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FY 2007 Appropriations Hearing before the
Senate Appropriations Subcommittee on Energy and Water

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Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to testify today on the Office of Science's Fiscal Year (FY) 2007 budget request. I appreciate your strong support for basic research in the physical sciences, Mr. Chairman, and your understanding of the importance of this research to our Nation's energy security and economic competitiveness. I also want to thank the Members of the Subcommittee for their support. This budget represents a strong commitment on the part of the President to ensure continued U.S. leadership in the basic sciences. I believe this budget will enable the Office of Science to strengthen U.S. scientific leadership and carry out its mission to deliver the revolutionary discoveries and scientific tools that transform our understanding of energy and matter and advance our national, economic and energy security.

The Office of Science requests $4,101,710,000 for the FY 2007 Science appropriation, an increase of $505,319,000 over the FY 2006 appropriation. As part of the President's American Competitiveness Initiative, the FY 2007 Budget represents the beginning of the President's commitment to double, over 10 years, the sum of the research investment at the Office of Science, the National Science Foundation, and the Department of Commerce's National Institute of Standards and Technology. This commitment will help ensure that the United States remains the world leader in critical areas of basic scientific research; maintains an order of magnitude dominance for large-scale scientific facilities and instrumentation in the key fields of science and technology that will drive the twenty-first century economy; pursues the transformational technologies necessary for greater energy security and independence for our Nation; and nurtures and develops a world-class scientific and engineering workforce.

The Office of Science is the lead Federal supporter for basic research in the physical sciences in the U.S., and the steward for fields such as systems biology for energy and the environment, materials science, high energy physics, nuclear physics, heavy element chemistry, plasma physics, magnetic fusion, and catalysis. It also supports unique and vital components of U.S. research in climate change and geophysics. Researchers funded through the Office of Science are working on some of the most pressing scientific challenges of our age including: 1) Harnessing the power of microbial communities for: energy production from renewable sources, carbon sequestration, and environmental remediation; 2) Expanding the frontiers of nanotechnology to develop materials with unprecedented properties for widespread potential scientific, energy, and industrial applications; 3) Pursuing the breakthroughs in materials science, nanotechnology, biotechnology, and other fields needed to make solar energy more cost-effective;
4) Demonstrating the scientific and technological feasibility of creating and controlling a sustained burning plasma to generate energy, as the next step toward making fusion power a commercial reality; 5) Using advanced computation, simulation, and modeling to understand and predict the behavior of complex systems, beyond the reach of our most powerful experimental probes, with transformational impact on a broad range of scientific and technological undertakings; 6) Understanding the origin of the universe and nature of dark matter and dark energy; and 7) Resolving key uncertainties and expanding the scientific foundation needed to understand, predict, and assess the potential effects of atmospheric carbon on climate and the environment.

U.S. preeminence in science, technology, and innovation will depend on the continued availability of the most advanced scientific research facilities for our researchers. The Office of Science builds and operates the world's most powerful array of scientific facilities and instruments, including advanced synchrotron light sources, the new Spallation Neutron Source, state-of-the-art Nanoscale Science Research Centers, genome sequencing facilities, supercomputers and high-speed networks, climate and environmental monitoring capabilities, and particle accelerators for high energy and nuclear physics. We are in the process of developing an X-ray free electron laser light source that can image single large macromolecules and measure in real-time changes in the chemical bond as chemical and biological reactions take place. Our premier tools of science at the ten national laboratories managed by the Office of Science are used by over 19,000 researchers and students from universities, other federal agencies, and private industry every year, and have enabled U.S. researchers to make some of the most important scientific discoveries of the past seventy years.

Office of Science leadership in basic research in the physical sciences, and stewardship of large research facilities, is directly linked to its role in training America's scientists, engineers, and teachers. Through the funding of a diverse portfolio of research at more than 300 colleges and universities nationwide, we provide direct support and access to research facilities for thousands of university students and researchers in the physical and biological sciences and mathematics. Facilities at the national laboratories provide unique opportunities for researchers and their students from across the country to pursue questions at the intersection of physics, chemistry, biology, computing, and materials science. The Office of Science also sponsors undergraduate student internships and fellowships for science and mathematics K-12 teachers for research experience and training at the national laboratories.

The FY 2007 budget request will allow the Office of Science to increase support for high-priority DOE mission-driven scientific research as well as support new initiatives; maintain optimum operations at our scientific user facilities; keep major facility construction projects on schedule and within budget; and treble educational, research, and training opportunities for the next generation of scientists, engineers, and teachers. The budget will also allow us to expand our contribution to basic research in support of the President's Hydrogen Fuel Initiative and the President's new Advanced Energy Initiative. Roughly half of our budget goes to construction and operations of the large scientific facilities, and the other half is approximately equally split between research at the DOE laboratories and research at universities. This budget will support the research of approximately 24,200 faculty, students, and postdoctoral researchers throughout the Nation, an increase of 2,600 from FY 2006.

The following programs are supported in the FY 2007 budget request: Basic Energy Sciences, Advanced Scientific Computing Research, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, Science Laboratories Infrastructure, Science Program Direction, Workforce Development for Teachers and Scientists, and Safeguards and Security.

FY 2007 PRESIDENT'S REQUEST
SUMMARY BY PROGRAM

(dollars in thousands)

	FY 2005 Appropriation	FY 2006 Appropriation	FY 2007 Request
Science			
Basic Energy Sciences	1,083,616	1,134,557	1,420,980
Advanced Scientific Computing Research	226,180	234,684	318,654
Biological and Environmental Research			
Base program	487,474	451,131	510,263
Congressionally directed projects	79,123	128,700	——
Total, Biological and Environmental Research	566,597	579,831	510,263
High Energy Physics	722,906	716,694	775,099
Nuclear Physics	394,549	367,034	454,060
Fusion Energy Sciences	266,947	287,644	318,950
Science Laboratories Infrastructure	37,498	41,684	50,888
Workforce Development for Teachers and Scientists	7,599	7,120	10,952
Science Program Direction	154,031	159,118	170,877
Safeguards and Security	67,168	68,025	70,987
Small Business Innovation Research/Small Business Technology Transfer	113,621	——	——
Subtotal, Science	3,640,712	3,596,391	4,101,710
Less use of prior year balances	-5,062	——	——
Total, Science	3,635,650	3,596,391	4,101,710

FY 2007 SCIENCE PRIORITIES

In his State of the Union Message on January 31, 2006, President George W. Bush stated,

"To keep America competitive, one commitment is necessary above all: We must continue to lead the world in human talent and creativity. Our greatest advantage in the world has always been our educated, hardworking, ambitious people–and we're going to keep that edge. Tonight I

announce an American Competitiveness Initiative, to encourage innovation throughout our economy, and to give our nation's children a firm grounding in math and science.

First, I propose to double the Federal commitment to the most critical basic research programs in the physical sciences over the next 10 years. This funding will support the work of America's most creative minds as they explore promising areas such as nanotechnology, supercomputing, and alternative energy sources."

I believe the American Competitiveness Initiative and this commitment by the President present an historic opportunity for science in our country and continued U.S. global competitiveness. Through the FY 2007 budget, the Office of Science will build on our record of results with new investments to maintain U.S. world-leadership status in the physical sciences, keep U.S. research and development at the forefront of global science, and increase America's talent pool in science, technology, engineering, and mathematics.

Determining science and technology priorities across the Office of Science programs is an ongoing process, both in times of budget stringency and budget increases. Several factors are considered in our prioritization, including scientific opportunities identified by our scientific advisory committees and the overall scientific community; DOE mission needs; and Administration and Departmental priorities. In FY 2007, we will support the priorities in scientific research, facility operations, and construction and laboratory infrastructure established in the past few years and outlined in the Office of Science Strategic Plan and 20-year Facilities Outlook, in addition to Presidential and Departmental initiatives.

The President's Hydrogen Fuel Initiative and the new Advanced Energy Initiative will be supported through our contributions to basic research in hydrogen, fusion, solar energy to transportation fuels, chemical separation and materials for advanced nuclear energy systems, and production of ethanol from cellulose. We will also continue strong support for other Administration priorities such as nanotechnology, advanced scientific computation, and climate change science and technology.

The Office of Science will actively lead and support the U.S. contributions to ITER, the international project to build and operate the first fusion science facility capable of producing a sustained, burning plasma to generate energy on a massive scale without environmental insult.

Full operations at four of the DOE Nanoscale Science Research Centers (NSRCs) and completion of construction and start-up operations for the fifth NSRC will be supported in FY 2007. These facilities are the Nation's premier nanoscience user centers, providing resources unmatched anywhere in the world for the synthesis, fabrication, and analysis of nanoparticles and nanomaterials.

We will fully fund the programs in advanced scientific computing including support for: increasing capacity to 100-150 teraflops (trillions of operations per second) for high-performance production computing at the National Energy Research Scientific Computing Center (NERSC); 250 teraflop capability for modeling and simulation of scientific problems in combustion, fusion, and complex chemical reactions at Oak Ridge National Laboratory's Leadership Computing Facility; and installation of a 100 teraflop peak capacity IBM Blue Gene P system at Argonne National Laboratory's Leadership Computing Facility to extend architectural diversity in leadership computing and address challenges in catalysis, protein/DNA complexes, and materials sciences related to next-generation design of nuclear reactors.

The Office of Science designs, constructs, and operates facilities and instruments that give U.S. scientists an "order of magnitude" lead over foreign competition in key scientific fields. For example, increasing the computing capacity at NERSC and the Leadership Computing Facilities will give the U.S. computational capabilities for open scientific research that are at least ten times greater than available anywhere else. The Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center, when it comes on line in 2009, will produce X-rays 10 billion times, or ten orders of magnitude more intense than any existing X-ray source in the world, and allow structural studies on individual nanoscale particles and single biomolecules. The Spallation Neutron Source (SNS), the world's forefront neutron scattering facility, will increase the number of neutrons available for cutting-edge research by a factor of ten over any existing Spallation neutron source in the world when operations begin this year. We will be supporting the first full year of SNS operations in FY 2007 as well as the fabrication of four to five instruments that are part of the initial suite of instruments for the target station.

In FY 2007, we will begin R&D and project engineering and design for the next generation of synchrotron light sources. The National Synchrotron Light Source-II (NSLS-II) will deliver orders of magnitude improvement in spatial resolution, providing the world's finest capabilities for X-ray imaging and enabling the study of material properties and functions, particularly at the nanoscale, at a level of detail and precision never before possible. Its energy resolution will explore dynamical properties of matter as no other light source has ever accomplished.

Our research programs in nuclear physics continue to receive strong support. We will continue optimum operations at the Relativistic Heavy Ion Collider (RHIC), and support additional instrumentation projects for RHIC for studying the properties of hot, dense nuclear matter, providing insight into the early universe. We will also support increased operations at the Continuous Electron Beam Accelerator Facility (CEBAF) and project engineering and design for doubling the energy of the existing beam at CEBAF to12 gigaelectron volts. It will image directly individual quarks and gluons in the nucleus, something never before accomplished.

In addition to supporting core experimental and theoretical high-energy physics research, we will double the resources for R&D for the proposed high-energy, high luminosity electron-positron International Linear Collider. And we will maintain strong support for U.S. participation in the research program at the Large Hadron Collider, scheduled to begin operations in 2007.

The Office of Science will expand the Genomics: GTL program–a program that builds on the advances in genome sequencing, molecular science, and computation, to understand and ultimately harness the functions of microbes to address DOE's mission needs.
We will also continue to support the development of leaders in the science and mathematics education community through a tripling of the number of K-12 teachers participating in the

Laboratory Science Teacher Professional Development program, focusing on middle school teachers and students. This immersion program, working with master teachers and laboratory mentor scientists, builds content knowledge, research skills, and a lasting connection to the scientific community, leading to more effective teaching that inspires students in science and mathematics.

SCIENCE ACCOMPLISHMENTS

Over the past 50 years, the Office of Science has blended cutting-edge research and innovative problem solving to keep the U.S. at the forefront of scientific discovery. American taxpayers have received great value for their investment in basic research sponsored by the Office of Science that has led to significant technological innovations, new intellectual capital, enhanced economic competitiveness, and improved quality of life. The following are some of the past year's highlights:

Promoting the Contributions of Physics to Our Quality of Life – 2005 World Year of Physics. The Office of Science, in coordination with researchers at universities nationwide and the DOE national laboratories, celebrated the 2005 World Year of Physics through a year-long program of activities and materials highlighting how physics enables advances in science and contributes to the quality of life. In celebration of the centennial of Albert Einstein's "miracle year", 1905, when he published four papers that laid the foundations of much of physics as we know it today, the Office of Science co-sponsored a new PBS NOVA program, "Einstein's Big Idea", and its associated educational materials. The program aired on PBS stations nationwide in October 2005. Library guides about the program were distributed to all 16,000 libraries nationwide, and teacher's guides were sent nationwide to 15,000 high school physics teachers, 3,700 middle school physics teachers, and 400 middle school science chairs. Several of the national laboratories held special lectures, symposia, and education events for local middle school and high school students and the surrounding communities. A DOE/Office of Science website was created to educate the public about the significance of Einstein's revolutionary work, describe the role of physics in various science and technology fields, publicize events, and highlight the work of DOE-sponsored physicists. The "DOE Physicists at Work" website continues to profile the work of young physicists conducting research in the universities and national laboratories funded by the Office of Science. Several activities coordinated by the American Physical Society were also co-sponsored by the Office of Science including Physics Quest, an outreach event held on the grounds of the Institute for Advanced Studies in Princeton, NJ, that took over 100,000 middle school students through a series of experiments on a hunt to finding Einstein's "missing treasure", and Physics on the Road, a project that supported the materials and equipment for teams from colleges and universities to perform physics demonstrations at schools and public venues.

Nobel Prize in Chemistry. The 2005 Nobel prize in chemistry was awarded to Robert H. Grubbs (CalTech), Richard R. Schrock (MIT), and Yves Chauvin (French Petroleum Institute) for the development of the "metathesis method" in organic synthesis. This method of selectively stripping out certain atoms in a compound and replacing them with atoms that were previously part of another compound employs novel catalysts to simplify the process of custom-building molecules with specialized properties. Metathesis has led to industrial and pharmaceutical methods that are more efficient, produce fewer by-products, and are more environmentally friendly. The work of the laureates has major significance in the production of fuels, synthetic fibers, plastics, and pharmaceuticals. The Office of Science has supported Dr. Schrock's work in catalytic chemistry at the Massachusetts Institute of Technology since 1979 and supported Dr. Grubbs' work in homogeneous catalysis at Caltech from 1979 through 1988.

Discoveries and Capabilities at the Frontier of Nanoscale Science. In 2005, the world's first hard X-ray nanoprobe beamline was activated at the Advanced Photon Source (Argonne). The X-ray microscope nanoprobe will provide spatial resolution of 30 nanometers or better, making it a valuable tool for studying nanomaterials as the new Center for Nanoscale Materials begins operations in 2006 at Argonne National Laboratory. Researchers at the Stanford Synchrotron Radiation Laboratory have developed new methods for studying the structure of nanomaterials through a combined use of X-ray scattering and absorption measurement techniques that has led to significant advances in understanding the structures of nanomaterials and routine characterization of bacterial nano-minerals. Scientific discoveries at the nanoscale in 2005 include the following: ultrathin films, six atoms thick, that retained ferroelectric properties needed for next generation nanoscale devices such as electronics and sensors; ultrafast laser techniques observed the fastest reversible phase transition between nanocrystal structures ever recorded with the transition of vanadium oxide crystals switching from a semiconducting to metallic phase material; the fabrication of novel semiconductor nanocrystal polymer solar cells that demonstrated surprisingly high efficiencies; and the development of the world's smallest synthetic nanomotor–a 300 nanometer gold rotor on a carbon nanotube shaft–demonstrating advances in the miniaturization of electromagnetic devices.

Delivering Forefront Computational and Networking Capabilities for Science. Several computational sciences and networking advances in made in 2005 enable more effective use of leadership-scale computing resources and management of the growing data volumes from the scientific user facilities: computer science researchers have significantly enhanced the performance of simulation models for fusion, atmospheric science, and quantum chemistry applications and continue to improve programming models that optimize complex scientific applications run on computers with hundreds to thousands of processors; researchers at Argonne National Laboratory have produced a new modeling and solution paradigm for the design of efficient electricity markets; the Energy Sciences Network completed the first metropolitan area network connecting six DOE sites in the San Francisco Bay Area with dual connectivity at 20 gigabits per second, 10 to 50 times the previous bandwidth at each site, also improving reliability and lowering costs; and the UltraScienceNet Testbed completed deployment in August 2005 of its a 20 gigabit per second reconfigurable optical network testbed designed to test advanced optical network technologies such as advanced data transfer networking technologies designed to meet the increasing demand for bandwidth and the needs of next-generation scientific instruments.

Advances in Biotechnology for Energy and the Environment. Progress towards understanding how living organisms interact with and respond to their environment, and how those processes involved can be utilized, was gained through the following accomplishments: researchers applied both genomic and proteomic approaches to characterize a naturally occurring microbial community for the first time at a remediation site, producing insights into potential biotechnology strategies for remediation of toxic materials; advanced genomic sequencing technologies applied to samples taken from the Sargasso Sea led to the discovery of over a million new genes that had never been seen before, identifying the potential of environmental genomics for discovering new microbe functionalities that can be harnessed for energy or environmental applications; researchers have developed the ability to insert fiber-optic probes into living cells to watch cellular processes unfold in real time; and a new clearinghouse was established that contains approximately 300 draft or completed genome sequences of microbes, associated information about the gene, protein functions, and biochemical pathways, and browsing tools to help researchers sort through and analyze genomic data.

Accomplishments in Theory, Simulation, and Experiments Energize Fusion Research Towards ITER. With progress on the international agreement to build ITER, investigations on the theory, simulation, and experimentation related to burning plasma and ITER related issues increased in 2005. The results of some of those studies include the following: researchers achieved ITER level plasma pressure at the Alcator C-Mod facility, a world record absolute pressure for magnetic confinement experiments; separate experiments on DIII-D indicated higher plasma pressures can be obtained without a penalty to energy confinement, suggesting that ITER could achieve higher fusion power output than originally conceived; multi-teraflop performance was achieved on a leading plasma micro-turbulence simulation code, demonstrating the ability of the code to effectively utilize increased computational capabilities and accelerate the pace of discoveries in this area of fusion plasma research; and high-performance reduced-activation steels tested under fusion-relevant conditions demonstrated superior performance under intense neutron radiation compared to conventional steels, making these materials lead candidates for structural components of ITER.

PROGRAM OBJECTIVES AND PERFORMANCE

The path from basic research to industrial competitiveness is not always obvious. History has taught us that seeking answers to fundamental questions results in a diverse array of practical applications as well as some remarkable revolutionary advances. Working with the scientific community, the Office of Science invests in the most promising research and sets definite and challenging long-term scientific goals with meaningful annual targets. The intent and impact of our performance goals may not always be clear to those outside the research community. Therefore the Office of Science has created a website (www.sc.doe.gov/measures) to better communicate what we are measuring and why it is important. This website also tracks progress toward management improvements and describes a wide array of program accomplishments.

ORGANIZATION

The OneSC Project was initiated to streamline the Office of Science structure and improve operations across the Office of Science complex in keeping with the principles of the President's

Management Agenda to manage government programs more efficiently and effectively. The Office of Science has been officially reorganized under the OneSC structure (Figure 2). Phase 1 of the reorganization was effective March 20, 2005. Phase 2 of OneSC involves human capital and organizational needs analyses and reengineering of SC business and management operations and processes. The Office of Science business practices and processes will be optimized to remove unnecessary work and support enhanced stewardship and oversight of the Office of Science laboratories. Attrition, retraining, reassignments, and workforce management incentives will be utilized to manage changes in staffing levels or skill mix needs resulting from Phase 2 activities. No downgrades, involuntary geographical transfers, separations, or reductions-in-force are planned or expected.

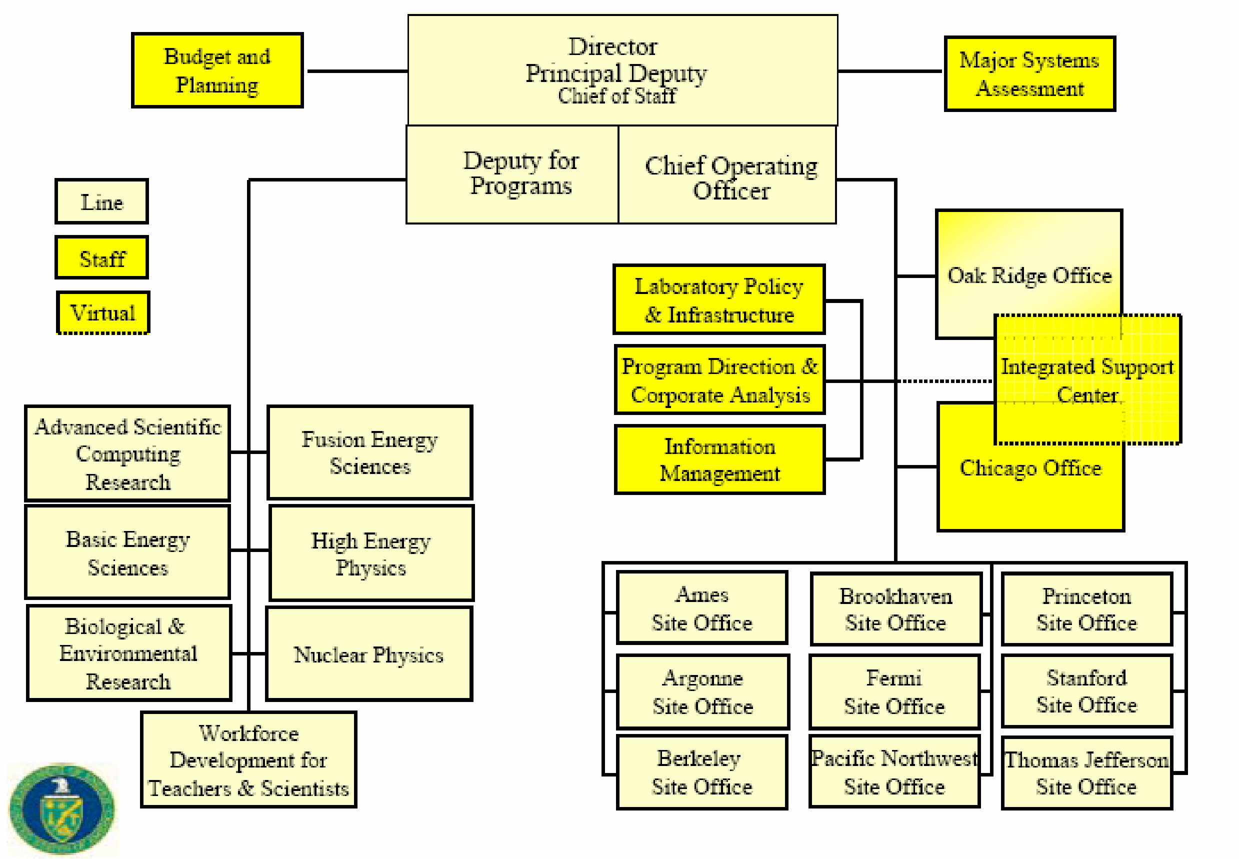

Figure 2

SCIENCE PROGRAMS

BASIC ENERGY SCIENCES

FY 2006 Appropriation - $1,134.6 Million; FY 2007 Request - $1,421.0 Million

Basic research supported by the Basic Energy Sciences (BES) program touches virtually every aspect of energy resources, production, conversion, efficiency, and waste mitigation. Research in materials sciences and engineering leads to the development of materials that improve the efficiency, economy, environmental acceptability, and safety of energy generation, conversion, transmission, and use. Research in chemistry leads to the development of advances such as efficient combustion systems with reduced emissions of pollutants; new solar photo conversion processes; improved catalysts for the production of fuels and chemicals; and better separations and analytical methods for applications in energy processes, environmental remediation, and waste management. Research in geosciences contributes to the solution of problems in multiple DOE mission areas, including reactive fluid flow studies to understand contaminant remediation and seismic imaging for reservoir definition. Research in the molecular and biochemical nature of photosynthesis aids the development of solar photo energy conversion and biomass conversion. In FY 2007, the Office of Science will support expanded efforts in basic research related to transformational energy technologies. Within BES, there are increases to ongoing basic research for effective solar energy utilization, for the hydrogen economy, and for work underpinning advanced nuclear energy power. BES also asks researchers to reach far beyond today's problems in order to provide the basis for long-term solutions to what is probably society's greatest challenge—a secure, abundant, and clean energy supply. To that end, the FY 2007 budget request would also increase research for grand challenge science questions and for new technique development in complex systems or emergent behavior, ultrafast science, mid-scale instrumentation, and chemical imaging.

BES also provides the Nation's researchers with world-class research facilities, including reactor- and accelerator-based neutron sources, light sources soon to include the X-ray free electron laser, nanoscale science research centers, and electron beam micro-characterization centers. These facilities provide outstanding capabilities for imaging and characterizing materials of all kinds from metals, alloys, and ceramics to fragile biological samples. The next steps in the characterization and the ultimate control of materials properties and chemical reactivity are to improve spatial resolution of imaging techniques; to enable a wide variety of samples, sample sizes, and sample environments to be used in imaging experiments; and to make measurements on very short time scales, comparable to the time of a chemical reaction or the formation of a chemical bond. With these tools, we will be able to understand how the composition of materials affects their properties, to watch proteins fold, to see chemical reactions, and to understand and observe the nature of the chemical bond. For FY 2007, BES scientific user facilities will be scheduled to operate at an optimal number of hours.

Construction of the Spallation Neutron Source (SNS) will be completed during the 3rd quarter of FY 2006 and will join the suite of BES scientific user facilities. In FY 2007, BES will support continued fabrication and commissioning of SNS instruments, funded both as part of the SNS project and from other sources including non-DOE sources, and will increase power to full levels. A new Major Item of Equipment is funded in FY 2007 that will allow the fabrication of approximately four to five additional instruments for the SNS, thus nearly completing the initial suite of 24 instruments that can be accommodated in the high-power target station.

Four Nanoscale Science Research Centers will be fully operational in FY 2007: the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory, the Molecular Foundry at Lawrence Berkeley National Laboratory, the Center for Nanoscale Materials at Argonne National Laboratory, and the Center for Integrated Nanotechnologies at Sandia National Laboratories and Los Alamos National Laboratory. A fifth Center, the Center for Functional Nanomaterials at Brookhaven National Laboratory, will receive final year construction funding. In FY 2007, there are significant shifts in the nanoscale science and engineering research activities contributing to the BES investments in research at the nanoscale and a substantial overall increase in funding. Overall, the total investment for these Nanoscale Science Research Centers decreases by about 10 percent owing to the planned decrease in construction funding. Funding for research at the nanoscale increases very significantly owing to increases in funding for activities related to the hydrogen economy, solar energy conversion, and advanced nuclear energy.

The Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC) will continue Project Engineering Design (PED) and construction at the planned levels. The purpose of the LCLS Project is to provide laser-like radiation in the X-ray region of the spectrum that is 10 billion times greater in peak power and peak brightness than any existing coherent X-ray light source and that has pulse lengths measured in femtoseconds—the timescale of electronic and atomic motions. The LCLS will the first facility in the world for such groundbreaking research in the physical and life sciences. Support is also provided for PED and R&D for the National Synchrotron Light Source-II (NSLS-II), which will be a new synchrotron light source, highly optimized to deliver ultra-high brightness and flux and exceptional beam stability. This would enable the study of material properties and functions with a spatial resolution of one nanometer (nm), an energy resolution of 0.1 millielectron volt (meV), and the ultra-high sensitivity required to perform spectroscopy on a single atom. NSLS-II will be transformational in opening new regimes of scientific discovery and investigation. The ability to probe materials with 1 nm or better spatial resolution and to analyze their dynamics with 0.1 meV energy resolution will be truly revolutionary.

The Scientific Discovery through Advanced Computing (SciDAC) program is a set of coordinated investments across all Office of Science mission areas with the goal of achieving breakthrough scientific advances via computer simulation that were impossible using theoretical or laboratory studies alone. The SciDAC program in BES consists of two major activities: (1) characterizing chemically reacting flows as exemplified by combustion and (2) achieving scalability in the first-principles calculation of molecular properties, including chemical reaction rates.

ADVANCED SCIENTIFIC COMPUTING RESEARCH

FY 2006 Appropriation - $234.7 Million; FY 2007 Request - $318.6 Million

The Advanced Scientific Computing Research (ASCR) program is expanding the capability of world-class scientific research capacity through advances in mathematics, high performance computing and advanced networks, and through the application of computers capable of many trillions of operations per second (terascale computers) to advanced scientific applications. Computer-based simulation enables us to understand and predict the behavior of complex systems that are beyond the reach of our most powerful experimental probes or our most sophisticated theories. Computational modeling has greatly advanced our understanding of fundamental processes of Nature, such as fluid flow and turbulence or molecular structure and reactivity. Soon, through modeling and simulation, we will be able to explore the interior of stars to understand how the chemical elements were created and learn how protein machines work inside living cells to enable the design of microbes that address critical energy or waste cleanup needs. We could also design novel catalysts and high-efficiency engines that expand our economy, lower pollution, and reduce our dependence on foreign oil. Computational science is increasingly important to progress at the frontiers of almost every scientific discipline and to our most challenging feats of engineering. The science of the future demands that we advance beyond our current computational abilities.

For the past two decades SC, and the worldwide scientific community, have been harvesting their success in building and developing the Internet. This has enabled roughly a doubling in bandwidth every two years with no increase in cost. However, the demands of today's facilities, which generate millions of gigabytes per year of data, now outstrip the capabilities of the Internet design and the algorithms, software tools, libraries, and environments needed to accelerate scientific discovery through modeling and simulation are beyond the realm of commercial interest. However, the evolution of the telecom market, including the availability of direct access to optical fiber at attractive prices and the availability of flexible dense wave division multiplexing (DWDM) products gives SC the possibility of exploiting these technologies to provide scientific data where it is needed at speeds commensurate with the new data volumes. However, to take advantage of this opportunity significant research is needed to integrate these capabilities, make them available to scientists, and build the infrastructure which can provide cybersecurity in this environment.

The Mathematical, Information, and Computational Sciences (MICS) effort supports the core research of the ASCR program. To establish and maintain networking, modeling and simulation leadership in scientific areas that are important to DOE's mission, the MICS subprogram employs a broad, but integrated, research strategy. The MICS subprogram's basic research portfolio in applied mathematics and computer science provides the foundation for enabling research activities, which include efforts to advance networking and to develop software tools, libraries, and environments. Results from enabling research supported by the MICS subprogram are used by computational scientists supported by other SC and DOE programs. This link to other DOE programs provides a tangible assessment of the value of the MICS subprogram for advancing scientific discovery and technology development through simulations. In addition to its research activities, the MICS subprogram plans, develops, and operates supercomputer and network facilities that are available—24 hours a day, 365 days a year—to researchers working on problems relevant to DOE's scientific missions. In FY 2007, the Energy Science Network (ESnet) will deliver a backbone network with two to four times the capability of today's network, to support the science mission of the Department. In addition, the National Energy Research Scientific Computing Center (NERSC) will be upgraded in FY 2006 to add a NERSC-5 machine with 100–150 teraflops of peak computing capacity early in FY 2007. The NERSC computational resources are integrated by a common high performance file storage system that enables users to easily use all machines. Therefore the new machine will significantly reduce the current oversubscription at NERSC which serves nearly 2,000 scientists annually.

The Oak Ridge National Laboratory (ORNL) Leadership Computing Facility (LCF), selected under the Leadership Computing Competition in FY 2004, will be enhanced to deliver 250 teraflops of peak capability in FY 2007 for scientific applications. In addition, further diversity with the LCF resources will be realized with an acquisition by Argonne National Laboratory (ANL) of a high performance IBM Blue Gene P with low-electrical power requirements and a peak capability of up to 100 teraflops. The expansion of the Leadership Computing Facility to include the Blue Gene computer at ANL was an important element of the joint ORNL, ANL, and PNNL proposal selected in 2004 to enable solutions for scientific problems beyond what would be attainable through a continued simple extrapolation of current computational capabilities. The capability provided in FY 2007 will accelerate scientific understanding in many areas of science important to DOE including materials science, biology, and advanced designs of nuclear reactors.

The research focus of ASCR SciDAC activities includes Integrated Software Infrastructure Centers (ISICs). ISICs are partnerships between DOE national laboratories and universities focused on research, development, and deployment of software to accelerate the development of SciDAC application codes. Progress to date includes significant improvements in performance modeling and analysis capabilities that have led to doubling the performance on 64 processors of the Community Atmosphere Model component of the SciDAC climate modeling activity. In FY 2006, ASCR is recompeting its SciDAC portfolio, with the exception of activities in partnership with the Office of Fusion Energy that were initiated in FY 2005. In addition, in FY 2007 ASCR will continue the competitively selected SciDAC institutes which can become centers of excellence in high end computational science in areas that are critical to DOE missions.

Advancing high performance computing and computation is a highly coordinated interagency effort. ASCR has extensive partnerships with other Federal agencies and the National Nuclear Security Administration (NNSA). The activities funded by the MICS subprogram are coordinated with other Federal efforts through the NITR&D subcommittee of the National Science and Technology Council and its Technology Committee. The Subcommittee coordinates planning, budgeting, and assessment activities of the multiagency NITR&D enterprise. DOE has been an active participant in these coordination groups and committees since their inception. The MICS subprogram will continue to coordinate its activities through these mechanisms and will lead the development of new coordinating mechanisms as needs arise. The DOE program solves mission critical problems in scientific computing. In addition, results from the DOE program benefit the Nation's information technology basic research effort. The FY 2007 program positions DOE to make additional contributions to this effort.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

FY 2006 Appropriation - $451.1[1] Million; FY 2007 Request - $510.3 Million

Biological and Environmental Research (BER) supports basic research with broad impacts on our health, our environment, and our energy future. Biotechnology solutions are possible for DOE energy and environmental challenges by understanding complex biological systems and developing computational tools to model and predict their behavior. An ability to predict long-range and regional climate enables effective planning for future needs in energy, agriculture, and land and water use. Understanding the global carbon cycle and the associated role and capabilities of microbes and plants can lead to solutions for reducing carbon dioxide concentrations in the atmosphere. Understanding the complex role of biology, geochemistry, and hydrology beneath the Earth's surface will lead to improved decision making and solutions for contaminated DOE weapons sites. Both normal and abnormal health—from normal human development to cancer to brain function—can be understood and improved using radiotracers, advanced imaging instruments, and novel biomedical devices. Understanding the biological effects of low doses of radiation can lead to the development of science-based health risk policy to better protect workers and citizens.

The FY 2007 budget includes funds for the continued expansion of the Genomics: GTL program—a program at the forefront of the biological revolution. This program employs a systems approach to biology at the interface of the biological, physical, and computational sciences to address DOE's mission needs. This research will continue to more fully characterize the inventory of multi-protein molecular machines found in selected DOE-relevant microbes and higher organisms. It will determine the diverse biochemical capabilities of microbes and microbial communities, especially as they relate to potential biological solutions to DOE needs, found in populations of microbes isolated from DOE-relevant sites. Within the Genomics: GTL program, BER will develop the understanding needed to advance biotechnology-based strategies for biofuel production, focusing on biohydrogen and bioethanol.

Ethanol produced from corn starch is currently the most widely consumed biofuel in the United States. The production of cellulosic ethanol from biomass has the potential to reduce current oil demand by one-third without reducing the food supply or damaging the environment. Currently, a biochemical conversion of biomass to ethanol involves three basic steps: (1) breakdown of raw biomass using heat and chemicals, (2) use of enzymes to breakdown plant cell wall materials into simple sugars, and (3) conversion of the sugars into ethanol using microbes. The long-term goal is to integrate the bioprocessing into a single step. Accomplishing this requires the development of genetically modified, multifunctional microbes or a stable mixed culture of

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1 *Does not include $128.7 Million in Congressionally directed projects*

microbes capable of carrying out all biologically mediated transformations needed for the complete conversion of biomass to ethanol. Research will be supported on a variety of enzymes and microbes that contribute (individually and together) to the conversion of cellulose to ethanol; analysis of enzymes to understand how they interact with and breakdown cellulose; a determination of the factors, such as temperature and different combinations of sugars, that influence biomass degradation or ethanol production; strategies for producing and maintaining stable mixed cultures of microbes; and improved capabilities for genetically engineering microbes that produce bioethanol. This research will lead to increased understanding of microbe-based production of cellulosic ethanol, increased production efficiencies, and reduced costs that will make cellulosic ethanol a cost competitive alternative to gasoline in the coming decades.

Under certain conditions, green algae and a type of bacteria known as cyanobacteria can use energy from the sun to split water and generate hydrogen. This process, known as biophotolysis, has the potential to produce hydrogen on the scale necessary for meeting future energy demand. It also uses water as a source of hydrogen—a clean, renewable, carbon-free (i.e., non-fossil fuel based), substrate available in virtually inexhaustible quantities and is potentially the most efficient conversion of solar energy to hydrogen. Theoretically, the maximum energetic efficiency for direct biophotolysis is 40% compared with a maximum of about 1% for hydrogen production from biomass (Critical Reviews in Microbiology 31, 19-31, 2005). Research will include investigations on a range of hydrogen-producing enzymes and organisms, understanding how hydrogenase (the enzyme that cleaves water to produce hydrogen) work, the inhibition of hydrogenase activity by oxygen, and genetic regulatory and biochemical processes that influence hydrogen production. This new knowledge will be used to engineer microbes to use in hydrogen bioreactors or enzyme-catalysts to use in bioinspired nanostructures for hydrogen production.

In 2003, the Administration launched the Climate Change Research Initiative (CCRI) to focus research on areas where substantial progress in understanding and predicting climate change, including its causes and consequences, is possible over the next five years. In FY 2007, BER will contribute to the CCRI from four programs: Terrestrial Carbon Processes, Climate Change Prediction, ARM, and Integrated Assessment. Activities will be focused on (1) helping to resolve the North American carbon sink question (i.e., the magnitude and location of the North American carbon sink); (2) deployment and operation of a mobile ARM Cloud and Radiation Testbed facility to provide data on the effects of clouds and aerosols on the atmospheric radiation budget in regions and locations of opportunity where data is lacking or sparse; (3) using advanced climate models to simulate potential effects of natural and human-induced climate forcing on global and regional climate and the potential effects on climate of alternative options for mitigating increases in human forcing of climate; and (4) developing and evaluating assessment tools needed to study costs and benefits of potential strategies for reducing net carbon dioxide emissions.

In FY 2007, BER SciDAC-enabled activities will allow climate scientists to gain unprecedented insights into potential effects of energy production and use on the global climate system. BER will also add a SciDAC component to GTL and Environmental Remediation research. GTL SciDAC will initiate new research to develop mathematical and computational tools needed for complex biological system modeling and for analysis of complex data sets, such as mass spectrometry data. Environmental Remediation SciDAC will provide an opportunity for subsurface and computational scientists to develop and improve methods of simulating subsurface reactive transport processes on “leadership class” computers.

Research emphasis within BER’s Environmental Remediation Sciences subprogram will be focused on issues of subsurface cleanup such as defining and understanding the processes that control contaminant fate and transport in the environment and providing opportunities for use, or manipulation of natural processes to alter contaminant mobility. The resulting knowledge and technology will assist DOE’s environmental clean-up and stewardship missions. Funding for experimental equipment recapitalization at the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) at Pacific Northwest National Laboratory (PNNL) will be increased in FY 2007.

BER will also continue in FY 2007 to support fundamental research in genomics, medical applications and measurement science, and the health effects of low dose radiation. Resources are developed and made widely available for determining protein structures at DOE synchrotrons, for high-throughput genetic studies using mice, and for DOE –relevant high-throughput genomic DNA sequencing. Building on DOE capabilities in physics, chemistry, engineering, biology and computation, BER supports fundamental imaging research, maintains core infrastructure for imaging research, and develops new technologies to improve the diagnosis and treatment of psycho-neurological diseases and cancer and to improve the function of patients with neurological disabilities such as blindness.

HIGH ENERGY PHYSICS

FY 2006 Appropriation - $716.7 Million; FY 2007 Request - $775.1 Million

The High Energy Physics (HEP) program provides over 90 percent of the Federal support for the Nation’s high energy physics research. This research advances our understanding of how the universe works at its most basic level, from the elementary constituents of matter to the recently discovered but still mysterious dark energy and dark matter that so dominate our universe. Our research aims to solve one of Nature’s deepest paradoxes: why does the universe appear to be made of matter but not antimatter? How can the laws of the atom and those of cosmological gravity resolve themselves to Einstein’s long-sought unified theory of matter and force? HEP provides research facilities and advances our knowledge, not only in high energy physics, but increasingly in other fields, including particle astrophysics and cosmology. Research advances in one field often have a strong impact on research directions in another. Technology that was developed in response to the demands of high energy physics research has also become indispensable to other fields of science and has found wide applications in industry and medicine, often in ways that could not have been predicted when the technology was first developed. Examples include medical imaging, radiation therapy for cancer using particle beams, ion implantation of layers in semiconductors, materials research with electron microscopy, and the World Wide Web. The accelerator technologies of high-power X-ray light sources, from synchrotron radiation facilities to the new coherent light sources, are all derived from high energy physics accelerator technology.

The U.S. HEP program in FY 2007 will continue to lead the world with forefront user facilities at the Fermi National Accelerator Laboratory (Fermilab) and SLAC that help answer the key scientific questions outlined above, but these facilities are scheduled to complete their scientific missions by the end of the decade. Thus, the longer-term HEP program supported by this request begins to develop new world-leading facilities in targeted areas (for example, neutrino physics) that will establish a U.S. leadership role in these areas in the next decade. Further, HEP has prioritized current R&D efforts to select those which will provide the most compelling science opportunities in the coming decade within the available resources. For these reasons, the highest priority R&D effort is the development of the proposed International Linear Collider (ILC), and this request significantly advances the ILC R&D program. In making these decisions HEP has carefully considered the recommendations of the High Energy Physics Advisory Panel (HEPAP) and planning studies produced by the U.S. scientific community, including the National Academy of Sciences.

R&D in support of the ILC is doubled relative to FY 2006 to support a U.S. leadership role in a comprehensive, coordinated international R&D program, and to provide a basis for U.S. industry to compete successfully for major subsystem contracts. The long-term goal of this effort is to support a decision on a construction start of an international electron-positron linear collider around the end of the decade. In FY 2005 an international collaboration called the Global Design Effort (GDE) was organized to coordinate the R&D and design of a linear collider.

To provide a nearer-term future HEP program, and to preserve future research options, R&D for accelerator and detector technologies, particularly in the growing area of neutrino physics, will continue at an increased level relative to FY 2006. With Tevatron improvements completed, much of the accelerator development effort at Fermilab in FY 2007 will focus on the neutrino program to study the universe's most prolific particle. The Neutrinos at the Main Injector (NuMI) beam allows studies of the fundamental physics of neutrino masses and mixings using the proton source section of the Tevatron complex. NuMI has begun operations and will eventually put much higher demands on that set of accelerators. A program of enhanced maintenance, operational improvements, and equipment upgrades is being developed to meet these higher demands, while continuing to run the Tevatron. Engineering design will begin on a new detector optimized to detect electron neutrinos, the Electron Neutrino Appearance (EνA) Detector, which will utilize the NuMI beam. Participation will begin in a reactor-based neutrino experiment. Meanwhile, R&D will continue for a high-intensity neutrino super beam facility and a double beta decay experiment. These efforts are part of a coordinated neutrino program developed from an American Physical Society study and a joint HEPAP/Nuclear Sciences Advisory Committee (NSAC) subpanel review.

In order to exploit the unique opportunity to expand the boundaries of our understanding of the matter-antimatter asymmetry in the universe, a high priority is given to continued operations and infrastructure support for the B-factory at SLAC. Upgrades to the accelerator and detector are currently scheduled for completion in 2006, and our baseline plan is to have B-factory operations conclude in FY 2008. We are also engaging with our advisory panels and international collaborating partners on the precise timetable for the future of B-Factory operations and follow-on data analyses.

As the Large Hadron Collider (LHC) accelerator nears its turn-on date in 2007, U.S. activities related to fabrication of detector components will be completed and new activities related to commissioning and pre-operations of these detectors, along with software and computing activities needed to analyze the data, will ramp-up significantly. A scientifically vigorous role for U.S. research groups in the LHC physics program will continue to be a high priority of the HEP program.

In order to explore the nature of dark energy, support for R&D on competitively-selected dark energy space-based mission concepts, including the Super Nova/Acceleration Probe (SNAP), will be significantly increased in FY 2007. SNAP will be a mission concept proposed for a potential interagency sponsored experiment with NASA, the Joint Dark Energy Mission (JDEM). This joint mission will provide important new information about the nature of dark energy that will in turn lead to a better understanding of the birth, evolution, and ultimate fate of the universe. In FY 2007, R&D will also be supported for ground facilities (in cooperation with NSF) and/or a variety of space-based facilities which could provide independent and complementary measurements of the nature of dark energy. Advice from the scientific community will be solicited to aid in selecting the particular concepts to be developed.

In FY 2005, the HEP program completed the original SciDAC programs in the areas of accelerator modeling and design, theoretical physics, astrophysics, and applying grid technology. Each of these projects has made significant strides in forging new and diverse collaborations (both among different disciplines of physics and between physicists and computational scientists) that have enabled the development and use of new and improved software for large-scale simulations. To build on these successes, the HEP program will re-compete its SciDAC portfolio in FY 2006 to obtain significant new insights through computational science into challenging problems that have the greatest impact in HEP mission areas.

NUCLEAR PHYSICS

FY 2006 Appropriation - $367.0 Million; FY 2007 Request - $454.1 Million

The Nuclear Physics (NP) program is the major sponsor of fundamental nuclear physics research in the Nation, providing about 90 percent of Federal support. NP builds and operates world-leading scientific facilities and state-of-the-art instrumentation to study the evolution and structure of nuclear matter, from the smallest building blocks, quarks and gluons, to the stable elements in the Universe created by stars. Key aspects to these studies are understanding how the quarks and gluons combine to form the nucleons (proton and neutron), what are the properties and behavior of nuclear matter under extreme conditions of temperature and pressure, and what are the properties and reaction rates for atomic nuclei up to their limits of stability. Results and insight from these studies are relevant to understanding how the universe evolved in its earliest moments, how the chemical elements were formed, and how the properties of one of Nature’s basic constituents, the neutrino, influences astrophysics phenomena such as supernovae. Nuclear physics also has had great impact on human life. Knowledge and techniques developed in pursuit of fundamental nuclear physics research are extensively utilized in our society today. The understanding of nuclear spin enabled the development of magnetic resonance imaging for medical use. Radioactive isotopes produced by accelerators and reactors are used for medical imaging, cancer therapy, and biochemical studies. Advances in cutting-edge instrumentation developed for nuclear physics experiments have relevance to technological needs in combating terrorism. The highly trained scientific and technical personnel in fundamental nuclear physics that are a product of the program are a valuable human resource for many applied fields.

The FY 2007 budget request increases support for operations and research by ~21% compared to FY 2006. At this funding level, overall operations of the four National User Facilities and research efforts at universities and laboratories are supported at near optimal levels. This will allow researchers to make effective progress towards the program's scientific goals and milestones. In FY 2007 modest funding is provided for generic exotic beam R&D directed towards development of capabilities for forefront nuclear structure and astrophysics studies and to understand the origin of the elements from iron to uranium.

When the Universe was a millionth of a second old, nuclear matter is believed to have existed in its most extreme energy density form called the quark-gluon plasma. Experiments at the Relativistic Heavy Ion Collider's (RHIC) at Brookhaven National Laboratory (BNL) are searching to find and characterize this new state. These efforts will continue in FY 2007, with increased support. NP, together with the National Aeronautics and Space Administration (NASA), begins construction of a new Electron Beam Ion Source (EBIS) to provide RHIC with more cost-effective, reliable, and versatile operations. Research and development activities, including the development of an innovative electron beam cooling system for RHIC, are expected to demonstrate the feasibility of increasing the luminosity or collision rate of the circulating beams by a factor of ten. In addition to RHIC efforts, the High Energy Density Physics activities include NP contributions to enhance the heavy ion triggering and measurement capabilities of LHC experiments under construction and the accompanying research program at universities and laboratories. Experiments at the LHC would permit measurements of the earliest highest energy density stage in the formation and development of matter at different conditions than those created at RHIC. The interplay of the different research programs at the LHC and the ongoing RHIC program will allow a detailed tomography of the hot, dense matter as it evolves from the "perfect fluid" (a fluid with zero viscosity) discovered at RHIC.

Operations of the Continuous Electron Beam Accelerator Facility (CEBAF) at Thomas Jefferson National Accelerator Facility (TJNAF) in FY 2007 will continue to advance our knowledge of the internal structure of protons and neutrons, particularly a unique property called "confinement" that binds together their fundamental constituents, particles called quarks and gluons. By providing precision experimental information concerning the quarks and gluons that form the protons and neutrons, the approximately 1000 experimental researchers that use CEBAF, together with researchers in nuclear theory, seek to provide a quantitative description of nuclear matter in terms of the fundamental theory of the strong interaction, Quantum ChromoDynamics. In FY 2007, the accelerator provides beams simultaneously to all three experimental halls and Project Engineering Design (PED) activities begin on the 12 GeV CEBAF Upgrade. This cost-effective upgrade would allow for a test of a proposed mechanism of "quark confinement" – one of the compelling unanswered puzzles of physics.

Efforts at the Argonne Tandem Linear Accelerator System (ATLAS) at ANL and the Holifield Radioactive Ion Beam Facility (HRIBF) at ORNL will be supported in FY 2007 to focus on investigating new regions of nuclear structure, studying interactions in nuclear matter like those occurring in neutron stars, and determining the reactions that created the nuclei of the chemical elements inside stars and supernovae. The GRETINA gamma-ray tracking array, currently under fabrication, will revolutionize gamma ray detection technology and offers dramatically improved capabilities to study the structure of nuclei at ATLAS, HRIBF, and elsewhere. The Fundamental Neutron Physics Beamline (FNPB) under fabrication at the SNS will provide a world-class capability to study the neutron decay properties, leading to a refined characterization of the weak force. Investments are made to initiate the fabrication of a neutron Electric Dipole Moment experiment, to be sited at the FNPB, in the search for new physics beyond the Standard Model.

The Nuclear Physics program funds SciDAC programs in the areas of theoretical physics (National Computational Infrastructure for Lattice Gauge Theory), astrophysics (Shedding New Light on Exploding Stars: TeraScale Simulations of Neutrino-Driven Supernovae and their Nucleosynthesis), and grid technology (Particle Physics Data Grid Collaborative Pilot). In FY 2006 proposal applications will be evaluated for new or renewal SciDAC grants.

The Low Energy subprogram and the Theory subprogram, through their activities at the Nuclear Data Center, will support increased basic research efforts relevant to advanced nuclear fuel cycle issues. These subprograms will support nuclear data efforts and selected experiments that will lead to improvements in nuclear reaction cross-sections needed to calculate with reduced uncertainties the transmutation behavior for proposed advanced fuel cycles.

FUSION ENERGY SCIENCES

FY 2006 Appropriation - $287.7 Million; FY 2007 Request - $318.9 Million

The Fusion Energy Sciences (FES) program advances the theoretical and experimental understanding of plasma and fusion science, including a close collaboration with international partners in identifying and exploring plasma and fusion physics issues through specialized facilities. The FES program supports research in: plasma science; magnetically confined plasmas; advances in tokamak design; innovative confinement options; nonneutral plasma physics and High Energy Density Physics (HEDP); and cutting edge technologies. FES also leads U.S. participation in ITER, an experiment to study and demonstrate the sustained burning of fusion fuel. This international collaboration will provide an unparalleled scientific research opportunity with a goal of demonstrating the scientific and technical feasibility of fusion power. Fusion is the energy source that powers the sun and stars. Fusion power could play a key role in U.S. long-term energy plans and independence because it offers the potential for plentiful, safe and environmentally benign energy.

The site selection for the international ITER Project, Cadarache, France, in the European Union, was a major six party decision on June 28, 2005, at a Ministerial-level meeting in Moscow, Russia. Negotiations continued throughout the Fall of 2005, which led to the ITER parties (a) approving and welcoming the designated Director General Nominee chosen to lead the ITER organization, (b) approving and welcoming India into the ITER negotiations as a full non-host ITER party, and (c) completing the text of the draft ITER Agreement. In accordance with the Energy Policy Act of 2005, and as determined during the Fall 2005 ITER negotiations, the ITER Agreement directly addresses the following EPAct requirements.

- (i) clearly defines the U.S. financial contribution to construction and operations (as well as deactivation and decommissioning), as well as any other project costs associated with the project,
- (ii) ensures that the share of high-technology components of ITER that are manufactured in the United States is at least proportionate to the U.S. financial contribution to ITER,
- (iii) ensures, by virtue of the in-kind contribution procurement approach, that the United States will not be financially responsible for cost overruns in components manufactured by other ITER parties,
- (iv) guarantees the United States full access to all data generated by ITER,
- (v) enables U.S. researchers to propose and carry out an equitable share of experiments on ITER,
- (vi) provides the United States with a role in all collective decision-making related to ITER, and
- (vii) describes and defines the process for discontinuing and decommissioning ITER and the U.S. role in that process.

The U.S. Contributions to ITER project is being managed by the U.S. ITER Project Office (USIPO), established as a Princeton Plasma Physics Laboratory (PPPL)/Oak Ridge National Laboratory (ORNL) partnership. The FY 2007 request for the U.S. Contributions to ITER Major Item of Equipment (MIE) project maintains the overall Total Project Cost funding cap of $1,122,000,000. The U.S. effort will be consistent with the other ITER parties in the pace of starting the long lead procurements, in providing increased numbers of personnel to the ITER Organization, and in providing cash for common expenses. The profile is preliminary until the baseline scope, cost, and schedule for the MIE project are established, and the Director General Nominee and ITER Organization have achieved a standard mode of operation.

In support of ITER and U.S. Contributions to ITER, FES is placing increased emphasis on its national burning plasma program—a critical underpinning to the fusion science in ITER. FES plans to enhance burning plasma research efforts across the U.S. domestic fusion program, including: ITER R&D support both in physics and technology and exploring new modes of improved or extended ITER performance; developing safe and environmentally attractive technologies necessary for ITER; exploring fusion simulation efforts that examine the complex behavior of burning plasmas in tokamaks; carrying out experiments on our national FES facilities with diagnostics and plasma control that can be extrapolated to ITER; and integrating all that is learned into a forward-looking approach to future fusion applications.

The Energy Policy Act of 2005 Sec. 972(c)(5)(C) requires the Secretary of Energy to provide "a report describing how United States participation in the ITER will be funded without reducing funding for other programs in the Office of Science (including other fusion programs)…" The Department's FY 2007 budget provides for healthy increases for all programs within the Office of Science and supports the ITER request of $60,000,000 almost entirely from new funds in the Fusion Energy Sciences (FES) budget request.

The Director of the Office of Science has stated that the FES program in the Office of Science will reasonably bear at least some of the cost of building ITER from within its budget and that ITER will not unduly harm funding of other Office of Science research programs. The Department expects that the $1.122 billion ITER funding profile could have some effect on the overall allocation of funds, both within the FES program and within the Office of Science, in future budgets. This has been and will continue to be the standard practice for funding large, capital-intensive projects within DOE. Nevertheless, as demonstrated by this FY 2007 request, the Office of Science can fund ITER while maintaining healthy funding for other research programs.

The research and facility operations funding for the three major facilities will increase from the FY 2006 level. Operations at the largest facility, DIII-D, will increase from 7 weeks in FY 2006 to 12 weeks in FY 2007, while operations at C-Mod at MIT and NSTX at PPPL will each increase by one week over FY 2006, to 15 and 12 weeks respectively. A new baseline was established in July 2005 for the National Compact Stellarator Experiment (NCSX), a joint PPPL/ORNL advanced stellarator experiment being built at PPPL. It results in a 14-month delay in the schedule with completion in July 2009 and a new TEC of $92,401,000. The FY 2007 request supports the new baseline. Funding for the FES SciDAC program will increase in FY 2007 to continue development of tools that facilitate international fusion collaborations and initiate development of an integrated software environment that can accommodate the wide range of space and time scales and the multiple phenomena that are encountered in simulations of fusion systems. Within SciDAC, the Fusion Simulation Project is a major initiative involving plasma physicists, applied mathematicians, and computer scientists to create a comprehensive set of models of fusion systems, combined with the algorithms required to implement the models and the computational infrastructure to enable them to work together.

Other changes include redirections in fusion theory, High Energy Density Physics, research in heavy ion beam science, plasma technology and materials research, and experimental plasma research. Congressionally-directed, non-defense research at the Atlas pulsed power facility is discontinued in FY 2007.

SCIENCE LABORATORIES INFRASTRUCTURE

FY 2006 Appropriation - $41.7 Million; FY 2007 Request - $50.9 Million

The mission of the Science Laboratories Infrastructure (SLI) program is to enable the conduct of DOE research missions at the Office of Science laboratories by funding line item construction projects to maintain the general purpose infrastructure and the clean up for reuse or removal of excess facilities. The program also supports Office of Science landlord responsibilities for the 24,000 acre Oak Ridge Reservation and provides Payments in Lieu of Taxes (PILT) to local communities around ANL-East, BNL, and ORNL.

In FY 2007, SLI will initiate funding for four construction projects: the Seismic Safety Upgrade of Buildings, Phase I, at the Lawrence Berkeley National Laboratory (LBNL); the Modernization of Building 4500N, Wing 4, Phase I, at ORNL; the Building Electrical Services Upgrade, Phase II, at the ANL; and Renovate Science Lab, Phase I, at BNL. Funding for the PNNL Physical Sciences Facility is requested in the National Nuclear Security Administration's (NNSA's) Nuclear Non-Proliferation R&D program for FY 2007. This project is cofunded by the Office of Science, NNSA, and the Department of Homeland Security. The demolition of the Bevatron at LBNL is funded at $14.0 million.

WORKFORCE DEVELOPMENT FOR TEACHERS AND SCIENTISTS

FY 2006 Appropriation - $7.1 Million; FY 2007 Request - $10.9 Million

The mission of the Workforce Development for Teachers and Scientists (WDTS) program is to provide a continuum of educational opportunities to the Nation's students and teachers of science, technology, engineering, and mathematics (STEM).

The Laboratory Science Teacher Professional Development (LSTPD) program increases to expand participation from 108 teachers in FY 2006 to 300 in FY 2007. The Faculty Sabbatical activity was initiated in FY 2005 for faculty from Minority Serving Institutions (MSI) and reduced in FY 2006 due to feedback from MSI faculty who expressed their inability to participate in sabbatical programs and a preference for shorter fellowship-type opportunities. FY 2007 participation will be reduced to two faculty members. The Science Undergraduate Laboratory Internship (SULI) programs will be increased to add approximately 55 students. The Albert Einstein Distinguished Educator Fellowship and the National and Middle School Science Bowls will all continue.

SCIENCE PROGRAM DIRECTION

FY 2006 Appropriation - $159.1 Million; FY 2007 Request - $170.9 Million

Science Program Direction (SCPD) enables a skilled, highly motivated Federal workforce to manage the Office of Science's basic and applied research portfolio, programs, projects, and facilities in support of new and improved energy, environmental, and health technologies. SCPD consists of two subprograms: Program Direction and Field Operations.

The Program Direction subprogram is the single funding source for the Office of Science Federal staff in headquarters responsible for managing, directing, administering, and supporting the broad spectrum of Office of Science disciplines. This subprogram includes planning and analysis activities, providing the capabilities needed to plan, evaluate, and communicate the scientific excellence, relevance, and performance of the Office of Science basic research programs. Additionally, Program Direction includes funding for the Office of Scientific and Technical Information. The Field Operations subprogram is the funding source for the Federal workforce in the Field responsible for management and administrative functions performed within the Chicago and Oak Ridge Operations Offices, and site offices supporting the Office of Science laboratories and facilities.

In FY 2007, Program Direction funding increases by 7.4%. Most of the increase will support an additional 25 FTEs for program management positions, to address recent committee of visitor recommendations and to mange the increase in the research activities in the FY 2007 budget. The increase also supports a 2.2% pay raise; an increased cap for SES basic pay; other pay related costs such as the government's contributions for employee health insurance and Federal Employees' Retirement System (FERS); escalation of non-pay categories, such as travel, training, and contracts; and increased e-Gov assessments and other fixed operating requirements across the Office of Science complex. Finally, the increase will cover requirements not requested in previous budget requests, including travel expenses of Office of Science Advisory Committee members and requirements related to Appendix A of OMB Circular A-123, Management's Responsibility for Internal Control.

SAFEGUARDS AND SECURITY

FY 2006 Appropriation - $68.0 Million; FY 2007 Request - $71.0 Million

The Safeguards and Security (S&S) program ensures appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of 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. The Office of Science's Integrated Safeguards and Security Management strategy encompasses a tailored approach to safeguards and security. As such, each site has a specific protection program that is analyzed and defined in its individual Security Plan. This approach allows each site to design varying degrees of protection commensurate with the risks and consequences described in their site-specific threat scenarios.

The FY 2007 budget will ensure adequate security posture for Office of Science facilities by protecting fundamental science, national security, and the health and safety of DOE and contractor employees, the public and the environment. FY 2007 includes funding necessary to protect people and property at the 2003 Design Basis Threat (DBT) level. In FY 2007, an increase in funding for the Cyber Security program element is being requested to begin to address the promulgation of new National Institute of Standards and Technology (NIST) requirements which are required by the Federal Information Security Management Act (FISMA) to improve the Federal and an Office of Science laboratory cyber security posture.

CONCLUSION

I want to thank you, Mr. Chairman, for providing this opportunity to discuss the Office of Science research programs and our contributions to the Nation's scientific enterprise. On behalf of DOE, I am pleased to present this FY 2007 budget request for the Office of Science.

This concludes my testimony. I would be pleased to answer any questions you might have.

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Office of Science