative performance measures to evaluate the societal impact of basic research, and 4) a case study methodology to ensure the success of future case studies of societal impact of SC science. (Met goal)	Improve and integrate performance planning and measures between budget documents and DOE performance plans; conduct six pilot retrospective and/or prospective studies to examine the societal impact of SC research. (SC8-1)	Publish results of quantitative performance measures study in open literature; fully incorporate results into SC evaluation regime. Conduct at least six studies/year to demonstrate the societal impact of SC science programs. (SC8-1)

Significant Accomplishments and Program Shifts

- The Office of Science (SC) responsiveness to Government Performance and Results Act (GPRA) requirements was improved in FY 2001 through an evaluation of performance measures, tools and mechanisms and the launching of a research management best practices benchmarking study.

- The Department of Energy Science Portfolio was updated in FY 2001 to better characterize the R&D efforts within the Department with regard to basic research. This portfolio will be maintained to assist the Director of the Office of Science in managing the Department's Science investments.

- Science policy studies and scientific research trend analyses were provided to Office of Science program managers and to other public science organizations in FY 2001, including the first results of a three-year study of international science trends that will inform SC's future strategic planning efforts.

- The FY 2003 program is continuing at the same level as FY 2002, but shifting its emphasis to new methods of evaluation of the science managed by the Office of Science. This shift in emphasis results from research conducted in FY 2001 and continuing in FY 2002 that was designed to create new evaluation tools (e.g., case studies, quantitative measures, and data mining) that will help to validate the excellence, relevance and leadership of the Office of Science programs. In addition, research projects will be sponsored in FY 2003 to demonstrate the societal impact of SC science programs and to create sophisticated data models and analysis techniques to better illustrate scientific trends and achievements.

Funding Profile

(dollars in thousands)

	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Current Appropriation	FY 2003 Request
Energy Research Analyses					
Energy Research Analyses	950	1,000	-5	995	1,020
Subtotal, Energy Research Analyses	950	1,000	-5	995	1,020
General Reduction	0	-5	5	0	0
Total Energy Research Analyses	950[a]	995	0	995	1,020

Public Law Authorization:
Public Law 95-91, "Department of Energy Organization Act"
Public Law 103-62, "Government Performance and Results Act of 1993"

[a] Excludes $25,000 which was transferred to the SBIR and $1,000 which was transferred to the STTR program.

Funding by Site

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Albuquerque Operations Office					
Sandia National Lab/Albuquerque	200	5	100	+95	+1,900.0%
Chicago Operations Office					
Fermi National Accelerator Laboratory	22	0	0	0	--
Chicago Operations Office	200	357	310	-47	-13.2%
Total, Chicago Operations Office	222	357	310	-47	-13.2%
Oak Ridge Operations Office					
Oak Ridge Institute for Science and Education	77	0	55	+55	--
Oakland Operations Office					
Lawrence Berkeley National Laboratory	50	0	50	+50	--
Richland Operations Office					
Pacific Northwest National Laboratory	401	254	465	+211	+83.1%
Washington Headquarters	0	379	40	-339	-89.4%
Total, Energy Research Analyses	950 [a]	995	1,020	+25	+2.5%

[a] Excludes $25,000 which was transferred to the SBIR and $1,000 which was transferred to the STTR program.

Site Description

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory (LBNL) is a Multiprogram Laboratory located in Berkeley, California. The Laboratory is on a 200-acre site adjacent to the Berkeley campus of the University of California. This activity contributes to the Energy Research Analyses program's formulation of long-term and strategic plans.

Oak Ridge Institute for Science and Education

Oak Ridge Institute for Science and Education (ORISE) is located on 150 acres in Oak Ridge, Tennessee. ORISE facilitates and coordinates communication and outreach activities, and conducts studies on workforce trends in the sciences.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) is a Multiprogram Laboratory located on a 640 acre site at the Department's Hanford site in Richland, Washington. PNNL carries out research in the areas of portfolio and economic analysis to contribute to the Energy Research Analyses program's formulation of long-term plans and science policy. This activity includes assessments of international basic energy science programs, trends in Federal and private sector investments in energy R&D, and science management trends and benchmarking.

Sandia National Laboratories

Sandia National Laboratories (SNL) is a Multiprogram Laboratory, with a total of 3,700 acres, located in Albuquerque, New Mexico, with sites in Livermore, California, and Tonopah, Nevada. SNL carries out research in the areas of technical program planning and merit review practices to contribute to the Energy Research Analyses program's formulation of best practices for long term plans, science policy and peer reviews. This activity includes assessments of best practices in research and development organizations.

All Other Sites

Includes funds for research awaiting distribution pending finalization of program office detailed planning.

Energy Research Analyses

Mission Supporting Goals and Objectives

The ERA program supports Office of Science programs through the development of management tools and support, analysis of policy direction set by the Administration and the Congress, development and integration of Office of Science strategic plans and research portfolios, evaluation of programs and performance, and facilitation of SC collaborations with other Federal agencies and major stakeholders.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Energy Research Analyses.................	950	969	993	+24	+2.5%
SBIR/STTR	0	26	27	+1	+3.8%
Total, Energy Research Analyses	950	995	1,020	+25	+2.5%

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Energy Research Analyses	**950**	**969**	**993**

In FY 2003, ERA will focus on four major areas:

- *Evaluation studies* will be conducted by independent researchers to identify trends in the DOE research portfolio and potential societal impacts of research, as well as areas of portfolio performance that could be optimized.
- *Research projects* will inform policy direction, characterize key issues in the research environment and their affect on SC programs, and identify potential duplications, gaps and opportunities within the Department's basic research portfolio by collaborating with SC or DOE programs, other agencies, the national laboratories or universities. Research projects are envisioned with universities, laboratories and private sector research performers, and with DOE or SC partners, and entail the conduct of original broad-based research efforts**.**
- *Performance measurement* efforts will develop indicators of SC's international leadership, excellence, and relevance; develop data for a broad suite of quantitative measures used for the Annual Performance Plan and other reports; as well as provide a broad based effort to develop computational tools and visualization techniques designed to manage vast amounts of data to assist in policy and planning forecasting of SC science programs.
- *Stakeholder Collaboration & Communication* will ensure that Office of Science programs are well integrated into the Federal research portfolio and that the societal impact of SC programs is understood.

SBIR/STTR	**0**	**26**	**27**

In FY 2001, $25,000 and $1,000 were transferred to the SBIR and STTR programs, respectively. The FY 2002 and FY 2003 amounts are the estimated requirement for the continuation of the SBIR and STTR program.

Total, Energy Research Analyses	**950**	**995**	**1,020**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Energy Research Analyses	
■ The FY 2003 program is continuing at the same level, but is shifting emphasis to communications and research activities to support science managed and funded by the Office of Science programs.	+24
SBIR/STTR	
■ Increase in SBIR/STTR due to increase in operating expenses.	+1
Total Funding Change, Energy Research Analyses	+25

Science Laboratories Infrastructure

Program Mission

The mission of the Science Laboratories Infrastructure (SLI) program (formerly the Multiprogram Energy Laboratories – Facilities Support program) is to conduct Departmental research missions at the Office of Science (SC) multiprogram and program dedicated laboratories by funding: line item construction to maintain the general purpose infrastructure (GPI); and the clean-up and removal of excess facilities. The program also supports SC landlord responsibilities for the 36,000 acre Oak Ridge Reservation and provides Payments in Lieu of Taxes (PILT) to local communities around ANL-E, BNL, and ORNL.

Strategic Objective

SC8-2: Ensure efficient SC program management of research and construction projects through a re-engineering effort of SC processes by FY 2003 that will support world-class science through systematic improvements in SC's laboratory physical infrastructure, security, and ES&H.

Progress toward accomplishing this Strategic Objective will be measured by Program Strategic Performance Goals, Indicators and Annual Targets, as follows:

Program Strategic Performance Goals

SC8-2A: Reduce the Recapitalization Period (RP) from 170 years in FY 2002 to 80 in FY 2005. The RP is defined as the number of years it takes to replace/rehabilitate the existing general purpose infrastructure (GPI) at a given capital investment level. This period is computed by dividing the replacement plant value of the GPI by the annual capital investment funding level (composed of general plant projects (GPP) funding, general purpose equipment (GPE) funding and general purpose line item (LI) funding. (Laboratories Facilities Support subprogram)

Performance Indicator

The reduction in the RP from year to year

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Based on capital investment funding level of $73,000,000 in FY 2001, the RP is 163 years. (Met goal.)	Based on capital investment funding level of $70,000,000 for FY 2002, the RP will be 170 years. (SC8-2A)	Based on proposed capital investment funding level of $83,000,000 for FY 2003, the RP will decline to 143 years. (SC8-2A)

SC8-2B: Eliminate all excess SC facilities by the end of FY 2008. The backlog of excess facilities projects that can be eliminated in the next few years is currently estimated at 29. This figure does not include 29 "contaminated" excess facilities identified as candidates for transfer to the Office of Environmental Management in FY 2003 and FY 2004. (Excess Facilities Disposition subprogram)

Performance Indicator
Reductions as measured by the number (and percentage) of excess facilities and square footage (and percent of total excess space) removed (or made usable).

Performance Standards
As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
N/A – no program	A Congressionally added FY 2002 Facilities and Infrastructure (F&I) Program of $10,000,000 will allow the clean-up/removal of approximately 30 excess facilities with a reduction of approximately 400,000 square feet in FY 2002. (SC8-2B)	Estimated disposal (or cleanout) of 10 (34% of 29 total) facilities with a reduction of approximately 176,000 square feet (35% of total). (SC8-2B)

Significant Accomplishments and Program Shifts

- Broaden program to include all SC program dedicated laboratories along with the multiprogram laboratories. These program dedicated laboratories include Ames Laboratory, Fermi National Accelerator Laboratory, Oak Ridge Institute for Science and Education, Princeton Plasma Physics Laboratory, Thomas Jefferson National Accelerator Facility, and Stanford Linear Accelerator Center.
- Include in the Science Laboratories Infrastructure program an Excess Facilities Disposition subprogram to address the disposition of excess facilities resulting in economies and efficiencies in laboratory operations.
- Progress in Line Item Projects – Three projects were completed in FY 2001: the ANL-E Central Supply Facility; the BNL Electrical Systems Modifications, Phase I; and the ANL-E Electrical Systems Upgrade, Phase III. Two projects are scheduled for completion in FY 2002: LBNL Building 77 - Rehabilitation of Building Structure and Systems, Phase I and the BNL Sanitary Systems Modifications, Phase III. Two projects are scheduled for completion in FY 2003: ORNL Electrical Systems Upgrades and the ANL-E Fire Safety Improvements, Phase IV.

Funding Profile

(dollars in thousands)

	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Current Appropriation	FY 2003 Request
Science Laboratories Infrastructure (SLI)					
Laboratories Facilities Support.........	22,775	22,816	-125	22,691	32,601
Oak Ridge Landlord..........................	4,112	7,359	-2,880	4,479	5,079
Excess Facilities Disposition	0	0	9,960	9,960	5,055
Subtotal, Science Laboratories Infrastructure	26,887	30,175	6,955	37,130	42,735
Facilities and Infrastructure..............	0	10,000[a]	-10,000	0	0
Subtotal Science Laboratories Infrastructure..	26,887	40,175	-3,045	37,130	42,735
General Reduction	---	-165[b]	165	0	0
Total, Science Laboratories Infrastructure	26,887[cd]	40,010	-2,880	37,130	42,735

Public Law Authorization:
Public Law 95-91, "Department of Energy Organization Act"
Public Law 103-62, "Government Performance and Results Act of 1993"

[a] FY 2002 Appropriation provided $10,000,000 in a new program added by Congress titled "Facilities and Infrastructure." Funding for this activity is proposed for inclusion in the Science Laboratories Infrastructure program (Excess Facilities Disposition) in FY 2003.
[b] General reduction includes $125,000 for Science Laboratories Infrastructure (formerly Multiprogram Energy Laboratories – Facilities Support program) and $40,000 for Facilities and Infrastructure.
[c] Excludes $3,047,000 in FY 2001 and $2,880,000 in FY 2002 for Oak Ridge Landlord activities transferred to Science Program Direction in FY 2003.
[d] Excludes $240,000, which was transferred to the Science Safeguards and Security program in an FY 2001 reprogramming.

Funding by Site

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Chicago Operations Office					
Argonne National Laboratory	6,611	3,643	4,205	+562	+15.4%
Brookhaven National Laboratory	6,444	7,413	8,513	+1,100	+14.8%
Princeton Plasma Physics Laboratory	0	875	545	-330	-37.7%
Chicago Operations Office	980	895	1,020	+125	+14.0%
Total, Chicago Operations Office	14,035	12,826	14,283	+1,457	+11.4%
Oakland Operations Office					
Lawrence Berkeley National Laboratory	2,113	6,900	5,607	-1,293	-18.7%
Lawrence Livermore National Laboratory	0	350	250	-100	-28.6%
Stanford Linear Accelerator Center	0	400	0	-400	--
Total, Oakland Operations Office	2,113	7,650	5,857	-1,793	-23.4%
Oak Ridge Operations Office					
Thomas Jefferson National Accelerator Facility	0	0	1,500	+1,500	--
Oak Ridge National Laboratory	6,627	10,745	12,016	+1,271	+11.8%
Oak Ridge Operations Office	4,112	4,479	5,079	+600	+13.4%
Total, Oak Ridge Operations Office	10,739	15,224	18,595	+3,371	+22.1%
Richland Operations Office					
Pacific Northwest National Laboratory	0	1,377	4,000	+2,623	+190.5%
Washington Headquarters	0	53	0	-53	--
Total, Science Laboratories Infrastructure	26,887 [a] [b]	37,130 [a]	42,735	+5,605	+15.1%

[a] Excludes $3,047,000 in FY 2001 and $2,880,000 in FY 2002 for Oak Ridge Landlord responsibilities transferred to Science Program Direction in FY 2003.

[b] Excludes $240,000 which was transferred to the Science Safeguards and Security program in an FY 2001 reprogramming.

Site Description

Ames Laboratory

Ames Laboratory (Ames) is located in Ames, Iowa, and is a national center for the synthesis, analysis, and engineering of rare-earth metals and their compounds. Ames conducts fundamental research in the physical, chemical, and mathematical sciences associated with energy generation and storage. The laboratory consists of 10 facilities (.32 million gross square feet of space) with the average age of the facilities being 36 years. Approximately 100 percent of the space is considered adequate.

Argonne National Laboratory - East

Argonne National Laboratory - East (ANL-E) in Argonne, Illinois, is a Multiprogram Laboratory located on a 1,700 acre site in suburban Chicago. The laboratory consists of 139 facilities (4.6 million gross square feet of space) with the average age of the facilities being 31 years. Approximately 44 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition. The SLI program is currently funding the following project:

- MEL-001-17 Mechanical and Control Systems Upgrade, Phase I (TEC $9,000,000) This ongoing project will upgrade or replace 30-40 year old, deteriorated mechanical system components in various facilities. These will include HVAC, drainage, steam supply, and condensate return systems. This project will optimize capacity, enhance system reliability and performance, improve safety, and reduce maintenance costs. These systems are no longer adequate, reliable, or efficient, and do not meet current ES&H standards (e.g., failure of a laboratory exhaust system could lead to release of radioactive material).

The program also provides funding through the Chicago Operations Office for Payments in Lieu of Taxes (PILT) as authorized by the Atomic Energy Act of 1954, as amended. These discretionary payments are made to state or local governments where the Department or its predecessor agencies have acquired property previously subject to state or local taxation.

Brookhaven National Laboratory

Brookhaven National Laboratory is a Multiprogram Laboratory located on a 5,200 acre site in Upton, New York. The laboratory consists of 745 facilities (4.1 million gross square feet of space) with the average age of the facilities being 40 years. Approximately 35 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition. The SLI program is currently funding the following projects:

- MEL-001-13 Groundwater and Surface Water Protection Upgrades (TEC $6,050,000) This on-going project will address a backlog of ground and surface water protection projects which are commitments to regulators. These include: proper closure of inactive supply and injection wells; runoff control for the surplus material storage yard; containment and runoff control for the radioactive material storage yard; replacement of 12 hydraulic elevator cylinders; removal of 22 underground fuel oil tanks; and replacement of radioactive waste tanks with secondarily contained tanks.

- MEL-001-16 Electrical Systems Modifications, Phase II (TEC $6,770,000) This ongoing project is the second phase of the modernization and refurbishment of the laboratory's deteriorating 50 year-old electrical infrastructure. The project includes: installation of two new 13.8 kV feeders to provide alternate sources to existing, aged feeders; installation of additional underground ductbanks to support a new 13.8 kV feeder; replacement of 2.4 kV switchgear to increase system reliability and safety; reconditioning of fifty 480-volt circuit breakers including replacing obsolete trip units with modern, solid-state trip devices; and the retrofit of ten 13.8 kV air breakers with new vacuum technology.

The following new project is proposed in the FY 2003 request:

- MEL-001-027 Research Support Building, Phase I (TEC $18,200,000) This 45,000 sq. ft. Research Support Building, is intended to consolidate Staff Services, Public Affairs, Human Resources, Credit Union, Library and other support functions in a central quadrangle to provide staff and visiting scientists with convenient and efficient support. This facility, the first of four phases in the BNL Master Revitalization Plan, will include a lobby with a visitor information center to assist visiting scientists, and a coordinated office layout of related support services. After completion of this project, **51,000 sq. ft. of WW II era structures will be torn down**. Based on total life-cycle costs, productivity gains, avoided energy and maintenance costs, the Research Support Building will provide a return on investment of 14.4% and a simple payback of 9 years.

The program also provides funding through the Chicago Operations Office for Payments in Lieu of Taxes (PILT) as authorized by the Atomic Energy Act of 1954, as amended. These discretionary payments are made to state or local governments where the Department or its predecessor agencies have acquired property previously subject to state or local taxation.

Fermi National Accelerator Laboratory

Fermi National Accelerator Laboratory is a single-program laboratory leading the nation in construction and operation of large facilities for research in high-energy and particle physics. The laboratory is located in Batavia, Illinois, and consists of 447 facilities (2.2 million gross square feet of space) with the average age of the facilities being 36 years. Approximately 100 percent of the space is considered adequate.

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory is a Multiprogram Laboratory located in Berkeley, California. The laboratory is on a 200 acre site adjacent to the Berkeley campus branch of the University of California. The laboratory consists of 176 facilities (1.7 million gross square feet of space) with the average age of the facilities being 31 years. Approximately 22 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition. The SLI program is currently funding the following projects:

- MEL-001-12 Site-wide Water Distribution System Upgrade (TEC $8,300,000) This ongoing project rehabilitates the Lab's High Pressure Water (HPW) System to include: replacement of all 1.4 km of cast iron pipe with ductile iron pipe; installing cathodic protection; replacing and adding pressure reducing stations to prevent excessive system pressure at lower lab elevations; adding an emergency fire water tank to serve the East Canyon; and providing the two current emergency fire water tanks with new liners and seismic upgrades.

The following new project is proposed in the FY 2003 request:

- MEL-001-28 – Building 77 Rehabilitation of Structures and Systems, Phase II (TEC $13,360,000) This project will provide design for the rehabilitation of Building 77 to correct mechanical, electrical, and architectural deficiencies in Buildings 77 (a 68,000 sq. ft. high-bay industrial facility) and 77A (10,000 sq. ft. industrial facility). Both 33 year-old buildings house machine shop and assembly operations in which production of highly sophisticated research components for a variety of DOE research projects takes place. Current work includes precision machining, fabrication and assembly of components for the Advanced Light Source, the Dual-Axis Radiographic Hydrodynamic Test Facility (DAHRT) project, the Spallation Neutron Source, and the ATLAS Detector. Infrastructure systems installed by this project will include HVAC, power distribution, lighting, and noise absorption materials. The improvements are necessary to satisfy urgent demands for high levels of cleanliness, temperature and humidity control, and OSHA and reliability requirements. This is the second of two projects, the first project, funded in FY 1999 and currently in progress, will correct structural deficiencies in Building 77.

Oak Ridge Institute for Science and Education

Oak Ridge Institute for Science and Education (ORISE) is an academic and training facility providing specialized scientific and safety training to DOE and other institutions. ORISE is an international leader in radiation-related emergency response and epidemiological studies. The laboratory consists of 21 facilities, 0.2 million gross square feet of space, with the average age of the facilities being 40 years. Approximately 92 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition.

Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is a Multiprogram Laboratory located on a 24,000 acre site in Oak Ridge, Tennessee. The laboratory consists of 461 facilities (4.5 million gross square feet of space) with the average age of the facilities being 31 years. Approximately 90 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition. The SLI program is currently funding the following projects:

- MEL-001-14 Fire Protection System Upgrade (TEC $5,920,000) This ongoing project replaces deteriorated, obsolete systems with more reliable fire alarm and suppression capabilities; replaces the single 16-inch water main in the east central section of ORNL with a looped system; and extends coverage of automatic alarm and sprinkler systems to areas not previously served. Upgrading the fire alarm receiving equipment at the site fire department headquarters ensures its reliability, modernizes its technology, and meets the demands of an expanded fire alarm system network.

- MEL-001-15 Laboratory Facilities HVAC Upgrade (TEC $7,100,000) This ongoing project provides improvements to aging HVAC systems (average age 38 years) located in the 13 buildings which comprise ORNL's central research complex and make additions and improvements to the chilled water distribution system. This includes: redesign of the cooling water distribution system to reduce the number of pumps required and installing more efficient pumps, thereby reducing operations and maintenance costs; installation of an 800 ft., 8-inch-diameter pipe, chill water cross-tie to Buildings 4501/4505 from the underground tie-line between Buildings 4500N/4509 to address low capacity problems in 4501/4505; installation of a 500 ft. 4-inch-diameter pipe to feed new chilled water coils in the east wing of Building 3500; upgrade of the existing 50 year-old air handler with new dampers, filters, steam coils, and controls; and replacement of constant volume, obsolete air handlers in various buildings with variable air volume (VAV) improvements to more efficiently control temperature.

- MEL-001-25 Research Support Center (TEC $16,100,000) This ongoing project will construct a 50,000 sq. ft. facility to house the core support service facilities and serve as the cornerstone and focal point of the East Research Campus envisioned in the ORNL Facility Revitalization Project. This building will include an auditorium and conference center (currently there is no adequate auditorium conference space available at ORNL), cafeteria, visitor reception and control area, and offices for approximately 50 people. It will facilitate consolidation of functions that are presently scattered throughout the Laboratory complex in facilities that are old (30-50 years), undersized, poorly located, or scheduled to be surplused. **This project includes removal of the 4300 sq. ft. Main Portal (Building 5000).** The facility will serve as a modern center for meeting, collaborating, and exchanging scientific ideas for ORNL staff and the nearly 30,000 visitors, guests, and collaborators that use ORNL facilities each year. The new cafeteria will replace the existing cafeteria (to be reused, possibly as a training facility), which was constructed in 1953. The existing cafeteria is poorly located to serve the current staff and is adjacent to the original production area of the lab now undergoing decontamination. The estimated simple payback is seven years.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) is a Multiprogram Laboratory located on a 960 acre site on the south end of the Hanford Reservation near Richland, Washington. The laboratory consists of 58 facilities (0.8 million gross square feet of space) with the average age of the facilities being 30 years. Approximately 26 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition. The SLI program is currently funding the following project:

- MEL-001-18 Laboratory Systems Upgrades (TEC $9,000,000) This ongoing project will upgrade or replace 20-50 year old mechanical system components in eight high occupancy facilities at PNNL. This project will upgrade these obsolete systems with more efficient, better performing systems to enhance the quality of science while reducing maintenance and energy costs. This upgrade will include: replacement of HVAC supply and exhaust fans; replacement, rehabilitation or modification of numerous chemical exhaust fume hoods; installation of computerized, remote, digital controls on various systems to improve operations; and replacement of an emergency power generator.

Princeton Plasma Physics Laboratory

Princeton Plasma Physics Laboratory (PPPL) is a collaborative national center dedicated to plasma and fusion science. PPPL has a leading international role in developing the theoretical, experimental, and technology innovations needed to make fusion practical and affordable. PPPL is located in Princeton, New Jersey, and consists of 34 facilities (0.7 million gross square feet of space) with the average age of the facilities being 22 years. Approximately 89 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition.

Stanford Linear Accelerator Center

Stanford Linear Accelerator Center (SLAC) is a program-dedicated laboratory (High Energy Physics) located on 426 acres in Menlo Park, California, and is the home of the Stanford Synchrotron Radiation Laboratory (SSRL). The Stanford Synchrotron Radiation Laboratory was built in 1974 to utilize the intense x-ray beams from the SPEAR storage ring that was built for particle physics by the SLAC laboratory. Over the years, the SSRL grew to be one of the main innovators in the production and use of synchrotron radiation with the development of wigglers and undulators that form the basis of all third generation synchrotron sources. The facility is now comprised of 25 experimental stations and is used each year by over 700 researchers from industry, government laboratories and universities. SLAC consists of 187 facilities (1.8 million gross square feet of space) with the average age of 22 years. Approximately 98 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition.

Thomas Jefferson National Accelerator Facility

Thomas Jefferson National Accelerator Facility (TJNAF) is a national user facility for nuclear science using continuous beams of high-energy electrons to discover the underlying quark and gluon structure of nucleons and nuclei. TJNAF has 1,600 users, about half of which are actively engaged in experiments at a given time. TJNAF is located in Newport News, Virginia, and consists of 172 facilities (.7 million gross square feet of space) with the average age of the facilities being 11 years. Approximately 89 percent of the space is considered adequate, while the remainder needs rehabilitation or replacement/demolition. The SLI program proposes to fund the following new project in FY 2003:

- MEL-001-33 Continuous Electron Beam Accelerator Facility (CEBAF) Center Addition, Phase I (TEC $10,500,000) - This project is phase I of two phases to provide for an addition to the CEBAF Center office building. The purpose of the two phases is to replace off-site leased facilities and to collocate staff for enhanced productivity. This first addition will add 51,000 square feet of office space and 5,000 square feet of conference/meeting room space with a 2.7-year simple payback and a 25% rate of return. **20,000 sq.ft. of inadequate space will be vacated and removed at the conclusion of this project**. These two phases will provide additional space for 273 employees and 346 users.

Chicago Operations Office

The Chicago Operations Office processes the Payments in Lieu of Taxes made to the local taxing authorities at Brookhaven National Laboratory and Argonne National Laboratory-East.

Oak Ridge Operations Office

The Oak Ridge Landlord program provides for centralized Oak Ridge Operations Office (ORO) infrastructure requirements and general operating costs for activities on the Oak Ridge Reservation outside plant fences and activities to maintain a viable operations office, including maintenance of roads and grounds and other infrastructure, Payments In Lieu of Taxes, and other needs related to landlord activities.

Laboratories Facilities Support

Mission Supporting Goals and Objectives

This subprogram, previously titled the Multiprogram Energy - Laboratories Facilities Support (MEL-FS) subprogram, has been broadened to include SC single purpose as well as the multi-purpose laboratories and re-titled the Laboratories Facilities Support (LFS) subprogram to reflect this change.

The LFS subprogram improves the condition of laboratory buildings (i.e., increasing the percentage of buildings rated adequate) provide Payments in Lieu of Taxes (PILT) assistance for communities surrounding Brookhaven National Laboratory and Argonne National Laboratory-East; and funds the highest priority projects by first ranking them using the Life Cycle Asset Management (LCAM) Cost-Risk-Impact Matrix that takes into account risk, impacts, and mission need. Based on these rankings, the subprogram funds the highest priority projects that reduce risk, ensure continuity of operations, avoid or reduce costs, and increase productivity.

The LFS subprogram supports the program's goal to ensure that support facilities at the Office of Science (SC) laboratories can meet the Department's research needs primarily by refurbishing or replacing deteriorated, outmoded, unsafe, and inefficient general purpose and site-wide infrastructure. General purpose and site-wide facilities are general use, service and support facilities such as administrative space, cafeterias, general office/laboratory space, utility systems, sanitary sewers, roads, etc.

Capital investment requirements for SC laboratories are identified in laboratory Strategic Facilities Plans. These ten-year site plans include priority lists of proposed facilities and infrastructure needs. These plans (currently under SC review) assume the full modernization/revitalization of the infrastructure of the labs will be completed over a ten-year period. The backlog of modernization needs is on the order of $2 billion with the unfunded portion about $1.3 billion. Of the identified infrastructure needs, nearly 85% is to rehabilitate or replace buildings.

The large backlog of building related projects reflects the fact that the condition of 53% of the laboratory space is rated adequate, while the remaining 47% needs rehabilitation or replacement/demolition. Often, even adequate space is not functional for modern research purposes (e.g., a well maintained 1940 vintage wooden barracks is not particularly useful when modern, high technology equipped lab/office or “clean room” space is needed). The large percentage of inadequate space is attributable to:

- the age of the facilities (over 69% of the buildings are 30 years old or older and, 43% are 40 years old or older)
- changing research needs that require different kinds of space (e.g., more office space and light laboratory space than hot cells)
- obsolescence of existing systems and components
- changing technology (e.g., digital controls)
- changing environmental, safety and health regulations, and
- inadequate capital investment in the past

The backlog of utilities and ES&H related projects is much lower due to previous investments by the SLI program over the last 20 years. Utilities and ES&H projects consistently scored highest in the prioritization system mentioned below and therefore received funding, while the building related projects were largely postponed.

The SLI program strives to improve the condition of laboratory buildings (i.e., increasing the percentage of buildings rated adequate based on definitions and criteria provided in the DOE corporate Facilities Information Management Systems) by increasing the percentage of facilities rated adequate over time. The percentage of space rated adequate in FY 2001 is 53%.

In any given budget year, all candidate construction projects for funding by the LFS subprogram are first ranked using the DOE Life Cycle Asset Management (LCAM) Cost-Risk-Impact Matrix that takes into account risk, impacts, and mission need. The projects that have ES&H as the principal driver are further prioritized using the Risk Prioritization Model from the DOE ES&H and Infrastructure Management Plan process. Based on these rankings, the subprogram funds the highest priority projects that reduce risk, ensure continuity of operations, avoid or reduce costs, and increase productivity. All FY 2001-FY 2003 funded projects were evaluated by an integrated infrastructure management team as the highest priority projects and each has a Capital Asset Management Process (CAMP) score greater than 60.

The LFS subprogram ensures that the funded projects are managed effectively and completed within the established cost, scope and schedule baselines. **Performance will be measured by** the number of all SLI projects completed within the approved baseline for cost (at or below the appropriated Total Estimated Cost), scope (within 10%), and schedule (within six months). Two projects scheduled for completion in FY 2001 were completed within the approved baselines for cost, scope, and schedule; the third was descoped due to unforeseen labor market conditions and building operational commitments that delayed completion of the project.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Purpose Facilities	8,816	5,380	19,107	+13,727	+255.1%
Environment, Safety and Health	12,979	16,416	12,474	-3,942	-24.0%
Payment in Lieu of Taxes (PILT)	980	895	1,020	+125	+14.0%
Total, Laboratories Facilities Support	22,775	22,691	32,601	+9,910	+43.7%

Detailed Program Justification

	FY 2001	FY 2002	FY 2003
	(dollars in thousands)		
General Purpose Facilities	**8,816**	**5,380**	**19,107**

Provides funding to support the initiation of three new subprojects in FY 2003 as well as the continuation of one FY 2001 subproject and two FY 2002 subprojects under the Science Laboratories Infrastructure (MEL-001) construction project data sheet. These are summarized below. More details are provided in the construction project data sheet presented later.

The FY 2003 funding is for design and construction activities for: 1) the LBNL Building 77 Rehabilitation of Structures and Systems, Phase II ($1,757,000); 2) BNL Research Support Building, Phase I ($3,250,000); 3) TJNAF CEBAF Center Addition, Phase I ($1,500,000). The latter two projects are for new buildings to provide 96,000 sq. ft. of modern research support space while eliminating 71,000 sq. ft. of old, deteriorated buildings that cannot be economically renovated.

The FY 2002 subprojects are the PNNL Laboratory Systems Upgrade ($4,000,000) and the ORNL Research Support Center ($5,000,000).

The FY 2001 subproject is the ORNL Laboratory Facilities HVAC Upgrade ($3,600,000).

Environment, Safety and Health	**12,979**	**16,416**	**12,474**

Provides funding to support the continuation of one FY 2002 and four FY 2001 ES&H subprojects in the Science Laboratories Infrastructure Project (MEL-001) construction project data sheet. These are summarized below. More details are provided in the construction project data sheet presented below.

The FY 2002 subproject is the ANL-E Mechanical and Control Systems Upgrade, Phase I ($3,045,000).

The FY 2001 subprojects are: BNL Groundwater and Surface Water Protection Upgrades ($1,398,000); ORNL Fire Protection System Upgrade ($2,216,000); LBNL Site-wide Water Distribution System Upgrade ($2,900,000); and BNL Electrical Systems Modifications, Phase II ($2,915,000).

PILT	**980**	**895**	**1,020**

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Continue meeting Payments in Lieu of Taxes (PILT) assistance requirements for communities surrounding Brookhaven National Laboratory and Argonne National Laboratory-East. PILT payment levels are negotiated between the Department and local governments. The PILT payments equaled the negotiated levels in FY 2001.			
Total, Laboratories Facilities Support	**22,775**	**22,691**	**32,601**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Laboratories Facilities Support	
■ Additional funding in the General Purpose Facilities (GPF) area is to address the large backlog of infrastructure needs at all SC labs	+13,727
■ Reduction in the Environment Safety and Health (ES&H) area (to approximately FY 2001 level) reflects the reduction in needs resulting from a significant FY 2002 ES&H investment and shifting program priorities to GPF needs	-3,942
■ Increase in funding to meet PILT requirements	+125
Total Funding Change, Laboratories Facilities Support	+9,910

Excess Facilities Disposition

Mission Supporting Goals and Objectives

This is a new subprogram in the FY 2003 Science Laboratories Infrastructure program and will address those excess facilities needs that are the responsibility of SC as steward for the SC laboratories. In FY 2002, these funds were appropriated in a separate Facilities and Infrastructure program added by Congress.

The Excess Facilities Disposition (EFD) subprogram eliminates excess facilities at the SC laboratories to reduce long-term costs and liabilities to support programmatic initiatives (e.g. making land available for new programs). In addition to removal of excess facilities, the subprogram will also clean-up facilities for reuse where such re-use is economical and can provide needed functionality.

The subprogram supports this goal by evaluating and prioritizing the backlog of excess facilities projects that can be cleaned-up or eliminated in the next few years, which is on the order of $36,000,000. Examples of candidate projects to be undertaken are provided below. Final selection of projects to be undertaken will be based on program priorities including footprint reduction, risk reduction (e.g., removal of hazards), availability of space/land for research activities, and cost savings (e.g., elimination of surveillance and maintenance costs).

This subprogram does not address major process contaminated facilities such as research reactors that, under DOE policy, are to be transferred to the Office of Environmental Management for final disposition. Also, this subprogram does not provide for removal or replacement of "occupied" buildings (e.g., old, deteriorated and marginally functional ones that are to be replaced by new modern buildings). Such building replacement projects are funded under the previously discussed LFS subprogram and would include removal of the old buildings as part of the justification for the project.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Excess Facilities Disposition	0	9,960	5,055	-4,905	-49.2%
Total, Excess Facilities Disposition	0	9,960	5,055	-4,905	-49.2%

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Excess Facilities Disposition	**0**	**9,960**	**5,055**

Provides operating funds to eliminate excess facilities that are no longer needed at SC laboratories and that require resources to monitor and maintain them in safe and secure conditions. FY 2002 Facilities and Infrastructure (F&I) program funding of $9,960,000 allows for the clean-up/removal of approximately 30 excess facilities. Below is a list of projects included in the FY 2002 F&I program:

- ANL-E ($810,000) – Cleanup of Building 205 Sample Carousel; cleanup of Building 315 Cell 6 Pit; cleanup of Building 315 Radiochemistry Lab (approximately 1,300 sq.ft.)

- BNL ($1,350,000) – Demolition of Building 318; demolition of Building 960 Complex; abandoned well closure and demolition of Buildings 93, 168, 915, and 917 (approximately 34,000 sq.ft.)

- LBNL ($2,500,000) – Removal of motor generators from Building 51; removal of the Heavy Ion Spectrometer System (HISS) Magnet and Structure “51G,” removal of shielding blocks/beam lines from External Particle Beam (EPB) hall (approximately 21,000 sq.ft.)

- LLNL ($350,000) – Demolition and removal of the Magnetic Fusion Energy Direct Current power supply (approximately 60,000 sq.ft.)

- ORNL ($3,125,000) – Stabilization and cleanout of Building 9201-3; stabilization and cleanout of EN tandem space in Building 5500; demolition of Building 2013; demolition of Building 2506; deactivation/demolition of Building 6003 (approximately 224,000 sq.ft.)

- PNNL ($497,000) – Demolition of Building 331-B Radioactive Inhalation Facility and Dog Kennels (approximately 26,000 sq.ft.)

- SLAC ($400,000) – Demolition of the following: Building 232 - Experimental Facilities Department/Cryogenics Conference Room; Building 125 - Test Beam Facility Control Room; Building 111 – 40” Bubble Chamber Building; Building 109 – Experimental Facilities Department High Bay Building; Building 404 – Experimental Shelter; Building 133 – Stanford Linear Detector Cherenkov Ring Imaging Detector Clean Room; Building 265 – Computer Trailer; Building 295 – End Station A Office Trailer #1; Building 291 - End Station A Office Trailer #2; Building 296 – SLAC User Trailer #2; Building 297 – SLAC User Trailer #3 (approximately 13,000 sq.ft.)

- PPPL ($875,000) – Preparation for Princeton Beta Experiment Modification (PBX) Disposition (approximately 27,000 sq.ft.)

- A small amount ($53,000) is held for emergent requirements.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

In FY 2002 an estimated 400,000 total square feet of space will be removed or cleaned up for reuse.

Below is a list of projects to be undertaken in FY 2003:

- ANL-E ($1,160,000) – Building 40 (Instrument Calibration) Disposal and Partial Facility Demolition (approximately 7,000 sq. ft.)
- BNL ($950,000) – Demolition of Buildings 89, 920, 91 and 118 (approximately 32,000 sq. ft.)
- LBNL ($950,000) – Disposal of Experiment Hall concrete shield blocks, magnets, and activated components (approximately 6,000 sq. ft.)
- LLNL ($250,000) – Demolish Magnetic Fusion Energy bridge and utility lines (approximately 1,100 sq. ft.)
- ORNL ($1,200,000) – Building 1,000 deactivation/demolition (approximately 59,000 sq. ft.)
- PPPL ($545,000) – Princeton Beta Experiment Modification (PBX)/Princeton Large Torus (PLT) subsystem removals (approximately 71,000 sq. ft.)

Individual projects and amounts are subject to revision based on evolving program priorities including risk reduction (e.g., removal of hazards), footprint reduction, cost savings (e.g., elimination of surveillance and maintenance costs), and availability of space/land for new research activities.

In FY 2003, an estimated 176,000 total square feet of space will be removed or cleaned up for reuse.

	FY 2001	FY 2002	FY 2003
Total, Excess Facilities Disposition	**0**	**9,960**	**5,055**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Excess Facilities Disposition	
▪ FY 2002 Excess Facilities Disposition funding was appropriated in a new program titled, “Facilities and Infrastructure.” Report language directed that a minimum of 25% of the funds be used for Excess Facilities. This activity is proposed for inclusion in the SLI budget with continued funding at a reduced level in FY 2003.	-4,905
Total Funding Change, Excess Facilities Disposition	-4,905

Oak Ridge Landlord

Mission Supporting Goals and Objectives

The Oak Ridge Landlord subprogram supports activities to maintain continuity of operations at the Oak Ridge Reservation (ORR) and the Oak Ridge Operations Office (ORO) to minimize interruptions related to infrastructure and/or other systems failures.

This subprogram supports landlord responsibilities for the centralized ORR, including infrastructure of the ORR, the 24,000 acres of the Reservation outside of the Y-12 plant, ORNL, and the East Tennessee Technology Park, and DOE facilities in the town of Oak Ridge. This includes roads and grounds and other infrastructure maintenance, ES&H support and improvements, PILT for Oak Ridge communities, and other needs related to landlord requirements. These activities maintain continuity of operations at the Oak Ridge Reservation and the ORO and minimize interruptions due to infrastructure and/or other systems failures. In FY 2001 there were no significant interruptions due to infrastructure failures.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Oak Ridge Landlord...	4,112	4,479	5,079	+600	+13.4%

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
■ **Roads, Grounds and Other Infrastructure and ES&H Support and Improvements**……………………………..	**2,000**	**2,200**	**2,488**
■ **Payments in Lieu of Taxes (PILT)**…………………….	**1,900**	**1,900**	**2,300**

Payments in Lieu of Taxes (PILT) to the City of Oak Ridge, and Anderson and Roane Counties.

	FY 2001	FY 2002	FY 2003
■ **Reservation Technical Support**………………………	**212**	**379**	**291**

Includes recurring activities such Site Mapping, National Archives Records Administration, and support for legacy legal cases.

	FY 2001	FY 2002	FY 2003
Total, Oak Ridge Landlord...	**4,112**	**4,479**	**5,079**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Oak Ridge Landlord	
■ Increases the Roads, Grounds and Other Infrastructure and ES&H Support and Improvements to more aggressively address deficiencies and expected increase in traffic due to the Spallation Neutron Source project.	+288
■ Supports the negotiated increase in the per acre value of land used to calculate the PILT payment.	+400
■ Maintain ORR technical support at approximately the FY 2002 level.	-88
Total Funding Change, Oak Ridge Landlord	+600

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects (ORO Landlord)........	0	0	0	0	--
Capital Equipment (ORO Landlord)	0	0	0	0	--
Total, Capital Operating Expenses	0	0	0	0	--

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 2001	FY 2002	FY 2003	Unapprop. Balance
Project – 02-SC-001 Laboratories Facilities Support Project						
FY 2002 PED Datasheet	N/A	N/A	0	3,183	0	0
Project – 03-SC-001 Laboratories Facilities Support Project						
FY 2003 PED Datasheet	N/A	N/A	0	0	3,355	0
Project - MEL-001 Laboratories Facilities Support Project						
FY 2003 Construction Datasheet	N/A	N/A	21,795	18,613	28,226	54,425
Total, LFS Construction	N/A	N/A	21,795	21,796	31,581	54,425

03-SC-001 – Science Laboratories Infrastructure, Project Engineering Design (PED), Various Locations

1. Construction Schedule History

Fiscal Quarter				Total Estimated Cost ($000)
A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete	

N/A-See Subproject details

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2003	3,355	3,355	2,775
2004	0	0	580

3. Project Description, Justification and Scope

This project funds PED for two types of subprojects:

- Projects that renovate or replace inefficient and unreliable general purpose facilities (GPF) including general use, service and support facilities such as administrative space, cafeterias, utility systems, and roads; and
- Projects to correct Environment, Safety and Health (ES&H) deficiencies including deteriorated steam lines, environmental insult, fire safety improvements, sanitary system upgrades and electrical system replacements.

This PED data sheet requests design funding for three FY 2003 new starts: Lawrence Berkeley National Laboratory; Building 77 Rehabilitation of Structures and Systems, Phase II; Brookhaven National Laboratory Research Support Building, Phase I; and the Thomas Jefferson National Accelerator Facility Continuous Electron Beam Accelerator Facility (CEBAF) Center Addition, Phase I.

FY 2003 Proposed Design Projects

General Purpose Facilities Projects:

03 -01: MEL-001-028 – Building 77 Rehabilitation of Structures and Systems, Phase II (LBNL)

Fiscal Quarter				Total Estimated Cost (Design Only) ($000)	Full Total Estimated Cost Projection [a] ($000)
A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
1Q 2003	2Q 2004	3Q 2004	N/A	1,100	13,360

Fiscal Year	Appropriations	Obligations	Costs
2003	1,100	1,100	820
2004	0	0	280

This design project will provide design for the rehabilitation of Building 77 to correct mechanical, electrical and architectural deficiencies in Buildings 77 (a 68,000 sq. ft. high-bay industrial facility) and 77A (10,000 sq. ft. industrial facility). Both 33 year-old buildings house machine shop and assembly operations in which production of highly sophisticated research components for a variety of DOE research projects takes place. Current work includes precision machining, fabrication and assembly of components for the Advanced Light Source, the Dual-Axis Radiographic Hydrodynamic Test Facility (DAHRT) project, the Spallation Neutron Source, and the ATLAS Detector. Infrastructure systems installed by this project will include HVAC, power distribution, lighting, and noise absorption materials. The improvements are necessary to satisfy urgent demands for high levels of cleanliness, temperature and humidity control, and OSHA and reliability requirements. This is the second of two projects, the first project, funded in FY 1999 and currently in progress, will correct structural deficiencies in Building 77.

[a] The full TEC Projection (design and construction) is a preliminary estimate based on conceptual data and should not be construed as a project baseline.

03 -02: MEL-001-027 – Research Support Building, Phase I (BNL)

Fiscal Quarter				Total Estimated Cost (Design Only) ($000)	Full Total Estimated Cost Projection [a] ($000)
A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
1Q 2003	2Q 2004	3Q 2004	N/A	1,710	18,200

Fiscal Year	Appropriations	Obligations	Costs
2003	1,710	1,710	1,410
2004	0	0	300

This design project will provide design for construction of the Research Support Building, Phase I. This 45,000 sq.ft. Research Support Building is intended to consolidate Staff Services, Public Affairs, Human Resources, Credit Union, Library and other support functions in a central quadrangle to provide staff and visiting scientists with convenient and efficient support. This facility, the first of four phases in the BNL Master Revitalization Plan, will include a lobby with a visitor information center to assist visiting scientists, and a coordinated office layout of related support services. After completion of this project, 51,000 sq. ft. of WWI era structures will be torn down. Based on total life-cycle costs, productivity gains, avoided energy and maintenance costs, the Research Support Building will provide a return on investment of 14.4% and a simple payback of 9 years.

03 -03: MEL-001-033 – CEBAF Center Addition, Phase I (TJNAF)

Fiscal Quarter				Total Estimated Cost (Design Only) ($000)	Full Total Estimated Cost Projection [a] ($000)
A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
1Q 2003	4Q 2003	1Q 2004	N/A	545	10,500

Fiscal Year	Appropriations	Obligations	Costs
2003	545	545	545

This design project will provide design for Phase I of two phases to provide for an addition to the CEBAF Center office building. The purpose of the two phases is to eliminate inadequate space, replace off-site leased facilities and to collocate staff for enhanced productivity. The first addition will add 51,000 square feet of office space and 5,000 of conference/meeting room space with a 2.7-year simple payback and a 25% rate of return. 20,000 sq. ft. of inadequate space will be vacated and removed at the conclusion of this project. These two phases will provide additional space for 273 employees and 346 users.

[a] The full TEC Projection (design and construction) is a preliminary estimate based on conceptual data and should not be construed as a project baseline.

Ongoing PED Design Projects

(dollars in thousands)

(Design Project No. PED-02-SC-001) Multiprogram Energy Laboratories, Project Engineering Design (PED), Various Locations	Location	Design TEC	Approp. to Date	Obligs. to Date	Costs to Date	Design Start	Design Completion	Constr. Status (Fiscal Year)
General Purpose Facilities Projects:								
02-01: MEL-001-018 Lab. Systems Upgrade	PNNL	880	880	0	0	1Q2002	3Q2003	2Q2003

This design project will provide design to upgrade or replace 20-50 year old mechanical system components in eight high occupancy facilities at PNNL. This project will upgrade these obsolete systems with more efficient, better performing systems to enhance the quality of science while reducing maintenance and energy costs. This upgrade will include: replacement of HVAC supply and exhaust fans; replacement, rehabilitation or modification of numerous chemical exhaust fume hoods; installation of computerized, remote, digital controls on various systems to improve operations; and replacement of an emergency power generator.

02-03: MEL-001-025 Research Support Center	ORNL	1,500	1,500	0	0	1Q2002	3Q2003	2Q2003

This design project will construct a 50,000 sq. ft. facility to house the core support service facilities and serve as the cornerstone and focal point of the East Research Campus envisioned in the ORNL Facility Revitalization Project. This building will include an auditorium and conference center (currently there is no adequate auditorium/conference space available at ORNL), cafeteria, visitor reception and control area, and support offices for approximately 50 occupants. It will facilitate consolidation of functions, which are presently scattered throughout the Laboratory complex in facilities that are old (30-50 years), undersized, poorly located, or scheduled for surplus. This project will include removal of the 4300 sq. ft. Main Portal (Building 5000). The facility will serve as a modern center for meeting, collaborating, and exchanging scientific ideas for ORNL staff and the nearly 30,000 visitors, guests, and collaborators that use ORNL facilities each year. The new cafeteria will replace the existing cafeteria (to be reused, possibly as a training center), which was constructed in 1953. The existing cafeteria is poorly located to serve the current staff and is adjacent to the original production area of the lab now undergoing decontamination. The estimated simple payback is seven years.

(Design Project No. PED-02-SC-001) Multiprogram Energy Laboratories, Project Engineering Design (PED), Various Locations	Location	Design TEC	Approp. to Date	Obligs. to Date	Costs to Date	Design Start	Design Completion	Constr. Status (Fiscal Year)
ES&H Projects:								
02-08: MEL-001-017 Mechanical Control Systems Upgrade, Ph. I	ANL	803	803	0	0	1Q2002	3Q2003	2Q2003

This design project will provide design to upgrade and replace 30-40 year old mechanical system components in various facilities. It will optimize capacity, enhance system reliability and performance, improve safety, and reduce maintenance and repair costs of primary building mechanical equipment and control systems. The mechanical systems designated for replacement are no longer adequate, reliable, or efficient, and do not meet current ES&H standards (i.e. failure of laboratory exhaust systems could lead to the release of radioactive material). Specifically, this project will: upgrade HVAC systems in Bldgs. 221 and 362, including heating and cooling coils, fans, filter systems, ductwork, controls, and variable frequency drive fans; upgrade lab exhaust systems in Bldgs. 202 and 306, including new fans, ductwork, and controls; upgrade corroded drainage systems in Bldgs. 200, 205 and 350; and upgrade steam and condensate return systems in 12 facilities in the 360 area. This will include high and low pressure steam supply piping and associated pressure reducing stations, valves, and accessories; and replacing condensate pumping systems including piping, valves and system controls.

FY 2002 Total		3,183	3,183	0	0

4. Details of Cost Estimate

N/A

5. Method of Performance

Design services will be obtained through competitive and/or negotiated contracts. M&O contractor staff may be utilized in areas involving security, production, proliferation, etc. concerns.

6. Schedule of Project Funding

N/A

MEL-001 – Science Laboratories Infrastructure Project, Various Locations

(Changes from FY 2002 Congressional Budget Request are denoted with a vertical line in the left margin.)

Significant Changes

None

1. Construction Schedule History

Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		

N/A -- See subproject details

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Project Engineering & Design (PED)			
FY 2002	3,183 [a]	3,183	2,385
FY 2003	3,355 [b]	3,355	3,573
FY 2004	0	0	580
Construction			
Prior Years	21,114	21,114	7,680
FY 2001	21,795	21,795	17,900
FY 2002	18,613	18,613	12,450
FY 2003	28,226	28,226	27,445
FY 2004	30,622	30,622	35,500
FY 2005	23,803	23,803	27,500
FY 2006	0	0	12,000
FY 2007	0	0	3,698

[a] Title I and Title II Design funding of $880,000 (Subproject 18); $803,000 (Subproject 17); and $1,500,000 (Subproject 25) requested under Project Engineering Design (PED) Project No. 02-SC-001.

[b] Title I and Title II Design funding of $1,710,000 (Subproject 27); $1,100,000 (Subproject 28); $545,000 (Subproject 33) requested under Project Engineering Design (PED) Project No. 03-SC-001.

3. Project Description, Justification and Scope

This project funds two types of subprojects:

- Projects that renovate or replace inefficient and unreliable general purpose facilities (GPF) including general use, service and support facilities such as administrative space, cafeterias, utility systems, and roads; and
- Projects to correct Environment, Safety, and Health (ES&H) deficiencies including deteriorated steam lines, environmental insult, fire safety improvements, sanitary system upgrades and electrical system replacements.

General Purpose Facilities Projects:

a. Subproject 04 - Electrical Systems Modifications, Phase I (BNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
5,730	4,730	1,000	0	0	0	2Q 2000 - 4Q 2001

This project is the first phase of a planned modernization and refurbishment of the Laboratory's electrical infrastructure. The project provides for the replacement of 30 to 50 year old deteriorating underground electrical cables, the addition of underground ductbanks to replace damaged portions and support new cabling, the installation of a new 13.8 kV - 2.4 kV step-down transformer substation to address capacity and operational problems, and the retrofitting/reconditioning of switchgear power circuit breakers.

b. Subproject 05 - Bldg. 77 - Rehabilitation of Building Structure and Systems (LBNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
8,000	6,887	1,113	0	0	0	3Q 2000 - 2Q 2002

This project will rehabilitate Building 77's structural system to restore lateral force resistance and arrest differential foundation settlement. These upgrades will restore this 33 year-old, 68,000 sq.ft. building to acceptable seismic performance and prevent loss at this facility due to structure failures.

c. Subproject 06 - Central Supply Facility (ANL-E)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
5,900	5,240	660	0	0	0	3Q 2000 – 4Q 2001

This project includes a 22,000 sq.ft. addition to the Transportation and Grounds Facility (Bldg. 46) along with remodeling of 3,500 sq.ft. of space in the existing Transportation and Grounds Facility. The project will result in economies and efficiencies by providing a highly efficient and cost-effective consolidated facility to meet the missions of the Materials Group and the Property Group of ANL-East and will eliminate the need for 89,630 square feet of substandard (50 year-old) space in ssix buildings which will be demolished (Bldgs. 4, 5, 6, 26, 27, and 28). The Materials Group receives, sorts, stores, retrieves, and distributes the majority of all materials and supplies for the Laboratory. The Property Group tags, controls, stores, and distributes excess property and precious metals for the Laboratory. This facility will contain truck docks; receiving and distribution areas; inventory control; general material storage; support and office areas; property storage; and exterior hazardous storage. This project will also eliminate 7,000 linear feet of steam supply and return lines.

d. Subproject 08 - Electrical Systems Upgrade (ORNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
5,900	357	5,543	0	0	0	3Q 2001 - 2Q 2003

This project will replace electrical distribution feeders and upgrade transformers and switchgear feeding research facilities and primary utility support facilities throughout the Oak Ridge National Laboratory (ORNL) complex. It will also provide advanced protective relaying and metering capabilities at major substations. The project is part of a phased infrastructure upgrade to restore the electrical distribution systems serving the ORNL. The purpose of the upgrade is to maintain a reliable source of electrical power appropriate for servicing scientific research facilities. Without the proposed upgrade, the potential for electrical faults and outages will increase as the distribution system ages, with attendant increased risk of equipment damage and the potential inability to meet laboratory programmatic goals due to downtime of critical facilities. These facilities include the central research facilities, supercomputing facility, Robotics and Process Systems facility, the central chilled water plant, and the steam plant. Also, maintenance costs involved in continued operation of the existing deteriorated system will increase as the system ages.

e. Subproject 15 – Laboratory Facilities HVAC Upgrade (ORNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
7,100	0	500	3,000	3,600	0	3Q 2002 – 2Q 2004

This project will provide improvements to aging HVAC systems (average age 38 years) located in the thirteen (13) buildings which comprise Oak Ridge National Laboratory's (ORNL's) central research complex and additions and improvements to the chiller water distribution system. This includes: redesign of the cooling water distribution system to reduce the number of pumps required and installing more efficient pumps, thereby reducing operations and maintenance costs; installation of an 800 ft., 8-inch-diameter pipe, chill water cross-tie to Bldgs. 4501/4505 from the underground tie-line between Bldgs. 4500N/4509 to address low capacity problems in 4501/4505; installation of a 500 ft. 4-inch-diameter pipe to feed new chilled water coils in the east wing of Bldg. 3500; upgrade of the existing 50 year-old air handler with new dampers, filters, steam coils, and controls; and replacement of constant volume, obsolete air handlers in various buildings with variable air volume (VAV) improvements to more efficiently control temperature.

f. Subproject 18 – Laboratory Systems Upgrades (PNNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
9,000	0	0	880 [a]	4,000	4,120	2Q 2003 – 2Q 2005

This project will upgrade or replace 20-50 year old mechanical system components in eight high occupancy facilities at PNNL. This project will upgrade these obsolete systems with more efficient, better performing systems to enhance the quality of science while reducing maintenance and energy costs. This upgrade will include: replacement of HVAC supply and exhaust fans; replacement, rehabilitation or modification of numerous chemical exhaust fume hoods; installation of computerized, remote, digital controls on various systems to improve operations; and replacement of an emergency power generator.

g. Subproject 25 – Research Support Center (ORNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
16,100	0	0	1,500 [a]	5,000	9,600	2Q 2003 – 2Q 2005

This project will construct a 50,000 sq. ft. facility to house the core support service facilities and serve as the cornerstone and focal point of the East Research Campus envisioned in the ORNL Facility Revitalization Project. This building will include an auditorium and conference center (currently there is no adequate auditorium/conference space available at ORNL), cafeteria, visitor reception and control area, and offices for approximately 50 people. It will facilitate consolidation of functions,

[a] Title I and Title II Design funding requested under Project Engineering Design (PED) Project No. 02-SC-001.

which are presently scattered throughout the Laboratory complex in facilities that are old (30-50 years), undersized, poorly located, or scheduled to be surplused. This project will include removal of the 4300 sq. ft. Main Portal (Building 5000). The facility will serve as a modern center for meeting, collaborating, and exchanging scientific ideas for ORNL staff and nearly 30,000 visitors, guests, and collaborators that use ORNL facilities each year. The new cafeteria will replace the existing cafeteria (to be reused, possibly as a training facility), which was constructed in 1953. The existing cafeteria is poorly located to serve the current staff and is adjacent to the original production area of the lab now undergoing decontamination. The estimated simple payback is seven years.

h. Subproject 27 – Research Support Building , Phase I (BNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
18,200	0	0	0	3,250 [a]	14,950	1Q 2004 – 3Q 2006

This project will construct a 45,000 sq. ft. facility to consolidate Staff Services, Public Affairs, Human Resources, Credit Union, Library, and other support functions in a central quadrangle to provide staff and visiting scientists with convenient and efficient support. This facility, the first of four phases in the BNL Master Revitalization Plan, will include a lobby with a visitor information center to assist visiting scientists, and a coordinated office layout of related support services. After completion of this project, 51,000 sq. ft. of WWII era structures will be torn down. Based on total life-cycle costs, productivity gains, avoided energy and maintenance costs, the Research Support Building will provide a return on investment of 14.4% and a simple payback of 9 years.

i. Subproject 28 – Building 77 Rehabilitation of Structures and Systems, Phase II (LBNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
13,360	0	0	0	1,757 [b]	11,603	2Q 2004 – 2Q 2006

This project will provide for the rehabilitation of Building 77 to correct mechanical, electrical and architectural deficiencies in Buildings 77 (a 68,000 sq.ft. high-bay industrial facility) and 77A (10,000 sq.ft.industrial facility). Both 33 year-old buildings house machine shop and assembly operations in which production of highly sophisticated research components for a variety of DOE research projects takes place. Current work includes precision machining, fabrication and assembly of components for the Advanced Light Source, the Dual-Axis Radiographic Hydrodynamic Test Facility (DAHRT) project, the Spallation Neutron Source, and the ATLAS Detector. Infrastructure systems installed by this project will include HVAC, power distribution, lighting, and noise absorption materials. The improvements are necessary to satisfy urgent demands for high levels of cleanliness, temperature and humidity control, and OSHA and reliability requirements. This is the second of two projects, the first project, funded in FY99 and currently in progress, will correct structural deficiencies in Bldg. 77.

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[a] Title I and Title II Design funding of $1,710,000 requested under Project Engineering Design (PED) Project No. 03-SC-001.

[b] Title I and Title II Design funding of $1,100,000 requested under Project Engineering Design (PED) Project No. 03-SC-001.

j. Subproject 33 – Continuous Electron Beam Accelerator Facility (CEBAF) Center Addition, Phase I (TJNAF)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
10,500	0	0	0	1,500[a]	9,000	4Q 2003 – 4Q 2005

This project will construct Phase I of two phases to provide for an addition to the CEBAF Center office building. The purpose of the two phases is to eliminate inadequate space, replace off-site leased facilities and to collocate staff for enhanced productivity. This first addition will add 51,000 sq. ft. of office space and 5,000 of conference/meeting room space with a 2.7-year simple payback and a 25% rate of return. 20,000 sq. ft of inadequate space will be vacated and removed at the conclusion of this project. These two phases will provide additional space for 273 employees and 346 users

ES&H Projects:

a. Subproject 07 - Sanitary System Modifications, Phase III, (BNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
6,500	3,500	3,000	0	0	0	1Q 2000 - 2Q 2002

The BNL Sanitary System consists of over 20 miles of collection piping that collects sanitary waste from nearly all the BNL facilities. The collection piping transports the waste via gravity piping and lift stations to a sewage treatment plant (STP). This project is the third phase of the upgrade of the Laboratory sanitary waste system. In the first two phases, major operations of the STP were upgraded and approximately 14,000 feet of trunk sewer lines were replaced, repaired, or lined. Phase III will continue this upgrade and will replace or rehabilitate approximately 9,900 feet of existing deteriorated (8 to 20 inch) sewer piping, connect five facilities to the sanitary system by installing 7,500 feet of new sewer pipe, and two new lift stations. This will eliminate non-compliant leaching fields and cess pools, reduce non-contact cooling water flow into the sewage system by 72 million gallons per year by: diverting flow to the storm system; converting water heat exchangers to air cooled condensers; and replacing water cooled equipment in 15 buildings. The STP anaerobic sludge digester will be replaced with an aerobic sludge digester to eliminate high maintenance activity and improve performance.

[a] Title I and Title II Design funding of $545,000 requested under Project Engineering Design (PED) Project No. 03-SC-001.

b. Subproject 09 - Fire Safety Improvements, Phase IV (ANL-E)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
8,381	400	5,951	2,030	0	0	3Q 2001 - 2Q 2003

This project will complete the effort of correcting known deficiencies with respect to fire detection and alarm systems; life safety and OSHA related sprinkler systems; and critical means of egress in twenty-eight (28) buildings at the Argonne National Laboratory-East (ANL-E) site. Correction of these deficiencies is required to comply with DOE Order 420.1, OSHA 1910,164, and OSHA Subpart C. These deficiencies, if uncorrected, could result in unmitigated risks of injury to personnel and/or damage to DOE property in case of fire.

c. Subproject 12 - Site-wide Water Distribution System Upgrade (LBNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
8,300	0	1,000	4,400	2,900	0	2Q 2002 – 1Q 2004

This project will rehabilitate the Laboratory's High Pressure Water (HPW) System that supplies over 100 facilities at LBNL. The HPW System provides domestic water, fire water, treated water, cooling tower water and low conductivity water. It consists of 9.6 km of pipe (1.4 km of cast iron pipe, 6.3 km of ductile iron pipe, and 1.9 km of cement lined coated steel pipe), associated valves, pumps, fittings etc. and two 200,000 gallon emergency fire water tanks. This project will: replace all cast iron pipe, which is in imminent danger of failing, with ductile iron pipe; electrically isolate pipe and provide cathodic protection; replace leaking valves and add pressure reducing stations to prevent excessive system pressure at lower lab elevations; add an emergency fire water tank to serve the East Canyon; and provide the two current emergency fire water tanks with new liners and seismic upgrades.

d. Subproject 13 - Groundwater and Surface Water Protection Upgrades (BNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
6,050	0	1,889	2,763	1,398	0	2Q 2002 - 1Q 2004

This project will implement a backlog of ground and surface water protection projects that are commitments to regulators. These include: proper closure of inactive supply and injection wells; runoff control for the surplus material storage yard; containment and runoff control for the radioactive material storage yard; replacement of 12 hydraulic elevator cylinders; removal of 22 underground fuel oil tanks; and other Suffolk County Article 12 upgrades.

e. Subproject 14 - Fire Protection System Upgrade (ORNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
5,920	0	584	3,120	2,216	0	3Q 2002 - 4Q 2004

This project will upgrade the 36 year-old fire protection system with improved, more reliable fire alarm and suppression capabilities by: replacing deteriorated, obsolete systems; replacing the single 16-inch water main in the east central section of ORNL with a looped system (7,000 lf of 16 inch pipe); and by extending coverage of automatic alarm systems to areas not previously served. New fire alarm equipment will provide emergency responders with greatly improved annunciation of the causes and locations of alarms and will provide code compliant occupant notification evacuation alarms for enhanced life safety. It will also include timesaving, automatic diagnostic capabilities that will reduce maintenance costs. The new occupant notification systems will comply with the Americans with Disabilities Act. The fire alarm receiving equipment at the site fire department headquarters will be upgraded to ensure its reliability, modernize its technology, and meet the demands of an expanded fire alarm system network.

f. Subproject 16 – Electrical Systems Modifications, Phase II (BNL)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
6,770	0	555	3,300	2,915	0	2Q 2002 – 1Q 2004

This project is the second phase of the modernization and refurbishment of the Laboratory's deteriorating 50 year-old electrical infrastructure. The project includes: installation of two new 13.8 kV feeders to provide alternate sources to existing, aged feeders; installation of additional underground ductbanks to support a new 13.8 kV feeder; replacement of 2.4 kV switchgear to increase system reliability/safety; reconditioning of 50 480-volt circuit breakers including replacing obsolete trip units with modern, solid-state trip devices; and the retrofit of 10 13.8 kV air breakers with new vacuum technology.

g. Subproject 17 – – Mechanical and Control Systems Upgrade, Phase I (ANL-E)

TEC	Prev.	FY 2001	FY 2002	FY 2003	Outyear	Construction Start/ Completion Dates
9,000	0	0	803 [a]	3,045	5,152	3Q 2003 – 3Q 2005

This design project will provide design to upgrade and replace 30-40 year old mechanical system components in various facilities. It will optimize capacity, enhance system reliability and performance, improve safety, and reduce maintenance and repair costs of primary building mechanical equipment and control systems. The mechanical systems designated for replacement are no longer adequate, reliable, or efficient, and do not meet current ES&H standards (i.e. failure of

[a] Title I and Title II Design funding requested under Project Engineering Design (PED) Project No. 02-SC-001.

laboratory exhaust systems could lead to the release of radioactive material). Specifically, this project will: upgrade HVAC systems in Bldgs. 221 and 362, including heating and cooling coils, fans, filter systems, ductwork, controls, and variable frequency drive fans; upgrade lab exhaust systems in Bldgs. 202 and 306, including new fans, ductwork, and controls; upgrade corroded drainage systems in Bldgs. 200, 205 and 350; and upgrade steam and condensate return systems in 12 facilities in the 360 area. This will include high and low pressure steam supply piping and associated pressure reducing stations, valves, and accessories; and replacing condensate pumping systems including piping, valves and system controls.

4. Details of Cost Estimate

N/A

5. Method of Performance

To the extent feasible, construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bids.

6. Schedule of Project Funding

N/A

7. Related Annual Funding Requirements

N/A

8. Design and Construction of Federal Facilities

All DOE facilities are designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, "Federal Compliance with Pollution Control Standards;" section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order 12196, and the related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part 1960); and the Architectural Barriers Act, Public Law 90-480, and implementing instructions in 41 CFR 101-19.6. The project will be located in an area not subject to flooding determined in accordance with Executive Order 11988. DOE has reviewed the GSA inventory of Federal Scientific laboratories and found insufficient space available, as reported by the GSA inventory.

control systems. The mechanical systems designated for replacement are no longer adequate, reliable, or efficient, and do not meet current ES&H standards (i.e. failure of laboratory exhaust systems could lead to the release of radioactive material). Specifically, this project will: upgrade HVAC systems in Bldgs. 221 and 362, including heating and cooling coils, fans, filter systems, ductwork, controls, and variable frequency drive fans; upgrade lab exhaust systems in Bldgs. 202 and 306, including new fans, ductwork, and controls; upgrade corroded drainage systems in Bldgs. 200, 205 and 350; and upgrade steam and condensate return systems in 12 facilities in the 360 area. This will include high and low pressure steam supply piping and associated pressure reducing stations, valves, and accessories; and replacing condensate pumping systems including piping, valves and system controls.

4. Details of Cost Estimate

N/A

5. Method of Performance

To the extent feasible, construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bids.

6. Schedule of Project Funding

N/A

7. Related Annual Funding Requirements

N/A

8. Design and Construction of Federal Facilities

All DOE facilities are designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, "Federal Compliance with Pollution Control Standards;" section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order 12196, and the related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part 1960); and the Architectural Barriers Act, Public Law 90-480, and implementing instructions in 41 CFR 101-19.6. The project will be located in an area not subject to flooding determined in accordance with Executive Order 11988. DOE has reviewed the GSA inventory of Federal Scientific laboratories and found insufficient space available, as reported by the GSA inventory.

Fusion Energy Sciences

Program Mission

The Fusion Energy Sciences (FES) program leads the national research effort to advance plasma science, fusion science, and fusion technology—the knowledge base needed for an economically and environmentally attractive fusion energy source. Fusion offers the potential for abundant, safe, environmentally attractive, affordable energy. The science and the technology of fusion have progressed to the point that the next major research step is the exploration of the physics of a self-sustained plasma reaction in a burning plasma physics experiment. The Office of Science (SC) will fund research that supports such an experiment. In addition, SC will fund the exploration of innovative approaches to confining, heating, and fueling plasmas. In order to develop a predictive capability to design future fusion experiments and energy systems, unique, state-of-the-art experiments and theoretical models benchmarked against those experiments will be funded by SC. The characteristics of the materials used in the construction of fusion power plants will determine the environmental impact that those power plants will have on the environment. SC will support scientific research aimed at developing materials for fusion applications in coordination with its basic materials science program that will ensure that fusion-generated power will have a minimal environmental impact. SC will support and sustain basic plasma science research as the vital scientific core of the fusion program.

Strategic Objectives

SC6: Advance the fundamental understanding of plasma, the fourth state of matter, and enhance predictive capabilities, through the comparison of well-diagnosed experiments, theory and simulation; for Magnetic Fusion Energy (MFE), resolve outstanding scientific issues and establish reduced-cost paths to more attractive fusion energy systems by investigating a broad range of innovative magnetic confinement configurations; advance understanding and innovation in high-performance plasmas, optimizing for projected power-plant requirements; develop enabling technologies to advance fusion science, pursue innovative technologies and materials to improve the vision for fusion energy; and apply systems analysis to optimize fusion development; for Inertial Fusion Energy (IFE), leveraging from the Inertial Confinement Fusion (ICF) program sponsored by the National Nuclear Security Agency's (NNSA) Office of Defense Programs, advance the fundamental understanding and predictability of high energy density plasmas for IFE.

SC7: Provided major advanced scientific user facilities where scientific excellence is validated by external review; average operational downtime does not exceed 10% of schedule; construction and upgrades are within 10% of schedule and budget; and facility technology research and development programs meet their goals.

Progress toward accomplishing these Strategic Objectives will be measured by Program Strategic Performance Goals, Indicators and Annual Targets, as follows:

Program Strategic Performance Goals

SC6-1: Develop the basis for a reliable capability to predict the behavior of magnetically confined plasma and use the advances in the Tokamak concept to enable the start of the burning plasma physics phase of the U.S. fusion sciences program. (Science subprogram)

Performance Indicator

The range of parameter space over which theoretical modeling and experiments agree.

Performance Standards

As discussed in Corporate Context/Executive Summary.

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Improved nonlinear magneto-hydrodynamics codes to be capable of computing the effect of realistic resistive walls and plasma rotation on advanced tokamak pressure limits. (met goal)	Use recently upgraded plasma microwave heating system and new sensors on DIII-D to study feedback stabilization of disruptive plasma oscillations.	Complete installation of internal coils for feedback control of plasma instabilities on DIII-D, and conduct a first set of experiments demonstrating the effectiveness of these coils in controlling plasma instabilities, and compare with theoretical predictions.
Evaluated first physics results from the innovative Electric Tokamak at UCLA, to study fast plasma rotation and associated radial electric fields due to radiofrequency-drive, in order to enhance plasma pressure in sustained, stable plasmas. (Exploratory Concept-Electric Tokamak) (met goal)	Successfully demonstrate innovative techniques for initiating and maintaining current in a spherical torus.	Produce high temperature plasmas with 5 Megawatts of Ion Cyclotron Radio Frequency (ICRF) power for pulse lengths of 0.5 seconds in Alcator C-Mod. Study the stability and confinement properties of these plasmas, which would have collisionalities in the same range as that expected for the burning plasma regime.

SC6-2: Develop the cutting edge technologies that enable FES research facilities to achieve their scientific goals and investigate innovations needed to create attractive visions of designs and technologies for fusion energy systems. (Enabling R&D subprogram)

Performance Indicator

Percentage of milestones met for installing components developed by the Enabling R&D program on existing experimental devices.

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Completed the DOE-Japan Atomic Energy Research Institute collaboration on fusion plasma chamber exhaust processing in the Tritium Systems Test Assembly (TSTA) facility at LANL. (met goal)	Complete design and fabrication of the High-Power Prototype advanced ion-cyclotron radio frequency antenna that will be used at the Joint European Torus (JET).	Complete testing of the High-Power Prototype advanced ion-cyclotron radio frequency antenna that will be used at the Joint European Torus.
Initiated a new U.S.-Japan collaborative program for research on enabling technologies, materials, and engineering science for an attractive fusion energy source. (met goal)	Complete measurements and analysis of thermal creep of Vanadium Alloy (V-4Cr-4Ti) in vacuum and lithium environments, determine controlling creep mechanisms and access operating temperature limits.	Complete preliminary experimental and modeling investigations of nano-scale thermodynamic, mechanical, and creep-rupture properties of nanocomposited ferritic steels.

SC7-6: Manage all FES facility operations and construction to the highest standards of overall performance, using merit evaluation and independent peer review. (Facility Operations subprogram)

Performance Indicator

Percent on time/on budget, percent unscheduled downtime.

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Kept deviations in cost and schedule for upgrades and construction of scientific user facilities within 10 percent of approved baselines; achieved planned cost and schedule performance for dismantling, packaging, and offsite shipping of the Tokamak Fusion Test Reactor (TFTR) systems [Met Goal]	Keep deviations in cost and schedule for upgrades and construction of scientific user facilities within 10 percent of approved baselines; successfully complete within cost and in a safe manner all TFTR decontamination and decommissioning activities.	Keep deviations in cost and schedule for upgrades and construction of scientific user facilities within 10 percent of approved baselines; complete the National Compact Stellarator Experiment (NCSX) Conceptual Design and begin the Preliminary Design.
Kept deviations in weeks of operation for each major facility within 10 percent of the approved plan. [Met Goal]	Keep deviations in weeks of operation for each major facility within 10 percent of the approved plan.	Keep deviations in weeks of operation for each major facility within 10 percent of the approved plan.

Significant Accomplishments and Program Shifts

Science

SCIENCE ACCOMPLISHMENTS

Research funded by the Fusion Energy Sciences program in FY 2001 produced major scientific results over a wide range of activities. Examples of these results include:

- Enhanced Understanding of Electric Currents in a Plasma—Experiments on controlling electric currents in the plasma with high-power microwaves on DIII-D have demonstrated the predicted improvement in the efficiency of this process with increased plasma pressure, and achieved the efficiency that is required for future "advanced tokamak" experiments. The same microwave system was also used to eliminate a class of instabilities that otherwise limit the achievable plasma pressure in these "advanced" operating modes.
- Improvements in High Harmonic Fast Wave Heating—This heating technique has emerged as a powerful control tool on National Spherical Torus Experiment (NSTX). This form of wave heating now permits new operating scenarios with overall improvements in plasma heating effectiveness.
- Improvements in Controlling Plasma Heating—Researchers have continued to work on a powerful tool for creating and manipulating desired "internal transport barriers" which prevent unwanted heat leakage from magnetically confined fusion plasmas. At the Alcator C-Mod, researchers have developed a technique known as "off-axis ion cyclotron radio frequency heating," which can produce a clean transport barrier in the core. Using multiple frequencies, it is now found that the evolution of the transport barrier can be controlled and the potential for steady-state operation has been demonstrated.
- Reduction in Energy Transport—Greatly reduced energy transport has been achieved in the Reversed Field Pinch (RFP), an innovative confinement concept experiment at the University of Wisconsin. Optimization of the current-profile has further improved confinement so that the global energy confinement time is now nine times that of a standard RFP plasma. This confinement significantly exceeds the empirical scaling that has characterized this fusion concept for several decades.
- Enhanced Plasma Control System on DIII-D — As plasma pressure increases, the plasma itself can cause deformations of the magnetic field configuration, which very rapidly destroy the plasma confinement. Theoretical predictions indicated that a perfectly conducting wall surrounding the plasma can improve its stability. It was also believed that when the plasma spins rapidly, an ordinary metallic wall should have the same stabilizing properties of a perfectly conducting wall. Recent experiments at DIII-D by a collaborative team of scientists from General Atomics, Columbia University and Princeton Plasma Physics Laboratory have made use of new plasma control systems to improve stability. The control system detects and opposes deformations of the plasma in much the same way that a superconducting wall would; it also automatically corrects small irregularities in the magnetic field, which would otherwise tend to have a "braking" effect on the rotation of the plasma. With the new control system, the plasma pressure was increased stably up to levels almost twice as high as allowed in absence of such control. These results are potentially important for the development of steady-state advanced tokamaks, and may allow these devices to operate stably well above the conventional pressure limit if plasma rotation can be maintained.

- A Novel Operating Mode on Alcator C-Mod—The Enhanced D-alpha (EDA) operating mode first seen on Alcator C-Mod exhibits many promising features, such as excellent energy confinement, while exhibiting neither accumulation of impurities nor the occurrence of large edge oscillations. New and very accurate measurements have revealed that the density and electric field fluctuations, from a quasi-coherent oscillation, drive particle transport across magnetic field lines. These results together with ongoing theoretical efforts provide insight with regard to the physics of this very promising mode of operation for future machines.

- Development of Turbulence Modeling Computer Codes—Simulation codes containing turbulence computer models, in which plasma is represented by charged particles, including an improved physics model for the behavior of electrons, have been developed. Calculations using the code show that electron dynamics affect plasma stability in the presence of variations in ion temperature along the plasma radius. Previously, the system was modeled by electrons with simplified physics. It was shown that electrons are also responsible for instabilities due to variations in electron temperature. This research permits much more realistic modeling of transport.

- Improvements in Computer Modeling of the Plasma Edge—Recent improvements in computer modeling of edge turbulence have made it possible to simulate the transition from low confinement mode to high confinement mode in a tokamak. The models not only reproduce the main aspects of the transition, but also reproduce the sizes and frequencies of the turbulent regions that are in agreement with the experimental data.

- Advances in Understanding IFE Beam Transport—How a heavy ion driver beam is transported and focused in a target chamber must be known with high confidence because of the impact this information has on both target requirements and the beam that must be produced by the accelerator. Initial efforts directed toward this problem, including beam neutralization, have been carried out by upgrading existing facilities at LBNL and beginning development of a new plasma source conceived at PPPL.

- A New Research Device for Addressing IFE Development—One of the scientific and technical challenges to development of heavy ion drivers for IFE is the production of intense beams. A new 500-kilovolt test-stand was completed at LLNL and will be used for experiments to provide better understanding of the physics that determines how the necessary beam intensities can be generated. These experiments will provide the basis for new ion sources to be used in future high current experiments.

- Operation of a New Plasma Source—A coaxial magnetized plasma gun (spheromak source) with unconventional design has been constructed at Caltech and is now operational. The new gun emphasizes geometric simplicity to provide insight into a novel startup mechanism and spheromak formation. This method allows one to dispense with the large, expensive high voltage insulators used in traditional designs.

- Initial Operation of an Advanced Stellarator—The Helical Symmetric Experiment (HSX), the first advanced stellarator in the world to test quasi-symmetry, is completing its first year of plasma operations at the University of Wisconsin. Well-formed nested magnetic surfaces have been observed, and a method has been developed and applied to experimentally measure the magnitude of the magnetic field.

- Initial Operation of a New Field Reversed Configuration Experiment—The Translation, Confinement, & Sustainment (TCS), Field Reversed Configuration (FRC) experiment became fully operational at the University of Washington. Rotating magnetic fields were applied using the Los Alamos National Laboratory-built power supply. Standard elongated, flux confined FRCs were generated and sustained in steady state for as long as the power was supplied (up to 2.5 milliseconds). Both analytical and numerical models were developed to explain this unique current drive mechanism, which has many possible applications to fusion confinement.

Facility Operations

FACILITY ACCOMPLISHMENTS

In FY 2001, funding was provided to operate facilities in support of fusion research experiments and to upgrade facilities to enable further research in fusion and plasma science. Examples of accomplishments in this area include:

- The DIII-D program continued to identify improved methods of operation of fusion facilities. DIII-D was operated with high plasma density, a key issue for future machine designs, and the operating methods were extended to the large JET tokamak in England in a collaborative program. Improved performance was achieved in both facilities. Also, DIII-D accomplished a small-scale test of magnetic field feedback controls, which have enabled improved plasma performance. Also, the new Electron Cyclotron Heating System performed very well.
- Improved plasma operating scenarios with long pulses and high reproducibility were developed at NSTX. These efforts include the development of elongation control algorithms, experimentation with plasma current ramp rates, boronization, and between-shots helium glow discharge cleaning. In addition, NSTX plasma operation has been improved by the full coverage of the plasma facing surfaces with carbon tiles, which reduced a significant source of metallic impurities. Further, the neutral beam system was successfully brought into operation.
- The Alcator C-Mod Lower Hybrid heating system improvement project, a combined MIT/PPPL collaboration, successfully completed the system final design, and procurement of components was initiated. The project is on track for completion in FY 2003.
- The TFTR decontamination and decommissioning (D&D) activities at PPPL proceeded on cost and schedule. There were a number of significant technical accomplishments during the year. In the first quarter, PPPL conducted the largest single lift of the project when they removed the 92-ton umbrella structure over the vacuum vessel. In addition, PPPL has filled the TFTR vacuum vessel with concrete and has initiated cutting the vessel into smaller pieces to be sent to a DOE waste repository for burial.

Enabling R&D

SCIENCE ACCOMPLISHMENTS

A number of technological advances were made in FY 2001 that enabled plasma experiments to achieve their research goals, allowed access to experimental regimes in devices not available domestically, and provided innovations in new technologies that improve the vision of fusion as an attractive energy source. Examples include:

- Scientists at Princeton Plasma Physics Lab, University of California San Diego, and Sandia National Lab conducted experiments in a toroidal plasma to investigate the phenomenon of plasma contact with liquid surfaces and to guide development of models for plasma-liquid interactions critical to research on innovative concepts for plasma particle removal and surface heat flux removal. Such capabilities could be readily used for scientific studies in plasma experiments to control key parameters of the plasma edge, such as plasma particle density and temperature, and to carry away intense surface heat locally deposited by the plasma at its edge. For the longer-term, liquid surface technology can provide for much longer lifetimes and higher performance plasma-facing components than is possible with conventional solid surface approaches.

- Researchers at Oak Ridge National Lab, University of California Los Angeles, University of California Santa Barbara, and Lawrence Livermore National Lab developed models for microstructural evolution in candidate fusion materials under simulated conditions associated with fusion. These models unify and integrate the theories on mechanisms that control damage production from energetic neutron bombardment. Also, the models enable nanosystem methods for designing fusion materials with significantly improved performance and lifetimes, and with elemental tailoring that minimizes radioactivity generation by neutron-induced transmutation. The ability to produce superior materials for fusion applications is critical to the viability of using fusion energy for practical applications with benign environmental impacts.
- Researchers at ORNL and PPPL began the design of the prototype of a high power radio frequency antenna that will enable increased levels of plasma heating. The prototype, which will be built in FY 2002 and tested in FY 2003, will validate the design, performance, and fabrication techniques of antennas to be built for use in the JET plasma experiment. These antennas, which will provide the world's most powerful radio frequency plasma heating capability, will permit investigation into advanced modes of fusion-relevant plasma performance.
- Work was initiated on the Safety and Tritium Applied Research (STAR) facility at INEEL, the site for all FES-funded tritium research following the shutdown of the Tritium Systems Test Assembly (TSTA) facility at Los Alamos National Lab. Tritium research at STAR will be focused on more fundamental studies than were conducted at TSTA and will use a small fraction of the tritium used at TSTA for fusion fuel cycle demonstration. In FY 2003, experiments will begin on tritium-related issues of candidate coolant materials for fusion energy systems and of plasma interaction with materials.

AWARDS

- An ORNL researcher received the American Nuclear Society's (ANL) Outstanding Lifetime Achievement Award from the ANS Fusion Energy Division.
- A Cal Tech research scientist has been selected to receive this year's Solar Physics division (SPD) Popular Writing Award to a professional scientist for an article "Simulating Solar Prominences in the Laboratory," which appeared in American Scientist. Each year the SPD Popular Writing Awards Committee awards one prize to a scientist for articles published in U.S. or Canadian newspapers, magazines, or semi-popular journals.
- An NSTX team member at PPPL received the "Engineer of the Year" Award from the New Jersey Society of Professional Engineers, in recognition of outstanding achievements in engineering, contributions to the development of fusion as a long-term energy source, and notable service in enhancing the prestige of the engineering profession.
- The 2001 American Physical Society, Division of Plasma Physics Award for Excellence in Plasma Physics was received by four researchers at three institutions - General Atomics, the University of California, Los Angeles, and the Princeton Plasma Physics Laboratory.
- A University of Maryland fusion theorist received the American Physical Society's James Clark Maxwell Prize for Plasma Physics.

- Eight fusion researchers were elected Fellows of the American Physical Society.
- One fusion researcher was elected a Fellow of the American Nuclear Society.

PROGRAM SHIFTS

The budget requested for FY 2003 is $9,830,000 higher than the FY 2002 Appropriation. The FY 2003 budget generally supports the program balance and priorities recommended by the Fusion Energy Sciences Advisory Committee and supported by the Secretary of Energy Advisory Board and the National Research Council (NRC).

Science

The General Plasma Science program is increased to reflect additional collaborative efforts with NSF. For the remainder of this subprogram, scientific efforts will continue at the pace established in FY 2002.

Facility Operations

Funds made available by the expected completion of the TFTR D&D activity, and an increase of $9.8 million to the overall FES budget are used to increase significantly the run times at each of the three major fusion experimental facilities. The remainder of the funds made available by the completion of the TFTR D&D activity is used to maintain base program research efforts at their FY 2002 level, and to initiate the design and fabrication of the National Compact Stellarator Experiment (NCSX) Major Item of Equipment project at PPPL.

Enabling R&D

Materials research is increased to take advantage of advances in microstructural design of materials for fusion. Funding for Advanced Design and Analysis is reduced nearly $1,000,000 with the completion of a two-year study of possible IFE power plant systems. The remainder of the scientific efforts funded under this subprogram will continue at the pace established in FY 2002.

Workforce Development

The FES program, the Nation's primary sponsor of research in plasma physics and fusion science, supports development of the R&D workforce by funding undergraduate researchers, graduate students working toward a doctoral degree, and postdoctoral associates developing their research and management skills. The R&D workforce developed as a part of this program provides new scientific talent to areas of fundamental research. It also provides talented people to a wide variety of technical and industrial fields that require finely honed thinking and problem solving abilities and computing and technical skills. Scientists trained through association with the FES program are employed in related fields such as plasma processing, space plasma physics, plasma electronics, and accelerator/beam physics as well as in other fields as diverse as biotechnology and investment and finance.

In FY 2001, the FES program supported 365 graduate students and post-doctoral investigators. Of these, 50 conducted research at the DIII-D tokamak at General Atomics, the Alcator C-Mod tokamak at MIT, or the NSTX at PPPL.

Scientific Facilities Utilization

The Fusion Energy Sciences request includes $111,037,000 to operate and make use of major fusion scientific user facilities. The Department's three major fusion energy physics facilities are: the DIII-D tokamak at General Atomics in San Diego, California; the Alcator C-Mod Tokamak at the Massachusetts Institute of Technology; and the National Spherical Torus Experiment at the Princeton Plasma Physics Laboratory. These three facilities are each unique in the world's fusion program and offer opportunities to address specific fusion science issues that will contribute to the expanding knowledge base of fusion. Taken together, these facilities represent a nearly $1,000,000,000 capital investment by the U.S. Government, in current year dollars.

The funding requested will provide research time for about 560 scientists in universities, federally sponsored laboratories, and industry, and will leverage both federally and internationally sponsored research, consistent with a strategy for enhancing the U.S. National science investment.

Funding Profile

(dollars in thousands)

	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Current Appropriation	FY 2003 Request
Fusion Energy Sciences					
Science	131,347	138,252	-592	137,660	142,565
Facility Operations	77,002	74,420	-269	74,151	78,653
Enabling R&D	33,608	35,823	-154	35,669	36,092
Subtotal, Fusion Energy Sciences	241,957	248,495	-1,015	247,480	257,310
General Reduction	0	-1,015	+1,015	0	0
Total, Fusion Energy Sciences	241,957 [a] [b]	247,480	0	247,480	257,310

Public Law Authorization:
Public Law 95-91, "Department of Energy Organization Act"
Public Law 103-62, "Government Performance and Results Act of 1993"

[a] Excludes $5,849,000 which has been transferred to the SBIR program and $351,000 which has been transferred to the STTR program.

[b] Excludes $336,000 transferred to Science Safeguards and Security program in an FY 2001 reprogramming.

Funding By Site

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Albuquerque Operations Office					
Los Alamos National Laboratory	7,258	7,378	7,308	-70	-0.9%
Sandia National Laboratories	3,178	2,992	3,213	+221	+7.4%
Total, Albuquerque Operations Office	10,436	10,370	10,521	+151	+1.5%
Chicago Operations Office					
Argonne National Laboratory	2,404	1,661	1,522	-139	-8.4%
Princeton Plasma Physics Laboratory	70,649	68,794	63,576	-5,218	-7.6%
Chicago Operations Office	44,975	44,569	49,317	+4,748	+10.7%
Total, Chicago Operations Office	118,028	115,024	114,415	-609	-0.5%
Idaho Operations Office					
Idaho National Engineering and Environmental Laboratory	2,210	2,326	2,392	+66	+2.8%
Oakland Operations Office					
Lawrence Berkeley National Laboratory	5,510	5,861	5,799	-62	-1.1%
Lawrence Livermore National Laboratory	14,586	14,255	14,411	+156	+1.1%
Oakland Operations Office	71,254	69,004	73,779	+4,775	+6.9%
Total, Oakland Operations Office	91,350	89,120	93,989	+4,869	+5.5%
Oak Ridge Operations Office					
Oak Ridge Inst. for Science & Education	940	419	808	+389	+92.8%
Oak Ridge National Laboratory	17,024	17,884	19,258	+1,374	+7.7%
Oak Ridge Operations Office	39	0	0	0	--
Total, Oak Ridge Operations Office	18,003	18,303	20,066	+1,763	+9.6%
Richland Operations Office					
Pacific Northwest National Laboratory	1,427	1,328	1,556	+228	+17.2%
Richland Operations Office	32	0	0	0	--
Total, Richland Operations Office	1,459	1,328	1,556	+228	+17.2%
Savannah River Operations Office					
Savannah River Laboratory	0	50	49	-1	-2.0%
Washington Headquarters	471	10,959	14,322	+3,363	+30.7%
Total, Fusion Energy Sciences	241,957 [a] [b]	247,480	257,310	+9,830	+4.0%

[a] Excludes $5,849,000 which has been transferred to the SBIR program and $351,000 which has been transferred to the STTR program.

[b] Excludes $336,000 transferred to Science Safeguards and Security program in an FY 2001 reprogramming.

Site Description

Argonne National Laboratory

Argonne National Laboratory (ANL) in Argonne, Illinois, is a Multiprogram Laboratory located on a 1,700-acre site in suburban Chicago. ANL has a satellite site located in Idaho Falls, Idaho. Argonne's Fusion Energy Sciences program contributes to a variety of enabling R&D program activities. Argonne has a lead role internationally in analytical models and experiments for liquid metal cooling in fusion devices. Studies of coatings for candidate structural alloy materials are conducted in a liquid lithium flow loop. Argonne's capabilities in the engineering design of fusion energy systems have contributed to the design of components, as well as to analysis supporting the studies of fusion power plant concepts.

Idaho National Engineering and Environmental Laboratory

Idaho National Engineering and Environmental Laboratory (INEEL) is a Multiprogram Laboratory located on 572,000 acres in Idaho Falls, Idaho. Since 1978, INEEL has been the Fusion Energy Sciences program's lead laboratory for fusion safety. As the lead laboratory, it has helped to develop the fusion safety database that will demonstrate the environmental and safety characteristics of both nearer term fusion devices and future fusion power plants. Research at INEEL focuses on the safety aspects of both magnetic and inertial fusion concepts for existing and planned domestic experiments, and developing further our domestic safety database using existing collaborative arrangements to conduct work on international facilities. In addition, with the shutdown of the Tritium Systems Test Assembly (TSTA) facility at LANL, INEEL will expand their research and facilities capabilities to include tritium science activities.

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory (LBNL) is a Multiprogram Laboratory located in Berkeley, California. The Laboratory is on a 200-acre site adjacent to the Berkeley campus of the University of California. For the Fusion Energy Sciences program, the laboratory's mission is to study and apply the physics of heavy ion beams and to advance related technologies for the U.S. Inertial Fusion Energy program. LBNL, LLNL, and PPPL work together in advancing the physics of heavy ion drivers through the Heavy Ion Fusion Virtual National Laboratory.

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory (LLNL) is a Multiprogram Laboratory located on an 821-acre site in Livermore, California. LLNL works with the Lawrence Berkley National Laboratory on the Heavy Ion Fusion program. The LLNL program also includes collaborations with General Atomics on the DIII-D tokamak, operation of an innovative concept experiment, the Sustained Spheromak Physics Experiment (SSPX) at LLNL, and benchmarking of fusion physics computer models with experiments such as DIII-D. LLNL, LBNL, and PPPL work together in advancing the physics of heavy ion drivers through the Heavy Ion Fusion Virtual National Laboratory.

Los Alamos National Laboratory

Los Alamos National Laboratory is a Multiprogram Laboratory located on a 27,000-acre site in Los Alamos, New Mexico. The budget supports the creation of computer codes for modeling the stability of plasmas, as well as work in diagnostics, innovative fusion plasma confinement concepts such as Magnetized Target Fusion, and the removal of the remainder of the recoverable tritium in FY 2003 from and completion of the stabilization of the Tritium Systems Test Assembly facility.

Oak Ridge Institute for Science and Education

Oak Ridge Institute for Science and Education (ORISE), operated by Oak Ridge Associated Universities (ORAU), is located on a 150-acre site in Oak Ridge, Tennessee. Established in 1946, ORAU is a consortium of 88 colleges and universities. The institute undertakes national and international programs in education, training, health, and the environment. For the FES program, ORISE supports the operation of the Fusion Energy Sciences Advisory Committee and administrative aspects of some FES program peer reviews. It also acts as an independent and unbiased agent to administer the Fusion Energy Sciences Graduate and Postgraduate Fellowship programs, in conjunction with FES, the Oak Ridge Operations Office, participating universities, DOE laboratories, and industries.

Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is a Multiprogram Laboratory located on a 24,000-acre site in Oak Ridge, Tennessee. ORNL develops a broad range of components that are critical for improving the research capability of fusion experiments located at other institutions and that are essential for developing fusion as an environmentally acceptable energy source. The laboratory is a leader in the theory of heating of plasmas by electromagnetic waves, antenna design, and design and modeling of pellet injectors to fuel the plasma and control the density of plasma particles. Research is also done in the area of turbulence and its effect on the transport of heat through plasmas. Computer codes developed at the laboratory are also used to model plasma processing in industry. While some ORNL scientists are located full-time at off-site locations, others carry out their collaborations with short visits to the host institutions, followed by extensive computer communications from ORNL for data analysis and interpretation, and theoretical studies. ORNL is also a leader in stellarator theory and design, and is a major partner with PPPL in conceptual design of the NCSX. ORNL leads the advanced fusion structural materials science program, contributes to research on all materials systems of fusion interest, coordinates experimental collaborations for two U.S.-Japan programs, and coordinates fusion materials activities.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) is a Multiprogram Laboratory located on 640 acres at the Department's Hanford site in Richland, Washington. The Fusion Energy Sciences program at PNNL is focused on research on materials that can survive in a fusion neutron environment. The available facilities used for this research include mechanical testing and analytical equipment, including state-of-the-art electron microscopes, that are either located in radiation shielded hot cells or have been adapted for use in evaluation of radioactive materials after exposure in fission test reactors. Experienced scientists and engineers at PNNL provide leadership in the evaluation of ceramic matrix composites for fusion applications and support work on vanadium, copper and ferritic steels as part of the U.S. fusion materials team. PNNL also plays a leadership role in a fusion materials collaboration with Japan, with Japanese owned test and analytical equipment located in PNNL facilities and used by both PNNL staff and up to ten Japanese visiting scientists per year.

Princeton Plasma Physics Laboratory

Princeton Plasma Physics Laboratory (PPPL) is a program-dedicated laboratory (Fusion Energy Sciences) located on 72 acres in Princeton, New Jersey. PPPL is the only U.S. Department of Energy (DOE) laboratory devoted primarily to plasma and fusion science. It hosts experimental facilities used by multi-institutional research teams and also sends researchers and specialized equipment to other fusion facilities in the United States and abroad. PPPL is the host for the NSTX, which is an innovative toroidal confinement device closely related to the tokamak, and is currently working on the conceptual design of another innovative toroidal concept, the NCSX, a compact stellarator. PPPL scientists and engineers have significant involvement in the DIII-D and Alcator C-Mod tokamaks in the U.S. and the large JET (Europe) and JT-60U (Japan) tokamaks abroad. This research is focused on developing the scientific understanding and innovations required for an attractive fusion energy source. PPPL scientists are also involved in several basic plasma science experiments, ranging from magnetic reconnection to plasma processing. PPPL, through its association with Princeton University, provides high quality education in fusion-related sciences, having produced more than 175 Ph.D. graduates since it's founding in 1951. PPPL, LBNL, and LLNL work together in advancing the physics of heavy ion drivers through the Heavy Ion Fusion Virtual National Laboratory.

Sandia National Laboratory

Sandia National Laboratory is a Multiprogram Laboratory, located on a 3,700 acre site in Albuquerque, New Mexico, with other sites in Livermore, California, and Tonopah, Nevada. Sandia's Fusion Energy Sciences program plays a lead role in developing components for fusion devices through the study of plasma interactions with materials, the behavior of materials exposed to high heat fluxes, and the interface of plasmas and the walls of fusion devices. Sandia selects, specifies, and develops materials for components exposed to high heat and particles fluxes and conducts extensive analysis of prototypes to qualify components before their use in fusion devices. Materials samples and prototypes are tested in Sandia's Plasma Materials Test Facility, which uses high-power electron beams to simulate the high heat fluxes expected in fusion environments. Materials and components are exposed to tritium-containing plasmas in the Tritium Plasma Experiment. Tested materials are characterized using Sandia's accelerator facilities for ion beam analysis. Sandia supports a wide variety of domestic and international experiments in the areas of tritium inventory removal, materials postmortem analysis, diagnostics development, and component design and testing.

All Other Sites

The Fusion Energy Sciences program funds research at more than 50 colleges and universities located in approximately 30 states. It also funds the DIII-D tokamak experiment and related programs at General Atomics, an industrial firm located in San Diego, California.

Science

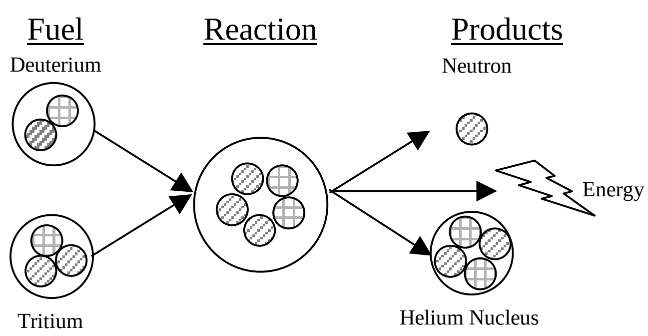
Mission Supporting Goals and Objectives

The Science subprogram develops the basis for a reliable capability to predict the behavior of plasma in a broad range of plasma confinement configurations and use advances in the Tokamak concept to enable the start of the burning plasma physics phase of the U.S. fusion sciences program. Over the next five years FES-funded research will advance the understanding of plasma, the fourth state of matter and enhance predictive capabilities, through comparison of experiments, theory and simulation. This integrated research will focus on well-defined plasma scientific issues including turbulence and transport, macroscopic stability, wave particle interactions and multiphase interfaces. Progress will be made on methods for sustaining and controlling high temperature, high density plasmas, based on improved understanding of fundamental issues. Advanced computational techniques will be integrated into research to provide significantly improved predictive capability for plasma behavior.

An additional objective of the Science subprogram is to broaden the intellectual and institutional base in fundamental plasma science. Two activities, an NSF/DOE partnership in plasma physics and engineering and development grants for junior members of university plasma physics faculties, have been the major contributors to this objective.

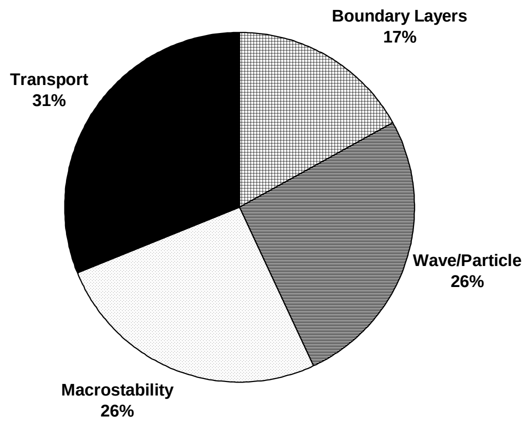
Plasma science is the study of the ionized matter that makes up 99 percent of the visible universe, ranging from neon lights to stars. It includes not only plasma physics but also other physical phenomena in ionized matter, such as atomic, molecular, radiation-transport, excitation and ionization processes. These phenomena can play significant roles in partially ionized media and in the interaction of plasmas with material walls. Plasma science contributes not only to fusion research, but also to many other fields of science and technology, such as astrophysics and industrial processing, and to national security.

Fusion science is focused primarily on describing the fundamental processes taking place in plasmas where the temperatures (greater than 100 million degrees Celsius) and densities permit hydrogenic nuclei that collide to fuse together, releasing energy and producing the nucleus of a helium atom and a neutron.



The Fusion Process

Fusion science shares many scientific issues with plasma science. For Magnetic Fusion Energy (MFE), these scientific issues include: (1) chaos, turbulence, and transport; (2) stability, magnetic reconnection, and dynamos (3) wave-particle interaction and plasma heating; and (4) sheaths and boundary layers. Progress in all of these research issues is likely to be required for ultimate success in achieving a practical fusion energy source.



Science subprogram estimated funding allocation to address the MFE science issues.

For IFE, the two major science issues are: (1) high energy density physics that describes intense laser-plasma and beam-plasma interactions, and (2) non-neutral plasmas, as is seen in the formation, transport, and focusing of intense heavy ion beams.

The largest component of the Science subprogram is research that focuses on gaining a predictive understanding of the behavior of the high temperature, high-density plasmas typically required for fusion energy applications. The tokamak magnetic confinement concept has thus far been the most effective approach for confining plasmas with stellar temperatures within a laboratory environment. Many of the important issues in fusion science are being studied in an integrated program on the two major U.S. tokamak facilities, DIII-D at General Atomics and Alcator C-Mod at the Massachusetts Institute of Technology. Both DIII-D and Alcator C-Mod are operated as national science user facilities with research programs established through public research forums, program advisory committee recommendations, and peer review. There is also a very active program of collaboration with comparable experience abroad aimed at establishing an international database of Tokamak experimental results.

DIII-D has extensive diagnostic instrumentation to measure what is happening in the plasma. It also has unique capabilities to shape the plasma, which, in turn, affect particle transport in the plasma and the stability of the plasma. DIII-D has been a major contributor to the world fusion program over the past decade in the areas of plasma turbulence, energy and particle transport, electron-cyclotron plasma heating and current drive, plasma stability, and boundary layer physics using a “magnetic divertor” to control magnetic field configuration at the edge of the plasma. (The divertor is produced by magnet coils that bend the magnetic field at the edge of the tokamak out into a region where plasma particles following the field are neutralized and pumped away.)

Alcator C-Mod is a unique, compact tokamak facility that uses intense magnetic fields to confine high temperature, high-density plasmas in a small volume. It is also unique in the use of metal (molybdenum) walls to accommodate the high power densities in this compact device. Alcator C-Mod has made significant contributions to the world fusion program in the area of ion-cyclotron frequency wave-particle interaction, plasma heating, stability, and confinement.

In the future, both DIII-D and Alcator C-Mod will focus on using their flexible plasma shaping and dynamic control capabilities to attain good confinement and stability by controlling the distribution of current in the plasma with radio wave current drive and the interface between the plasma edge and the material walls of the confinement vessel with a "magnetic divertor." Achieving these high performance regimes for longer pulse duration will require simultaneous advances in all of the scientific issues listed above.

In addition to the advanced toroidal research on DIII-D and Alcator C-Mod, exploratory work will continue on two university tokamak experiments. The goal of the High Beta Tokamak (HBT) at Columbia University is to demonstrate the feasibility of stabilizing high plasma pressure within a tokamak configuration by a combination of a close-fitting conducting wall, plasma rotation, and active feedback. This work will be closely coordinated with the DIII-D program, and promising results have already been achieved on DIII-D. The Electric Tokamak (ET) at UCLA will explore several new approaches to toroidal magnetic confinement; emphasizing radio wave driven plasma rotation and the achievement of very high plasma pressure relative to the applied magnetic field to produce a deep magnetic well.

The next largest research component is work on alternative concepts, aimed at extending fusion science and identifying concepts that may have favorable stability or transport characteristics that could improve the economic and environmental attractiveness of fusion energy sources. The largest element of the alternative concepts program is the NSTX at Princeton Plasma Physics Laboratory, which began its first full year of operation in FY 2000. Like DIII-D and Alcator C-Mod, NSTX is also operated as a national scientific user facility.

NSTX has a unique, nearly spherical plasma shape that complements the doughnut shaped tokamak and provides a test of the theory of toroidal magnetic confinement as the spherical limit is approached. Its favorable stability properties allow confinement at high plasma pressure relative to the applied magnetic field, and its high rate of shear for the flowing plasma should stabilize turbulence and lead to very good confinement. An associated issue for spherical torus configurations is the challenge of driving plasma current via radio-frequency waves or biasing electrodes. New computational and experimental techniques will be needed for the unique geometry and field configuration of the NSTX.

Exploratory research will also continue, on more than a dozen small-scale, alternative concept devices and basic science experiments, focusing on the scientific topics for which each experiment is optimized. For example, the Madison Symmetric Torus at the University of Wisconsin is a toroidal configuration with high current but low toroidal magnetic field that reverses direction near the edge of the discharge. The magnetic dynamo effect, which results from turbulent processes inside the plasma, spontaneously generates the field reversal at the plasma edge. This innovative experiment is investigating the dynamo mechanism, which is of interest to several fields of science including space and astrophysics, and turbulent transport, which is of interest to fusion science. The Levitated Dipole Experiment, a joint Massachusetts Institute of Technology/Columbia University program is exploring plasma confinement in a novel magnetic dipole configuration (similar to the magnetic fields constraining plasma in the earth's magnetosphere). At the Princeton Plasma Physics Laboratory, the Magnetic Reconnection Experiment addresses fundamental questions in magnetic reconnection, the process by which currents and flows in a plasma can induce changes in the topology of the magnetic field by breaking and reconnecting magnetic field lines. Magnetic reconnection is important not only in fusion experiments but also in phenomena like the solar flares, the solar wind and astrophysical plasmas.

A different set of insights into stability properties of plasmas should be developed from investigations into new stellarator configurations taking advantage of advances in stellarator theory, new computational capabilities, and insights from recent tokamak research. These stellarator configurations are nearly axisymmetric (like a tokamak) but do not require an externally driven current to produce an equilibrium. Thus, they should have transport properties similar to a tokamak but should have different stability properties. A national team is working on the design of a medium-size National Compact Stellarator Experiment (NCSX) that would be used to study plasma turbulence, energy and particle transport, and stability in this novel geometry. Conceptual designs also use an even more radical approach in the Quasi-Poloridal Stellarator (QPS), which has a different symmetry to achieve an even more compact configuration. Both approaches will strengthen U.S. involvement in the much larger world stellarator program.

An entirely different set of science explorations is being carried out in the area of high energy density plasma physics, the underlying field for Inertial Fusion Energy (IFE). In pursuing this science, the IFE activity is exploring an alternate path for fusion energy that would capitalize on the major R&D effort in inertial confinement fusion (ICF) carried out for stockpile stewardship purposes within the NNSA Office of Defense Programs. The IFE program depends on the ICF program for experimental research into the high energy density physics required for the design of energy producing targets and for future testing of the viability of IFE targets in the National Ignition Facility at LLNL. Efforts in IFE focus on understanding the physics of systems that will be needed to produce a viable inertial fusion energy source. These include heavy ion beam systems for heating and compressing a target pellet to fusion conditions, the experimental and theoretical scientific basis for modeling target chamber responses, and the physics of high-gain targets. The physics of intense heavy ion beams and other non-neutral plasmas is both rich and subtle, due to the kinetic and nonlinear nature of the systems and the wide range of spatial and temporal scales involved. For these reasons, heavy ion beam physics is of interest to the larger accelerator and beam physics community. The modeling of the fusion chamber environment is very complex and must include multi-beam, neutralization, stripping, beam and plasma ionization processes, and return current effects.

The theory and modeling program provides the conceptual underpinning for the fusion sciences program. Theory efforts meet the challenge of describing complex non-linear plasma systems at the most fundamental level. These descriptions range from analytic theory to highly sophisticated computer simulation codes, both of which are used to analyze data from current experiments, guide future experiments, design future experimental devices, and assess projections of their performance. Analytic theory and computer codes represent a growing knowledge base that, in the end, is expected to lead to a predictive understanding of how fusion plasmas can be sustained and manipulated.

An important element of the theory and modeling program is the FES portion of the Office of Science's Scientific Discovery Through Advanced Computing (SciDAC) program. Major scientific challenges exist in many areas of plasma and fusion science that can best be addressed through advances in scientific supercomputing. Projects currently underway are focused on understanding and controlling plasma turbulence, investigating the physics of magnetic reconnection, understanding and controlling magnetohydrodynamic instabilities in magnetically confined plasmas, simulating the propagation and absorption of radio waves in magnetically confined plasmas, and understanding atomic physics in the edge region of plasmas.

The general plasma science program supports basic plasma science and engineering research and advances the discipline of plasma physics. Topics explored include a broad range of fundamental research efforts in wave-plasma physics, dusty plasmas, non-neutral plasmas, and boundary layer effects. Important elements of this program include the NSF/DOE Partnership in Basic Plasma Science and Engineering, the Junior Faculty in Plasma Physics Development program, and the basic and applied plasma physics program at DOE laboratories.

In addition to their work on domestic experiments, scientists from the United States participate in leading edge scientific experiments on fusion facilities abroad, and conduct comparative studies to enhance understanding of underlying physics. The Fusion Energy Sciences program has a long-standing policy of seeking collaboration internationally in the pursuit of timely scientific issues. Collaboration avoids duplication of facilities that exist abroad. These include the world's highest performance tokamaks (JET in England and JT-60 in Japan), a stellarator (the Large Helical Device) in Japan, a superconducting tokamak (Tore Supra) in France, and several smaller devices. In addition, the U.S. is collaborating with South Korea on the design of a long-pulse, superconducting, advanced tokamak (KSTAR). These collaborations provide a valuable link with the 80% of the world's fusion research that is conducted outside the U.S.

Finally, development of improved diagnostic tools for analyzing plasma behavior continues to provide new insights into fusion plasmas and enables the detailed comparison between fusion theory and experiments. Non-perturbing measurements of the dynamic temperatures, densities, and electromagnetic fields in the core of near-burning plasmas presents a formidable challenge. Nonetheless, considerable progress in obtaining quantitative measurements has been made over the last decade. Balanced progress in theory and modeling, experimental operation, and the development of improved measurement systems has provided an excellent formula for scientific progress in fusion.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Tokamak Experimental Research	44,960	44,602	48,609	+4,007	+9.0%
Alternative Concept Experimental Research	50,620	50,736	50,913	+177	+0.3%
Theory	27,290	27,146	27,608	+462	+1.7%
General Plasma Science	8,477	8,786	9,060	+274	+3.1%
SBIR/STTR	0	6,390	6,375	-15	-0.2%
Total, Science	131,347	137,660	142,565	+4,905	+3.6%

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Tokamak Experimental Research	**44,960**	**44,602**	**48,609**
▪ **DIII-D Research**	**22,775**	**21,880**	**22,733**

The DIII-D tokamak facility provides the largest, well-diagnosed, high temperature experimental magnetic fusion facility in the U.S. The DIII-D experimental program is structured along the four key Magnetic Fusion Energy (MFE) fusion topical science areas — energy transport, stability, plasma-wave interactions, and boundary physics, and five thrust areas that integrate across topical areas to achieve fusion goals. In FY 2003, funding for physics research and data analysis will be increased. Research in all topical science and thrust areas will be pursued using the new microwave heating hardware modifications, a new diagnostic for current profile measurements, and enhanced computational tools. In particular, emphasis on testing different transport theories by comparison of experimental results and physics based computer models will continue. Control of stability limits, which has gone through an initial phase of experiments, will be further investigated by modification of current profiles with electron cyclotron waves. These studies are closely coupled to the theoretical basis for the instabilities. The installation of equipment that will allow 6 MW of electron cyclotron heating power to be injected into the plasma will be completed in the first quarter of FY 2002; this heating power will be used to further verify the predicted current drive physics. A new DIII-D operating mode exhibits two radial regions of improved heat insulation (transport barriers). The resulting plasmas have very high performance and possible steady state potential. Research efforts will be focused on finding a way to alleviate limitations imposed by the requirement of neutral beam injection in a direction to reduce the plasma current (for shaping the current profile) while maximizing the amount of current generated by the plasma itself. In FY 2003, the experimental operating time is being increased allowing an expanded experimental program on the topical science areas and on investigation of the physics of promising new approaches to Advanced Tokamaks.

▪ **Alcator C-Mod Research**	**7,391**	**7,745**	**8,464**

The Alcator C-Mod facility, by virtue of its very high magnetic field, is particularly well suited to operate in plasma regimes that are relevant to future, much larger fusion tokamaks as well as to compact, high field and density burning plasma physics tokamaks. The approach to ignition and sustained burn of a plasma is an important integrating science topic for fusion. In FY 2003, the funding for physics research and data analysis will be significantly increased from its current level. Research will be pursued to examine the physics of the plasma edge, power and particle exhaust from the plasma, mechanisms of self-generation of flows in the plasma, and the characteristics of the advanced confinement modes that are achieved in the plasma when currents are driven by radio waves. It will also continue to focus on exploring physics techniques for radiating away the large parallel heat flow encountered in the plasma exhaust at high densities and on visualization diagnostics for turbulence in the edge and core of high density plasmas. Increased operation of the machine will also allow further exploration of the compact high field tokamak regimes and operation scenarios required for achievement of ignition in compact devices. A new lower hybrid current drive system will be in the process of being commissioned. In FY 2003, radio frequency heating power will be increased and better discharge density control will be implemented, creating plasma conditions characterized by low collisionality, close to that required for a future power plant.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
▪ **International Collaborations and Education**.....................	**7,550**	**8,005**	**10,255**

International collaboration provides the opportunity for U.S. scientists to work with their colleagues on unique foreign tokamaks (JET, Tore Supra, TEXTOR, and ASDEX-UG in Europe, JT-60U in Japan, and KSTAR in Korea). These collaborations produce complementary and comparative data to those obtained on the U.S. tokamaks to further the scientific understanding of fusion physics and enhance the pace of fusion energy development. The United States will participate in the International Tokamak Physics Activity (ITPA) with Japan, Europe, and Russia to enhance collaboration on physics issues related to tokamak burning plasmas. In FY 2003, the collaboration with these programs will focus on ways of using the unique aspects of these facilities to make progress on the four key MFE Science issues cited in the Science Subprogram description. Funding for educational activities in FY 2003 will support research at historically black colleges and universities, graduate and postgraduate fellowships in fusion science and technology, summer internships for undergraduates, general science literacy programs for teachers and students, and outreach efforts related to fusion science and technology.

▪ **Experimental Plasma Research (Tokamaks)**.....................	**7,244**	**6,972**	**7,157**

Funding provided in this category supports research on innovative tokamak experiments at universities and the development of diagnostic instruments.

Several unique, innovative tokamak experiments are supported. In FY 2003, the High Beta Tokamak at Columbia will continue work on feedback stabilization of magnetohydrodynamic instabilities. Experiments in the Electric Tokamak at UCLA will continue to be directed at developing an understanding of the effects of plasma rotation at progressively higher levels of radio frequency heating power.

Development of unique measurement capabilities (diagnostic systems) that provide an understanding of the plasma behavior in fusion research devices will continue. This research provides the necessary information for analysis codes and theoretical interpretation. Some key areas of diagnostic research include the development of: (1) techniques to measure the cause of heat and particle loss from the core to the edge of magnetically confined plasmas, including techniques aimed at understanding how barriers to heat loss can be formed in plasmas; (2) methods to measure the production, movement, and loss/retention of the particles that are needed to ignite and sustain a burning plasma; and (3) new approaches that are required to measure plasma parameters in alternate magnetic configurations, which add unique constraints due to magnetic field configuration and strength, and limited lines of sight into the plasma. The requested funding level in FY 2003 supports the highest-rated renewal proposals, as well as any new research programs, that are recommended for funding as a result of a competitive peer review of the diagnostics development program in FY 2002.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Alternative Concept Experimental Research	**50,620**	**50,736**	**50,913**
▪ **NSTX Research**	**12,446**	**12,625**	**13,696**

NSTX is the one of the world's two largest embodiments of the spherical torus confinement concept. Plasmas in spherical tori have been predicted to be stable even when high ratios of plasma-to-magnetic pressure and self-driven current fraction exist simultaneously in the presence of a nearby conducting wall bounding the plasma. If these predictions are verified in detail, it would indicate that spherical tori use applied magnetic fields more efficiently than most other magnetic confinement systems and, could therefore, be expected to lead to more cost-effective fusion power systems in the long term.

In FY 2003, the funding for physics research and data analysis will be increased. The NSTX research team will focus on evaluating the plasma stability limits with auxiliary heating. Procedures for operating NSTX while using an improved control system will be refined. The investigation of the spherical torus plasma properties appropriate for enabling plasma pulse durations up to 1 second using non-inductive current drive is a crucial mission element of the NSTX program. The experience and understanding in current startup and maintenance using Coaxial Helicity Injection, radio-frequency wave, pressure gradient (bootstrap current), and magnetic induction will be combined to create the plasma conditions that minimize the dissipation of the solenoid magnet flux while permitting increased plasma pulse durations. In FY 2003 the program will demonstrate the use of a combination of non-inductive techniques to assist in starting up the plasma and sustaining it for up to 1 second and in development of operational scenarios for subsequent requirements of longer duration and higher performance plasmas. Extensive measurements and analysis of the interactions among these current drive techniques will be carried out over a range of plasma parameters and conditions to establish a basis to begin the development of the plasma conditions that enable the extension of the plasma pulse toward 5 seconds during FY 2004-2006.

In preparation for longer-term objectives, the research activities will concentrate on measuring and analyzing the dispersion of edge heat flux and assessing the impact on plasma facing component requirements under high heating power in NSTX; exploring and characterizing spherical torus plasmas having simultaneously good plasma containment and high plasma-to-magnetic pressure ratio for durations much larger than the energy containment times; and measuring and analyzing the effects of energetic ion driven instabilities on the physics mechanisms that limit the high ratios of plasma-to-applied toroidal field pressure and high energy confinement efficiency in spherical torus plasmas. The spherical torus plasma, as in all high beta plasmas, is uniquely characterized by fast ions of supra-Alfven velocities and with large radius of gyration relative to plasma size that could potentially lead to new plasma behaviors of interest. Comparison with theory will contribute to the scientific understanding of these effects needed to consider future experiments with similar energetic ion properties.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
▪ **Experimental Plasma Research (Alternatives)**..................	**24,536**	**24,609**	**23,443**

This budget category includes most of the experimental research on plasma confinement configurations outside of the three major national facilities described above. Funds in this category are provided for twelve small experiments, one intermediate level proof-of-principle experiment (reversed field pinch), and research in support of a novel compact stellarator design.

The majority of the research is directed toward toroidal configurations (the toroidal direction is the long way around a magnetic "doughnut"). For configurations with a large toroidal magnetic field, the research is focused on stellarators with special combinations of confining magnetic fields. The Helically Symmetric Torus at the University of Wisconsin is the world's first stellarator designed to use a simplified combination of such magnetic fields. Stellarator research at Auburn, ORNL, and PPPL also supports the new proof-of-principle experiment, NCSX, being proposed as part of the facility operation subprogram.

Two small spherical tori, the Helicity Injection Tokamak at the University of Washington and the Pegasus Experiment at the University of Wisconsin, are used in the experimental study of the physics of these compact toroidal shapes. Of particular interest for many of these small-scale experiments are methods used to form the magnetic shapes and to sustain them by injection of additional current in a controlled manner so that the configuration is not de-stabilized and destroyed.

Research on high energy density configurations in which the toroidal field is less than the poloidal (the short way around the magnetic "doughnut") field concentrates on pulse sustainment, confinement, and magnetic field reconnection (formation) processes. Many of these innovative experiments have relatively short pulses in comparison to tokamak discharges, and these experiments are investigating means of sustaining the pulse. These programs include the Madison Symmetric Torus (University of Wisconsin), a spheromak experiment at LLNL, and a small experiment at the California Institute of Technology designed to study the basic physics of the reconnection (formation) process itself.

Research on toroidal systems with the highest energy density includes systems with no toroidal magnetic field and relatively small poloidal magnetic fields. The field reversed configuration (FRC) experiment at the University of Washington, the world's most advanced experiment of this type, focuses on sustaining the relatively short pulses of these plasmas through novel electrical and plasma processes. The ion ring experiment at Cornell University seeks gross stabilization of the FRC through the use of large particle orbits in the magnetic fields (charged particles tend to move in circles in magnetic fields, hence the "orbit"). The levitated dipole experiment (LDX) at MIT will be studying a variant where the confining poloidal magnetic fields are generated by a superconducting magnetic ring located within the plasma itself. Dipole confinement is of great scientific interest in many solar and astrophysical plasma systems.

The magnetized target fusion program (funded by the FES program) at LANL and the Air Force Research Laboratory will study the possibility that an FRC plasma can be compressed to multi-keV temperatures using fast liner compression technology developed by the DOE Defense Programs.

In FY 2003, research efforts on most of these exploratory activities will continue. Research on new concepts will be initiated and old ones discontinued as appropriate through peer review.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
▪ **Inertial Fusion Energy Experiments**	**13,638**	**13,502**	**13,774**

The inertial fusion energy program has research components that encompass many of the scientific and technical elements that form the basis of an inertial fusion energy system. Heavy ion accelerators continue to be the leading IFE driver candidate. Understanding the physics of the intense heavy ion beam (multiple charged Bismuth, for example), a non-neutral plasma, is one of the outstanding scientific issues. Considerable progress has been made on developing a predictive physics model for intense heavy ion beams. This model, which includes aspects of the accelerator system, has the goal of providing an "end to end" simulation of a heavy ion accelerator. The close interplay between scaled experiments and theory and calculation assures that the model has been validated against experiment. Technical elements of the program include the continuing development of experimental systems to study beam formation by high current ion sources, beam acceleration and focusing. The high current experiment (HCX) at LBNL will be the primary experimental facility for heavy ion beam transport studies. The 500 kV test stand at LLNL will be used to study the physics of intense ion sources. Physics experiments carried out on NNSA-funded facilities including the National Ignition Facility (NIF) will provide high energy density physics data to be used in the design of targets for IFE experiments. NIF will provide validation of target design for actual model targets. The IFE science program will be focused on scientific and technical elements that will allow progress toward future integrated experiments.

Theory	**27,290**	**27,146**	**27,608**

The goal of the theory and computation program is to achieve a quantitative understanding of the behavior of fusion plasmas for interpreting experiments and for guiding the design of future devices. Considerable progress has been made in areas of macroscopic equilibrium and stability of magnetically confined plasmas and turbulence and transport in tokamak plasmas.

The theory and modeling development program is a broad-based program with researchers located at national laboratories, universities, and industry. The main thrust of the work in tokamak theory is aimed at developing a predictive understanding of advanced tokamak operating modes. These tools are also being extended to innovative or alternate confinement geometries. In alternate concept theory, the emphasis is on understanding the fundamental processes determining equilibrium, stability, and confinement in each concept. The generic theory work supports the development of basic plasma theory and atomic physics theory that is applicable to fusion research and to basic plasma science. A separate modeling effort is dedicated to developing computational tools to assist in the analysis of experimental data.

In FY 2003 the theory and computation program will continue to emphasize advanced computing and will make use of rapid developments in computer hardware to attack complex problems involving a large range of scales in time and space. These problems were beyond the capability of computers in the past, but advancements in computation are allowing a new look at problems that once seemed almost intractable. The objective of the advanced computing activities, including the SciDAC program, is to promote the use of modern computer languages and advanced computing techniques to bring about a qualitative improvement in the development of models of plasma behavior. This will ensure that advanced modeling tools are available to support a set of innovative national experiments and fruitful collaboration on major international facilities. In FY 2003, efforts will be focused on comparison of

	FY 2001	FY 2002	FY 2003

experimental results with improved turbulence calculations, the inclusion of the plasma's self-generated currents in gross stability simulations, simulation of the propagation and absorption of short wavelength waves in magnetized plasmas, and improved simulations of magnetic reconnection. These additions will improve the fidelity of the simulations and provide an enhanced predictive understanding of fusion plasmas.

	FY 2001	FY 2002	FY 2003
General Plasma Science	**8,477**	**8,786**	**9,060**

The general plasma science program is directed toward basic plasma science and engineering research. This research strengthens the fundamental underpinnings of the discipline of plasma physics, which makes contributions in many basic and applied physics areas, one of which is fusion energy. Principal investigators at universities, laboratories and private industry carry out the research. A critically important element is the education of plasma physicists. Continuing elements of this program are the NSF/DOE Partnership in Basic Plasma Science and Engineering, the Junior Faculty in Plasma Physics Development program and the basic and applied plasma physics program at DOE laboratories. In FY 2003, the program will continue to fund proposals that have been peer reviewed. A major joint announcement of opportunity in basic plasma physics will be held in 2003 under the NSF/DOE Partnership. Basic plasma physics user facilities will be supported at both universities and laboratories. Atomic and molecular data for fusion will continue to be generated and distributed through openly available databases. The Office of Fusion Energy Sciences will share the cost of funding plasma physics frontier science centers funded by NSF.

	FY 2001	FY 2002	FY 2003
SBIR/STTR	**0**	**6,390**	**6,375**

In FY 2001 $4,994,000 and $300,000 were transferred to the SBIR and STTR programs, respectively. The FY 2002 and FY 2003 amounts are the estimated requirements for the continuation of these programs. Beginning in FY 2002, all FES program SBIR/STTR requirements will be funded in the Science subprogram.

	FY 2001	FY 2002	FY 2003
Total, Science	**131,347**	**137,660**	**142,565**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Tokamak Experimental Research	
▪ Funding for DIII-D research is increased about 3.9% to provide additional funding for plasma research and data analysis in support of increased facility operations	+853
▪ Funding for Alcator C-Mod research is increased about 9.3% to provide for additional data analysis and research in support of increased facility operations	+719
▪ Funding is increased to allow for funding a number of modest scale research activities pending the outcome of reviews. This also provides partial funding for the transfer of ORNL personnel and equipment to a new experimental site on the ORNL campus	+2,250
▪ The level of funding for Tokamak Experimental Plasma Research is modestly increased to allow scientific efforts at close to the pace established in FY 2002	+185
Total, Tokamak Experimental Research	+4,007
Alternative Concept Experimental Research	
▪ Funding for NSTX research is increased about 8.5% to provide for additional diagnostics development, data analysis, and research in support of increased operations	+1,071
▪ Funding for compact stellarator research at PPPL and ORNL in this subprogram is reduced (-$2,501,000) as funding to start fabrication of the NCSX project is provided under the Facility Operations subprogram. Funding for other Alternate Concepts research is increased (+$1,335,000) to allow scientific efforts to follow up on FY 2002 results	-1,166
▪ Funding for IFE science is slightly increased to allow research to proceed close to the pace established in FY 2002	+272
Total, Alternative Concept Experimental Research	+177
Theory	
▪ Funding for theory and modeling to support experiments is increased to allow scientific efforts to proceed at close to the pace established in FY 2002.	+462
Total, Theory	+462

	FY 2003 vs. FY 2002 ($000)
General Plasma Science	
▪ The funds available for the NSF/DOE partnership are increased to provide funding opportunities within the NSF/DOE partnership, the plasma physics Junior Faculty Development possible program, and support with NSF of plasma science centers..........	+274
Total, General Plasma Science	+274
SBIR/STTR	
▪ Support for SBIR/STTR is provided at the mandated level.	-15
Total Funding Change, Science	+4,905

Facility Operations

Mission Supporting Goals and Objectives

The Facility Operations subprogram manages all FES facility operations and construction to the highest standards of overall performance, using merit evaluation and independent peer review. The fusion research facilities will be operated in a safe and environmentally sound manner, with high efficiency relative to the planned number of weeks of operation, with maximum quantity and quality of data collection relative to the installed diagnostic capability, and in a manner responsive to the needs of the scientific users. In addition, construction, fabrication and upgrades of major fusion facilities will be accomplished in accordance with highest standards and with minimum deviation from approved cost and schedule baselines.

This activity provides mainly for the operation, maintenance and enhancement of major fusion research facilities; namely, DIII-D at General Atomics, Alcator C-Mod at MIT, and NSTX at PPPL. These user facilities enable U.S. scientists from universities, laboratories, and industry, as well as visiting foreign scientists, to conduct the world-class research funded in the Science and Enabling R&D subprograms. The facilities consist of magnetic plasma confinement devices, plasma heating and current drive systems, diagnostics and instrumentation, experimental areas, computing and computer networking facilities, and other auxiliary systems. The Facility Operations subprogram funds: operating and maintenance personnel, electric power, expendable supplies, replacement parts, system modifications and facility enhancements as well as capital equipment funding for upgrading and enhancing the research capability of DIII-D and C-Mod. In FY2003, a significant increase in the operating time for the major fusion research facilities, to a level of 21 weeks for each facility, is proposed. This will provide an excellent scientific return on the capital investment in these facilities and will enable a much broader investigation of key fusion science issues than heretofore possible. Examples of this scientific return are described in the Science Subprogram section.

With the anticipated completion of TFTR D&D in FY 2002, funding from that activity is proposed to be used in FY 2003 to provide additional support for existing experiments, to increase the operating time of the major facilities and to initiate a Major Item of Equipment project. This project, known as the National Compact Stellarator Experiment (NCSX), would be located at PPPL and consists of the design and fabrication of a compact stellarator proof-of-principle class experiment. The Fusion Energy Sciences Advisory Committee has supported the physics basis for NCSX. This fusion confinement concept has the potential to be operated without plasma disruptions, leading to power plant designs that are simpler and more reliable than those based on the current lead concept, the tokamak. The initial total estimated cost (TEC) of NCSX is $69,000,000, with completion scheduled for mid-FY 2007. However, since the conceptual design has not been completed, the cost and schedule estimates are preliminary.

Funding is also included in this subprogram for General Plant Projects (GPP) and General Purpose Equipment (GPE) at PPPL. GPP and GPE funding supports essential facility renovations and other necessary capital alterations and additions to buildings and utility systems.

In summary, the principal objective of the Facility Operations subprogram is to operate the major fusion research facilities in a safe, environmentally sound manner for the number of weeks shown in the table below. Operating in this manner will maximize the quantity and quality of data collected at the facilities while building a culture of operational excellence and complying with all applicable safety and environmental requirements. Funding included for these facilities provides a significant increase in operating time relative to FY 2002.

The table below summarizes the scheduled weeks of operations for DIII-D, C-Mod, and NSTX.

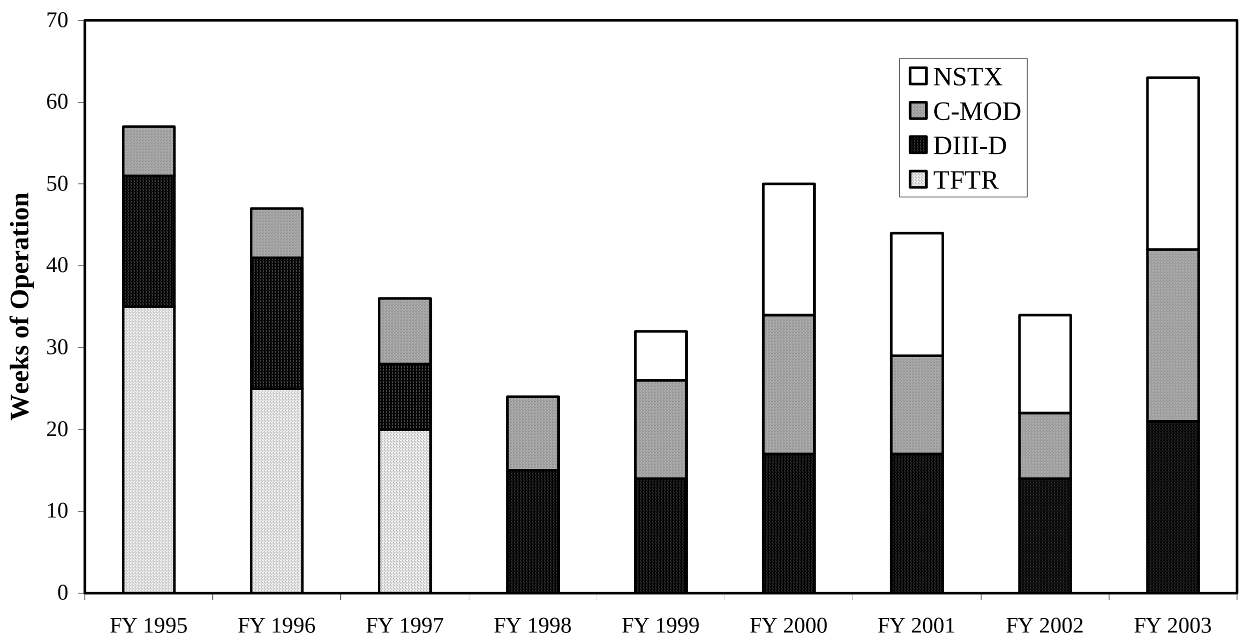
Accomplishments will be reported on specific performance measures involving leadership, excellence, and relevance; quality; and safety and health. The specific measures are for the deviation in weeks of operation of the major facilities to be within 10% of the scheduled weeks and for deviations in cost and schedule for construction, fabrication and upgrade projects to be within 10% of approved baselines. Data on worker injuries will be obtained and reviewed.

Weeks of Fusion Facility Operation

(Weeks of Operations)

	FY 2001	FY 2002	FY 2003
DIII-D	17	14	21
Alcator C-Mod	12	8	21
NSTX	15	12	21

Recent operating history of major fusion experimental facilities



Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
TFTR	19,625	19,604	0	-19,604	--
DIII-D	29,134	29,037	32,909	+3,872	+13.3%
Alcator C-Mod	10,645	9,835	13,789	+3,954	+40.2%
NSTX	15,089	14,186	19,446	+5,260	+37.1%
NCSX	0	0	11,026	+11,026	--
GPP/GPE/Other	2,509	1,489	1,483	-6	-0.4%
Total, Facility Operations	77,002	74,151	78,653	+4,502	+6.1%

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
TFTR	**19,625**	**19,604**	**0**

The TFTR Decontamination and Decommissioning (D&D) activity is planned for completion in FY 2002.

DIII-D	**29,134**	**29,037**	**32,909**

Provide significantly increased support for operation, maintenance, and improvement of the DIII-D facility and its auxiliary systems, such as the Electron Cyclotron Heating (ECH) systems. In FY 2003, these funds support 21 weeks of plasma operation.

Alcator C-Mod	**10,645**	**9,835**	**13,789**

Provide significantly increased support for operation, maintenance, major inspection of the electrical generator, and minor machine improvements. In FY 2003, these funds support 21 weeks of plasma operation. Fabrication of a plasma heating and current drive system for Alcator C-Mod will be completed in FY 2003. This enhancement, called lower Hybrid Modification, is a Major Item of Equipment with a TEC of $5,190,000 and a FY 2003 request of $1,019,000.

NSTX	**15,089**	**14, 186**	**19,446**

Provide significantly increased support for operation, maintenance, and improvement of the NSTX facility and installation of planned diagnostic upgrades. In FY 2003, these funds support 21 weeks of plasma operation.

NCSX	**0**	**0**	**11,026**

Initiate a Major Item of Equipment project to design and fabricate a compact stellarator proof-of principle class experiment with a TEC of $69,000,000. The TEC is preliminary because it is based on pre-conceptual design activities. The estimate will be improved as conceptual and preliminary design work is completed. Cost growth of up to 20% may occur before an approved baseline is established.

	FY 2001	FY 2002	FY 2003
	(dollars in thousands)		
General Plant Projects/General Purpose Equipment/Other	**2,509**	**1,489**	**1,483**

These funds provide primarily for general infrastructure repairs and upgrades for the PPPL site based upon quantitative analysis of safety requirements, equipment reliability and research needs.

	FY 2001	FY 2002	FY 2003
Total, Facility Operations	**77,002**	**74,151**	**78,653**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
TFTR	
▪ The TFTR Decontamination and Decommissioning (D&D) activity is planned for completion in FY 2002	-19,604
DIII-D	
▪ Experimental operating time is being increased from 14 weeks to 21 weeks to support high priority experiments and thereby relieve a large backlog of desirable research proposals	+3,872
Alcator C-Mod	
▪ Experimental operating time is being increased from 8 weeks to 21 weeks to support high priority experiments that take advantage of C-Mod's unique high field and wave heating systems	+3,954
NSTX	
▪ Experimental operating time is being increased from 12 weeks to 21 weeks to support important experiments that explore the limits of this unique, innovative confinement concept	+5,260
NCSX	
• Funding is provided to initiate the design and fabrication of the NCSX project at PPPL	+11,026
GPP/GPE/Other	
• Funding held essentially constant	-6
Total Funding Change, Facility Operations	+4,502

Enabling R&D

Mission Supporting Goals and Objectives

The Enabling R&D subprogram develops the cutting edge technologies that enable FES research facilities to achieve their goals and investigates innovations needed to create attractive visions of designs and technologies for fusion energy systems.

The Engineering Research element has completed a major restructuring following the U.S. withdrawal from the International Thermonuclear Experimental Reactor (ITER) project. The scope of activities has been substantially broadened to address more fully the diversity of domestic interests in enabling R&D for both magnetic and inertial fusion energy systems. These activities now focus on critical technology needs for enabling U.S. plasma experiments to achieve their full performance capability. Also, international technology collaborations allow the U.S. to access plasma experimental conditions not available domestically. These activities also include investigation of the scientific foundations of innovative technology concepts for future experiments. Another activity is advanced design of the most scientifically challenging systems for next-step fusion research facilities, i.e. facilities that may be needed in the immediate future. Also included are analysis and studies of critical scientific and technological issues, the results of which will provide guidance for optimizing future experimental approaches and for understanding the implications of fusion research on applications to fusion energy.

The Materials Research element continues to focus on the key science issues of materials for practical and environmentally attractive uses in fusion research and facilities while taking steps to implement the FESAC recommendations of 1998 that fusion materials research become more strongly oriented toward modeling and theory activities. This has made this element more effective at using and leveraging the substantial work on nanosystems and computational materials science being funded elsewhere, as well as more capable of contributing to broader materials research in niche areas of materials science. In addition, materials research of interest to both magnetic and inertial fusion energy systems has now been included in this element.

Management of the diverse and distributed collection of fusion enabling R&D activities is being accomplished through a Virtual Laboratory for Technology, with community-based coordination and communication of plans, progress, and results.

Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Engineering Research	26,979	28,528	28,454	-74	-0.3%
Materials Research	6,629	7,141	7,638	+497	+7.0%
Total, Enabling R&D	33,608	35,669	36,092	+423	+1.2%

Detailed Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
Engineering Research	**26,979**	**28,528**	**28,454**
▪ **Plasma Technology**	**12,040**	**11,777**	**12,092**

Plasma Technology efforts will be focused on critical needs of domestic plasma experiments and on the scientific foundations of innovative technology concepts for use in future magnetic and inertial fusion experiments. Nearer-term experiment support efforts will be oriented toward plasma facing components and plasma heating and fueling technologies. By early FY 2003, it is planned to complete testing of a prototype radio frequency antenna for the JET, the world's only plasma experiment using the complete set of fusion fuels, which will enable JET to build a powerful plasma heating device workable under rapidly changing plasma parameters. A design assessment for deploying a first-generation liquid metal system that interacts with the plasma to permit direct control of plasma particle densities and temperatures in NSTX or C-Mod will be completed. By the end of FY 2003, it is planned to complete the basic research that will determine the feasibility of deploying new plasma-facing component technology, which is based on flowing liquid surfaces, that could revolutionize the approach to plasma particle density and edge temperature control in plasma experiments. Development will continue to ensure the needed robustness of the current 1.0 million watt microwave generator that will efficiently heat plasmas to temperatures needed to verify computer models; development will also address critical issues on an advanced 1.5 million watt generator. Funds will be provided to continue superconducting magnet research and innovative technology research in the area of plasma-surface interaction sciences that will enable fusion experimental facilities to achieve their major scientific research goals and full performance potential.

	FY 2001	FY 2002	FY 2003
▪ **Fusion Technology**	**9,691**	**10,318**	**10,906**

Fusion Technology efforts will be focused on technology innovations and model improvements needed to resolve critical issues faced by both inertial and magnetic fusion concepts. These issues include identifying innovative approaches to fusion reaction chamber design as well as tritium and safety-related aspects of these chambers. In FY 2003, the required tritium inventory reduction and stabilization at TSTA will be completed and transferred to EM. By early FY 2003, it is planned to begin experiments in the newly constructed Safety and Tritium Applied Research (STAR) Facility at INEEL under a cost-sharing collaboration with Japan to resolve key issues of tritium control and chemistry for coolants proposed to be used in fusion energy systems. Technical assessment will be continued for technology issues and approaches for inertial fusion energy concepts in the areas of the high energy density plasma chambers, target fabrication and tracking, and target-chamber interfaces, including studies of safety issues. Funds will continue to be provided for the US/Japan collaboration

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

on innovative chamber technology research at a level that allows the US to more fully exploit investments made to enable this collaboration in tritium, coolant flow, and heat transfer research facilities.

▪ **Advanced Design**	**5,248**	**6,433**	**5,456**

Funding for this element will focus on design studies of systems for next-step plasma science experiment options. Systems science studies to assess both the research needs underlying achievement of the safety, economics, and environmental characteristics and the prospects of possible inertial and advanced magnetic confinement concept fusion energy systems will be conducted in an iterative fashion with the experimental community.

Materials Research..	**6,629**	**7,141**	**7,638**

Materials Research remains a key element of establishing the scientific foundations for safe and environmentally attractive uses of fusion. Through a wide variety of modeling and experiment activities aimed at the science of materials behavior in fusion environments, research on candidate materials for the structural elements of fusion chambers will continue. Priorities for this work are based on the innovative approaches to evaluating materials and improved modeling of materials behavior that were adopted as a result of recommendations from the FESAC review completed in 1998. Research includes materials and conditions relevant to inertial fusion systems as well as magnetic systems. Investigations will be conducted on the limits of strength and toughness of materials based on dislocation propagation and interactions with crystalline matrix obstacles, and the changes to thermal and electrical conductivity in materials based on electron and photon transport and scattering at the atomic level.

SBIR/STTR..	**0**	**0**	**0**

In FY 2001 $855,000 and $51,000 were transferred to the SBIR and STTR programs, respectively. Beginning in FY 2002, all SBIR/STTR requirements will be funded in the Science subprogram.

Total, Enabling R&D	**33,608**	**35,669**	**36,092**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Engineering Research	
▪ Funding for plasma technologies is increased to allow scientific efforts to proceed at the pace established in FY 2002.	+315
▪ Funding for TSTA is decreased slightly to $2,953,000 as efforts to clean up the facility prior to turning it over to the Office of Environmental Management for Decontamination and Decommissioning are expected to be coming to completion. Funding for other fusion technologies activities is increased to allow scientific efforts to proceed at the pace established in FY 2002.	+588
▪ Funding is reduced due to the completion of the series of workshops necessary to prepare for the July 2002 community planning activity.	-977
Total, Engineering Research	-74
Materials Research	
▪ Funding for materials research is increased to allow additional peer reviewed scientific efforts to be initiated	+497
Total Funding Change, Enabling R&D	+423

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
General Plant Projects	2,094	1,370	995	-375	-27.4%
Capital Equipment	9,123	4,975	15,774	+10,799	+217.1%
Total, Capital Operating Expenses	11,217	6,345	16,769	+10,424	+164.3%

Major Items of Equipment *(TEC $2 million or greater)*

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior Year Approp-riations	FY 2001	FY 2002	FY 2003 Request at Target	Accept-ance Date
DIII-D Upgrade	27,203	26,360	843	0	0	FY 2001
Alcator C-Mod LH Modification	5,190	1,133	1,833	1,205	1,019	FY 2003
NCSX	69,000[a]	0	0	0	11,026	FY 2007
Total, Major Items of Equipment		27,493	2,676	1,205	12,045	

[a] TEC based on pre-conceptual design activities. The estimates will be improved as conceptual and preliminary design work is completed. Cost growth of up to 20% may occur.

Safeguards and Security

Program Mission

The mission of the Office of Science (SC) Safeguards and Security program is to ensure appropriate levels of protection against: unauthorized access, theft, diversion, loss of custody or destruction of Department of Energy (DOE) assets and hostile acts that may cause adverse impacts on fundamental science, national security or the health and safety of DOE and contractor employees, the public or the environment. Each site has a tailored protection program as analyzed and defined in each site's Security Plan (SP) or other appropriate plan. SC's Integrated Safeguards and Security Management (ISSM) strategy encompasses a graded approach to safeguards and security. This approach allows each site to design varying degrees of protection commensurate with the risks and consequences described with their site-specific threat scenarios.

The following is a brief description of the type of activities performed:

Protective Forces

The Physical Protection Protective Forces activity provides for security guards or other specialized personnel and equipment training and management needed to effectively carry out the protection tasks during normal and security emergency conditions.

Security Systems

The Physical Security Protective Systems activity provides for equipment to protect vital security interests and government property per the local threat. Equipment and hardware includes fences, barriers, lighting, sensors, entry control devices, etc. This hardware and equipment is generally operated and used to support the protective guard mission as well.

Information Security

The Information Security activity ensures that materials and documents, that may contain sensitive or classified information, are accurately and consistently identified, properly reviewed for content, appropriately marked and protected from unauthorized disclosure, and ultimately destroyed in an appropriate manner.

Cyber Security

The Cyber Security activity ensures that sensitive and classified information that is electronically processed or transmitted is properly identified and protected, and that all electronic systems have an appropriate level of infrastructure reliability and integrity.

Personnel Security

The Personnel Security activity includes security clearance programs, employee security education and visitor control. Employee education and awareness is accomplished through initial and termination briefings, re-orientations, computer based training, special workshops, publications, signs, and posters.

Material Control and Accountability

The Material Control and Accountability activity provides for the control and accountability of special nuclear materials, including training and development for assessing the amounts of material involved in packaged items, process systems and wastes. Additionally, this activity documents that a theft, diversion or operational loss of special nuclear material has not occurred. Also included is on-site and off-site transport of special nuclear materials in accordance with mission, environmental and safety requirements.

Program Management

The Program Management activity includes policy oversight and development and updating of security plans, assessments and approvals to determine if assets are at risk. Also encompassed are contractor management and administration, planning and integration of security activities into facility operations.

Strategic Objective

SC8-6: Ensure efficient SC program management of research and construction projects through a re-engineering effort of SC processes by FY 2003 that will support world class science through systematic improvements in SC's laboratory physical infrastructure, security, and ES&H.

Progress toward accomplishing this Strategic Objective will be measured by Program Strategic Performance Goals, Indicators and Annual Targets, as follows:

Program Strategic Performance Goals

SC8-6A: Performance will be measured by a 95% success rate for preventing unauthorized intrusions into SC Cyber Systems that process sensitive but unclassified information commensurate with risk.

Performance Indicator

Prevent unauthorized cyber intrusions. This will be accomplished by: (1) Reviewing Computer Incident Advisory Capability (CIAC) incident reports for SC sites that process sensitive but unclassified information to establish a current baseline number of unauthorized intrusions into SC Cyber Systems; and (2) 100% of SC CSPPs submitted and approved in a complete and timely manner. (SC8-6A)

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
During FY 2001, no national security incidents occurred within SC that caused unacceptable risk or damage to the Department. [Met Goal]	Establish baseline of actual intrusions.	95% success rate for preventing unauthorized intrusions into SC Cyber Systems that process sensitive but unclassified information commensurate with risk from FY 2002 baseline. This will be accomplished by: (1) Reviewing Computer Incident

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
		Advisory Capability (CIAC) incident reports for SC sites that process sensitive but unclassified information to establish a current baseline number of unauthorized intrusions into SC Cyber Systems; (2) Achieving, maintaining, and verifying that incidents remain below 5% and update Computer Security Program Plans (CSPPs) to reflect this posture; and (3) 100% of SC CSPPs submitted and approved in a complete and timely manner. (SC8-6A)

SC8-6B: Performance will be measured by a 95% success rate for prevention of unauthorized access into SC security areas.

Performance Indicator

Prevent unauthorized physical intrusions. This will be accomplished by: (1) Reviewing SC security area authorizations, central alarm station, and protective force post and patrol discrepancy logs to establish a current baseline number; and (2) 100% of Facility Security Surveys accomplished in a complete and timely manner. (SC8-6B)

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
During FY 2001, no national security incidents occurred within SC that caused unacceptable risk or damage to the Department. [Met Goal]	Establish baseline of actual intrusions.	95% success rate for prevention of unauthorized access into SC Security areas from FY 2002 baseline. This will be accomplished by: (1) Reviewing SC security area authorizations, central alarm station, and protective force post and patrol discrepancy logs to establish a current baseline number; (2) Achieving, maintaining, and verifying that unauthorized access incidents are less than 5%; and (3) 100% of Facility Security Surveys accomplished in a complete and timely manner. (SC8-6B)

Significant Accomplishments and Program Shifts

In FY 2003 there are no significant program shifts. In FY 2002 increased program emphasis was provided to cyber security commensurate with increased threats and technology advances. These improvements are in place and continue to be updated commensurate with technology advances and program risks. Physical security upgrades will be completed to ensure the protection of special nuclear materials as well as technical enhancements to electronic access controls.

Funding Profile

(dollars in thousands)

	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Current Appropriation	FY 2003 Request
Science Safeguards and Security					
Protective Forces	21,207	25,511	-4,105	21,406	22,345
Security Systems	3,798	7,473	-2,304	5,169	4,532
Information Security	874	1,248	-212	1,036	1,000
Cyber Security	6,631	10,630	-31	10,599	11,714
Personnel Security	1,859	2,837	-144	2,693	2,576
Material Control and Accountability	1,787	3,330	-683	2,647	2,676
Program Management	2,925	4,383	-324	4,059	3,284
Subtotal, Science Safeguards and Security	39,081	55,412	-7,803	47,609	48,127
Less Security Charge for Reimbursable Work	-4,648	-4,912	452	-4,460	-4,383
Subtotal, Science Safeguards and Security	34,433	50,500	-7,351	43,149	43,744
General Reduction	0	-205	205	0	0
Total, Science Safeguards and Security	34,433[a][b]	50,295	-7,146	43,149[b]	43,744

Public Law Authorization:
Public Law 95-91, "Department of Energy Organization Act"
Public Law 103-62, "Government Performance and Results Act of 1993"

[a] Includes $5,280,000 transferred from other Science programs ($4,780,000) and NNSA ($500,000) in an FY 2001 reprogramming.

[b] Excludes $6,194,000 in FY 2001 and $7,146,000 in FY 2002 transferred to Environmental Management in FY 2003 for Argonne National Laboratory – West safeguards and security activities.

Funding By Site

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Chicago Operations Office					
Ames Laboratory	264	397	409	+12	+3.0%
Argonne National Laboratory	5,139	7,679	7,809	+130	+1.7%
Brookhaven National Laboratory	9,428	10,916	10,970	+54	+0.5%
Fermi National Accelerator Laboratory	2,430	2,763	2,837	+74	+2.7%
Princeton Plasma Physics Laboratory	1,735	1,828	1,855	+27	+1.5%
Total, Chicago Operations Office	18,996	23,583	23,880	+297	+1.3%
Oakland Operations Office					
Lawrence Berkeley National Laboratory	3,492	4,706	4,753	+47	+1.0%
Stanford Linear Accelerator Center	1,814	2,150	2,207	+57	+2.7%
Total, Oakland Operations Office	5,306	6,856	6,960	+104	+1.5%
Oak Ridge Operations Office					
Oak Ridge Inst. for Science & Education	884	1,248	1,254	+6	+0.5%
Oak Ridge National Laboratory	4,939	7,882	7,913	+31	+0.4%
Thomas Jefferson National Accelerator Facility	552	947	972	+25	+2.6%
Oak Ridge Operations Office	8,404	7,062	7,148	+86	+1.2%
Total, Oak Ridge Operations Office	14,779	17,139	17,287	+148	+0.9%
Washington Headquarters	0	31	0	-31	--
Total, Science Safeguards and Security	39,081	47,609	48,127	+518	+1.1%
Less Security Charge for Reimbursable Work	-4,648	-4,460	-4,383	+77	+1.7%
Total, Science Safeguards and Security	34,433[ab]	43,149[b]	43,744	+595	+1.4%

[a] Includes $5,280,000 transferred from other Science programs ($4,780,000) and NNSA ($500,000) in an FY 2001 reprogramming.

[b] Excludes $6,194,000 in FY 2001 and $7,146,000 in FY 2002 transferred to Environmental Management in FY 2003 for Argonne National Laboratory – West safeguards and security activities.

Site Description

Safeguards and Security activities are conducted to meet the requirements of the following program elements: Physical Protection Protective Forces, Physical Security Protective Systems, Information Security, Cyber Security, Personnel Security, Material Control and Accountability, and Program Management. A summary level description of each activity is provided in the preceding Program Mission narrative. These activities ensure adequate protection of DOE security interests.

The attainment of the Safeguards and Security program goals and objectives are measured by progress made towards established performance measures. The technical excellence of the field security program is continually re-evaluated through field and Headquarters reviews. **Performance will be measured** at all sites by accomplishing the following:

- 95% success rate for preventing unauthorized intrusions into SC Cyber Systems that process sensitive but unclassified information commensurate with risk.
- 95% success rate for prevention of unauthorized access into SC security areas.

Detailed Program Justification

(dollars in thousands)

	FY 2001	FY 2002	FY 2003
Ames Laboratory..	**264**	**397**	**409**

The Ames Laboratory Safeguards and Security program coordinates planning, policy, implementation and oversight in the areas of security systems, protective forces, personnel security, material control and accountability, and cyber security. A protective force is maintained to provide protection of personnel, equipment, and property from acts of theft, vandalism, and sabotage through facility walk throughs, monitoring of electronic alarm systems, and emergency communications. Material control and accountability is maintained to prevent and/or deter the loss or misuse of nuclear materials. An increase in cyber security (+$13,000) will assist with current computer infrastructure protection needs and maintain status quo without enhancements. Minor adjustments are made in other elements (-$1,000) because of changing safeguards and security needs. Reimbursable work is included in the numbers above; the amount for FY 2003 is $26,000.

	FY 2001	FY 2002	FY 2003
Argonne National Laboratory...	**5,139**	**7,679**	**7,809**

The Argonne National Laboratory Safeguards and Security program provides protection of nuclear materials, classified matter, government property, and other vital assets from unauthorized access, theft, diversion, sabotage, espionage, and other hostile acts that may cause risks to national security, the health and safety of DOE and contractor employees, the public, or the environment. Program activities include security systems, material control and accountability, information and cyber security, and personnel security. In addition, a protective force is maintained. These activities ensure that the facility, personnel, and assets remain safe from potential threats. An increase (+$108,000) provides continuation of current cyber security initiatives, assist with current computer infrastructure protection needs and (+$94,000) in protective forces. There are adjustments to other elements (-$72,000) because of changing safeguards and security needs. Reimbursable work is included in the numbers above; the amount for FY 2003 is $388,000.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Brookhaven National Laboratory....................................	**9,428**	**10,916**	**10,970**

Brookhaven National Laboratory (BNL) Safeguards and Security program activities are focused on protective forces, cyber security, physical security, and material control and accountability. BNL operates a transportation division to move special nuclear materials around the site. Material control and accountability efforts focus on accurately accounting for and protecting the sites special nuclear materials. An increase (+$150,000) provides continuation of current cyber security initiatives, assist with current computer infrastructure protection needs and (+$312,000) in protective forces. There are adjustments (-$408,000) primarily to security systems and program management because of changing safeguards and security needs. Reimbursable work is included in the numbers above; the amount for FY 2003 is $806,000.

Fermi National Accelerator Laboratory	**2,430**	**2,763**	**2,837**

Fermi National Accelerator Laboratory Safeguards and Security program efforts are directed at maintaining protective force staffing and operations to protect personnel and the facility as well as at continuing cyber security, security systems, and a material control and accountability program to accurately account for and protect the facilities special nuclear materials. An increase to cyber security (+$77,000) will address infrastructure protection needs. There are adjustments to other elements (-$3,000) because of changing safeguards and security needs.

Lawrence Berkeley National Laboratory	**3,492**	**4,706**	**4,753**

The Lawrence Berkeley National Laboratory Safeguards and Security program provides physical protection of personnel and laboratory facilities. This is accomplished with protective forces, security systems, cyber security, personnel security, and material control and accountability of special nuclear material. An increase (+$463,000) provides continuation of current cyber security initiatives, assists with current computer infrastructure protection needs. Protective Forces increases (+$270,000). There is a reduction (-$686,000) to the other elements because of changing safeguards and security needs. Reimbursable work is included in the numbers above; the amount for FY 2003 is $830,000.

Oak Ridge Institute for Science and Education	**884**	**1,248**	**1,254**

The Oak Ridge Institute for Science and Education (ORISE) Safeguards and Security program provides physical protection/protective force services by employing unarmed security officers. The facilities are designated as property protection areas for the purpose of protecting government owned assets. In addition to the government owned facilities and personal property, ORISE possesses small quantities of nuclear materials that must be protected. The program includes information security, personnel security, protective forces, security systems, and cyber security. An increase (+$102,000) provides continuation of current cyber security initiatives, and assists with current computer infrastructure protection needs. Protective forces increases (+$50,000). There are reductions (-$146,000) primarily in security systems and program management because of changing safeguards and security needs. Reimbursable work is included in the numbers above; the amount for FY 2003 is $319,000.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Oak Ridge National Laboratory	**4,939**	**7,882**	**7,913**

The Oak Ridge National Laboratory (ORNL) Safeguards and Security program includes security systems, information security, cyber security, personnel security, material control and accountability, and program management. Program planning functions at the Laboratory provide for short and long range strategic planning, and special safeguards plans associated with both day-to-day protection of site-wide security interests and preparation for contingency operations. Additionally, ORNL is responsible for provision of overall laboratory policy direction and oversight in the security arena, for conducting recurring programmatic self-assessments; for assuring a viable ORNL Foreign Ownership, Control or Influence (FOCI) program is in place; and for identifying, or tracking, and obtaining closure on findings or deficiencies noted during inspections, surveys, or assessments of safeguards and security programs. The increase in cyber security (+$140,000) to assist with current computer infrastructure protection needs is partially offset by a reduction (-$109,000) in program management. Reimbursable work is included in the numbers above; the amount for FY 2003 is $1,945,000.

Oak Ridge Operations Office	**8,404**	**7,062**	**7,148**

The Oak Ridge Operations Office Safeguards and Security program provides for contractor protective forces for the Oak Ridge National Laboratory. This includes protection of a category 1 Special Nuclear Material Facility. The program also consists of a minimal amount of funding for security systems, information security and personnel security. An increase (+$86,000) for protective forces is provided in order to protect people and property.

Princeton Plasma Physics Laboratory	**1,735**	**1,828**	**1,855**

The Princeton Plasma Physics Laboratory Safeguards and Security program provides for protection of nuclear materials, government property, and other vital assets from unauthorized access, theft, diversion, sabotage, or other hostile acts. These activities result in reduced risk to national security and the health and safety of DOE and contractor employees, the public, and the environment. There is a slight increase in the costs of cyber security (+$26,000) and security systems (+$45,000) partially offset by a reduction in program management (-$46,000). Also, there is a minor increase for protective forces (+$2,000). Reimbursable work is included in the numbers above; the amount for FY 2003 is $54,000.

Stanford Linear Accelerator Center	**1,814**	**2,150**	**2,207**

The Stanford Linear Accelerator Center Safeguards and Security program focuses on reducing the risk to DOE national facilities and assets. The program consists primarily of physical protection protective forces and cyber security program elements. An increase (+$49,000) for protective forces is provided to protect people and property, and (+$8,000) for cyber security to assist with current computer infrastructure protection needs. Reimbursable work is included in the numbers above; the amount for FY 2003 is $15,000.

	FY 2001	FY 2002	FY 2003
	(dollars in thousands)		
Thomas Jefferson National Accelerator Facility............	**552**	**947**	**972**

Thomas Jefferson National Accelerator Facility has a guard force that provides 24-hour services for the accelerator site and after-hours property protection security for the entire site. Other security programs include cyber security, program management, and security systems. An increase (+$28,000) provides continuation of current cyber security initiatives, assist with current computer infrastructure protection needs and (+$19,000) in protective forces. There is an adjustment (-$22,000) primarily in program management because of changing safeguards and security needs.

All Other...	**0**	**31**	**0**

This funding provides for program management needs for the Office of Science in FY 2002.

Subtotal, Science Safeguards and Security.....................	**39,081**	**47,609**	**48,127**
Less Security Charge for Reimbursable Work..............	**-4,648**	**-4,460**	**-4,383**
Total, Science Safeguards and Security...........................	**34,433**	**43,149**	**43,744**

Detailed Funding Schedule

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Ames Laboratory					
Protective Forces	126	140	143	+3	+2.1%
Security Systems	30	26	24	-2	-7.7%
Cyber Security	25	135	148	+13	+9.6%
Personnel Security	36	42	42	0	0.0%
Material Control and Accountability	6	6	7	+1	+16.7%
Program Management	41	48	45	-3	-6.3%
Total, Ames Laboratory	264	397	409	+12	+3.0%
Argonne National Laboratory					
Protective Forces	2,255	3,115	3,209	+94	+3.0%
Security Systems	294	480	455	-25	-5.2%
Information Security	126	246	211	-35	-14.2%
Cyber Security	893	1,780	1,888	+108	+6.1%
Personnel Security	634	885	904	+19	+2.1%
Material Control and Accountability	550	780	796	+16	+2.1%
Program Management	387	393	346	-47	-12.0%
Total, Argonne National Laboratory	5,139	7,679	7,809	+130	+1.7%
Brookhaven National Laboratory					
Protective Forces	5,553	5,834	6,146	+312	+5.3%
Security Systems	667	734	577	-157	-21.4%
Information Security	72	126	131	+5	+4.0%
Cyber Security	1,479	2,320	2,470	+150	+6.5%
Personnel Security	43	49	49	0	0.0%
Material Control and Accountability	592	701	742	+41	+5.8%
Program Management	1,022	1,152	855	-297	-25.8%
Total, Brookhaven National Laboratory	9,428	10,916	10,970	+54	+0.5%
Fermi National Accelerator Laboratory					
Protective Forces	1,427	1,646	1,700	+54	+3.3%
Security Systems	388	267	246	-21	-7.9%
Cyber Security	445	703	780	+77	+11.0%
Material Control and Accountability	65	36	49	+13	+36.1%
Program Management	105	111	62	-49	-44.1%
Total, Fermi National Accelerator Laboratory	2,430	2,763	2,837	+74	+2.7%

	FY 2001	FY 2002	FY 2003	$ Change	% Change
	(dollars in thousands)				
Lawrence Berkeley National Laboratory					
Protective Forces	1,086	1,122	1,392	+270	+24.1%
Security Systems	686	1,360	942	-418	-30.7%
Cyber Security	1,336	1,556	2,019	+463	+29.8%
Personnel Security	8	147	11	-136	-92.5%
Material Control and Accountability	16	80	38	-42	-52.5%
Program Management	360	441	351	-90	-20.4%
Total, Lawrence Berkeley National Laboratory	3,492	4,706	4,753	+47	+1.0%
Oak Ridge Institute for Science and Education					
Protective Forces	212	238	288	+50	+21.0%
Security Systems	65	162	100	-62	-38.3%
Information Security	91	145	139	-6	-4.1%
Cyber Security	371	318	420	+102	+32.1%
Personnel Security	140	108	108	0	0.0%
Program Management	5	277	199	-78	-28.2%
Total, Oak Ridge Institute for Science and Education	884	1,248	1,254	+6	+0.5%
Oak Ridge National Laboratory					
Security Systems	1,504	1,790	1,790	0	0.0%
Information Security	203	304	304	0	0.0%
Cyber Security	997	2,165	2,305	+140	+6.5%
Personnel Security	756	1,182	1,182	0	0.0%
Material Control and Accountability	558	1,044	1,044	0	0.0%
Program Management	921	1,397	1,288	-109	-7.8%
Total, Oak Ridge National Laboratory	4,939	7,882	7,913	+31	+0.4%
Oak Ridge Operations Office					
Protective Forces	7,679	6,455	6,541	+86	+1.3%
Security Systems	101	112	112	0	0.0%
Information Security	382	215	215	0	0.0%
Personnel Security	242	280	280	0	0.0%
Total, Oak Ridge Operations Office	8,404	7,062	7,148	+86	+1.2%
Princeton Plasma Physics Laboratory					
Protective Forces	933	903	905	+2	+0.2%
Security Systems	30	68	113	+45	+66.2%
Cyber Security	688	749	775	+26	+3.5%
Program Management	84	108	62	-46	-42.6%
Total, Princeton Plasma Physics Laboratory	1,735	1,828	1,855	+27	+1.5%

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Stanford Linear Accelerator Center					
Protective Forces	1,492	1,557	1,606	+49	+3.1%
Cyber Security	322	593	601	+8	+1.3%
Total, Stanford Linear Accelerator Center	1,814	2,150	2,207	+57	+2.7%
Thomas Jefferson National Accelerator Facility					
Protective Forces	444	396	415	+19	+4.8%
Security Systems	33	170	173	+3	+1.8%
Cyber Security	75	280	308	+28	+10.0%
Program Management	0	101	76	-25	-24.8%
Total, Thomas Jefferson National Accelerator Facility	552	947	972	+25	+2.6%
All Other					
Program Management	0	31	0	-31	--
Subtotal, Science Safeguards and Security	39,081	47,609	48,127	+518	+1.1%
Less Security Charge for Reimbursable Work	-4,648	-4,460	-4,383	+77	+1.7%
Total, Science Safeguards and Security	34,433	43,149	43,744	+595	+1.4%

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Ames Laboratory	
▪ Slight increase in cyber security (+$13,000), and other minor adjustments (-$1,000) because of changing safeguards and security needs...	+12
Argonne National Laboratory	
▪ Increases primarily in protective forces (+$94,000) and cyber security (+$108,000) and other adjustments made (-$72,000) because of changing safeguards and security needs...	+130
Brookhaven National Laboratory	
▪ Increases primarily in protective forces (+$312,000) and cyber security (+$150,000), and other adjustments (-$408,000) primarily in security systems and program management because of changing safeguards and security needs	+54
Fermi National Accelerator Laboratory	
▪ Increase primarily in cyber security (+$77,000) and adjustments to other elements (-$3,000) because of changing safeguards and security needs.	+74
Lawrence Berkeley National Laboratory	
▪ Increases in protective forces (+$270,000) and cyber security (+$463,000) offset by reductions to other elements (-$686,000) because of changing safeguards and security needs.	+47
Oak Ridge Institute for Science and Education	
▪ Increases to protective forces (+$50,000) and cyber security (+$102,000) partially offset by reductions (-$146,000) primarily to security systems and program management because of changing safeguards and security needs	+6
Oak Ridge National Laboratory	
▪ Increase in cyber security (+$140,000) partially offset by a reduction to program management (-$109,000) because of changing safeguards and security needs.	+31
Oak Ridge Operations Office	
▪ Increase in protective forces because of changing safeguards and security needs	+86
Princeton Plasma Physics Laboratory	
▪ Increases primarily in security systems (+$45,000) and cyber security (+$26,000) and other adjustments (-$44,000) primarily in program management because of changing safeguards and security needs..	+27

	FY 2003 vs. FY 2002 ($000)
Stanford Linear Accelerator Center	
▪ Increases in protective forces (+$49,000), and cyber security (+$8,000) because of changing safeguards and security needs	+57
Thomas Jefferson National Accelerator Facility	
▪ Increases primarily in protective forces (+$19,000) and cyber security (+$28,000) and other adjustments (-$22,000) primarily in program management because of changing safeguards and security needs.	+25
All Other	
▪ Reduction in program management for an FY 2002 activity	-31
Subtotal Funding Change, Science Safeguards and Security	+518
Less Security Charge for Reimbursable Work	+77
Total Funding Change, Science Safeguards and Security	+595

Capital Operating Expenses & Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Capital Equipment.......................................	161	0	0	0	0.0%
Total, Capital Operating Expenses...............	161	0	0	0	0.0%

Science Program Direction

Program Mission

The mission of Science Program Direction is: to provide and support a skilled, highly motivated Federal workforce to manage a broad set of scientific disciplines, programs, projects, and facilities. This program enables a skilled, highly motivated Federal workforce to manage the Office of Science's (SC) research portfolio and facilities in support of new and improved energy, environmental, and health technologies, and provides continuous science education opportunities.

Science Program Direction consists of three subprograms: Program Direction, Science Education, and Field Operations. Beginning in FY 2003, Program Direction and Field Operations are realigned to include all functions performed in the Office of Science (SC) Field complex in the Field Operations subprogram. With this change, the Program Direction subprogram becomes the single funding source for the SC Federal staff in Headquarters responsible for directing, administering, and supporting the broad spectrum of SC scientific disciplines. The Science Education subprogram supports four educational human resource development programs. The Department is committed to programs that train students to enter careers in Science, Mathematics, Engineering, and Technology (SMET). Each of the development activities within the Science Education subprogram targets a different group to attract a broad range of students and faculty to the programs and to expand the pipeline of students who can enter the SMET workforce. In this fashion the activities should help our national laboratories and the nation meet the demand for a well-trained scientific/technical workforce and strengthen the national security. The Field Operations subprogram is the centralized funding source for the Field Federal workforce responsible for the management and administrative functions at the Chicago and Oak Ridge Operations Offices and program management oversight provided by the site offices supporting SC laboratories and facilities, e.g., Argonne, Brookhaven, Fermi, and Lawrence Berkeley National Laboratories; the Princeton Plasma Physics Laboratory; the Thomas Jefferson National Accelerator Facility; the Stanford Linear Accelerator Center; and the Spallation Neutron Source.

Strategic Objective

SC-8: Ensure efficient SC program management of research and construction projects through a re-engineering effort by FY 2003 that will support world class science through systematic improvements in SC's laboratory physical infrastructure, security, and ES&H.

Progress toward accomplishing these Strategic Objectives will be measured by Program Strategic Performance Goals, Indicators and Annual Targets, as follows:

Program Strategic Performance Goals

SC8-3: Provide and support a world class Federal workforce with the capability to manage basic and applied research and development in support of new and improved energy, environmental, and health technologies by focusing on human capital management, strategic management systems, e-commerce initiatives, and providing efficient information management products and services. (Program Direction subprogram)

Performance Indicators

Number of completed workforce actions; research proposals received electronically.

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
Establish and fill 10 Excepted Service (EJ) positions. Implement process improvements and automated recruitment methods to expedite filling critical vacancies. [Met Goal]	Prepare a 5-Year Workforce Restructuring Plan. Recruit for all scientific and technical positions via the automated DOE Job On-line to reach a more diverse candidate pool and decrease the time to fill positions. Implement simplified position classification process/system to reduce administrative burdens and processing times. (SC8-3)	Implement actions netting near-term results as identified in 5-Year Workforce Plan. Initiate actions netting long-term culture and process changes. (SC8-3)
Implement the Procurement Module of the SC integrated system for internal grants administration processing. [Met Goal]	Initiate receipt of research proposals electronically through the Procurement Module of the SC integrated system; establish benchmark at 25% - currently at zero. (SC8-3)	Initiate receipt of research proposals electronically through the Procurement Module of the SC integrated system; establish benchmark at 50%. (SC8-3)
Develop and implement corporate application “Execution Work Management” supporting e-receipt/distribution of proposals. 100% roll out of Windows 2000. [Met Goal]	Initiate 2 major enhancements to the corporate application “Execution Work Management” package to include organization and tracking of electronic grants, proposals and abstracts. Implement Intranet Portal to provide a single login to all SC HQ corporate applications; establish benchmark of 100% - currently zero. Implement 2 corporate applications; “Worksheet Exchange” capability to export/import data from the Financial Management Information System for use in budget formulation and “Abstract Tracking” capability to create, modify, manage, view, and publish SC’s project abstracts. (SC8-3)	Implement 2 additional functionalities within the “Support Services” administrative functions package supporting SC’s concurrence process and procedures. Provide 10 new functionalities within the “Intranet” and “Execution Work Management,” packages to include electronic concurrence routing, mechanisms to release and receive field work proposals, etc. (SC8-3)

SC8-4: Expand the number and diversity of the applicant pool in the Office of Science undergraduate research internship programs; establish outside evaluation to assess the quality or the program as measured by student deliverables and evaluations; and develop a tracking system to monitor the long-term impact on career choices. (Science Education subprogram)

Performance Indicator

Number and quality of applicants.

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
More than 1,000 applicants for undergraduate laboratory research internships were received. 479 students were selected for summer 2001. 479 students were placed. [Met Goal]	Increase the number and/or diversity of the applicants by 20%. (SC8-4)	Increase the number and/or diversity of the applicants by 10%. (SC8-4)
80% of the student's research abstracts were acceptable for printing in the Undergraduate Research Journal. 15 full research papers are being published along with about 450 abstracts. [Met Goal]	90% of students submit acceptable abstracts. (SC8-4)	90% of students submit acceptable abstracts. (SC8-4)
Begin tracking employment of Participants at National labs and associated institutions. The Center for Workforce Development has begun the tracking of the students that are placed as interns. The database has been created at PNNL and all applicant students have been compiled and waiting for acceptance. After acceptance, the placed students will be tracked. [Met Goal}	Track career choices of at least 25% of the participating students. (SC8-4)	Track career choices of at least 25% of the participating students. (SC8-4)

SC8-5: Support a world class Federal workforce within the SC Field structure that (1) takes federal program and project management actions, (e.g., approvals, permits, self assessments, budgeting, etc.) to ensure safe, secure and efficient mission accomplishment in the field; (2) manages cradle to grave acquisition processes from strategy development to solicitation and award through closeout; (3) takes actions to preserve and protect DOE resources, provide for security of people, property and information, and conduct stakeholder interactions; and (4) maintains internal operations such as human resources, training, payroll and travel, legal counsel and information management, that enable the workforce to successfully perform. (Field Operations subprogram)

Performance Indicator

Percent costs avoided; number of accidents and incidents per year.

Performance Standards

As discussed in Corporate Context/Executive Summary.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Targets	FY 2003 Targets
	Take actions appropriate to the Headquarters and Field organizations to reduce SC's cost of doing business. Through re-engineering, areas of improvement will be identified where work could be taken out of the system by process improvements or the elimination of unnecessary requirements, thereby lowering the cost of doing business and improving SC's performance and accountability. These actions will result in Federal staffing changes. (SC8-5)	Continue to take actions appropriate to Headquarters and Field organizations to reduce SC's cost of doing business. Through re-engineering, areas of improvement will be identified where work could be taken out of the system by process improvements or the elimination of unnecessary requirements, thereby lowering the cost of doing business and improving SC's performance and accountability. These actions will result in Federal staffing changes. (SC8-5)
	Using the standard DOE metrics to track security incidents and trends and safety and health performance, take contractual and federal actions to reduce incidents and accidents by at least 20% compared to last year with the goal of zero security infractions and zero accidents. (SC8-5)	Using the standard DOE metrics to track security incidents and trends and safety and health performance, take contractual and federal actions to reduce incidents and accidents by at least 20% compared to last year with the goal of zero security infractions and zero accidents. (SC8-5)

Significant Accomplishments and Program Shifts

SCIENCE ACCOMPLISHMENTS

Program Direction

- Achieved technical excellence in SC programs despite managing one of the largest, most diversified, and complex basic research portfolios in the Federal Government with a relatively small Federal and contractor support staff.
- Aligned Federal safeguards and security activities at Oak Ridge Operations Office under Program Direction commencing in FY 2002.
- In FY 2001, established a partnership with the Office of Management, Budget and Evaluation that resulted in expediting the position classification and recruitment processes.

Science Education

- The Energy Research Undergraduate Laboratory Fellowship (ERULF) program has implemented an innovative, interactive Internet system to receive and process hundreds of student applications for summer, fall, and spring semester research appointments at participating DOE laboratories. The automated system is virtually paperless and provides an excellent example of how the Internet can be used to streamline the operation of the Department's research participation programs. The on-line application system is linked with an SC laboratory central processing center called EducationLink.

This system will enhance communication with the participants regarding their internships, contain pre- and post-surveys that quantify student knowledge, performance and improvement, and allow SC to measure program effectiveness and track students in their career path, and be a hosting site for publishing student papers and abstracts.

- Through special recruitment efforts, the Energy Research Undergraduate Laboratory Fellowship Program has attracted a diverse group of students using the electronic application. Nearly 20 percent of those submitting applications were from under-represented groups. Approximately 40 percent of the applicants were females, and more than 25 percent were from low-income families. In the summer of 1999, more than 400 appointments were made through the new application process and in the summers of 2000 and 2001 more than 500 appointments were made each year through the new application process.
- An undergraduate student journal was recently created which publishes full-length peer-reviewed research papers and abstracts of students in the program.
- Program Guidebooks were developed for the student participants in ERULF and the Community College Initiative (CCI) which provided formats and instructions for the written requirements, including scientific abstract, research paper, oral presentation, poster and education module.
- One additional regional competition was held in conjunction with DOE's National Science Bowl®. More than 11,000 high school students participated in the 61 regional science bowl tournaments.
- Saturday morning science seminars were added to the National Science Bowl weekend, introducing students to many contemporary issues and findings in scientific research.
- National Science Bowl awards were expanded to include a wide variety of academic awards to the top 18 teams and a Civility Award sponsored by IBM.
- The Albert Einstein Distinguished Educator Fellowship Program placed four outstanding K-12 science, math, and technology teachers in Congressional offices and one at DOE, as directed by legislation. The National Aeronautics and Space Administration and the National Science Foundation contributed funds to place seven additional Einstein Fellows in those agencies.
- In FY 2001, SC piloted for the third year, its DOE Community College Institute of Science and Technology. In the summer of 2001, more than 100 community college students attended a 10-week scientific research experience at several DOE multipurpose laboratories. Almost 60 percent of the participating students came from underrepresented groups in SMET; many were "non-traditional" students.

Field Operations

- Completed Phase I of an electronic-based document system to electronically distribute and track documents and records. Mail handlers now use one common system to log and scan both incoming and outgoing correspondence.
- Successfully implemented the Electronic Commerce–Web Based (EC Web) system. EC-Web is used for simplified acquisition requisitions and credit card purchases.
- Implemented the Employee Self Service (ESS) feature of the Corporate Human Resources Information System (CHRIS). Federal employees can now view payroll, benefits, and other personal information at their desktops via Internet access.

- The Oak Ridge Financial Service Center (ORFSC) successfully completed the migration of financial systems of satellite offices into Oak Ridge; one system now serves all offices: Oak Ridge Operations Office; Office of Scientific and Technical Information; Ohio Field Office; Savannah River Operations Office; Rocky Flats; Richland Operations Office; Strategic Petroleum Reserve Project Office; and the National Energy Technology Laboratory.
- Oak Ridge Operations Office is continuing both the development and the deployment of a budget execution and formulation system that supports funds control, financial plan distribution, and budget formulation. Oak Ridge, Chicago and two other offices, Savannah River and the Strategic Petroleum Reserve, are currently using this web-based system. The system provides a variety of report options used for analysis and funds tracking.
- Two acquisition process improvement activities that affected the closeout process and cost/price analysis at the Chicago Operations Office were conducted. Their implementation resulted in the saving of time and productive labor hours, as well as expediting the closeout process and the award process for Small Business Innovation Research and Small Business Technology Transfer program agreements.
- In response to SC's emphasis on the timely award of assistance instruments, the Chicago Acquisition and Assistance Group established a team to concentrate on processing and administering SC actions. In FY 2000, the team processed 1,149 actions, with an on-time award percentage of 91, which is considered outstanding.
- The Chicago Financial Services Group successfully converted all grants under the Department of Health and Human Services Payment Management System to the Automated Standard Application for Payments (ASAP) during the period May 2000 to February 2001. A schedule is in place to convert all remaining grants to ASAP by March 2002.
- The Chicago Intellectual Property Center of Excellence processed a significant portion of the inventions reported to DOE on innovations made under DOE contracts.
- The Brookhaven Area Office has established the first Small Business Development Center. The center aids small businesses in obtaining financial assistance, and also provides access for small businesses to the scientific staff at the Brookhvaven National Laboratory to help advance technologies for marketing.
- In FY 2001, the Chicago Operations Office incorporated the results of the Information Architecture Plan completed in FY 2000. The plan addresses their business needs and are consistent with Chicago’s strategic goals as well as the Clinger-Cohen Act of 1996.
- The Chicago Operations Office successfully supported DOE's science and technology mission at our laboratories through the negotiation and execution of five-year performance-based management and operating contracts. New contracts have been negotiated for Ames Laboratory (December 1999) and Argonne National Laboratory (June 2000). DOE has signed a five-year extension of its contract with Princeton University for management and operation of the Princeton Plasma Physics Laboratory in New Jersey. The new agreement will run from October 1, 2001, to September 30, 2006, and is valued at approximately $350,000,000 based on current funding.
- Initiated action to make the Field Operations subprogram the central funding source for all SC-funded Federal Field activities and take on additional resource requirements beginning in FY 2003, including the transfer of support service activities previously budgeted in the Science Laboratories Infrastructure program (Oak Ridge Landlord activity), and safeguards and security responsibilities at the Chicago Operations Office previously budgeted by the Office of Security and Emergency Operations.

PROGRAM SHIFTS

- Beginning with FY 2003, the Program Direction and Field Operations subprograms are restructured to align all functions performed in the SC Field complex within the Field Operations subprogram. With this change, Program Direction is the funding source for only SC Federal staff in Headquarters. In FY 2003, the Field Operations subprogram becomes the central funding source for all SC sponsored Federal field employees and the cost of administration within the field structure. In addition, support service activity previously budgeted under the Science Laboratories Infrastructure program (Oak Ridge Landlord activity) will be funded under the Field Operations subprogram in FY 2003. Line management responsibility for safeguards and security at both Oak Ridge and Chicago will be funded in the Field Operations subprogram. Funding for Chicago safeguards and security staff is transferred to SC from the Office of Security and Emergency Operations. This approach supports the thrust to reduce overhead by centralizing resources, properly aligning support service and line management responsibilities.
- In addition, SC is in the process of conducting a workforce reengineering study to address fundamental issues and functions within the Office. The study will design ways to maintain or improve SC's performance while reducing the cost of conducting its work. Phase I of the study—underway now—focuses on defining the principles by which a fully integrated Office of Science will operate, and on clarifying roles, responsibilities, authorities and accountabilities across the entire SC organization. Among the principles anticipated to emerge from the study are: use of consensus-based or industry standards rather than agency-specific orders wherever possible, reliance on external performance reviews instead of transactional oversight, tailoring DOE requirements to individual laboratories or programs as appropriate, and creating one seamless Office of Science regardless of geographic location. In anticipation of this, the FY 2003 budget request of $139,479,000 is significantly less than comparable budget requests in prior years. Consistent with the requested dollars, there is a net decrease of 203 full-time equivalents, mostly associated with downsizing the Federal workforce in the Field. The budget request for the Science Education subprogram is $5,460,000.
- The functions within the Environmental Management Science Program previously sponsored by the Office of Environmental Management and associated full-time equivalents (9) are transferred to SC in FY 2003. These resources are included as comparable adjustments in this budget. The Federal staff will become part of the Office of Biological and Environmental Research in Headquarters and thus are funded in the Program Direction subprogram.

Funding Profile

(dollars in thousands)

	FY 2001 Comparable Appropriation	FY 2002 Original Appropriation	FY 2002 Adjustments	FY 2002 Comparable Appropriation	FY 2003 Request
Science Program Direction					
Program Direction	47,831	72,500	-15,494	57,006	58,224
Science Education	4,460	4,460	0	4,460	5,460
Field Operations	87,570	63,000	+28,009	91,009	75,795
Subtotal, Science Program Direction	139,861	139,960	+12,515	152,475	139,479
General Reduction	0	-100	+100	0	0
Total, Science Program Direction	139,861[a] [b]	139,860	+12,615	152,475[a] [b]	139,479
Total Excluding Full Funding for Federal Retirements, Science Program Direction	132,865	132,862	+12,615	145,477	133,847
Staffing (FTEs)					
Headquarters (FTEs)	268	284	+9	293	299
Field (FTEs)	0 [c]	107 [c]	-107	0 [c]	0
Field Operations (FTEs)	621	551	+125	676	467
Total, FTEs	889	942	+27	969	766

Public Law Authorization:
Public Law 95-91, "Department of Energy Organization Act"
Public Law 103-62, "Government Performance and Results Act of 1993"

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[a] Excludes $1,050,000 transferred to Science Safeguards and Security program in an FY 2001 reprogramming. Includes $1,100,000 in FY 2001 for transfer of Oak Ridge Landlord safeguards and security responsibility from Science Safeguards and Security program; includes $3,047,000 in FY 2001 and $2,880,000 in FY 2002 transferred from the Science Laboratories Infrastructure program for Oak Ridge Landlord activities; includes $1,533,000 in FY 2001 and $1,598,000 in FY 2002 for Chicago Safeguards and Security staff transferred from the Office of Security and Emergency Operations; and includes $1,329,000 in FY 2001 and $1,139,000 in FY 2002 for the transfer of the Environmental Management Science Program function to SC from the Office of Environmental Management.

[b] The FY 2001 and FY 2002 columns of the FY 2003 Congressional Request include funding in the amount of $6,996,000 and $6,998,000, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to FY 2003 funding of $5,632,000.

[c] FY 2001 and FY 2002 FTEs are displayed comparable to the FY 2003 Request, where all Field FTEs are budgeted in Field Operations. The FY 2002 original appropriation column displays FTEs noncomparable.

Funding by Site

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Albuquerque Operations Office					
National Renewable Energy Laboratory	0	0	150	+150	--
Chicago Operations Office					
Argonne National Laboratory	430	430	615	+185	+43.0%
Brookhaven National Laboratory	420	430	615	+185	+43.0%
Fermi National Laboratory	50	20	100	+80	+400.0%
Princeton Plasma Physics Laboratory	110	125	100	-25	-20.0%
Chicago Operations Office	35,517	36,025	29,854	-6,171	-17.1%
Total, Chicago Operations Office	36,527	37,030	31,284	-5,746	-15.5%
Idaho Operations Office					
Idaho National Engineering and Environmental Laboratory	40	10	0	-10	--
Idaho Operations Office	35	0	0	0	--
Total, Idaho Operations Office	75	10	0	-10	--
Oakland Operations Office					
Lawrence Berkeley National Laboratory	445	480	750	+270	+56.3%
Stanford Linear Accelerator Center	125	150	150	0	--
Berkeley and Stanford Site Offices	3,279	3,452	3,110	-342	-9.9%
Total, Oakland Operations Office	3,849	4,082	4,010	-72	-1.8%
Oak Ridge Operations Office					
Oak Ridge Institute for Science and Education	714	1,230	1,250	+20	+1.6%
Thomas Jefferson National Accelerator Facility	45	50	100	+50	+100.0%
Oak Ridge Operations Office	49,634	52,067	43,406	-8,661	-16.6%
Total, Oak Ridge Operations Office	50,393	53,347	44,756	-8,591	-16.1%
Richland Operations Office					
Pacific Northwest National Laboratory	185	555	740	+185	+33.3%
Richland Operations Office	764	130	220	+90	+69.2%
Total, Richland Operations Office	949	685	960	+275	+40.1%
Washington Headquarters	48,068	57,321	58,319	+998	+1.7%
Total, Science Program Direction	139,861 [d]	152,475	139,479	-12,996	-8.5%

[d] Excludes $1,050,000 transferred to Science Safeguards and Security program in an FY 2001 reprogramming. Includes $1,100,000 in FY 2001 for transfer of Oak Ridge Landlord safeguards and security responsibility from Science Safeguards and Security program; includes $3,047,000 in FY 2001 and $2,880,000 in FY 2002 transferred from the Science Laboratories Infrastructure program for Oak Ridge Landlord activities; includes $1,533,000 in FY 2001 and $1,598,000 in FY 2002 for Chicago Safeguards and Security staff transferred from the Office of Security and Emergency Operations and includes $1,329,000 in FY 2001 and $1,139,000 in FY 2002 for the transfer of the Environmental Management Science Program function to SC from the Office of Environmental Management.

Site Description

Ames National Laboratory

Ames Laboratory (Ames), located in Ames, Iowa, is an integrated part of Iowa State University. Ames was formally established in 1947, by the Atomic Energy Commission, because of its successful development and efficient process in producing high-purity uranium metal in large quantities for atomic energy. Today, Ames pursues a broad range of priorities in the chemical, materials, engineering, environmental, mathematical and physical sciences. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Argonne National Laboratory

Argonne National Laboratory (ANL) in Argonne, Illinois, is a multi-program laboratory located on a 1,700-acre site in suburban Chicago. Argonne research falls into 4 broad categories: basic science, scientific facilities, energy resources, and environmental management. ANL has a satellite site located in Idaho Falls, Idaho. This site, referred to as Argonne-West, occupies approximately 900 acres and is the home of most of Argonne's major nuclear reactor research facilities. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Berkeley Site Office

The Berkeley Site Office provides institutional program management oversight in the execution of science programs contracted through Lawrence Berkeley National Laboratory and with US industries and universities.

Brookhaven National Laboratory

Brookhaven National Laboratory is a multi-program laboratory located on a 5,200-acre site in Upton, New York. Brookhaven creates and operates major facilities available to university, industrial, and government personnel for basic and applied research in the physical, biomedical, and environmental sciences, and in selected energy technologies. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Chicago Operations Office

Chicago supports the programmatic missions performed in support of science and technology, national security, energy research, and environmental management. They are responsible for the integrated, performance-based management of five major management and operating (M&O) laboratory sites--Argonne National Laboratory, Brookhaven National Laboratory, Fermi National Accelerator Laboratory, Princeton Plasma Physics Laboratory, and Ames Laboratory; and two government-owned and government-operated federal laboratories--Environmental Measurements Laboratory and New

Brunswick Laboratory. Chicago has oversight responsibility for more than 9,500 contractor employees located at various site offices across the Nation. This responsibility includes ensuring the security and safety of the taxpayer's investment in research facilities and other physical plant worth $4 billion and approximately 16,000 acres of land. Chicago hosts four major DOE Centers of Excellence, and as such, elements throughout the Department rely on Chicago for services and expertise within these areas: Center for Risk Excellence; the Grants Center of Excellence; the Intellectual Property Center of Excellence; and the Center of Excellence in Nuclear Material Measurement Science.

Fermi National Accelerator Laboratory

Fermi National Accelerator Laboratory (Fermilab) is located on a 6,800-acre site in Batavia, Illinois. It is the largest U.S. laboratory for research in high-energy physics and is second only to CERN, the European Laboratory for Particle Physics, in the world. About 2,500 scientific users, scientists from universities and laboratories throughout the U.S. and around the world, use Fermilab for their research. Fermilab's mission is the goal of high-energy physics: to learn what the universe is made of and how it works. Fermilab builds and operates the facilities that high-energy physicists need to do forefront research, and develops new accelerator technology for the experiments of the future. Fermilab is operated by Universities Research Association, a consortium of 89 research universities. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Idaho National Engineering and Environmental Laboratory

The Idaho National Engineering and Environmental Laboratory (INEEL) is located on 890 square miles in the southeastern Idaho desert. Other INEEL research and support facilities are located in nearby Idaho Falls. Within the laboratory complex are nine major applied engineering, interim storage and research and development facilities, operated by Bechtel, B&W Idaho for the U.S. Department of Energy. Today, INEEL is solving critical problems related to the environment, energy production and use, U.S. economic competitiveness, and national security. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory is a multi-program laboratory located in Berkeley, California, on a 200-acre site adjacent to the Berkeley campus of the University of California. The Laboratory is dedicated to performing leading-edge research in the biological, physical, materials, chemical, energy, and computer sciences. The Laboratory also operates unique user facilities available to qualified investigators. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

National Renewable Energy Laboratory

The National Renewable Energy Laboratory (NREL) is located on a 300-acre campus at the foot of South Table Mountain in Golden, Colorado. It is the world leader in renewable energy technology development. Since its inception in 1977, NREL's sole mission has been to develop renewable energy and energy efficiency technologies and transfer these technologies to the private sector. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Oak Ridge Institute for Science and Education

Oak Ridge Institute for Science and Education (ORISE) is located on a 150-acre site in Oak Ridge, Tennessee. ORISE conducts research into modeling radiation dosages for novel clinical, diagnostic, and therapeutic procedures. In addition, ORISE coordinates several research fellowship programs and the peer review of all Basic Energy Sciences funded research. ORISE manages and administers ORNL undergraduate research opportunities for students and faculty.

Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is a multi-program laboratory located on a 24,000-acre site in Oak Ridge, Tennessee. Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clear, abundant energy; restore and protect the environment; and contribute to national security.

Oak Ridge Operations Office

Oak Ridge is responsible for implementing elements of almost every major Departmental mission in science, energy resources, an environmental quality. They have oversight responsibility for ORNL, Thomas Jefferson National Accelerator Facility, Spallation Neutron Source, East Tennessee Technology Park (ETTP), Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, and the Oak Ridge Institute for Science and Education (ORISE). Oak Ridge also supports the recently established Y-12 Area Office under the National Nuclear Security Administration. Oak Ridge has oversight responsibility for more than 15,000 contractor employees located at these sites, as well as responsibility for over 43,000 acres of land and approximately 46,000,000 square feet of facility space, valued at over $12 billion. Other major initiatives at Oak Ridge include the successful transition of Portsmouth to cold standby; equipping facilities needed to support the DOE missions; developing and maintaining a trained, capable workforce; issuing a contract for the Uranium Depleted Uranium Hexafloride (DUF_6) Conversion Center; accelerating cleanup activities at all sites; expanding and maintaining prominence as a resource for advance neutron science; focusing on reindustralization and asset management; revitalizing ORNL; and using the Joint Institute for Biological Sciences and other resources to move ahead to the next phase of human genome research. Oak Ridge is also recognized as one of the Department's three Financial Centers of Excellence.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) is a multi-program laboratory located on 640 acres at the Department's Hanford site in Richland, Washington. The Laboratory conducts research in the area of environmental science and technology and carries out related national security, energy, and human health programs. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Princeton Plasma Physics Laboratory

Princeton Plasma Physics Laboratory (PPPL) is a program-dedicated laboratory (Fusion Energy Sciences) located on 72 acres in Princeton, New Jersey. The primary mission of PPPL is to develop the scientific understanding and the innovations, which will lead to an attractive fusion energy source. Associated missions include conducting world-class research along the broad frontier of plasma science and providing the highest quality of scientific education. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Richland Operations Office

Richland is responsible for and manages all environmental cleanup and science and technology development at the 560 square mile Hanford Site, coordinating closely with contractor companies hired to manage and complete the work of the world's largest cleanup project. The primary contractors are Fluor Daniel Hanford and its subcontractors, the Bechtel Hanford, Inc, the Hanford Environmental Health Foundation, and the Battelle Memorial Institute, which serves as the contractor for Laboratory operations of the Pacific Northwest National Laboratory. Richland also manages the cooperative agreement with Associated Western Universities to administer research appointments at National Laboratories and universities, for undergraduate students and faculty, as part of the Office of Science funded Education Programs.

Stanford Linear Accelerator Center

Stanford Linear Accelerator Center (SLAC) is a program-dedicated laboratory (High Energy Physics) located on 426 acres in Menlo Park, California. SLAC is a national basic research laboratory, probing the structure of matter at the atomic scale with x-rays and at much smaller scales with electron and positron beams. SLAC scientists perform experimental and theoretical research in elementary particle physics using electron beams, plus a broad program of research in atomic and solid state physics, chemistry, biology, and medicine using synchrotron radiation. There are also active programs in the development of accelerators and detectors for high-energy physics research and of new sources and instrumentation for synchrotron radiation research. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Stanford Site Office

The Stanford Site Office provides institutional program management oversight in the execution of basic research at the Stanford Linear Accelerator Center, a national laboratory operated under a contract with Stanford University.

Thomas Jefferson National Accelerator Facility

Thomas Jefferson National Accelerator Facility (Jefferson Lab) is a program-dedicated laboratory (Nuclear Physics) located on 273 acres in Newport News, Virginia. Jefferson Lab is a basic research laboratory built to probe the nucleus of the atom to learn more about the quark structure of matter. The Laboratory gives scientists a unique and unprecedented probe to study quarks, the particles that make up protons and neutrons in an atom's nucleus. Educational activities supported at the laboratory are directed towards providing hands-on research experiences for undergraduate students and faculty participants on state-of-the-art equipment while engaging them in important issues at the forefront of scientific inquiry.

Program Direction

Mission Supporting Goals and Objectives

The Program Direction subprogram provides the Federal staff and associated costs required for overall direction and execution of SC program and advisory responsibilities in Headquarters. The subprogram supports staff in the High Energy Physics, Nuclear Physics, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, Advanced Scientific Computing Research, Science Laboratories Infrastructure, and Energy Research Analyses programs, including management, resource, policy, and technical support staff. The staff includes scientific and technical personnel as well as program support personnel in the areas of budget and finance; general administration; grants and contracts; information technology; policy review and coordination; infrastructure management; construction management; safeguards and security; and environment, safety and health. Program Direction also includes resources to cover the costs of centrally provided goods and services procured through the Working Capital Fund at Headquarters, such as supplies, rent, telecommunications, desktop infrastructure, etc.

Funding Schedule

(dollars in thousands, whole FTEs)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Headquarters					
Salaries and Benefits	32,369	37,527	38,136	+609	+1.6%
Travel	1,534	1,534	1,534	0	--
Support Services	7,408	7,275	6,384	-891	-12.2%
Other Related Expenses	6,520	10,670	12,170	+1,500	+14.1%
Total, Headquarters	47,831 [a]	57,006 [a]	58,224 [a]	+1,218	+2.1%
Total Excluding Full Funding for Federal Retirements, Program Direction	45,771	54,936	55,984	+1,048	+1.9%
Full Time Equivalents	268	293	299	+6	+2.0%

[a] The FY 2001 and FY 2002 columns of the FY 2003 Congressional Request include funding in the amount of $2,060 and $2,070, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to FY 2003 funding of $2,240.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Salaries and Benefits	**32,369**	**37,527**	**38,136**

This supports 299 Full Time Equivalents (FTEs) in Headquarters, six more than the FY 2002 comparable appropriation. The success of the Department's basic research programs is directly dependent on the viability of its scientific and technical workforce. By FY 2003, 33 percent of the SC workforce will be eligible to retire and increases to 45 percent by the end of FY 2005. SC is taking steps to preserve its technical, research, and scientific management capabilities. SC strives to attract highly qualified applicants to its workforce by offering these extraordinary candidates recruitment bonuses and using existing Federal personnel authorities to provide salaries comparable with the private sector. The justification for the six additional FTEs is as follows:

One FTE (1 of 6) is requested for a computer scientist to serve as the program manager for the Advanced Scientific Computing Research Scientific Discovery through the Advanced Computing (SciDAC) program. Currently there is one program manager who is managing two full-time efforts, the base computer science program in Mathematical, Information, and Computational Sciences and the computer science component of the SciDAC program. To ensure effective leadership of the computer science research portfolio for SC, an additional FTE is needed.

One FTE (2 of 6) is requested to support developments in the nanoscale arena. Funding and emphasis for nanoscale science will increase substantially in the future. In prior fiscal years, aspects of this research were included in many Basic Energy Science (BES) Core Research Activities, and a number of BES program managers administered this research. This diffused management worked until now. However, with the start of construction of three Nanoscale Science Research Centers (NSRCs) a dedicated program manager is required to coordinate the research, facility construction, and the eventual operation of the three research centers.

One additional FTE (3 of 6) is requested for a program manager with expertise in x-ray and neutron scattering. SC is experiencing increased activity in these areas that necessitates an additional FTE. The Stanford Synchrotron Radiation Laboratory at the SLAC will be upgraded to a third-generation light source thus increasing its capabilities and attracting a larger user population. Other areas of increased activity include, the High Flux Isotope Reactor at the ORNL that will be upgraded and result in one of the world's best steady-state neutron source. Instrument construction/upgrades will occur at the Manual Lujan, Jr. Neutron Scattering Center at Los Alamos National Laboratory. Instruments for the Spallation Neutron Source at ORNL will also be purchased. Other workload aspects include international activities with Japan and Europe and interactions with other agencies through standing Office of Science and Technology Policy interagency committees on synchrotron radiation and neutron scattering.

One FTE (4 of 6) is also requested for an additional program manager to support Chemical Reactivity and Chemical Theory/Modeling/Simulation activities. This is one of the largest Core Research Activities in BES. The emphasis has grown out of new directions in nano- and supramolecular chemistry and the need to understand and control chemical reactivity because of its impacts on the agency missions. Additional challenges involve complex gas phase reactions in the presence of surfaces and particulates and reactions in water and other solvents.

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003

An additional senior level, meteorologist/physical scientist FTE (5 of 6) is requested to support Climate Change Research within the Environmental Sciences Division of Biological and Environmental Research. This research directly underpins the DOE mission in National Energy Security and the Secretary's mission and priority to support the President's Climate Change Initiatives by developing models that predict what concentrations of trace atmospheric gases and aerosols result in unacceptable climate change. Advanced models will also provide enhanced capabilities necessary to detect and defend against the intentional release of hazardous chemical and biological agents to the atmosphere.

Lastly, a senior level geneticist/biological scientist (6 of 6) is needed to develop, implement, and manage the SC Genomes to Life Research program. This research directly underpins the DOE mission in National Energy Security and the Secretary's priorities by identifying and characterizing the structure and regulation of multiprotein complexes that carry out the biological functions of cells. This research will also help determine the functional capacity of complex microbial communities needed to develop biotechnology solutions for clean energy, carbon sequestration, environmental cleanup, and bioterrorism detection and defeat.

Travel	**1,534**	**1,534**	**1,534**

Travel includes all costs of transportation of persons, subsistence of travelers, and incidental travel expenses in accordance with Federal travel regulations.

Support Services	**7,408**	**7,275**	**6,384**

Provides funding for general administrative services and technical expertise provided as part of day-to-day operations and information technology (IT) maintenance and enhancements.

- Continue day-to-day operations within SC, e.g., mailroom operations; travel management; environment, safety and health support; security and cyber security support, and administering the Small Business Innovation Research program.

Standardize, integrate, and invest in IT that will best support improved mission accomplishment and promote IT efficiencies consistent with the provisions of the Information Technology Management Reform Act of 1996. SC provides a real-time computer Helpdesk, incorporates new technologies and maintains corporate systems that support grants management and other major business functions, e.g., improve Internet tools and make information and corporate systems more easily accessible; enhance cyber security capabilities; continue planned enhancements; and retire legacy systems – all as outlined in SC's Five-Year Information Management Strategic Plan.

Other Related Expenses	**6,520**	**10,670**	**12,170**

Provides funds for a variety of tools, goods, and services that support the Federal workforce, including acquisitions made through the Working Capital Fund (WCF), computer and office equipment, publications, training, etc and continue support for the Corporate Research and Development (R&D) Portfolio Management Environment (PME).

For FY 2003, funding for PME is increased by $1,500,000. In total, $5,500,000 is requested in FY 2003 to proceed with modernizing and streamlining the Department's R&D management processes. Several modules are being developed in stages, e.g., R&D tracking, reporting, and program execution. In FY 2003, the requirements definition, design, and software for tracking and reporting (Module III) will be implemented ($4,000,000). The complete production environment will be in place (hardware, software, and communications) and will have an annual maintenance cost ($1,300,000). In addition, an Architectural Assessment Study is planned, to ensure compliance with DOE's Information Architecture as well as integration of the Corporate PME with existing information systems in the field and headquarters that will be supplying data ($200,000). Full PME implementation is to occur over a three-year period. DOE will be able to extract energy-related research data funded by various sources from a central reliable repository. The PME will become the technology infrastructure, providing information integration methodologies, and process enhancement that will enable electronic cradle-to-grave tracking of research projects, information sharing across programs, and snapshots of the Department's R&D. In the end, DOE will improve its management of R&D data, provide a corporate view across the complex, align with applicable laws and report information to Congress.

Total, Program Direction	**47,831**	**57,006**	**58,224**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Salaries and Benefits	
■ Supports 299 FTEs, 6 FTEs more than the comparable FY 2002 budget, includes the government's share of increased costs associated with pension and annuitant health care benefits, and factors a 2.6 percent pay adjustment in personnel compensation.	+609
Support Services	
■ Restructure support for information management activities.	-891
Other Related Expenses	
■ Continue Corporate Research & Development (R&D) Portfolio Management Environment (PME) efforts	+1,500
Total Funding Change, Program Direction	+1,218

Support Services

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Technical Support Services					
Test and Evaluation Studies	750	750	750	0	--
Total, Technical Support Services	750	750	750	0	--
Management Support Services					
ADP Support	5,538	4,975	4,084	-891	-17.9%
Administrative Support	1,120	1,550	1,550	0	--
Total, Management Support Services	6,658	6,525	5,634	-891	-13.7%
Total, Support Services	7,408	7,275	6,384	-891	-12.2%

Other Related Expenses

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Training	65	65	65	0	--
Working Capital Fund	4,004	4,205	4,205	0	--
Information Technology Hardware and Software/Maintenance Acquisitions	951	0	0	0	--
Other	1,500	6,400	7,900	+1,500	+23.4%
Total, Other Related Expenses	6,520	10,670	12,170	+1,500	+14.1%

Science Education

Mission Supporting Goals and Objectives

The **Science Education** subprogram supports four educational/human resource development programs. The Department is committed to programs that train students to enter careers in **S**cience, **M**athematics, **E**ngineering, and **T**echnology (SMET). Each of the subprograms targets a different group in order to attract as broad a range of students to the programs and to expand the pipeline of students who can enter the SMET workforce. In this fashion, the programs should help our National Laboratories and the nation meet the demand for a well-trained scientific/technical workforce. Because of the partnership between the Department and the National Science Foundation (NSF), research opportunities will be extended to community college faculty, enabling a broader and lasting impact on community college programs.

- The *Energy Research Undergraduate Laboratory Fellowship Program (ERULF)*, formerly known as the Laboratory Cooperative Program, is designed to provide workforce development through research experiences at DOE laboratories for highly motivated undergraduate students from any two or four year accredited college or university. These opportunities complement the students' academic training and introduce them to the unique intellectual and physical resources present at the DOE laboratories. Appointments are available during the spring, summer, and fall terms. These research opportunities have also been extended in collaboration with the National Science Foundation (NSF) to undergraduate students in NSF programs, including those who are preparing for teaching careers in science, mathematics or technology.
- The *National Science Bowl® Program* is a highly publicized academic competition among high school students who answer questions on scientific topics in astronomy, biology, chemistry, mathematics, physics, earth, computer and general science. This program was created to encourage high school students across the Nation to excel in math and science and to pursue careers in those fields. Since its inception, more than 70,000 high school students have participated in regional tournaments leading up to the national finals. This program provides the students, and teachers who have prepared them, a forum to receive national recognition for their talent and hard work.
- The *Albert Einstein Distinguished Educator Fellowship Program* supports outstanding science and mathematics teachers, who provide insight, extensive knowledge, and practical experience to the Legislative and Executive branches. This program is in compliance with the Albert Einstein Distinguished Educator Act of 1994 (signed into law in November 1994). The law gives DOE responsibility for administering the program of distinguished educator fellowships for elementary and secondary school mathematics and science teachers.
- The *DOE Community College Institute (CCI) of Science and Technology* provides a 10-week human resource development program through research experience at several DOE National Laboratories for highly motivated community college students. The CCI is targeted at underserved community college students who have not had an opportunity to work in an advanced science research environment. It incorporates both an individually mentored research component and a set of enrichment activities which include: lectures, classroom activities, career guidance/planning, and field trips. Appointments are available during the summer. These research opportunities have also been extended in collaboration with the National Science Foundation (NSF) to community college students and faculty in NSF programs.

Funding Schedule

	(dollars in thousands)				
	FY 2001	FY 2002	FY 2003	$ Change	% Change
Energy Research Undergraduate Laboratory Fellowships	2,447	2,669	2,900	+231	+8.7%
National Science Bowl® Program	597	660	660	0	--
Albert Einstein Distinguished Educator Fellowship Program	810	460	500	+40	+8.7%
Community College Institute of Biotechnology, Environmental Science, and Computing	606	671	1,400	+729	+108.6%
Total, Science Education	4,460	4,460	5,460	+1,000	+22.4%

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Energy Research Undergraduate Laboratory Fellowships	**2,447**	**2,669**	**2,900**

The Energy Research Undergraduate Laboratory Fellowship (ERULF) Program is the oldest of the Science Education programs. The ERULF program supports a diverse group of students at our National Laboratories in individually mentored research experiences. Through these unique and highly focused experiences these students will comprise a repository of talent to help the DOE meet its science mission goals. The paradigms of the program are: 1) students apply on a competitive basis and are matched with mentors working in the students' fields of interest; 2) students spend an intensive 10-16 weeks working under the individual mentorship of resident scientists; 3) students must each produce an abstract and formal research report; 4) students attend seminars that broaden their view of career options and help them understand how to become members of the scientific community; and 5) program goals and outcomes are measured based on students' research papers, students' abstracts, surveys and outside evaluation. An undergraduate student journal was recently created which publishes selected full research papers and all abstracts of students in the program. The National Science Foundation (NSF) began a collaboration with this program as of FY 2001.

The program will ensure a steady flow of students with technical expertise into the Nation's pipeline of workers in both academia and industry. A system is being created to track students in their academic career paths.

A sub-component of the ERULF Program is the Pre-Service Teacher Program. The paradigms of the program are: 1) students apply on a competitive basis and are matched with mentors working the student's field of interest; 2) students spend an intensive 10 weeks working under the mentorship of master teachers and laboratory scientists to help maximize the building of content, knowledge, and skills through the research experience; 3) students must produce an abstract and an educational module

	FY 2001	FY 2002	FY 2003

(dollars in thousands)

related to their research and may also produce a research paper or poster or oral presentation; 4) students attend professional enrichment activities, workshops and seminars that help students apply what they learn to their academic program and the classroom, and also to help them understand how to become members of the scientific community, and enhance their communication and other professional skills; and 5) program goals and outcomes are measured based on students' abstracts, education modules, surveys and outside evaluation. An undergraduate student journal was recently created which publishes selected full research papers and education modules and all abstracts of students in the program. The National Science Foundation entered into a collaboration with this program in FY 2001.

	FY 2001	FY 2002	FY 2003
National Science Bowl ® Program	**597**	**660**	**660**

SC will manage and support the National Science Bowl® for high school students from across the country for DOE. Since its inception, more than 70,000 high school students have participated in this event. The National Science Bowl® is a highly publicized academic competition among teams of high school students who answer questions on scientific topics in astronomy, biology, chemistry, mathematics, physics, earth, computer, and general science. In 1991, DOE developed the National Science Bowl® to encourage high school students from across the Nation to excel in math and science and to pursue careers in those fields. The National Science Bowl® provides the students and teachers a forum to receive national recognition for their talent and hard work. Saturday seminars in the latest scientific topics have been added to the National Science Bowl® weekend. Students participating in the National Science Bowl ® will be tracked to see the long-term impact on their academic and career choices.

	FY 2001	FY 2002	FY 2003
Albert Einstein Distinguished Educator Fellowship Program..	**810**	**460**	**500**

The Albert Einstein Fellowship Awards for outstanding K-12 science, math, and technology teachers continues to be a strong pillar of the program for bringing real classroom and education expertise to our education programs and outreach activities. This Congressional initiative, established by the Albert Einstein Distinguished Educator Fellowship Act of 1994, has enabled the Department to maintain an enriching relationship with the Triangle Coalition for Science and Technology Education. The Triangle Coalition administers the program for the Department of Energy through the recruitment, application, selection and placement of the Einstein Fellows and evaluation of the program.

	FY 2001	FY 2002	FY 2003
DOE Community College Institute of Biotechnology, Environmental Science, and Computing...	**606**	**671**	**1,400**

The DOE Community College Institute (CCI) of Science and Technology was originally a collaborative effort between DOE and its National Laboratories with the American Association of Community Colleges and specified member institutions. Through a recent Memorandum of Understanding with the NSF, undergraduate students in NSF programs are participating in this program and in FY 2002 the program will be open to students from all community colleges. This program is designed to address shortages, particularly at the technician and paraprofessional levels and will help develop the human resources needed to continue building the Nation's capacity in critical areas for the next century. The

	FY 2001	FY 2002	FY 2003

(dollars in thousands)

Institute provides a ten-week research fellowship for highly qualified community college students at a DOE National Laboratory. The paradigms of the program are: 1) students apply on a competitive basis and are matched with mentors working in the students' field of interest; 2) students spend an intensive 10 weeks working under the individual mentorship of resident scientists; 3) students must each produce an abstract and formal research report; 4) students attend professional enrichment activities, workshops and seminars that broaden their view of career options, help them understand how to become members of the scientific community, and enhance their communication and other professional skills; and 5) program goals and outcomes are measured based on students' research papers, students' abstracts, surveys and outside evaluation. An undergraduate student journal was recently created which publishes selected full research papers and all abstracts of students in the program. The National Science Foundation entered into a collaboration with this program in FY 2001. This allows NSF's undergraduate programs to include a DOE community college internship in their opportunities they provide to students.

	FY 2001	FY 2002	FY 2003
Total, Science Education	**4,460**	**4,460**	**5,460**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
■ Additional students and faculty will be supported under the ERULF program.	+231
■ Increase stipends for the Einstein Fellows and administrative expenses.	+40
■ Increase the number of students and faculty participating in the CCI program.	+729
Total Funding Change, Science Education	+1,000

Field Operations

Mission Supporting Goals and Objectives

The Field Operations subprogram enables the SC Field complex to manage programs, projects, laboratories, facilities, grants and contracts in support of science and technology, energy research, and environmental management activities under their purview.

In FY 2003, this Field Operations subprogram is the central funding source for all SC sponsored Federal field employees and the cost of administration within the field structure. The workforce manages and serves many different departmental missions at the Chicago and Oak Ridge Operations Offices and provides program management oversight for SC laboratories and facilities, e.g., Argonne, Brookhaven, Fermi, and Lawrence Berkeley National Laboratories; the Princeton Plasma Physics Laboratory; the Thomas Jefferson National Accelerator Facility; the Stanford Linear Accelerator Center; and the Spallation Neutron Source. Program oversight and safeguards and security functions performed in the Field were funded in the Program Direction subprogram prior to this FY 2003 realignment. In addition, several functions requiring technical support that were funded in the Oak Ridge Landlord activity in the Science Laboratories Infrastructure program are supported in this Field Operations subprogram: emergency management, directives management, training and development, and the Financial Service Center at Oak Ridge.

This subprogram provides Federal salaries and benefits for the following: financial stewardship, personnel management, contract and procurement acquisition, labor relations, security, legal counsel, public and congressional liaison, intellectual property and patent management, environmental compliance, safety and health management, infrastructure operations maintenance, information systems development and support, and reindustrialization.

In addition, this subprogram provides funding for the fixed requirements associated with rent, utilities, and telecommunications. Other requirements such as information technology maintenance, administrative support, mail services, document classification, personnel security clearances, emergency management, printing and reproduction, travel, certification training, vehicle acquisition and maintenance, equipment, classified/unclassified data handling, records management, health care services, guard services, and facility and ground maintenance are also included. These infrastructure requirements are relatively fixed. The Operations Offices are also responsible for supplying office space and materials for the Office of Inspector General located at each site. Other operational requirements funded include occasional contractor support to perform ecological surveys, cost validations, and environmental assessments; ensure compliance with Defense Nuclear Facilities Safety Board safety initiatives; abide by site preservation laws and regulations; and perform procurement contract closeout activities. Departmental and programmatic initiatives influence these requirements.

Integrating Headquarters functions with those of the Field, moving accountability from SC to the contractors through contracts that stipulate increased reliance on national standards and clarifying line management accountability offer the greatest opportunity for gains in efficiency and cost savings over the next few years. In broad terms, SC hopes to readjust its skills mix to reduce the number of positions required to provide contractor oversight. The optimum skill mix to support a streamlined office will depend upon SC's reengineering effort and the Department's ability to continue to move from a compliance-based oversight approach to one of performance-based.

Funding Schedule

(dollars in thousands, whole FTEs)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Chicago Operations Office					
Salaries and Benefits	28,364	28,910	22,653	-6,257	-21.6%
Travel	699	639	639	0	--
Support Services	2,505	2,888	2,934	+46	+1.6%
Other Related Expenses	3,139	3,128	3,128	0	--
Total, Chicago Operations Office	34,707	35,565	29,354	-6,211	-17.5%
Full Time Equivalents	278	291	215	-76	-26.1%
Berkeley/Stanford Site Offices					
Salaries and Benefits	2,549	2,722	2,380	-342	-12.6%
Travel	130	130	130	0	--
Support Services	0	0	0	0	--
Other Related Expenses	600	600	600	0	--
Total, Berkeley/Stanford Site Offices	3,279	3,452	3,110	-342	-9.9%
Full Time Equivalents	19	26	23	-3	-11.5%
Oak Ridge Operations Office					
Salaries and Benefits	33,482	36,056	27,395	-8,661	-24.0%
Travel	524	524	524	0	--
Support Services	10,858	10,789	10,789	0	--
Other Related Expenses	4,720	4,623	4,623	0	--
Total, Oak Ridge Operations Office	49,584	51,992	43,331	-8,661	-16.7%
Full Time Equivalents	324	359	229	-130	-36.2%
Total Field Operations					
Salaries and Benefits	64,395	67,688	52,428	-15,260	-22.5%
Travel	1,353	1,293	1,293	0	--
Support Services	13,363	13,677	13,723	+46	+0.3%
Other Related Expenses	8,459	8,351	8,351	0	--
Total, Field Operations	87,570 [a]	91,009 [a]	75,795 [a]	-15,214	-16.7%
Total Excluding Full Funding for Federal Retirements, Field Operations	82,634	86,081	72,403	-13,678	-15.9%
Full Time Equivalents	621	676	467	-209	-30.9%

[a] The FY 2001 and FY 2002 columns of the FY 2003 Congressional Request include funding in the amount of $4,936 and $4,928, respectively, for the Government's share of increased costs associated with pension and annuitant health care benefits. These funds are comparable to FY 2003 funding of $3,392.

Detailed Program Justification

	(dollars in thousands)		
	FY 2001	FY 2002	FY 2003
Salaries and Benefits	**64,395**	**67,688**	**52,428**

Supports 467 FTEs within the SC field complex, 209 FTEs less than the comparable FY 2002 budget. Past forced and mostly unstructured downsizing across SC, combined with the recent reorganizations of DOE and its Field Offices, has left SC with under-staffing in some areas and over-staffing in others. To address this, SC is in the process of conducting a workforce reengineering study to address fundamental issues and functions within the Office. This study will design ways to maintain or improve SC's performance while reducing the cost of conducting its work, and will guide SC's plans for FTE reductions over the next two years. Some FTE reductions can be achieved through a combination of attrition, buyout and early retirement incentives, however, the majority must occur through involuntary separations. Funding is included to offset costs anticipated with these workforce reductions.

Travel	**1,353**	**1,293**	**1,293**

Enables field staff to participate on task teams, work various issues, conduct compliance reviews, and perform contractor oversight to ensure implementation of DOE orders and regulatory requirements at the facilities under their purview. Also provides for attendance at conferences and training classes, and permanent change of station relocation, etc.

Support Services	**13,363**	**13,677**	**13,723**

The field uses a variety of administrative and technical assistance services that are critical to their success in meeting local customer needs. The services provided support information technology (IT) routine computer maintenance, specific improvements, operating systems upgrades, and cyber security, network monitoring, firewalls, and disaster recovery tools. Other areas include staffing 24-hour emergency and communications centers, safeguarding and securing assets (guards, processing security clearances, classifying records, protecting assets and property, etc.), processing/distributing mail, travel management centers, contract close-out activities, copy centers, trash removal, directives coordination, facility and grounds maintenance, filing and retrieving records, etc.

The request includes support service activity previously budgeted under the Science Laboratories Infrastructure program (Oak Ridge Landlord account) and funding for SC's safeguards and security responsibilities at the Chicago Operations Office transferred from the Office of Security and Emergency Operations.

Other Related Expenses	**8,459**	**8,351**	**8,351**

Funds day-to-day requirements associated with operating a viable office, including fixed costs associated with occupying office space, utilities, telecommunications and other costs of doing business, e.g., postage, printing and reproduction, copier leases, site-wide health care units, records storage assessments, etc. Employee training and development and the supplies and furnishings used by the Federal staff are also included.

Total, Field Operations	**87,570**	**91,009**	**75,795**

Explanation of Funding Changes from FY 2002 to FY 2003

	FY 2003 vs. FY 2002 ($000)
Salaries and Benefits	
■ Supports 467 FTEs, 209 FTEs less than the comparable FY 2002 budget, as a part of a focused effort to restructure the Field Federal workforce; includes the government's share of increased costs associated with pension and annuitant health care benefits; and factors a 2.6 percent pay adjustment in personnel compensation.	-15,260
Support Services	
■ Reflects the transfer of the safeguards and security function at Chicago from the Office of Security and Emergency Operations to SC.	+46
Total Funding Change, Field Operations	-15,214

Support Services

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Technical Support Services					
Economic and Environmental Analysis	0	0	0	0	--
Total, Technical Support Services	0	0	0	0	--
Management Support Services					
ADP Support	5,500	5,271	5,271	0	--
Administrative Support	7,863	8,406	8,452	+46	+0.5%
Total, Management Support Services	13,363	13,677	13,723	+46	+0.3%
Total, Support Services	13,363	13,677	13,723	+46	+0.3%

Other Related Expenses

(dollars in thousands)

	FY 2001	FY 2002	FY 2003	$ Change	% Change
Training	620	620	620	0	--
Printing and Reproduction	336	255	255	0	--
Rent & Utilities & Telecommunication	4,430	4,620	4,620	0	--
Information Technology Hardware, Software, and Maintenance	847	577	577	0	--
Working Capital Fund	177	400	400	0	--
Other	2,049	1,879	1,879	0	--
Total, Support Services	8,459	8,351	8,351	0	--