Office of Science
Executive Budget Summary

The Office of Science (SC) requests $3,151,065,000 for Fiscal Year (FY) 2001in the "Science" appropriation, an increase of $363,438,000 over FY 2000, to invest in thousands of individual research projects at hundreds of research facilities across the U.S., primarily at our national laboratories and research universities. In addition, the FY 2001 request will support: continuing construction of the Spallation Neutron Source; increasing investments in nano-scale science to make significant contributions to the interagency initiative in nano-technology; implementing advanced computational modeling and simulation for DOE's broad scientific challenges; investigating the workings of the microbial cell for DOE applications; improving the utilization of our major scientific user facilities; and updating the skills of our technical workforce. Within the "Energy Supply" appropriation an increase of $702,000 is requested for the Technical Information Management program.

A History of Success:

The National Academy of Sciences has noted that much of U.S. economic growth, quality of life, and security derive from the national investment and leadership in science and technology. In FY 2000, the Department of Energy (DOE) is the third-largest government sponsor of basic research in the U.S., principally through the programs managed by SC. In service to DOE's applied missions in energy resources, national security, and environmental quality, SC programs lead the nation in many areas of the physical and computational sciences and contribute significantly to major advances in biological and environmental research. These programs have extended the frontiers of science and contribute to our economy through achievements such as:

- Supporting the fundamental research of 70 Nobel Laureates, from Enrico Fermi and E.O. Lawrence to Richard Smalley and Paul Boyer;
- Contributing to the development of the current generation of high-energy and high-power-output lithium and lithium-ion batteries through research in nonaqueous electrolytes;
- Enabling treatment of disease and addiction by building on brain-imaging studies based on SC work in Positron Emission Tomography;
- Developing computational ability exceeding one teraflop of sustained performance for DOE research applications;
- Advancing miniaturization through research into nanowires and phenomena such as conductance quantization;
- Advancing the physics of plasmas, a key element in the manufacture of materials coatings, semi-conductors, lighting systems, and waste disposal systems; and
- Discovering quarks, from the original three light ones - up, down and strange - to the heavy ones - charm, beauty, and top. All of the quarks were discovered at DOE laboratories between 1960 and 1995.

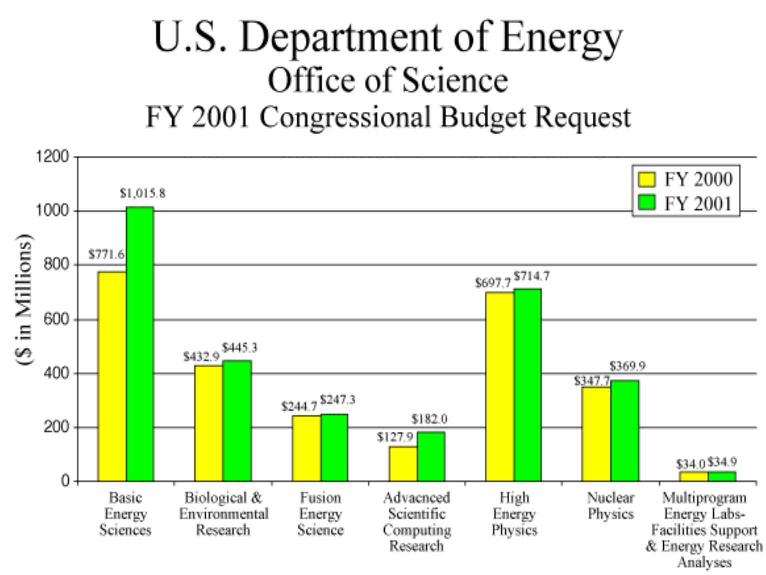

Figure 1

A New Plan for DOE Science:

The 20th century has brought many scientific advances that have resulted in dramatic changes in our standard of living. New opportunities are opening every day as we learn to control matter at the atomic level, develop cleaner new energy sources, simulate that which we cannot easily test in the laboratory, and look deeply into the cosmos to the very origins of matter and energy. At the same time, federal science programs are being called upon to deliver more for less. Managers and scientists must scrutinize their investments and establish priorities more carefully than ever before.

The SC Strategic Plan and Science Portfolio, published in June 1999 and available on the Web at www.sc.doe.gov, are part of a long range planning process to define the goals, objectives, strategies and portfolio of research that will enable DOE to succeed in it's technology driven missions. Bold new questions and intriguing scientific challenges designed to build the scientific foundations for a strong and prosperous nation in the 21st century are contained within the pages of the SC Strategic Plan. The goals of the Strategic Plan are outlined in Figure 2.

Figure 2

The Science Portfolio provides the link between the goals and strategies of the Plan and the research activities within the SC programs. The Portfolio identifies the motivations, activities, accomplishments, and near-term resources for SC's research programs.

Development of the Strategic Plan and Portfolio identified new opportunities in high impact areas of research. Roadmapping efforts are under development to explore the potential of complex systems, carbon sequestration, computational modeling and simulation, and scientific facilities as applied to SC research interests. The roadmaps will identify the steps that are needed to achieve the desired DOE goals.

Implementing the Plan - Priorities:

The FY 2001 budget request, depicted in Figure 1 and Table 1, has a program structure that meets our mission, consistent with departmental goals and strategies. The major SC programs are High Energy and Nuclear Physics, Basic Energy Sciences, Biological and Environmental Research, Advanced Scientific Computing Research, and Fusion Energy Sciences.

The five goals contained in the Strategic Plan provide a framework for current programs and a platform for future efforts. FY 2001 initiatives and priorities are detailed below.

Nanoscale Discovery - The principal missions of the DOE in Energy, Defense and the Environment will benefit greatly from future developments in nanoscale science, engineering and technology. The SC research program has a strong focus on nanoscale discovery, the development of fundamental scientific understanding, and the conversion of these into useful technological solutions.

A key challenge in nanoscience is to understand how deliberate tailoring of materials on the nanoscale can lead to novel properties and new functionalities. Examples include: the addition of aluminum oxide nanoparticles that convert aluminum metal into a material with wear resistance equal to that of the best bearing steel; novel chemical properties of nanocrystals that show promise as photocatalysts to speed the breakdown of toxic wastes; and, meso-porous structures integrated with micromachined components that are used to produce high-sensitivity and highly selective chip-based detectors of chemical warfare agents. These and other nanostructures are already recognized as likely components of 21st century optical communications, printing, computing, chemical sensing, and energy conversion technologies.

The DOE is well prepared to make major contributions to developing nanoscale scientific understanding and ultimately nanotechnologies through its research programs and its materials characterization, synthesis, in-situ diagnostic, and computing capabilities. The DOE and its national laboratories maintain a large array of major scientific user facilities that are ideally suited to nanoscience discovery and to developing a fundamental understanding of nanoscale processes.

FY 2001 funding is being requested as part of the proposed multiagency National Nanotechnology effort. New efforts are proposed to attain a fundamental scientific understanding of nanoscale phenomena; to achieve the ability to design and synthesize materials at the atomic level to produce materials with desired properties and functions; to attain a fundamental understanding of the processes by which living organisms create materials and functional complexes to serve as a guide and a benchmark by which to measure our progress in synthetic design and synthesis; and to develop experimental characterization tools and theory/modeling/simulation tools necessary to drive the nanoscale revolution.

The synergy of these DOE assets, in partnership with universities and industry, will provide the best opportunity for nanoscience discoveries to be converted rapidly into technological advances that will meet a variety of national needs and enable the U.S. to reap the benefits of an emerging technological revolution.

Non-Defense Scientific Supercomputing— Computational modeling and simulation is one of the most significant developments in the practice of scientific research in the 20th century. Scientific and engineering simulation has dramatically advanced our understanding of nature and has been used to gain insights into the behavior of such complex natural and engineered systems as the weather, materials properties, turbulence and fluid flow, and high-density plasmas.

Dramatic advances in computer technologies in the past decade have set the stage for major advancements in computational modeling and simulation capability. Within the next five years, high-performance computing systems capability will increase by a factor of 1000 (to terascale computing). These computing systems will enable scientists to predict the behavior of a broad range of complex natural and engineered systems at a level of accuracy and detail never before achieved. This will have an enormous impact on broad classes of scientific research and will ultimately address DOE's most demanding, mission-driven challenges.

DOE has a long history of accomplishment in scientific computing. As a result, the Department has served as the proving ground for new computer technologies—subjecting these technologies to the demands that only its most computationally intensive simulations could provide. In 1974, the Department established the first civilian supercomputer center for a national scientific community, the National Magnetic Fusion Energy Computing Center, which became a model for centers established a decade later by NSF and other agencies.

DOE's achievements in software for scientific computing are equally impressive. DOE led the transition from the vector supercomputers of the 1970s and 1980s to the massively parallel supercomputers of today, providing much of the basic software required to use the massively parallel supercomputers. Many of the scientific simulation software packages for massively parallel supercomputers were developed by DOE, a fact recognized by periodic awards from the supercomputing community.

To realize the advances promised by terascale computing, SC will focus on: the development of: a new generation of computational modeling and simulation software that takes full advantage of terascale computers; and the terascale systems infrastructure and software needed to make terascale computers usable for advanced scientific simulation.

The proposed investments support the recommendations outlined in the report by the President's Information Technology Advisory Committee (PITAC) and take advantage of the capabilities being developed in the Accelerated Strategic Computing Initiative (ASCI) in the Office of Defense Programs for DOE's "Stockpile Stewardship Program."

Simulation of complex systems requires integration of a broad range of physical, chemical and biological processes, knowledge of which can cut across research programs in the Office of Science. In addition, terascale computers pose problems far more complex than those encountered with vector supercomputers, necessitating close collaboration between disciplinary computational scientists, computer scientists, and applied mathematicians. The formation of integrated, multidisciplinary teams is the key to success, an approach that DOE has successfully exploited in many past projects, ranging from the development of new accelerators to the establishment of the fundamental basis for understanding climate change.

Spallation Neutron Source (SNS) - As the needs of our high technology society have changed, so have the ways in which we develop new materials to meet these needs. It has become increasingly important to create new materials that perform under severe conditions and yet are stronger, lighter and cheaper. Major research facilities are used to understand and "engineer" materials at the atomic level so that they have improved macroscopic properties and perform better in new applications. The SNS is a next-generation facility for just this kind of research.

The SNS project will provide a short-pulse spallation neutron source for neutron scattering and related research in broad areas of the physical, chemical, materials, biological and medical sciences. When completed in 2006, the SNS will be more than ten times more powerful than the most powerful neutron source now in existence. The total project cost for the SNS is $1,440,000,000.

Neutron scattering will play a role in all forms of materials and design, including the development of smaller and faster electronic devices; lightweight alloys, plastics and polymers for transportation and other applications; magnetic materials for more effective motors and for improved magnetic storage capacity; and new drugs for medical care.

Researchers from academia, the national laboratories and industry will use the SNS to conduct research. Both basic and applied research will be conducted as will technology development in the fields of condensed matter physics, materials sciences, magnetic materials, polymers and complex fluids, chemistry, biology, and engineering. It is anticipated that 1,000-2,000 scientists and engineers will utilize the SNS each year and that it will meet the nation's need for neutron research well into the 21^{st} century.

The SNS is a partnership between five DOE laboratories [Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Lawrence Berkeley National Laboratory (LBNL), Los Alamos National Laboratory (LANL), Oak

Ridge National Laboratory (ORNL)] that takes advantage of the specialized technical capabilities of each laboratory.

The project is centrally managed from the SNS Project Office at ORNL under the leadership of an experienced Project Executive Director, who has primary authority over the project staff at all five laboratories.

Scientific Facilities Utilization - The FY 2001 budget request strongly supports Scientific Facilities Utilization in the following programs: Basic Energy Sciences, High Energy Physics, Nuclear Physics, Fusion Energy Sciences, Biological and Environmental Research, and Advanced Scientific Computing Research.

Each year, over 15,000 university, industry, and government-sponsored scientists conduct cutting edge experiments at these particle accelerators, high-flux neutron sources, synchrotron radiation light sources, and other specialized facilities. The user community continues to be pleased with the service provided to them by the SC scientific facilities, as evidenced by their many letters of support and by the positive results of surveys conducted at the facilities.

In FY 2001, operating budgets are increasing at the synchrotron radiation light sources and the neutron scattering facilities to provide increased operating time and support for users and to fabricate instruments and beamlines to serve the large and growing user community at these facilities.

Large Hadron Collider (LHC) - The foremost high energy physics research facility of the next decade will be the LHC at CERN, the European Laboratory for Particle Physics. The primary physics goals of the LHC will impact our understanding of the origin of mass through studies of the elusive "Higgs" particle, exploration of the structure and interactions of quarks, and unanticipated phenomena. The High Energy Physics Advisory Panel (HEPAP) strongly endorsed participation in the LHC to provide U.S. access to the high energy frontier in order to maintain the U.S. as a world leader in this fundamental area of science.

DOE and the National Science Foundation (NSF) have entered into an agreement with CERN about contributions to the LHC accelerator and detectors as part of U.S. participation in the LHC program. This agreement, signed in 1997, provides access for U.S. scientists to the next decade's premier high energy physics facility. Under the agreement, the DOE will contribute $450 million ($250 million for the detectors and $200 million for the accelerator) to the LHC effort over the period FY 1996 through FY 2004. The total cost of the LHC is estimated at about $6 billion.

SC has conducted cost and schedule reviews of the U.S. funded components of the LHC project. All of the reviews concluded that the costs are properly estimated and the schedule is feasible.

The agreement with CERN also provides for U.S. involvement in the management of the project and participation in key management committees. This will enable the U.S. to monitor the progress of the project and to ensure full access for U.S. scientists to the research opportunities of the facility.

Fermilab is the lead laboratory for the accelerator portion of the U.S. LHC program, which it will execute in cooperation with BNL and LBNL. BNL is the host laboratory for the ATLAS detector, which also involves ANL, LBNL, and 28 university groups.

Fermilab is the host laboratory for the Compact Muon Solenoid (CMS) detector portion of the project, including BNL, LANL, and 33 university groups. Cost and schedule baselines have been reviewed and validated for each of the three portions of the project, and management systems are in place to monitor progress against baselines.

Life Sciences – Beginning in FY 2001, the Office of Science will support two key areas in the life sciences –- the Microbial Cell Project and Biomedical Engineering.

The goal of the Microbial Cell Project is to develop a comprehensive understanding of the complete workings of a microbial cell. Examples include: DNA sequence; the identification of all of the microbe's genes; the production of all of the proteins whose assembly instructions are contained in the genes; and the complex interaction of the genes and proteins in a cell that give the microbe its life and its unique characteristics and behaviors.

The key scientific challenges are far greater than simply understanding how individual genes and proteins work. We need to understand how genes and proteins are regulated in a coordinated manner and how they are integrated into a functional, interactive cell. The Microbial Cell Project will challenge scientists to go beyond the leveraging of tools and technologies for high throughput DNA sequencing. This will require high throughput approaches for determining the structure and function of proteins, computational biology and bioinformatics resources; the development and use of sophisticated imaging and analytical sensing technologies; and novel approaches to modeling and analyzing complex systems.

This information will address DOE needs in energy use and production, bioremediation, and carbon sequestration, and will provide exciting, new, and previously unavailable information to the entire biological community.

The Biomedical Engineering Program capitalizes on DOE's unique resources and expertise in the biological, physical, chemical and engineering sciences to develop new research opportunities for technological advancement against problems dealing with human health. This activity will: advance fundamental concepts; create knowledge from the molecular to the organ systems level; and develop innovative biologics, materials, processes, implants, devices, and informatics systems to be used for the prevention, diagnosis, and treatment of disease. DOE's Biomedical Engineering Program will complement other Federal programs by supporting early stage research at the national laboratories that cannot be funded by other Agencies.

Scientific and Technical Workforce Retention and Recruitment – During 1999, DOE conducted a systematic analysis of critical staffing needs within the context of current and projected R&D program missions. As a result, staffing shortfalls were identified, especially in scientific and technical disciplines. The Department will focus on building and sustaining a talented and diverse workforce of R&D Technical Managers through innovative recruitment strategies, retention incentives, comprehensive training and development programs, and succession planning.

The Office of Science, utilizing Program Direction funds, will recruit experienced scientists and related support staff in areas important to the Department's science mission. Other key activities to be supported include motivating and retaining highly skilled, top-performing technical managers, and the training of new and current scientists.

The Number of Graduate Students and Post Doctoral Investigators Supported

	Research Support	at User Facilities
FY 1999	6,550	4,840

Recent Office of Science Successes:

- Contributed 16% of the first one billion base pairs of human DNA sequence deposited in public databases by the human genome project.
- Advanced theoretical physics by demonstrating and verifying that all known "string" theories are equivalent.

- Developed and made publicly available the numerical linear algebra libraries on which today's high performance computers rely. These libraries represent decades of research.
- Observed the formation of two new chemical elements (numbers 116 and 118) at the LBNL's 88-Inch Cyclotron.
- Developed a rapid, efficient, self-assembly process for making "nanocomposite" materials, clearing the way for new materials with unprecedented mechanical properties.
- Advanced our understanding of tearing and reconnection in magnetic fields. This is important in many areas of fusion science, including understanding the eruptions of energetic bursts from the surface of the sun.

In addition, hundreds of principal investigators funded by SC have won dozens of major prizes and awards sponsored by the President, the Department, the National Academy of Sciences (NAS), the National Academy of Engineering, and the major professional societies.

Major Program Activities for FY 2001:

The **Basic Energy Sciences** (BES) program is one of the nation's major sponsors of fundamental research in broad areas of materials sciences, chemical sciences, geosciences, plant and microbial sciences, and engineering sciences. This program encompasses more than 2,400 researchers in 200 institutions and 17 of the nation's outstanding user facilities. BES principal investigators are recognized through the receipt of dozens of major prizes and awards from the scientific community.

The BES program has taken a leadership role in defining and addressing the 21^{st} century challenges facing the physical and biological sciences – from understanding collective effects in materials to designing new materials atom by atom and, finally, to developing functional materials. This work underpins the nanoscale science, engineering, and technology initiative. In addition, BES will support construction of the Spallation Neutron Source and ongoing enhancements and maintenance activities at existing reactor and spallation neutron sources and synchrotron light sources.

The BES FY 2001 request supports the Climate Change Technology Initiative (CCTI) emphasizing fundamental research in sequestration science, science for efficient technologies, and fundamental science to advance low- and no-carbon energy sources. Examples include such diverse topics as: high-temperature materials for more efficient combustion; magnetic materials that reduce energy loss during use; semiconductor materials for solar-energy conversion; the foundations to enable evaluation of carbon dioxide sequestration in subsurface geologic formations; and the biological process of photosynthesis, which is central to global carbon cycling.

BES plays a central role in several of the SC priorities for FY 2001 described previously including the construction of the Spallation Neutron Source, enhanced Scientific Facility Utilization, and the National Nanotechnology Initiative. FY 2001 funding also is being requested in BES for fundamental research on microbial biochemistry. Microbes have dramatic impacts on energy production and conservation. The knowledge of the complex interactions that collectively characterize the life and function of these simplest of life forms will permit the control, modification, and use of microbes for both natural and industrial energy-related applications.

BES will also increase its investments in Robotics and Intelligent Machines for future applications important to DOE missions and to enable remote access to the SC user facilities.

The **Biological and Environmental Research** (BER) program has, for over 50 years, invested in advanced environmental and biomedical research to develop knowledge connected to energy. Fundamental research in genomics, structural biology, medical imaging, biomedical engineering, global climate change, and bioremediation at national laboratories, universities, and private institutions, BER develops the knowledge needed to identify, understand, and anticipate the long-term health and environmental consequences of energy production, development and use.

The scientific user facilities supported by BER provide unique capabilities for research in such key areas as structural biology and environmental science. Expanded funding for scientific facilities utilization will assure access to these facilities by scientists in universities, federal laboratories, and industry and will leverage both federally and privately sponsored research.

Construction of a new facility, the Laboratory for Comparative and Functional Genomics will be initiated at Oak Ridge National Laboratory. This facility will support high throughput determination of gene function in the mouse, a minimal model that is a key component of the Department's genome program.

In FY 2001, BER will continue to support basic research that contributes to interagency programs on the global impacts of and solutions for excess carbon in the environment - CCTI and the U.S. Global Change Research Program (US/GCRP).

The BER CCTI program is focused on carbon sequestration through enhancement of the natural terrestrial carbon cycle and sequestration of carbon in the oceans. The BER program complements carbon sequestration programs in BES and the DOE Office of Fossil Energy that focus primarily on other options for carbon sequestration.

FY 2001 will bring the first substantive research results from two new carbon sequestration sites that started collecting data at the end of FY 1999. Individual research projects at universities and national laboratories, started in FY 2000 and FY 2001, will also begin to yield results. The DNA sequences of four microorganisms that play prominent roles in the natural carbon cycle will have been determined. Structural biology studies will be conducted on the enzymes that regulate the processing of carbon in these four microbes to understand the molecular details of, and possibly to modify, these enzymes. Additional microbes with potential utility for enhanced carbon sequestration will also undergo DNA sequencing.

BER will initiate the Microbial Cell Project and expand its Biomedical Engineering Program as part of the Department's Life Sciences effort.

The **High Energy Physics** (HEP) program is directed at understanding the nature of matter and energy at the most fundamental level and the basic forces that govern all processes in nature. Fundamental research provides the foundation for our technology driven economy and advances the technically challenging missions of the Department of Energy.

The HEP FY 2001 request takes into consideration the recommendations of the High Energy Physics Advisory Panel's Gilman Report entitled "Planning for the Future of High-Energy Physics" (1998) through participation in the LHC project, increased support of university researchers, and optimum utilization of U.S. facilities.

The Fermilab 800 GeV fixed target program will complete data collection in FY 2000. Also in FY 2000, the Main Injector project was completed on schedule and within budget. The primary focus of the FY 2001 Fermilab program will be on Tevatron collider experiments that take advantage of the higher luminosity of the new Main Injector.

The SLAC B-factory was brought into full operation in FY 2000 on schedule and within budget. It has already recorded a world record peak luminosity of 2.7×10^{33} which is very close to the design luminosity of 3×10^{33} and an outstanding achievement for such a complex machine. In FY 2001 the B-factory will be operated for the BaBar experiment to collect data aimed at understanding matter-antimatter asymmetry.

The Alternating Gradient Synchrotron (AGS) at BNL was transferred from HEP to the Nuclear Physics Program in the 3rd Quarter of FY 1999 for use as part of the Relativistic Heavy Ion Collider (RHIC) facility. Limited operation of the AGS for HEP research is continuing in FY 2000 on an incremental cost basis. The high priority muon magnetic moment experiment took data in FY 2000 and will be completed during FY 2001. A follow-on experiment regarding the rare kaon will be supported in FY 2001.

The HEP program, in partnership with NSF, oversees U.S. participation in the Large Hadron Collider (LHC) at the European Laboratory for Particle Physics (CERN). HEP program funds were provided to support R&D, design and engineering work on the subsystems and components to be provided by the U.S. under the DOE-NSF agreement with CERN. The FY 2001 request for HEP includes $70 million for continued R&D, prototyping, setting up for production of accelerator components and ramping-up of production of detector subsystems. This work is part of the $450 million DOE contribution to the LHC effort negotiated with CERN.

Following the recommendations of the Gilman Report adopted by HEPAP, R&D will be continued on NLC with the goal of significantly reducing costs by applying such techniques as "design for manufacture". Fermilab has joined the R&D effort, which now involves four laboratories with SLAC as the lead laboratory and Fermilab, LBNL, and LLNL as partners.

The **Nuclear Physics** (NP) program provides primary support in the U.S. for fundamental research on the structure and interactions of atomic nuclei and the fundamental forces and particles of nature as manifested in nuclear matter. The NP program operates large and small research facilities located at DOE's national laboratories and research universities to provide microscopic probes of nuclear structures and forces.

The NP program works in close coordination with the Nuclear Physics program at the NSF and, jointly with NSF, charters the Nuclear Science Advisory Committee (NSAC) to provide advice on scientific opportunities and priorities. Construction of the Relativistic Heavy Ion Collider (RHIC) at BNL was completed in FY 1999 on schedule and within budget. Following initial operation and commissioning in FY 2000, RHIC will achieve full operation in FY 2001. Four detectors (STAR, PHENIX, BRAHMS and PHOBOS), involving over 950 researchers and students from 80 institutions and 19 nations, will allow a vigorous research program. The BNL Medium Energy Group will be re-directed in FY 2001 to concentrate on utilizing the new RHIC capabilities to investigate the origin of proton spin.

In FY 1999 the Isotope Separation On-Line Task Force, a subcommittee of NSAC, identified an optimal configuration for a next generation Rare Isotope Accelerator (RIA) facility. This facility was identified in the 1999 NSAC Long Range Plan for Nuclear Science as the highest priority for new construction. RIA R&D and preconceptual design activities continue in FY 2000 and FY 2001.

The U.S./Canadian Sudbury Neutrino Observatory (SNO) detector was completed in FY 1999. Data will be taken in FY 2000 and FY 2001 and initial measurements of solar neutrinos, relevant to the question of whether neutrinos have mass, are anticipated in FY 2001.

The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab will increase beam energy to 6 GeV in FY 2001, enabling experiments to discern objects 50% smaller than the current operating energy. This will allow important new research that is not currently possible at CEBAF and much of the planned research program to be carried out twice as fast.

The BLAST detector at the MIT/Bates Linear Accelerator Center will be completed in FY 2001 and will initiate its research program, which will utilize high current continuous beams in the new South Hall Pulse Stretcher Ring.

The **Fusion Energy Sciences** (FES) program is the nation's primary sponsor of research in fusion science and plasma physics. It is a multi-purpose, research effort, producing valuable scientific knowledge and technological benefits in the near term and providing the science base for a fusion energy option in the long term. In FY 2001, FES will continue to make progress in: understanding the physics of plasmas; identifying and exploring innovative and cost-effective development paths to fusion energy; and exploring the science and technology of energy producing plasmas.

An integrated FES program plan will be completed during FY 2000. This plan will incorporate the findings and recommendations of the Secretary of Energy Advisory Board and National Research Council reviews as well as the technical understandings of the Fusion Energy Sciences Advisory Committee's assessment of the program and the 1999 Fusion Summer Study.

The FES program will continue to operate three significant user facilities: DIII-D at General Atomics, Alcator C-Mod at MIT, and NSTX at the Princeton Plasma Physics Laboratory (PPPL). Scientists from universities, industry, and national laboratories will continue world class experiments at DIII-D and Alcator C-Mod on advanced tokamak modes of operation. A team of scientists will conduct pioneering experiments on NSTX, a medium-scale spherical torus, which may lead to a more cost-effective development path to fusion energy. A DOE-NSF partnership in Basic Plasma Science and Engineering will continue, including a joint announcement to be issued in FY 2000 for new funding opportunities in FY 2001.

Operation of the Massachusetts Institute of Technology Levitated Dipole Experiment will begin in FY 2000, bringing the total number of exploratory level alternative concept experiments operating in the U.S. to 13. This important new investment is expected to pay dividends in the form of improved understanding of magnetic confinement concepts over the next decade.

The FES program also includes an increased effort on heavy ion accelerator physics aimed at a driver for inertial fusion. Successful completion of experiments using modular systems will lead to the design of an Integrated Research Experiment, a proof-of-principle inertial fusion energy facility.

The FES program continues to work toward improving the scientific and programmatic coordination between the magnetic and inertial elements of the program. Bilateral and multilateral science and technology research activities on major scientific facilities abroad will enable U.S. scientists to access plasma conditions not readily available on domestic facilities.

A Virtual Laboratory for Technology uses the internet to integrate all of the enabling technology R&D elements into a coordinated national program. Research will continue on low activation materials, high heat flux component systems, and magnetic, heating and fueling components.

The **Advanced Scientific Computing Research** (ASCR) program's primary mission is to discover, develop, and provide to researchers in various scientific disciplines the computational and networking tools that enable them to analyze, model, simulate, and predict complex phenomena important to the Department of Energy.

To accomplish this mission, the program fosters and supports fundamental research in advanced computing research – applied mathematics, computer science, and networking – and operates supercomputer, networking, and related facilities.

These have played a critical role in the evolution of high performance computing and networks.

The Mathematical, Information, and Computational Sciences (MICS) subprogram is responsible for carrying out the primary mission of the ASCR program. In all of the areas in which MICS supports research, the mission requirements far exceed the current state-of-the-art and the tools that the commercial marketplace can deliver. For this reason, the MICS subprogram is carefully managed to: integrate basic research; transform basic research results into software that can be transferred to scientists in other disciplines; and partner with users in scientific disciplines to validate the usefulness of the approach.

In FY 2001 the MICS subprogram will enhance its efforts to produce scientific computing, networking and collaboration tools needed by DOE researchers. These efforts will: increase access to multi-teraflop computers; establish a number of centers focused on the software challenges confronting terascale users; build partnerships between mathematicians, computer scientists, and scientists in other disciplines to produce advanced scientific software; tie together the physical and software services via common software framework building blocks ("middleware") to enable the success of the unique, data intensive, collaboratories of the future; and make significant contributions to the nation's Information Technology Research and Development effort.

MICS is changing the way it allocates resources at NERSC in the 21st century. The new allocation procedure proscribes that 60% of the resources will continue to be allocated directly by the SC program offices to research that they have peer reviewed. 40% of the resources will be allocated based on an independent peer review of proposals for high performance computing resources in a manner similar to the way other DOE user facilities allocate resources.

The FY 2001 request for the ASCR program also supports the Laboratory Technology Research subprogram, whose mission is to foster and support high-risk research in the natural sciences and engineering in partnership with the private sector leading to innovative applications relevant to the nation's energy sector.

The **Multiprogram Energy Laboratories - Facilities Support** (MELFS) program supports line items construction projects to replace and upgrade the general purpose infrastructure of the 5 SC multiprogram labs. The program also provides Payment in-lieu of Taxes to local communities around ANL and BNL; and, provides landlord support of the Oak Ridge Reservation and Operations Office.

The SC multiprogram labs are all over 50 years old and infrastructure investments are needed to ensure that the general purpose infrastructure supports the Department's research needs in a safe, environmentally sound, reliable, productive and cost-effective manner now and into the future. The FY 2001 budget will provide for 5 new utility related projects at LBNL, BNL and ORNL including water distribution systems, heating and ventilation systems, fire protection, electrical systems and surface and groundwater protection.

The **Science Program Direction** budget consists of three subprograms: Program Direction, Science Education, and Field Operations. Program Direction pays for the Federal staff and key support activities that provide the programmatic guidance within the Office of Science at headquarters. It also supports program-specific staff directly involved in executing SC programs at the Chicago, Oakland, and Oak Ridge Operations Offices. In FY 2001 there will be continued emphasis on integrated business management technology initiatives and supporting the ongoing efforts begun in FY 2000 related to succession planning and increasing diversity of the workforce. In addition, resources will be devoted to support the Department's Scientific and Technical Workforce Retention and Recruitment effort.

Scientific and Technical Workforce Retention and Recruitment focuses on building and sustaining a talented and diverse workforce of Research and Development (R&D) Technical Managers. During 1999, DOE conducted a systematic analysis of critical staffing needs within the context of R&D program missions, which identified current and projected staffing shortfalls, especially in scientific and technical disciplines. The Department will include innovative recruitment strategies, retention incentives, and comprehensive training and development programs for new and current employees, and succession planning. The FY 2001 program direction request for the Office of Science includes $2.0 million for this Scientific and Technical Workforce Retention and Recruitment effort. These funds will enable the Office of Science to recruit experienced scientists and related support staff in areas important to the Department's science mission, motivate and retain top-performing technical managers, and provide training in areas crucial for effective job performance.

The Science Education subprogram has as its mission to foster the next generation of scientists and engineers. A recent National Science Foundation (NSF) survey documents a five-year decrease in the number of science and engineering graduate students. Other studies indicate that the number of S&E graduates taking government positions is also sharply down. Science Education activities enable college and university students and faculty to take advantage of fellowship and research opportunities at the national laboratories and user facilities. Such initiatives are tailored to recruit and retain students interested in science and engineering. Science Education also sponsors the Energy Research Undergraduate Laboratory Fellowship Program, the Albert Einstein Distinguished Educator Fellowship Program and the National Science Bowl®. The DOE Institute of Biotechnology, Environmental Science, and Computing for Community Colleges is also sponsored within Science Education. This is the result of a successful pilot in 1999. All of these efforts are designed to ensure that the next generation of scientists and engineers accept careers in and meet the challenges of fundamental science, energy, the environment, and national security.

Field Operations funds the core management and administrative Federal staff and the related operational costs at three of the Department's multi-program Operations Offices that report to SC: Chicago, Oakland, and Oak Ridge. This account provides the resources necessary to support the scientific and technical work performed on behalf of Science and other DOE programs within the field/laboratory structure. These resources will support integrated business management systems aimed at providing coordinated, efficient and effective services and process improvements.

The 5% cut in FY 2000 funding for field operations combined with the reorganization of field management has had an impact on SC's ability to manage our programs. With the new organization, SC is confident in our ability to efficiently and effectively manage the field within requested funding.

The **Technical Information Management** (TIM) program maximizes the return on DOE's $7 billion annual R&D investment by collecting, preserving, and disseminating information resulting from these research programs. This information is recorded in three forms: journals, technical reports, and pre-prints. The TIM program has produced world-class web-based systems to provide full-text, electronic access to all three sources of information. The DOE Information Bridge (www.doe.gov/bridge) provides access to 70,000 technical reports. The newly launch PubScience (www.doe.gov/pubsci) provides electronic access to over 1,000 physical science journals – analogous to the capability PubMed provides in the life sciences.

FY 2001 accomplishments will include expanded coverage of science journals and a fully operational, searchable pre-print network. Also, the TIM program will continue its important role in obtaining foreign research information through two international information exchanges and, for the first time, will provide access to this information in electronic full-text. Finally, the program will provide enhanced protection and secure electronic access to a 50-year old repository of classified and sensitive R&D information.

Closing:

The reduction of FY 2000 funds for contractor travel is having a significant impact on our ability to conduct forefront research in the fundamental sciences. The advance of research is greatly aided by the exchange of ideas and the sharing of experiences. In many of the disciplines supported by the Office of Science, important exchanges take place at national and international scientific meetings and through interpersonal exchanges. Reductions in contractor travel have hampered these exchanges and have impacted SC's ability to recruit young scientists to the national laboratories.

James Decker
Director (Acting)
Office of Science

Table 1

OFFICE OF SCIENCE
FY 2001 PRESIDENT'S BUDGET REQUEST TO CONGRESS
(B/A in thousands of dollars)

	FY 1999 Conf. Approp.	FY 2000 Conf. Approp.	FY 2001 Pres. Request
Science			
Basic Energy Sciences	783,185	771,561	1,015,770
Advanced Scientific Computing Research	153,512	127,883	181,970
Biological and Environmental Research	425,890	432,886	445,260
Fusion Energy Sciences	217,248	244,686	247,270
High Energy Physics	680,716	697,743	714,730
Nuclear Physics	327,168	347,714	369,890
Energy Research Analyses	976	991	1,000
Multiprogram Energy Laboratories-Facilities Support	21,260	33,055	33,930
Science Program Direction	49,453	131,108	141,245
Small Business Innovation Research and Small Business Technology Transfer	81,461	-	-
Subtotal	2,740,869	2,787,627	3,151,065
General Reduction for Use of Prior Year Balances	(13,000)	-	-
Superconducting Super Collider	(7,600)	-	-
Total	2,720,269	2,787,627	3,151,065
Energy Supply R&D			
Technical Information Management	8,836	8,600	9,302
Small Business Innovation Research and Small Business Technology Transfer	4,874	-	-
General Reduction for Use of Prior Year Balances	(250)	-	-
Total	13,460	8,600	9,302

Table 2

OFFICE OF SCIENCE
FY 2001 PRESIDENT'S BUDGET REQUEST TO CONGRESS
(B/A in thousands of dollars)

	FY 1999 Conf. Approp.	FY 2000 Conf. Approp.	FY 2001 Pres. Request
Global Climate Change	111,608	119,901	122,347
Climate Change Technology Initiative	13,500	33,000	36,700
Science and Education Programs	4,500	4,500	6,500
Nanoscience Engineering and Technology	-	47,660	83,595
Robotics and Intelligent Machines	-	700	2,700
Microbial Cell Research	-	-	12,500
Bioengineering Research	-	1,700	6,700

Table 3

OFFICE OF SCIENCE
FY 2001 PRESIDENT'S BUDGET REQUEST TO CONGRESS
(B/A in thousands of dollars)

Major Site Funding	FY 1999 Conf. Approp.	FY 2000 Conf. Approp.	FY 2001 Pres. Request
AMES LABORATORY			
Advanced Scientific Computing Research	2,239	1,672	1,571
Basic Energy Sciences	18,838	16,990	16,165
Biological and Environmental Research	900	660	525
Total Laboratory	21,977	19,322	18,261
ARGONNE NATIONAL LABORATORY			
Advanced Scientific Computing Research	19,032	12,187	11,958
Basic Energy Sciences	144,752	140,005	160,726
Biological and Environmental Research	10,198	9,040	20,780
Fusion Energy Sciences	2,604	2,339	2,270
High Energy Physics	9,679	9,702	11,055
Multiprogram Energy Labs-Facilities Support	7,089	4,980	6,660
Nuclear Physics	17,039	16,304	16,965
Science Program Direction	797	200	900
Total Laboratory	211,190	194,757	231,314
BROOKHAVEN NATIONAL LABORATORY			
Advanced Scientific Computing Research	2,023	1,811	1,504
Basic Energy Sciences	79,425	75,441	75,769
Biological and Environmental Research	23,413	19,163	16,758
Energy Research Analyses	48	50	-
High Energy Physics	69,514	30,990	38,844
Multiprogram Energy Labs-Facilities Support	1,349	6,881	6,659
Nuclear Physics	117,305	132,463	145,783
Science Program Direction	398	250	600
Total Laboratory	293,475	267,049	285,917

Major Site Funding	FY 1999 Conf. Approp.	FY 2000 Conf. Approp.	FY 2001 Pres. Request
THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY			
Advanced Scientific Computing Research	151	50	200
Biological and Environmental Research	260	-	-
Nuclear Physics	71,673	72,730	74,715
Science Program Direction	-	-	150
Total Laboratory	72,084	72,780	75,065
FERMI NATIONAL ACCELERATOR LABORATORY			
Advanced Scientific Computing Research	213	60	200
Energy Research Analyses	-	-	60
High Energy Physics	296,713	286,253	282,730
Total Laboratory	296,926	286,313	282,990
IDAHO NATIONAL ENGINEERING LABORATORY			
Basic Energy Sciences	3,709	2,674	3,121
Biological and Environmental Research	2,084	1,761	1,489
Fusion Energy Sciences	1,804	1,623	1,701
Nuclear Physics	80	-	-
Total Laboratory	7,677	6,058	6,311
LAWRENCE BERKELEY NATIONAL LABORATORY			
Advanced Scientific Computing Research	57,969	53,865	64,457
Basic Energy Sciences	66,080	63,386	68,537
Biological and Environmental Research	39,163	43,581	40,532
Energy Research Analyses	165	30	75
Fusion Energy Sciences	4,971	7,877	7,655
High Energy Physics	26,706	33,627	37,786
Multiprogram Energy Labs-Facilities Support	4,854	6,133	2,113
Nuclear Physics	23,222	17,232	17,250
Science Program Direction	309	225	500
Total Laboratory	223,439	225,956	238,905

Major Site Funding	FY 1999 Conf. Approp.	FY 2000 Conf. Approp.	FY 2001 Pres. Request
LAWRENCE LIVERMORE NATIONAL LABORATORY			
Advanced Scientific Computing Research	3,620	3,210	3,160
Basic Energy Sciences	6,618	6,336	6,195
Biological and Environmental Research	41,127	40,110	38,875
Fusion Energy Sciences	11,696	13,063	12,716
High Energy Physics	1,496	1,230	850
Nuclear Physics	710	564	785
Total Laboratory	65,267	64,513	62,581
LOS ALAMOS NATIONAL LABORATORY			
Advanced Scientific Computing Research	15,206	11,873	10,560
Basic Energy Sciences	24,950	24,427	27,861
Biological and Environmental Research	22,362	19,280	17,971
Fusion Energy Sciences	4,365	6,094	5,960
High Energy Physics	870	860	800
Nuclear Physics	10,505	9,986	10,095
Total Laboratory	78,258	72,520	73,247
OAK RIDGE NATIONAL LABORATORY			
Advanced Scientific Computing Research	13,392	7,584	6,719
Basic Energy Sciences	221,267	207,551	372,644
Biological and Environmental Research	28,062	25,988	29,144
Energy Research Analyses	-	40	40
Fusion Energy Sciences	18,093	17,550	17,621
High Energy Physics	240	240	240
Multiprogram Energy Labs-Facilities Support	6,808	1,101	6,627
Nuclear Physics	16,094	15,173	16,120
Science Program Direction	439	320	800
Total Laboratory	304,395	275,547	449,955

Major Site Funding	FY 1999 Conf. Approp.	FY 2000 Conf. Approp.	FY 2001 Pres. Request
PACIFIC NORTHWEST NATIONAL LABORATORY			
Advanced Scientific Computing Research	4,312	2,602	2,210
Basic Energy Sciences	12,887	12,063	12,295
Biological and Environmental Research	79,879	64,339	65,312
Energy Research Analyses	250	250	300
Fusion Energy Sciences	1,415	1,385	1,385
High Energy Physics	10	-	-
Science Program Direction	572	275	750
Total Laboratory	99,325	80,914	82,252
NATIONAL RENEWABLE ENERGY LABORATORY			
Advanced Scientific Computing Research	127	-	-
Basic Energy Sciences	4,492	5,180	5,116
Total Laboratory	4,619	5,180	5,116
PRINCETON PLASMA PHYSICS LABORATORY			
Advanced Scientific Computing Research	121	45	200
Basic Energy Sciences	675	-	-
Fusion Energy Sciences	52,129	62,970	70,219
High Energy Physics	120	120	120
Science Program Direction	-	-	250
Total Laboratory	53,045	63,135	70,789
SANDIA NATIONAL LABORATORY			
Advanced Scientific Computing Research	5,651	4,798	4,705
Basic Energy Sciences	27,142	23,075	23,879
Biological and Environmental Research	3,537	1,490	3,091
Energy Research Analyses	-	50	75
Fusion Energy Sciences	4,120	3,338	3,232
Total Laboratory	40,450	32,751	34,982

Major Site Funding	FY 1999 Conf. Approp.	FY 2000 Conf. Approp.	FY 2001 Pres. Request
STANFORD LINEAR ACCELERATOR CENTER			
Advanced Scientific Computing Research	1,052	375	450
Basic Energy Sciences	26,475	23,042	31,592
Biological and Environmental Research	2,771	2,450	3,500
Fusion Energy Sciences	50	50	-
High Energy Physics	146,559	151,377	157,257
Science Program Direction	15	-	150
Total Laboratory	176,922	177,294	192,949