Science

Proposed Appropriation Language

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for science activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or facility or for plant or facility acquisition, construction, or expansion, and purchase of not more than [50] *57* passenger motor vehicles, 56 *of which are* for replacement only, including [one] *two* law enforcement [vehicle] *vehicles*, two ambulances, and [three] *two* buses, [$4,903,710,000] *$5,121,437, 000*, to remain available until expended[: Provided, That $15,000,000 appropriated under this heading under prior appropriation Acts for the Advanced Research Projects Agency—Energy is hereby transferred to the "Advanced Research Projects Agency—Energy" account: Provided further, That, of the amount appropriated in this paragraph, $76,890,000 shall be used for the projects specified in the table that appears under the heading "Congressionally Directed Science Projects" in the joint explanatory statement accompanying the conference report on this Act]. (Energy and Water Development and Related Agencies Appropriations Act, 2010.)

Explanation of Change

Changes are proposed to reflect the FY 2011 funding and vehicle request.

Office of Science

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2009 Current Appropriation	FY 2009 Current Recovery Act Appropriation[a]	FY 2010 Current Appropriation	FY 2011 Request
Office of Science				
Advanced Scientific Computing Research	358,772	+161,795	394,000	426,000
Basic Energy Sciences	1,535,765	+555,406	1,636,500	1,835,000
Biological and Environmental Research	585,176	+165,653	604,182	626,900
Fusion Energy Sciences	394,518	+91,023	426,000	380,000
High Energy Physics	775,868	+232,390	810,483	829,000
Nuclear Physics	500,307	+154,800	535,000	562,000
Workforce Development for Teachers and Scientists	13,583	+12,500	20,678	35,600
Science Laboratories Infrastructure	145,380	+198,114	127,600	126,000
Safeguards and Security	80,603	0	83,000	86,500
Science Program Direction	186,695	+5,600	189,377	214,437
Small Business Innovation Research (SBIR)/ Small Business Technology Transfer (STTR) (SC funding)	104,905[b]	+18,719[b]	0	0
Subtotal, Office of Science	4,681,572	+1,596,000[c]	4,826,820	5,121,437
Congressionally-directed projects	91,064	0	76,890	0
SBIR/STTR (Other DOE funding)	49,534[d]	+36,918[d]	0	0
Subtotal, Office of Science	4,822,170	+1,632,918	4,903,710	5,121,437
Use of prior year balances	-15,000	0	0	0
Total, Office of Science	4,807,170	+1,632,918	4,903,710	5,121,437
Advanced Research Projects Agency-Energy (ARPA-E)	6,300[e]	0	0	0
Total, Science Appropriation	4,813,470	+1,632,918	4,903,710	5,121,437

[a] The Recovery Act Current Appropriation column reflects the allocation of funding as of September 30, 2009 from the American Recovery and Reinvestment Act of 2009, P.L. 111–5. See the Department of Energy Recovery website at http://www.energy.gov/recovery for up-to-date information regarding Recovery Act funding.
[b] Reflects funding reprogrammed within the Science total to support the SBIR and STTR programs.
[c] $4,000,000 of the original $1,600,000,000 Recovery Act appropriation has been transferred to Departmental Administration for management and oversight.
[d] Reflects funding transferred from other DOE appropriation accounts to support the SBIR and STTR programs.
[e] $15,000,000 was appropriated in FY 2009 in the Science account for ARPA-E. The FY 2010 appropriation directed that this $15,000,000 be transferred to the Energy Transformation Acceleration Fund (ARPA-E). $8,700,000 has been transferred to date. Remaining balances of $6,300,000 will also be transferred during FY 2010.

Preface

The Office of Science request for Fiscal Year (FY) 2011 is $5,121,437,000, an increase of $217,727,000, or 4.4%, over the FY 2010 appropriation; and is $294,617,000, or 6.1%, over the FY 2010 appropriation excluding congressionally-directed projects.

Fundamentally new approaches to technologies for energy production, storage, and use are essential. To accomplish this will require sustained investments in exploratory and high-risk research in traditional and emerging disciplines, including the development of new tools and facilities; focused investments in high-priority research areas; and investments that train new generations of scientists and engineers to be leaders in the 21st century.

The FY 2011 budget request supports the President's Plan for Science and Innovation, which encompasses the entire Office of Science budget, as part of a strategy to double overall basic research funding at select agencies. As part of this plan, the FY 2011 request supports the training of students and researchers in fields critical to our national competitiveness and innovation economy, and supports investments in areas of research critical to our clean energy future and to making the U.S. a leader on climate change. The FY 2011 request also supports the President's priorities for the U.S. Global Change Research Program, the National Nanotechnology Initiative, and Networking and Information Technology Research and Development.

The Office of Science supports research programs in condensed matter and materials physics, chemistry, biology, climate and environmental sciences, applied mathematics, computational science, high energy physics, nuclear physics, plasma physics, and fusion energy sciences. The Office of Science also provides the Nation's researchers with state-of-the-art user facilities—the large machines of modern science. Increasingly, they are first-of-a-kind facilities, and they are in the billion-dollar-class range. These facilities offer capabilities that are unmatched anywhere in the world and enable U.S. researchers and industries to remain at the forefront of science, technology, and innovation. They include electron and proton accelerators and colliders for probing matter on scales from the subatomic to the macroscopic, the world's forefront neutron scattering facility and the world's best suite of synchrotron light sources for probing the structure and function of materials, and the world's largest and fastest computational resources devoted to the most challenging societal problems of our time. These facilities also include technologically advanced, large-scale field sites for investigating the effects of clouds on atmospheric radiation, comprehensively equipped nanoscience and molecular science centers, facilities for rapid genome sequencing and integrated environmental molecular sciences, and facilities for investigating the plasma state and its properties for stable fusion systems.

The Office of Science supports investigators from more than 300 academic institutions and from all of the DOE laboratories. The FY 2011 budget request will support about 27,000 Ph.D.'s, graduate students, undergraduates, engineers, and technicians. Nearly 26,000 researchers from universities, national laboratories, industry, and international partners are expected to use the Office of Science scientific user facilities in FY 2011.

The Office of Science is responsible for the oversight of ten of the DOE national laboratories: Ames National Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Fermi National Accelerator Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Princeton Plasma Physics Laboratory, SLAC National Accelerator Laboratory, and Thomas Jefferson National Accelerator Laboratory.

The Office of Science has ten programs: Advanced Scientific Computing Research (ASCR), Biological and Environmental Research (BER), Basic Energy Sciences (BES), Fusion Energy Sciences (FES), High Energy Physics (HEP), Nuclear Physics (NP), Workforce Development for Teachers and Scientists

(WDTS), Science Laboratories Infrastructure (SLI), Safeguards and Security (S&S), and Science Program Direction (SCPD).

Mission

The mission of the Office of Science is the delivery of scientific discoveries and major scientific tools to transform our understanding of nature and to advance the energy, economic, and national security of the United States.

Benefits

The Office of Science accomplishes its mission by supporting:

- *Science for Discovery* focused on unraveling nature's mysteries—from the study of subatomic particles, atoms, and molecules that make of the materials of our everyday world to DNA, proteins, cells, and entire biological systems;
- *Science for National Need* focused on advancing a clean energy agenda through basic research on energy production, storage, transmission, and use; and advancing our understanding of the Earth's climate through basic research in atmospheric and environmental sciences and climate change; and
- *National Scientific User Facilities*, the 21st century tools of science, engineering, and technology—providing the Nation's researchers with the most advanced tools of modern science including accelerators, colliders, supercomputers, light sources and neutron sources, and facilities for studying the nanoworld.

Performance

The Office of Science activities target the Secretary's Innovation goal (*Lead the world in science, technology, and engineering)*, and those activities underlie progress on the Secretary's Energy goal (*Build a competitive, low-carbon economy and secure America's energy future*) and Security goal (*Reduce nuclear dangers and environmental risks*). Each of the Office of Science research programs support fundamental, innovative, peer-reviewed research to create new knowledge in areas important to Office of Science and program missions, and support the design, construction, and operation of a wide array of scientific user facilities essential for advancing the frontiers of research in relevant areas of science and technology and providing the Nation scientific tools to remain at the forefront of innovation and competitiveness.

Program Overview

The *Advanced Scientific Computing Research* program supports research to discover, develop, and deploy the computational and networking capabilities to analyze, model, simulate, and predict complex phenomena important to DOE. Scientific computing is particularly important for the solution of research problems that are unsolvable through traditional theoretical and experimental approaches or are too hazardous, time-consuming, or expensive to solve by traditional means. ASCR supports research in applied mathematics, computer science, advanced networking, and computational partnerships (Scientific Discovery through Advanced Computing, or SciDAC); research and evaluation prototypes; and the operation of high performance computing systems and networks. In FY 2011, ASCR continues research efforts in the SciDAC, applied mathematics, and computer science programs. The FY 2011 request supports continued operations of the Leadership Computing Facilities at the Oak Ridge and Argonne National Laboratories, and the operations of the National Energy Research Scientific Computing (NERSC) facility, which reaches approximately one petaflop capacity in FY 2010, at Lawrence Berkeley National Laboratory. The Energy Sciences network (ESnet) will deliver 100–400 gigabit per second connections among the Office of Science laboratories in FY 2011.

The *Basic Energy Sciences* program supports research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels. BES-supported research disciplines—condensed matter and materials physics, chemistry, geosciences, and aspects of physical biosciences—provide the knowledge base for the control of the physical and chemical transformations of materials and the discovery and design of new materials with novel structures, functions, and properties. These disciplines drive new solutions and technologies in virtually every aspect of energy resources, production, conversion, transmission, storage, and efficiency. BES also plans, designs, constructs, and operates scientific user facilities that use x-ray, neutron, and electron beam scattering to probe the most fundamental electronic and atomic properties of materials at extreme limits of time, space, and energy resolution. The world-class scientific user facilities supported by BES provide important capabilities for fabricating, characterizing, and transforming materials of all kinds from metals, alloys, and ceramics to fragile bio-inspired and biological materials. In FY 2011, investments continue to support the Energy Frontier Research Centers (EFRCs), focused on accelerating fundamental energy sciences, as well as single investigator and small group awards. BES also takes part in the Department's multi-disciplinary Energy Innovation Hubs program. In FY 2011, BES-supported Hubs will focus on Fuels from Sunlight and Batteries and Energy Storage, and BES will support additional EFRCs focused on discovery and development of new materials and energy applications in areas such as carbon capture and advanced nuclear energy systems.

The *Biological and Environmental Research* program supports research to explore the frontiers of genome-enabled biology; discover the physical, chemical, and biological drivers of climate change; and seek the molecular determinants of environmental sustainability and stewardship. BER-supported systems biology research uncovers Nature's secrets from the diversity of microbes and plants to understand how biological systems work, how they interact with each other, and how they can be manipulated to harness their processes and products to contribute to new strategies for producing new biofuels, cleaning up legacy waste, and sequestering carbon dioxide (CO_2). BER plays a vital role in supporting research on atmospheric processes, climate modeling, interactions between ecosystems and greenhouse gases (especially CO_2), and analysis of impacts of climatic change on energy production and use. Subsurface biogeochemistry research seeks to understand the role that subsurface biogeochemical processes play in determining the fate and transport of contaminants including heavy metals and radionuclides. In FY 2011, BER continues research in systems biology, radiochemistry, climate science, and subsurface biogeochemistry. Support is provided for the three Bioenergy Research Centers, the Joint Genome Institute, and the Environmental Molecular Sciences Laboratory. The FY 2011 request includes investment in climate science research to more rapidly integrate existing and new knowledge into next-generation climate and Earth system prediction models that systematically reduce the uncertainties in predictions of decade to century climate change and increase the availability and usability of climate predictions to address the critical DOE mission to provide energy security to the Nation in a sustainable way. BER will also continue support for simulations and analyses needed for part of the Intergovernmental Panel on Climate Change Fifth Assessment.

The *Fusion Energy Sciences* program supports research to expand the fundamental understanding of matter at very high temperatures and densities and the scientific foundations needed to develop a fusion energy source. This is accomplished by studying plasmas under a wide range of temperature and density, developing advanced diagnostics to make detailed measurements of their properties, and creating theoretical/computational models to resolve the essential physics. FES operates scientific user facilities to enable world-leading research programs in high-temperature, magnetically confined plasmas, and leads the U.S. participation in the design and construction of ITER, the world's first facility for studying a sustained burning plasma. FES also supports enabling R&D to improve the components and systems that are used to build fusion facilities. The FY 2011 budget request funds the U.S. Contributions to ITER

project, including research and development of key components, long-lead procurements, personnel, and cash contribution to the ITER Organization. Research at the major experimental facilities in the FES program—the DIII-D tokamak, the Alcator C-Mod tokamak, and the National Spherical Torus Experiment—will continue to focus on providing solutions to high-priority technical issues and build a firm physics basis for ITER design and operation. Support for the Fusion Simulation Program computational initiative ramps up in FY 2011 as the program transitions from its planning phase to the full program. FES also continues to support the joint program in high energy density laboratory plasmas with the National Nuclear Security Administration.

The *High Energy Physics* program supports research to understand how the universe works at its most fundamental level. This is accomplished by discovering the most elementary constituents of matter and energy, probing the interactions among them, and exploring the basic nature of space and time itself. Research includes theoretical and experimental studies by individual investigators and large collaborative teams: some who gather and analyze data from accelerator facilities in the U.S. and around the world and others who develop and deploy ultra-sensitive ground- and space-based instruments to detect particles from space and observe astrophysical phenomena. The Tevatron Collider at Fermi National Accelerator Laboratory continues operations during FY 2011. Support for Large Hadron Collider (LHC) detector operations, maintenance, computing, and R&D continues in FY 2011 in order to maintain a U.S. leadership role in the LHC program. Construction continues for the Neutrinos at the Main Injector (NuMI) Off-Axis Neutrino Appearance (NOνA) project to enable key measurements of neutrino properties. Project engineering and design begins for two new experiments using the NuMI beam and other auxiliary beamlines: the Long Baseline Neutrino Experiment (LBNE) and the Muon to Electron (Mu2e) experiment. Several projects to pursue questions in dark matter, dark energy, and neutrino properties continue in FY 2011, including the Cryogenic Dark Matter Search at the Soudan Mine in Minnesota, the Dark Energy Survey experiment in Chile, and R&D for the Joint Dark Energy Mission and for experiments that may be located in the National Science Foundation's proposed Deep Underground Science and Engineering Laboratory (DUSEL). HEP also continues support for advanced accelerator and detector R&D.

The *Nuclear Physics* program supports research to discover, explore, and understand all forms of nuclear matter. The fundamental particles that compose nuclear matter, quarks and gluons, are relatively well understood, but exactly how they fit together and interact to create different types of matter in the universe is still largely not understood. To accomplish this, NP supports experimental and theoretical research to create, detect, and describe the different forms and complexities of nuclear matter that can exist in the universe, including those that are no longer found naturally. NP also provides stewardship of isotope production and technologies to advance important applications, research, and tools for that nation. The FY 2011 request supports near optimal levels of operations at the four NP scientific user facilities: the Continuous Electron Beam Accelerator Facility (CEBAF), the Relativistic Heavy Ion Collider (RHIC), the Argonne Tandem Linac Accelerator System (ATLAS), and the Holifield Radioactive Ion Beam Facility (HRIBF). Construction for the 12 GeV CEBAF Upgrade project continues as do activities for the proposed Facility for Rare Isotope Beams (FRIB). The request also supports several ongoing major items of equipment to address compelling scientific opportunities. In FY 2011, the Isotope Development and Production for Research Applications Program will focus on production of isotope needed by stakeholders and research isotope priorities identified by the Nuclear Science Advisory Committee and community input.

The *Workforce Development for Teachers and Scientists* program supports a range of activities for science, technology, engineering, and mathematics (STEM) students and educators, including the DOE Office of Science Graduate Fellowship program, undergraduate research programs that place students in

world class research environments at the DOE laboratories, mentorship programs for K–12 teachers and undergraduate faculty who teach STEM subjects, and nation-wide competitions at the middle school and high school levels, such as the National Science Bowl®. In FY 2011, the Office of Science will initiate a research program to assess the effectiveness of investments in science, consistent with the federal interagency Science of Science Policy initiative.

Office of Science Early Career Research Program

In July 2009, the Office of Science announced the establishment of the Office of Science Early Career Research Program to support outstanding scientists early in their careers in the disciplines supported by the Office of Science. This program provides competitively selected 5-year research awards to researchers who have received a Ph.D. within the past ten years and who are untenured, tenure-track assistant professors in U.S. academic institutions or full-time employees in DOE national laboratories. Early career researchers may apply to any of the Office of Science research programs. Proposed research topics must fall within the Office of Science programmatic priorities, which are provided in annual program announcements. This program addresses recommendations from multiple Committee of Visitors' reviews and reports such as the National Academies' 2005 study, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*.

FY 2010 is the first year of this program with support for approximately 65 research awards provided through Recovery Act funds. Proposals, which will be merit reviewed by external panels of experts, were due September 1, 2009, and awards are expected to be announced by May 2010. Beginning in FY 2011, the Office of Science will issue an annual solicitation, and the Office of Science research programs will support awards through annual appropriated funds. Approximately 60 new research awards to university and DOE laboratory researchers are expected to be awarded in FY 2011 based on this open, competitive process. Office of Science program offices with existing early career research award programs, such as the Outstanding Junior Investigator awards programs, will gradually integrate these programs into the Office of Science Early Career Research Program.

Isotope Development, Production, and Research

Isotope production at the Department of Energy is primarily the responsibility of the Office of Science with two exceptions: plutonium-238 production by the Office of Nuclear Energy (NE) and molybdenum-99 production supported by NNSA's Global Threat Reduction Initiative (GTRI).

The Isotope Development and Production for Research and Applications (Isotope) program located in SC's Nuclear Physics program offers more than 120 stable and radioactive isotopes for use in basic research and in medical diagnostic, medical treatment, national security, energy, and industrial applications. The Isotope program produces isotopes only where there is no U.S. private sector capability or where other production capacity is insufficient to meet U.S. needs. Isotope production for commercial use or repackaging is on a full-cost recovery basis, while isotopes produced solely for non-proprietary research purposes are provided at below cost. The Isotope program works in close collaboration with other federal agencies and the isotope-using communities to develop priorities for production. This past year, the Nuclear Science Advisory Committee issued its report establishing priorities for the production of research isotopes in April 2009. A long-term strategic plan for the program came out in November 2009. Both reports were developed with federal, commercial, and research community input. A current priority is the production of helium-3, used in neutron detection and cryogenics. Historically, helium-3 has been a by-product of tritium production for the U.S. weapons program. With the reduction in nuclear weapons, tritium production is at a low level and current demand for helium-3 has drawn down supplies. U.S. and international efforts are underway to address the helium-3 supply shortfall.

For nearly 50 years, NE's Space and Defense Power Systems program has supported the design, development, production, and safety of plutonium-238 radioisotope power systems. Science missions to explore the solar system and other government applications use plutonium-238 power systems. With a limited existing plutonium-238 stockpile, NE is working to re-establish domestic plutonium-238 production in order to assure continued availability of these power systems.

Molybdenum-99, or moly-99, is widely used in medical diagnosis and has been produced commercially with reactors using highly enriched uranium (HEU) fuel. Because of the nonproliferation mission to remove HEU from use, NNSA's GTRI program has the lead for moly-99. As part of its nuclear nonproliferation mission, and in light of the current moly-99 supply shortage, GTRI is working to demonstrate moly-99 production without the use of HEU. GTRI is implementing projects to demonstrate the viability of non-HEU based technologies for large-scale commercial moly-99 production, including accelerator technology, low-enriched uranium (LEU) target technology, LEU solution reactor technology, and neutron capture technology.

High-Risk, High-Reward Research[a]

The Office of Science programs incorporate high-risk, high-reward research elements in all of its research portfolios. Because advancing the frontiers of science also depends on the continued availability of state-of-the-art scientific facilities, the Office of Science constructs and operates national scientific facilities and instruments that comprise the world's most sophisticated suite of research capabilities.

Effective program management is critical to the support of high-risk, high-reward research. The Office of Science program managers are experts in their respective fields and communicate program research priorities and interests to the scientific community; select proposal reviewers that are open to bold ideas; provide guidance to merit reviewers—including guidance on consideration of high-risk, high-reward research; and make recommendations on proposal selection, weighing inputs from peer review with programmatic relevance, potential impact, and overall portfolio balance. Committees of Visitors review program portfolios triennially to assess, among other things, the balance and impact of the portfolios, including an assessment of high-risk, high-reward research.

The fraction of high-risk, high-reward activities is not easy to quantify, because such research is integrated within program portfolios. However, several mechanisms are used to identify and develop "high-reward" research topics, including Federal advisory committees, program and topical workshops, interagency working groups, National Academy of Sciences studies, and special Office of Science program solicitations. These activities have identified opportunities for new, compelling research. As examples, some of these opportunities are captured in the following reports: *Isotopes for the Nation's Future—A Long Range Plan*, by NSAC (2009); *New Science for a Secure and Sustainable Energy Future*, by the Basic Energy Sciences Advisory Committee (2008); *Identifying Outstanding Grand Challenges in Climate Change Research* workshop report (2008); *U.S. Particle Physics: Scientific Opportunities, A Strategic Plan for the Next Ten Years*, by the High Energy Physics Advisory Panel; and *The Frontiers of Nuclear Science*, by NSAC (2007).

Basic and Applied R&D Coordination

Coordination between the Department's basic research and applied technology programs is a high priority for the Secretary of Energy. The Department has a responsibility to coordinate its basic and applied research programs to effectively integrate R&D by the science and technology communities (e.g., national laboratories, universities, and private companies) that support the DOE mission. Efforts

[a] In compliance with reporting requirements in the America COMPETES Act (P.L. 110–69, section 1008).

have focused on improving communication and collaboration between federal program managers and increasing opportunities for collaborative efforts targeted at the interface of scientific research and technology development to ultimately accelerate DOE mission and national goals. Coordination between the basic and applied programs is also enhanced through joint programs, jointly-funded scientific facilities, and the program management activities of the DOE Small Business Innovation Research and Small Business Technology Transfer programs. Additionally, co-funding research activities and facilities at the DOE laboratories and funding mechanisms that encourage broad partnerships (e.g., Funding Opportunity Announcements) are also means by which the Department facilitates greater communication and research integration within the basic and applied research communities.

American Recovery and Reinvestment Act

The Office of Science received $1,632,918,000 under the American Recovery and Reinvestment Act of 2009. The Office of Science based Recovery Act funding decisions on two of the primary goals articulated in the Recovery Act's statement of purpose: to provide investments needed to increase economic efficiency by spurring technological advances in science, and to preserve and create jobs and promote economic recovery. The Office of Science's Recovery Act projects have the characteristics of being "shovel-ready," enhancing research infrastructure, supporting high-priority R&D, and minimizing outyear mortgages. Recovery Act projects include acceleration of ongoing line-item construction projects, acceleration of major items of equipment, upgrades to Office of Science scientific user facilities, laboratory general plant projects, and scientific research. More information on Office of Science Recovery Act supported activities can be found at the Department of Energy Recovery Act website (http://www.energy.gov/recovery/).

Energy Innovation Hubs

The Office of Science takes part in the Department's multi-disciplinary Energy Innovation Hubs, which will address topic areas that present the most critical barriers to achieving national energy and climate goals while proving the most resistant to solution by usual R&D enterprise structures. The Hubs are designed to accelerate the pace of scientific discovery and technology development to revolutionize how the U.S. produces, distributes, and uses energy. By the same token, they are intended to strengthen the Nation's competitiveness by building the expertise needed to lead our transition to a clean energy economy.

The Department's first three Energy Innovation Hubs, initiated in FY 2010, will explore Fuels from Sunlight, Energy Efficient Building Systems Design, and Modeling and Simulation for Nuclear Reactors. The Department already funds some promising R&D in these areas, and the Hubs will be able to build upon the new knowledge from these and other advances to reach the critical mass of R&D and engineering integration needed to accelerate major breakthroughs in these energy technologies. Each Hub will exist for a finite length of time and will focus on a single topic, but with work spanning the gamut from basic research, through engineering development, to facilitating commercialization by industry. Each Hub will be comprised of a highly collaborative team utilizing multiple scientific disciplines, engineering fields, and technology areas, working largely under one roof. By bringing together top talent across the full spectrum of R&D performers—including universities, private industry, non-profits, and government laboratories—each Hub is expected to conduct world-leading R&D in its topical area.

The Hubs are a central component of the Secretary of Energy's strategy to achieve the President's goals to reduce our dependence on foreign oil and our greenhouse gas emissions. The Hubs also embody the Secretary's goal to improve coordination between basic research and technology development. BES will support two Hubs in FY 2011, one focused on Fuels from Sunlight and a new Hub for Batteries and

Energy Storage. The primary objective in selecting the Hubs is to award the proposals that have the best chance to deliver transformative energy breakthroughs. The Hubs will therefore be selected on the basis of a competitive merit review; there are no preconceived goals for specific locations or geographical distribution of the Hubs. Universities, national laboratories, and the private sector—or partnerships among those groups—will be eligible to apply, similar to the DOE Bioenergy Research Center solicitation. Proposals will be selected based on external merit review and awards will provide support for research activities, not construction of new buildings. Additional information on the Hubs can be found at http://www.energy.gov/hubs/index.htm.

Scientific Workforce

The Office of Science, through its six research programs, supports the training of undergraduates, graduate students, and postdoctoral researchers as an integral part of the ongoing sponsored research activities at universities and DOE national laboratories. Office of Science programs also support the development of individual research programs of outstanding scientists early in their careers to stimulate research careers in disciplines supported by the Office of Science.

In addition, the Office of Science research programs support modest activities targeted towards undergraduate and graduate students, postdoctoral researchers, and K–12 science and math educators to educate and encourage new talent into fields important to the program-specific missions. These activities, in addition to the activities supported within the Workforce Development for Teachers and Scientists program, provide opportunities that will draw U.S. talent into science, technology, engineering, and mathematics; create the skilled scientific and technical workforce needed to develop solutions to our energy and environmental challenges in the 21st century; and enable the U.S. to continue to be the leader in science and innovation.

Undergraduate activities include intensive research training internships in specific areas such as geophysics, radiochemistry, nuclear science, computer science and computational-based sciences, plasma and fusion energy sciences, and climate science, and short courses in emerging areas in the physical sciences and engineering, including opportunities for groups underrepresented in the physical sciences. Graduate student level activities include support for short courses and lecture series as part of scientific professional society meetings; summer courses, lecture series, and experimental training courses in areas such as neutron and x-ray scattering, high energy physics, and genomic sciences; summer graduate research internships in targeted areas such as genomic science, radiochemistry, accelerator physics, and nuclear physics; and graduate research fellowships to support graduate study and research in areas of basic science and engineering important to the DOE mission. Opportunities directed towards K–12 educators include workshops, classroom presentations, and summer training programs that provide educators with content knowledge, materials, and activities related to the physical sciences and mathematics to use in the classroom.

Mission Readiness of Office of Science Laboratories

The mission readiness of a laboratory's facilities and infrastructure is the capability of those assets to enable delivery of the scientific mission assigned to that laboratory. Ensuring continued mission readiness into the future is the focus of the Science Laboratories Infrastructure program.

In FY 2009, the Office of Science began an Infrastructure Modernization initiative to revitalize Office of Science laboratories over ten years, with the goal of providing the modern laboratory infrastructure needed to deliver advances in science the Nation requires to remain competitive in the 21st century. Through this initiative, we are ensuring the laboratories have state-of-the-art facilities and utilities that are flexible, reliable, and sustainable, with environmentally stable research space and high performance computing space needed to support scientific discovery. New and renovated buildings and utilities will

include the latest temperature and humidity controls, clean power, and isolation from vibration and electromagnetic interference where needed. Facility designs will consider human factors to ensure collaborative and interactive work environments and allow for the integration of basic to applied research and development. The initiative includes a portfolio of projects funded through the SLI budget that will provide modern laboratory space, renovate space that does not meet research needs, replace facilities that are no longer cost effective to renovate or operate, modernize utility systems to prevent failures and ensure efficiency, and/or remove excess facilities to allow safe and efficient operations. The investments will not only improve the Office of Science's mission readiness but will also reduce deferred maintenance backlog thereby improving the overall Asset Condition Index.

Means and Strategies

All research projects and facilities undergo regular peer review and merit evaluation based on procedures set down in 10 CFR 605 for the extramural grant program and under a similar process for the laboratory programs and scientific user facilities. All new projects are selected through peer review and merit evaluation.

Office of Science programs ensure effective management processes for cost-effective investments and timely delivery of projects and utilize input from the scientific community to ensure progress is made and opportunities are identified. Programs also form mutually beneficial partnerships with programs sharing common goals. The basic science supported by each program is coordinated with the activities of other programs within the Office of Science, with programs of the DOE applied technology offices and the National Nuclear Security Administration, and with programs of other Federal agencies. The Office of Science also promotes the transfer of basic research results to contribute to DOE missions in areas of energy, environment, and national security. Program-specific means and strategies are described in detail in the individual program budget narrative sections.

Validation and Verification

Progress against established plans is evaluated by periodic internal and external performance reviews. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semiannual, and annual reviews consistent with specific program management plans are performed to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

Office of Science

Funding by Site by Program

(dollars in thousands)

	FY 2009	FY 2010	FY 2011
Ames Laboratory			
Advanced Scientific Computing Research	1,597	900	450
Basic Energy Sciences	21,485	19,563	19,563
Biological and Environmental Research	675	675	675
Workforce Development for Teachers and Scientists	463	240	556
Safeguards and Security	1,067	980	1,007
Total, Ames Laboratory	25,287	22,358	22,251
Ames Site Office			
Science Program Direction	536	585	621
Argonne National Laboratory			
Advanced Scientific Computing Research	53,721	54,570	68,205
Basic Energy Sciences	198,855	198,665	209,147
Biological and Environmental Research	28,627	29,266	28,913
Fusion Energy Sciences	125	125	125
High Energy Physics	17,113	13,422	13,568
Nuclear Physics	27,650	28,164	28,775
Workforce Development for Teachers and Scientists	1,916	466	2,012
Science Laboratories Infrastructure	10,000	8,000	15,000
Safeguards and Security	9,787	8,742	8,985
Total, Argonne National Laboratory	347,794	341,420	374,730
Argonne Site Office			
Science Program Direction	3,166	3,418	4,308
Berkeley Site Office			
Science Program Direction	3,685	4,462	4,586

(dollars in thousands)

	FY 2009	FY 2010	FY 2011
Brookhaven National Laboratory			
Advanced Scientific Computing Research	970	780	360
Basic Energy Sciences	201,326	235,186	247,915
Biological and Environmental Research	23,182	19,954	14,094
High Energy Physics	55,108	47,818	44,284
Nuclear Physics	176,957	179,418	192,981
Workforce Development for Teachers and Scientists	890	589	1,069
Science Laboratories Infrastructure	14,882	44,387	15,000
Safeguards and Security	11,824	11,632	11,955
Total, Brookhaven National Laboratory	485,139	539,764	527,658
Brookhaven Site Office			
Science Program Direction	3,930	5,120	5,445
Chicago Office			
Advanced Scientific Computing Research	54,656	53,611	27,917
Basic Energy Sciences	264,195	265,299	309,219
Biological and Environmental Research	167,669	160,043	161,632
Fusion Energy Sciences	149,054	152,083	151,342
High Energy Physics	142,626	134,504	133,068
Nuclear Physics	76,653	81,595	69,297
Workforce Development for Teachers and Scientists	135	164	5,000
Science Laboratories Infrastructure	756	0	0
Safeguards and Security	1,222	1,222	0
Science Program Direction	29,971	29,092	33,560
Congressionally Directed Projects	69,537	74,737	0
SBIR/STTR	154,439	0	0
Total, Chicago Office	1,110,913	952,350	891,035

(dollars in thousands)

	FY 2009	FY 2010	FY 2011
Fermi National Accelerator Laboratory			
Advanced Scientific Computing Research	910	790	180
High Energy Physics	389,043	397,273	408,705
Nuclear Physics	661	72	0
Workforce Development for Teachers and Scientists	294	105	637
Science Laboratories Infrastructure	0	0	7,524
Safeguards and Security	2,024	2,169	3,486
Total, Fermi National Accelerator Laboratory	392,932	400,409	420,532
Fermi Site Office			
Science Program Direction	2,112	2,363	2,700
Golden Field Office			
Workforce Development for Teachers and Scientists	869	176	722
Idaho National Laboratory			
Basic Energy Sciences	2,125	260	260
Biological and Environmental Research	2,238	1,717	1,304
Fusion Energy Sciences	2,272	2,172	2,222
Workforce Development for Teachers and Scientists	79	135	135
Congressionally Directed Projects	2,429	0	0
Total, Idaho National Laboratory	9,143	4,284	3,921
Lawrence Berkeley National Laboratory			
Advanced Scientific Computing Research	100,869	94,886	92,895
Basic Energy Sciences	163,071	139,607	143,183
Biological and Environmental Research	112,627	123,120	126,252
Fusion Energy Sciences	4,941	4,841	4,806
High Energy Physics	70,123	54,031	47,117
Nuclear Physics	28,151	27,136	21,271
Workforce Development for Teachers and Scientists	746	475	947
Science Laboratories Infrastructure	29,956	34,027	20,103
Safeguards and Security	5,529	5,059	5,201
Total, Lawrence Berkeley National Laboratory	516,013	483,182	461,775

(dollars in thousands)

	FY 2009	FY 2010	FY 2011
Lawrence Livermore National Laboratory			
Advanced Scientific Computing Research	14,652	13,929	7,632
Basic Energy Sciences	5,290	3,717	3,717
Biological and Environmental Research	25,362	14,891	11,503
Fusion Energy Sciences	13,886	10,744	13,145
High Energy Physics	1,552	794	793
Nuclear Physics	1,746	1,027	1,308
Workforce Development for Teachers and Scientists	130	89	294
Total, Lawrence Livermore National Laboratory	62,618	45,191	38,392
Los Alamos National Laboratory			
Advanced Scientific Computing Research	5,621	4,932	3,981
Basic Energy Sciences	41,050	33,287	35,208
Biological and Environmental Research	25,059	10,819	9,894
Fusion Energy Sciences	4,594	5,076	5,464
High Energy Physics	388	298	255
Nuclear Physics	12,064	10,014	15,128
Workforce Development for Teachers and Scientists	270	144	270
Congressionally Directed Projects	11,098	0	0
Total, Los Alamos National Laboratory	100,144	64,570	70,200
National Energy Technology Laboratory			
Workforce Development for Teachers and Scientists	782	586	1,150
National Renewable Energy Laboratory			
Advanced Scientific Computing Research	581	522	379
Basic Energy Sciences	12,608	7,209	7,209
Biological and Environmental Research	1,497	1,136	1,026
Workforce Development for Teachers and Scientists	50	55	100
Total, National Renewable Energy Laboratory	14,736	8,922	8,714
Nevada Site Office			
Basic Energy Sciences	232	244	244

	(dollars in thousands)		
	FY 2009	FY 2010	FY 2011
New Brunswick Laboratory			
Science Program Direction	6,132	6,132	7,015
Oak Ridge Institute for Science and Education			
Advanced Scientific Computing Research	1,024	1,000	1,000
Basic Energy Sciences	5,237	642	642
Biological and Environmental Research	5,742	5,305	3,371
Fusion Energy Sciences	2,208	1,742	1,450
High Energy Physics	945	250	250
Nuclear Physics	3,097	789	729
Workforce Development for Teachers and Scientists	3,643	2,418	17,724
Safeguards and Security	1,710	1,626	1,671
Total, Oak Ridge Institute for Science and Education	23,606	13,772	26,837
Oak Ridge National Laboratory			
Advanced Scientific Computing Research	104,435	91,125	103,753
Basic Energy Sciences	325,637	328,071	330,246
Biological and Environmental Research	70,882	65,825	59,752
Fusion Energy Sciences	142,099	151,579	97,400
High Energy Physics	123	2	0
Nuclear Physics	26,943	25,831	44,141
Workforce Development for Teachers and Scientists	100	0	0
Science Laboratories Infrastructure	25,103	0	0
Safeguards and Security	9,094	8,895	9,144
Total, Oak Ridge National Laboratory	704,416	671,328	644,436
Oak Ridge National Laboratory Site Office			
Science Program Direction	4,565	4,357	4,457

(dollars in thousands)

	FY 2009	FY 2010	FY 2011
Oak Ridge Office			
Science Laboratories Infrastructure	5,079	5,214	5,260
Safeguards and Security	19,174	19,357	19,895
Science Program Direction	43,483	37,834	42,257
Total, Oak Ridge Office	67,736	62,405	67,412
Office of Scientific and Technical Information			
Advanced Scientific Computing Research	106	177	106
Basic Energy Sciences	106	344	229
Biological and Environmental Research	373	469	389
Fusion Energy Sciences	106	178	122
High Energy Physics	106	230	110
Nuclear Physics	106	196	0
Workforce Development for Teachers and Scientists	180	250	300
Science Laboratories Infrastructure	2,500	0	0
Safeguards and Security	583	490	504
Science Program Direction	9,153	8,916	8,963
Total, Office of Scientific and Technical Information	13,319	11,250	10,723
Pacific Northwest National Laboratory			
Advanced Scientific Computing Research	7,349	5,067	3,745
Basic Energy Sciences	25,366	19,574	19,574
Biological and Environmental Research	102,200	109,274	107,474
Fusion Energy Sciences	900	1,326	1,838
Workforce Development for Teachers and Scientists	1,187	613	1,211
Science Laboratories Infrastructure	52,775	0	0
Safeguards and Security	11,256	11,163	11,476
Total, Pacific Northwest National Laboratory	201,033	147,017	145,318
Pacific Northwest Site Office			
Science Program Direction	5,564	5,264	6,173

(dollars in thousands)

	FY 2009	FY 2010	FY 2011
Princeton Plasma Physics Laboratory			
Advanced Scientific Computing Research	740	758	322
Fusion Energy Sciences	71,250	72,676	76,017
High Energy Physics	230	272	237
Workforce Development for Teachers and Scientists	375	243	541
Safeguards and Security	2,242	2,178	2,237
Total, Princeton Plasma Physics Laboratory	74,837	76,127	79,354
Princeton Site Office			
Science Program Direction	1,734	1,805	2,058
Sandia National Laboratories			
Advanced Scientific Computing Research	9,831	8,169	8,436
Basic Energy Sciences	44,373	36,108	36,397
Biological and Environmental Research	6,459	1,600	520
Fusion Energy Sciences	2,730	2,290	2,490
Nuclear Physics	275	0	0
Workforce Development for Teachers and Scientists	550	21	926
Congressionally Directed Projects	4,624	0	0
Total, Sandia National Laboratories	68,842	48,188	48,769
Savannah River National Laboratory			
Basic Energy Sciences	480	435	435
Biological and Environmental Research	622	363	0
Fusion Energy Sciences	50	0	0
Workforce Development for Teachers and Scientists	0	75	75
Total, Savannah River National Laboratory	1,152	873	510

	(dollars in thousands)		
	FY 2009	FY 2010	FY 2011
SLAC National Accelerator Laboratory			
Advanced Scientific Computing Research	200	200	200
Basic Energy Sciences	221,597	184,134	172,560
Biological and Environmental Research	5,352	4,150	4,150
High Energy Physics	91,024	88,824	87,177
Workforce Development for Teachers and Scientists	222	160	190
Science Laboratories Infrastructure	0	6,900	33,100
Safeguards and Security	2,679	2,643	2,716
Total, SLAC National Accelerator Laboratory	321,074	287,011	300,093
Stanford Site Office			
Science Program Direction	2,948	2,748	2,829
Thomas Jefferson National Accelerator Facility			
Advanced Scientific Computing Research	100	100	0
Basic Energy Sciences	900	900	0
Biological and Environmental Research	600	600	600
High Energy Physics	2,571	2,152	1,895
Nuclear Physics	119,618	112,321	129,893
Workforce Development for Teachers and Scientists	520	208	641
Science Laboratories Infrastructure	3,700	27,687	28,628
Safeguards and Security	1,504	1,432	1,470
Total, Thomas Jefferson National Accelerator Facility	129,513	145,400	163,127
Thomas Jefferson Site Office			
Science Program Direction	1,928	2,020	2,229

	(dollars in thousands)		
	FY 2009	FY 2010	FY 2011
Washington Headquarters			
Advanced Scientific Computing Research	1,410	62,484	106,439
Basic Energy Sciences	1,832	163,255	299,252
Biological and Environmental Research	6,010	54,975	95,351
Fusion Energy Sciences	303	21,168	23,579
High Energy Physics	1,716	70,613	91,541
Nuclear Physics	26,386	68,437	58,477
Workforce Development for Teachers and Scientists	182	13,466	1,100
Science Laboratories Infrastructure	629	1,385	1,385
Safeguards and Security	908	5,412	6,753
Science Program Direction	67,788	75,261	87,236
Congressionally Directed Projects	3,376	2,153	0
Total, Washington Headquarters	110,540	538,609	771,113
Waste Isolation Pilot Plant			
High Energy Physics	3,200	0	0
Total, Science	4,822,170	4,903,710	5,121,437

Office of Science

Major Changes or Shifts by Site

Argonne National Laboratory

- **Advanced Scientific Computing Research**: The Leadership Computing Facility will be undergoing site preparations for the 10-petaflop upgrade, while continuing to provide open high-performance computing capability with low electrical power consumption to enable scientific advances.

Fermi National Accelerator Laboratory

- **Science Laboratories Infrastructure**: The Utilities Upgrade project is initiated to upgrade the laboratory's industrial cooling water and high voltage electrical systems. Both of these systems are critical for the current and future mission at the laboratory. System components are at the end of their design life and replacement parts are no longer available.

Lawrence Berkeley National Laboratory

- **Advanced Scientific Computing Research**: The high performance computing resources at the National Energy Research Scientific Computing (NERSC) center will provide one petaflop of capacity computing to the Office of Science programs. The Energy Sciences network (ESnet) will begin deploying the 100 gigabit per second optical technologies developed through the Recovery Act funded Advanced Networking Initiative.

Oak Ridge National Laboratory

- **Advanced Scientific Computing Research**: The Leadership Computing Facility will explore hybrid architectures while providing more than two petaflops of open high-performance computing capability to enable scientific advances.

SLAC National Accelerator Laboratory

- **Basic Energy Sciences**: The Linac Coherent Light Source will begin its first full year of operations as a DOE user facility in FY 2011.
- **High Energy Physics**: In FY 2011, SLAC will begin full operations of the Facility for Accelerator Science and Experimental Test Beams (FACET) including a round of experiments in which the electron beam is accelerated by plasma wakefields (instead of the usual electromagnetic fields in a copper cavity). The ultimate goal of this effort will be demonstration of efficient accelerating structures with gradients well above 100 MeV per meter that could be incorporated into future accelerators.

Thomas Jefferson National Accelerator Facility

- **Science Laboratories Infrastructure**: The Utility Infrastructure Modernization project is initiated to upgrade the power distribution, cooling water, and communications systems to ensure the laboratory can continue to provide superconducting radio frequency expertise as well as research, development, and production of cryomodules in support of SC missions.

Site Description

Ames Laboratory

The Ames Laboratory is a program dedicated laboratory (Basic Energy Sciences). The laboratory is located on the campus of the Iowa State University, in Ames, Iowa, and consists of 12 buildings (327 thousand gross square feet of space). The average age of the buildings is 42 years. DOE does not own the land. Ames conducts fundamental research in the physical, chemical, and mathematical sciences associated with energy generation and storage. Ames is home to the **Materials Preparation Center**, which is dedicated to the preparation, purification, and characterization of rare-earth, alkaline-earth, and refractory metal and oxide materials.

- **Advanced Scientific Computing Research**: Ames conducts research in computer science and participates on Scientific Discovery through Advanced Computing (SciDAC) science application teams.
- **Basic Energy Sciences**: Ames supports experimental and theoretical research on rare earth elements in novel mechanical, magnetic, and superconducting materials. Ames scientists are experts on magnets, superconductors, and quasicrystals that incorporate rare earth elements. Ames also conducts research in focused areas within chemical and biochemical sciences.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Ames Site Office

The Ames Site Office provides the single federal presence with responsibility for contract performance at the Ames Laboratory. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Argonne National Laboratory

The Argonne National Laboratory (ANL) in Argonne, Illinois, is a multiprogram laboratory located on 1,500 acres in suburban Chicago. The laboratory consists of 99 buildings (4.6 million gross square feet of space). The average age of all the buildings is 37 years.

- **Advanced Scientific Computing Research**: ANL conducts research in applied mathematics and computer science, as well as research in advanced computing software tools. ANL also participates in scientific application partnerships and contributes to a number of the SciDAC science application teams. Further, it participates in both SciDAC Centers for Enabling Technologies and SciDAC Institutes that focus on specific software challenges confronting users of petascale computers. The ANL Leadership Computing Facility provides the computational science community with a world-leading computing capability dedicated to breakthrough science and engineering. The Leadership Computing Facility provides resources, including a 556-teraflop IBM Blue Gene/P system, which make computationally intensive projects of the largest scales possible.
- **Basic Energy Sciences**: ANL is home to research activities in broad areas of materials and chemical sciences. It is also the site of three user facilities—the Advanced Photon Source, the Center for Nanoscale Materials, and the Electron Microscopy Center for Materials Research.
  - The **Advanced Photon Source** is one of only three third-generation, hard x-ray synchrotron radiation light sources in the world. The 1,104-meter circumference facility—large enough to house a baseball park in its center—includes 34 bending magnets and 34 insertion devices, which generate a capacity of 68 beamlines for experimental research. Instruments on these beamlines attract researchers to study the structure and properties of materials in a variety of disciplines, including condensed matter physics, materials sciences, chemistry, geosciences, structural biology, medical imaging, and environmental sciences.
  - The **Electron Microscopy Center for Materials Research** develops and maintains capabilities for electron beam characterization and applies those capabilities to solve materials problems. The Center emphasizes three major areas: materials research, technique and instrumentation development, and operation as a national research facility. Research at the Center includes microscopy based studies on high-temperature superconducting materials, irradiation effects in metals and semiconductors, phase transformations, and processing related structure and chemistry of interfaces in thin films.
  - The **Center for Nanoscale Materials** provides capabilities for developing new methods for self assembly of nanostructures, exploring the nanoscale physics and chemistry of nontraditional electronic materials, and creating new probes for exploring nanoscale phenomena. The Center is organized around six scientific themes: nanomagnetism, bio-inorganic hybrids, nanocarbon, complex oxides, nanophotonics, and theory and simulation.
- **Biological and Environmental Research**: ANL conducts research on the molecular control of genes and gene pathways in microbes in addition to biological and geochemical research that supports environmental remediation. ANL operates beamlines for protein crystallography at the APS and also supports a growing community of users in environmental sciences.

In support of climate change research, ANL has oversight responsibility for coordinating the overall infrastructure operations of all three stationary Atmospheric Radiation Measure Climate Research Facility sites to ensure consistency, data quality, and site security and safety. This includes infrastructure coordination of communications, data transfer, and instrument calibration. ANL also provides the site manager for the Southern Great Plains site, who is responsible for coordinating the day-to-day operations and manages the deployment and operation of a mobile climate research facility. ANL conducts research on aerosol processes and properties, and develops and applies software to enable efficient long-term climate simulations on distributed-memory multiprocessor computing platforms. ANL is the task lead for developing new adjoint techniques in ocean modeling in the LBNL-led multi-lab effort on Abrupt Climate Change. In conjunction with Oak Ridge National Laboratory, Pacific Northwest National Laboratory, and six universities, ANL is a participating laboratory in the Carbon Sequestration in Terrestrial Ecosystems consortium, focusing on research to understand the processes controlling the rate of soil carbon accretion.

- **Fusion Energy Sciences**: ANL contributes a small effort in basic plasma science. In addition, ANL participates in the two-year planning study of the Fusion Simulation Program, contributing in the areas of algorithm development, code verification, software standards, and workflow needs and tools determination.
- **High Energy Physics**: ANL has unique capabilities in the areas of engineering, detector technology, and advanced accelerator and computing techniques. ANL continues to participate in the Tevatron and neutrino research programs at Fermi National Accelerator Laboratory (Fermilab) and analysis of data from these experimental programs will continue for several years. Other major ANL activities include working on the ATLAS (A Large Toroidal LHC Apparatus) experiment at the Large Hadron Collider, developing new detector technologies for future experiments, advancing accelerator R&D using the Argonne Wakefield Accelerator, and partnering with Fermilab in the development of superconducting radio frequency technology for future accelerators.
    - The **Argonne Wakefield Accelerator** is an R&D testbed that focuses on the physics and technology of high-gradient, dielectric-loaded structures for accelerating electrons. Two approaches are being pursued: a collinear, electron-beam driven dielectric-loaded wakefield accelerator and a two-beam accelerator. The goal is to identify and develop techniques which may lead to more efficient, compact, and inexpensive particle accelerators for future HEP applications. Research activities at this facility include the development of materials/coatings for high gradient research, dielectric-loaded and photonic band gap accelerating structures, left-handed meta-materials, high-power/high-brightness electron beams, and advanced beam diagnostics.
- **Nuclear Physics**: ANL operates the Argonne Tandem Linac Accelerator System national user facility, the world's premiere stable beam facility, and supports its corresponding R&D program. ANL nuclear scientists have expertise in detector development, computational techniques and advanced accelerator technology. Other activities include an on-site program of research using laser techniques (Atom Trap Trace Analysis); research programs at the Thomas Jefferson National Accelerator Facility (TJNAF), Fermilab, and Relativistic Heavy Ion Collider (RHIC); development and fabrication support for the Facility for Rare Isotope Beams (FRIB); theoretical calculations and investigations in subjects supporting the experimental research programs in medium energy and low energy physics; and data compilation and evaluation activities as part of the National Nuclear Data Program.

- The **Argonne Tandem Linac Accelerator System** national user facility provides variable energy and precision beams of stable ions from protons through uranium at energies near the Coulomb barrier (up to 10 MeV per nucleon) using a superconducting linear accelerator. Most work is performed with stable heavy-ion beams; however, an increasing percentage of the beams are rare isotope beams. The facility features a wide array of experimental instrumentation, including a world-leading ion-trap apparatus, the Advanced Penning Trap. The Gammasphere detector, coupled with the Fragment Mass Analyzer, is a unique world facility for measurement of nuclei at the limits of angular momentum (high-spin states). The facility nurtures a core competency in accelerator expertise with superconducting radiofrequency cavities for heavy ions that is relevant to the next generation of high-performance proton and heavy-ion linacs, and important to the SC mission and international stable and radioactive ion beam facilities. The combination of versatile beams and powerful instruments enables about 410 users annually to conduct research in a broad program in nuclear structure and dynamics, nuclear astrophysics, and fundamental interaction studies. The capabilities are being augmented by the fabrication of the Californium Rare Ion Beam Upgrade (CARIBU), which will be completed in FY 2010, as a source to provide new capabilities in neutron-rich radioactive beams. A new instrument, the Helical Orbital Spectrometer, employs a new concept to study reactions with radioactive beams from CARIBU.

- **Science Laboratories Infrastructure**: SLI enables DOE research missions at ANL by funding line item construction to maintain the general purpose infrastructure. The SLI program is currently funding the Energy Sciences Building project, which is constructing new, environmentally stable, specialized, and flexible space to replace some of the oldest and least effective research space for energy-related sciences.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Argonne Site Office

The Argonne Site Office provides the single federal presence with responsibility for contract performance at ANL. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Berkeley Site Office

The Berkeley Site Office provides the single federal presence with responsibility for contract performance at the Lawrence Berkeley National Laboratory. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Brookhaven National Laboratory

The Brookhaven National Laboratory (BNL) is a multiprogram laboratory located on 5,300 acres in Upton, New York. The laboratory consists of 331 SC buildings (4.0 million gross square feet of space). The average age of the buildings is 39 years. BNL creates and operates major facilities available to university, industrial, and government personnel for basic and applied research in the physical, biomedical, and environmental sciences, and in selected energy technologies.

- **Advanced Scientific Computing Research**: BNL conducts research in applied mathematics and participates on SciDAC science application teams. It also participates in SciDAC Centers for Enabling Technologies that focus on specific software challenges confronting users of petascale computers.
- **Basic Energy Sciences**: BNL conducts research efforts in materials sciences with emphasis on advanced scattering techniques, chemical sciences, and physical biosciences. It is also the site of two BES supported user facilities—the National Synchrotron Light Source and the Center for Functional Nanomaterials.
    - The **National Synchrotron Light Source** consists of two distinct electron storage rings. The x-ray storage ring is 170 meters in circumference and can accommodate 60 beamlines or experimental stations, and the vacuum-ultraviolet (VUV) storage ring can provide 25 additional beamlines around its circumference of 51 meters. Synchrotron light from the x-ray ring is used to determine the atomic structure of materials using diffraction, absorption, and imaging techniques. Experiments at the VUV ring help understand the atomic and electronic structure as well as the magnetic properties of a wide array of materials. Construction of a new synchrotron light source at BNL (the National Synchrotron Light Source II) is underway.
    - The **Center for Functional Nanomaterials** focuses on understanding the chemical and physical response of nanomaterials to make functional materials such as sensors, activators, and energy-conversion devices. It also provides clean rooms, general laboratories, and wet and dry laboratories for sample preparation, fabrication, and analysis. It includes equipment needed for laboratory and fabrication facilities for e-beam lithography, transmission electron microscopy, scanning probes and surface characterization, material synthesis and fabrication, and spectroscopy.
- **Biological and Environmental Research**: BNL operates beam lines for protein crystallography at the National Synchrotron Light Source for use by the national biological research community, research in biological structure determination, and research into new instrumentation for detecting x-rays and neutrons. BNL conducts molecular radiochemistry and imaging and instrumentation research, developing advanced technologies for biological imaging.
    - Climate change research includes the operation of the Atmospheric Radiation Measurement Climate Research Facility (ACRF) External Data resource that provides atmospheric system research investigators with data from non-ACRF sources, including satellite and ground-based systems. BNL scientists form an important part of the atmospheric system research science team, including providing special expertise in analyzing atmospheric data and simulating cloud and aerosol processes in climate models.
    - BNL is the lead for multi-institution research to address issues of model evaluation, development, and understanding of atmospheric processes.
    - BNL scientists play a leadership role in the operation of the Free-Air Carbon Dioxide Enrichment (FACE) experiment at the Duke Forest which seeks to understand how plants respond to elevated carbon dioxide concentrations in the atmosphere.
- **High Energy Physics**: BNL has unique resources in the engineering and technology for future accelerators and detectors, advanced computational resources, and the Accelerator Test Facility. BNL serves as the host laboratory for the U.S. ATLAS collaboration, which participates in the research of the ATLAS detector at the Large Hadron Collider. BNL manages the program of maintenance and operations for the ATLAS detector, operates the primary U.S. analysis facility for ATLAS data, and

is developing an analysis support center for U.S. based users. The group also contributes to the leadership and management of the U.S. International Linear Collider R&D effort and is a member of the Tevatron research collaboration at Fermilab.

BNL researchers have a leadership role in the Reactor Neutrino experiment in Daya Bay, China. BNL physicists are also involved in other neutrino physics efforts including research at the Neutrinos at the Main Injector (NuMI) facility with the Main Injector Neutrino Oscillation experiment at Fermilab and R&D and planning for future accelerator-based neutrino experiments, particularly the Long Baseline Neutrino Experiment.

- The BNL **Accelerator Test Facility** is a user facility that supports a broad range of advanced accelerator R&D. The core capabilities include a high-brightness photoinjector electron gun, a 70-MeV linac, high power lasers synchronized to the electron beam at a picosecond level, four beam lines, and a sophisticated computer control system. Participating researchers come from universities, national laboratories, and industries. Experiments carried out in this facility are proposal-driven and are typically in the areas involving interactions of high power electromagnetic radiation and high brightness electron beams, including laser acceleration of electrons and free-electron lasers. Other topics include the development of electron beams with extremely high brightness, photo-injectors, electron beam and radiation diagnostics, and computer controls.

- **Nuclear Physics**: Research activities include: use of relativistic heavy ion beams and polarized protons in the Relativistic Heavy Ion Collider (RHIC) to investigate hot, dense nuclear matter and to understand the internal "spin" structure of the proton; development of future detectors for RHIC; core competencies in accelerator R&D of beam-cooling techniques aimed at increasing the RHIC beam luminosity and of importance to other SC projects; R&D and calibration efforts directed towards research with neutrinos; a theory program emphasizing RHIC heavy ion and "spin" physics; data compilation and evaluation at the National Nuclear Data Center (NNDC) that is the central U.S. site for these national and international efforts; operations of the Brookhaven Linac Isotope Producer (BLIP) which produces research and commercial isotopes in short supply; and a research and development effort of new isotope production and processing techniques.

  - The **Relativistic Heavy Ion Collider** facility uses accelerators to inject beams into two rings of superconducting magnets of almost 4 kilometers circumference with 6 intersection regions where the beams can collide. RHIC can accelerate and collide a variety of heavy ions, including gold beams, up to an energy of 100 GeV per nucleon. RHIC is being used to search for and characterize hot, dense nuclear matter and has seen signs of the same quark-gluon plasma that is believed to have existed microseconds after the Big Bang. It can also collide polarized protons with beams of energy up to 250 GeV per nucleon—a unique capability. Two detectors are supported to provide complementary measurements, with some overlap in order to cross-calibrate the measurements: the Solenoidal Tracker at RHIC and the Pioneering High-Energy Nuclear Interacting Experiment.

  - The **Alternating Gradient Synchrotron** (AGS) accelerator provides high intensity pulsed proton beams up to 33 GeV on fixed targets and secondary beams of kaons, muons, pions, and anti-protons. The AGS is the injector of (polarized) proton and heavy-ion beams into RHIC, and its operations are supported by the NP Heavy Ion subprogram as part of the RHIC facility. The AGS is also utilized for radiation damage studies of electronic systems for NASA-supported work and work for other agencies.

- The **Booster Synchrotron** accelerator, part of the RHIC injector, provides heavy-ion beams to a dedicated beam line (NASA Space Radiation Laboratory) for biological and electronic systems radiation studies funded by NASA.
- The **Electron Beam Ion Source** (EBIS) accelerator and linac system will be completed in FY 2010 and will replace the aging Tandem Van de Graaff accelerators which have served as injectors for the Booster Synchrotron. EBIS, which was supported as a joint DOE/NASA project, promises greater efficiency, greater reliability, and lower maintenance costs as well as the potential for future upgrades.
- The **National Nuclear Data Center** (NNDC) is the central U.S. site for national and international nuclear data and compilation efforts. The U.S. Nuclear Data program is the United States' repository for information generated in low- and intermediate-energy nuclear physics research worldwide. This information consists of both bibliographic and numeric data. The Center is a resource for a very broad user community in basic nuclear science research and in all aspects of nuclear technology, with relevance to homeland security and advanced fuel cycles for nuclear reactors. Nuclear Data program-funded scientists at U.S. national laboratories and universities contribute to the Center's activities and responsibilities.
- The **Brookhaven Linac Isotope Producer** at BNL uses a linear accelerator that injects 200-MeV protons into the 33-GeV Alternating Gradient Synchrotron. The isotopes produced by BLIP, such as strontium-82, germanium-68, copper-67, and others, are used in medical diagnostic and therapeutic applications and other scientific research. The BLIP can operate in dedicated mode or in conjunction with RHIC operations.

- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure and remove excess facilities. The SLI program is currently funding the Renovate Science Laboratories, Phase II project that will modernize unsuitable laboratory space in buildings 510 (Physics) and 555 (Chemistry), allowing them to continue supporting research in Basic Energy Sciences and Nuclear and High Energy Physics. SLI is also funding construction of the Interdisciplinary Science Building, Phase I project at BNL that will provide high accuracy laboratories (e.g., equipped with precise temperature, humidity, and vibration controls), offices, and support space for energy-related research and development in a new interdisciplinary facility.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, protective force officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Brookhaven Site Office

The Brookhaven Site Office provides the single federal presence with responsibility for contract performance at BNL. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Chicago Office

The Chicago (CH) Office directly provides corporate support (procurement, legal, financial management, human resources, and facilities and infrastructure) to site offices responsible for program management oversight of six management and operating laboratories—the Ames, Argonne, Lawrence Berkeley, Brookhaven, Fermi, and Princeton laboratories—and one government-owned and government-operated Federal laboratory, the New Brunswick Laboratory. The administrative, business,

and technical expertise of CH is shared SC-wide through the Integrated Support Center concept. CH also serves as SC's grant center, administering grants to about 300 colleges and universities in all 50 states, Washington, D.C., and Puerto Rico, as determined by the SC program offices as well as non-SC offices.

- **Advanced Scientific Computing Research**: ASCR funds research at over 70 academic institutions located in 34 states supporting over 130 principal investigators.
- **Basic Energy Sciences**: BES funds research at 170 academic institutions located in 50 states.
- **Biological and Environmental Research**: BER funds research at over 200 institutions, including colleges, universities, private industry, and other federal and private research institutions located in 45 states, Washington, DC, and Puerto Rico.
- **Fusion Energy Sciences**: FES funds research grants and cooperative agreements at more than 50 colleges and universities located in approximately 30 states.
- **High Energy Physics**: HEP supports about 300 research groups at more than 100 colleges and universities located in 36 states, Washington, D.C., and Puerto Rico.
- **Nuclear Physics**: NP funds approximately 200 research grants at 90 colleges and universities located in 35 states and Washington, DC.
- **Safeguards and Security**: Program management and funding for local security interests will be transferred from the Chicago Office to the Fermi National Accelerator Laboratory in FY 2011.

Fermi National Accelerator Laboratory

Fermi National Accelerator Laboratory is a program-dedicated laboratory (High Energy Physics) located on a 6,800-acre site in Batavia, Illinois. The laboratory consists of 355 buildings (2.3 million gross square feet of space). The average age of the buildings is 43 years. Fermilab is the largest U.S. laboratory for research in high-energy physics and, world-wide, is second in size only to CERN, the European Laboratory for Particle Physics. About 2,000 scientific users—scientists from universities and laboratories throughout the U.S. and around the world—use Fermilab for their research. Fermilab's mission is that of the high-energy physics program: to understand matter at its deepest level, to identify its fundamental building blocks, and to understand how the laws of nature determine their interactions.

- **Advanced Scientific Computing Research**: Fermilab participates in SciDAC science application teams relevant to physics research, accelerator modeling, and distributed data. Fermilab also participates in SciDAC Centers for Enabling Technologies focusing on specific software challenges confronting users of petascale computers.
- **High Energy Physics**: Fermilab is the principal HEP experimental facility. Fermilab operates the **Tevatron** accelerator and colliding beam facility, which consists of a four-mile ring of superconducting magnets and two large multi-purpose detectors and is capable of accelerating protons and antiprotons to an energy of one trillion electron volts (1 TeV). The laboratory supports two Tevatron experiments, CDF and D-Zero, together home to about 1,400 physicists from Fermilab and other national laboratories, U.S. universities, and foreign universities and research institutes.
    - The Tevatron complex includes the **Neutrinos at the Main Injector** (NuMI) beamline, the world's highest intensity neutrino beam facility. NuMI provides a controlled beam of neutrinos to the Main Injector Neutrino Oscillation (MINOS) experiment located in the Soudan Mine in Minnesota and the Main Injector Neutrino ν-A (MINERνA) experiment located onsite at Fermilab. The NuMI Off-Axis Neutrino Appearance (NOνA) experiment will upgrade the

beamline and exploit the increased beam power to make further discoveries in neutrino physics. NOνA is under construction and will be in full operation in 2014.

- Fermilab is host laboratory for the U.S. Compact Muon Solenoid (CMS) collaboration, which conducts research using the CMS detector at the LHC. Fermilab manages the program of maintenance and operations for the CMS detector and operates the primary U.S. data analysis center for CMS. Fermilab is also the host laboratory for the LHC Accelerator Research Program which manages U.S. accelerator physicists' efforts on the commissioning, operations, and upgrades of the LHC.
- Fermilab is a leading national laboratory for research and development of future particle accelerator technologies. For example, the large scale infrastructure needed for the fabrication, processing, and testing of superconducting radio frequency cavities and cryomodules is being built at Fermilab. This includes horizontal and vertical test stands for cavity testing, high quality clean rooms and well-equipped rigging areas for assembly of cryomodules. Fermilab is the lead U.S. laboratory coordinating the national R&D program in this area.
- Fermilab also has an active program in particle astrophysics and cosmology. Fermilab is leading the development and fabrication of a camera to be used in the Dark Energy Survey, has significant participation in research on the direct detection of dark matter and ultra high energy cosmic rays, and is doing R&D towards next generation dark energy and dark matter experiments.
- Fermilab also has a significant program for R&D on advanced detector components for a variety of physics applications. The laboratory also maintains and operates a fixed target beam for testing of detector elements that hosts university, national laboratory, and international R&D groups.

- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure at Fermilab. In FY 2011, the SLI program is requesting funding for the Utilities Upgrade project to upgrade outdated industrial cooling water and high voltage electrical systems.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Fermi Site Office

The Fermi Site Office provides the single federal presence with responsibility for contract performance at Fermilab. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Idaho National Laboratory

Idaho National Laboratory (INL) is a multiprogram laboratory located on 572,000 acres in Idaho Falls, Idaho. Within the laboratory complex are nine major applied engineering, interim storage, and research and development facilities.

- **Basic Energy Sciences**: INL supports studies on materials sciences for nuclear fuels and the relationship of microstructure to materials properties.

- **Biological and Environmental Research**: INL is conducting research in subsurface biogeochemical research related to clean up of the nuclear weapons complex with an emphasis on understanding coupled processes affecting contaminant transport.
- **Fusion Energy Sciences**: Research at INL focuses on the safety aspects of magnetic fusion concepts for existing and future machines, such as a burning plasma experiment, and further developing the domestic fusion safety database using existing collaborative arrangements to conduct work on international facilities. In addition, INL has expanded their research and facilities capabilities to include tritium science activities at the Safety and Tritium Applied Research (STAR) national user facility—a small tritium laboratory where the fusion program can conduct tritium material science, chemistry, and safety experiments. INL also coordinates safety codes and standards within the ITER program.
- **Nuclear Physics:** The Advanced Test Reactor is supported for the production of select isotopes for the Isotope Program, such as gadolinium-153, an important isotope for applications such as positron emission tomography imaging.

Lawrence Berkeley National Laboratory

The Lawrence Berkeley National Laboratory (LBNL) is a multiprogram laboratory located in Berkeley, California, on a 200-acre site adjacent to the Berkeley campus of the University of California. The laboratory consists of 106 buildings (1.7 million gross square feet of space). The average age of the buildings is 40 years. LBNL is dedicated to performing leading-edge research in the biological, physical, materials, chemical, energy, and computer sciences. The land is leased from the University of California.

- **Advanced Scientific Computing Research**: LBNL conducts research in applied mathematics and computer science, as well as research in advanced computing software tools. LBNL also participates in several SciDAC science application teams and both SciDAC Centers for Enabling Technologies and SciDAC Institutes that focus on specific software challenges confronting users of petascale computers. LBNL manages the Energy Sciences network (ESnet). ESnet is one of the worlds most effective and progressive science-related computer networks that provides worldwide access and communications to Department of Energy facilities. LBNL is also the site of the National Energy Research Scientific Computing Center (NERSC), which provides a range of high-performance, state-of-the-art computing resources that are a critical element in the success of many SC research programs.
- **Basic Energy Sciences**: LBNL is home to major research efforts in materials sciences with emphasis on nanoscience, chemical sciences, geosciences, biosciences, and solar fuels research. It is also the site of three Basic Energy Sciences supported user facilities—the Advanced Light Source (ALS), the National Center for Electron Microscopy, and the Molecular Foundry.
    - The **Advanced Light Source** provides vacuum-ultraviolet light and x-rays for probing the electronic and magnetic structure of atoms, molecules, and solids, such as those for high-temperature superconductors. The high brightness and coherence of the ALS light are particularly suited for soft x-ray imaging of biological structures, environmental samples, polymers, magnetic nanostructures, and other inhomogeneous materials. Other uses of the ALS include holography, interferometry, and the study of molecules adsorbed on solid surfaces. The pulsed nature of the ALS light offers special opportunities for time resolved research, such as the dynamics of chemical reactions. Shorter wavelength x-rays are also used at structural biology experimental stations for x-ray crystallography and x-ray spectroscopy of proteins and other important biological macromolecules. The ALS User Support Building (USB) will provide high-

quality user support space in sufficient quantity to accommodate the very rapid growth in the number of ALS users and to accommodate projected future expansion of beamlines, instruments, and accelerator upgrades. The USB will contain staging areas for ALS experiments, space for a long beamline that will extend from the floor of the ALS into the USB, and temporary office space for visiting users.

- The **National Center for Electron Microscopy** provides instrumentation for high-resolution, electron-optical microcharacterization of atomic structure and composition of metals, ceramics, semiconductors, superconductors, and magnetic materials. This facility contains the highest resolution electron microscope in the U.S., the Transmission Electron Aberration Corrected Microscope.
- The **Molecular Foundry** provides users with instruments, techniques, and collaborators to enhance the study of the synthesis, characterization, and theory of nanoscale materials. Its focus is on the multidisciplinary development and understanding of both "soft" (biological and polymer) and "hard" (inorganic and microfabricated) nanostructured building blocks and the integration of these building blocks into complex functional assemblies. Scientific themes include inorganic nanostructures; nanofabrication; organic, polymer, and biopolymer nanostructures; biological nanostructures; imaging and manipulation of nanostructures; and theory of nanostructures. The facility offers expertise in a variety of techniques for the study of nanostructures, including electronic structure and excited-state methods, *ab initio* and classical molecular dynamics, quantum transport, and classical and quantum Monte Carlo approaches.

- **Biological and Environmental Research**: LBNL is the lead national laboratory managing the **Joint Genome Institute** (JGI); the principal goal of which is high-throughput genome sequencing and analysis techniques. The laboratory also conducts research on the molecular mechanisms of cell responses to low doses of radiation and on microbial systems biology research as part of Genomic Science. LBNL operates beamlines for determination of protein structure at the ALS for use by the national and international biological research community. The ALS also supports and is used by a growing environmental science community.
  - LBNL supports subsurface biogeochemical research and provides a systems approach to predictively understand subsurface biogeochemical processes impacting metal and radionuclide contaminant transport and remediation in subsurface environments.
  - LBNL conducts research to advance fundamental understanding of DOE-relevant microorganisms and microbial communities using systems biology approaches and analyses at the whole organism level and across multiple spatial and temporal scales.
  - LBNL conducts research on carbon cycling and carbon sequestration on terrestrial ecosystems to understand the processes controlling the exchange of CO_2 between terrestrial ecosystems and the atmosphere. It also conducts research on biological and ecological responses to climatic and atmospheric changes.
  - It also develops scalable implementation technologies that allow widely used climate models to run effectively and efficiently on massively parallel processing supercomputers. LBNL studies and quantifies the risks of abrupt climate change during the 21st century. LBNL is leading a multi-lab activity on Abrupt Climate Change Modeling through a series of linked projects that examine: dynamics of ice shelf-ocean interaction and evaluation of marine ice sheet stability, boreal/Arctic climate positive feedbacks, rapid destabilization of methane hydrates in Arctic

Ocean sediments, and mega-droughts in North America. It leads the task for examining boreal/Arctic feedbacks in this project.

- The **Joint BioEnergy Institute** (JBEI) at LBNL, one of three Genomic Science Bioenergy Research Centers, is focused on model plant systems (*Arabidopsis* and rice) for which the laboratory capabilities are well developed. Early results on their more tractable genomics will be shifted to potential bioenergy feedstock plants. The JBEI is experimenting with *E. coli* and yeast, two workhorse microbes for conversion, as well as the use of ionic liquids for deconstruction of biomass material. JBEI is also investigating biological production of alternatives to ethanol that would be better substitutes for gasoline and diesel.

- **Fusion Energy Sciences**: LBNL has been conducting research in developing ion beams for applications to high energy density laboratory plasmas (HEDLP) and inertial fusion energy sciences. Currently the laboratory has two major experimental systems for doing this research: the Neutralized Drift Compression Experiment (NDCX) and the High Current Experiment. Both experiments are directed at answering the question of how ion beams can be produced with the intensity required for research in HEDLP and inertial fusion energy sciences. LBNL is currently upgrading the Neutralized Drift Compression Experiment from its present configuration to NDCX-II. The NDCX-II facility will advance the science of drift compression of an ion beam to intensify the beam, and enhance the energy on target of the ion beam by a factor of 100. LBNL conducts this research together with the Lawrence Livermore National Laboratory and Princeton Plasma Physics Laboratory through the Heavy Ion Fusion Science Virtual National Laboratory.

- **High Energy Physics**: LBNL has unique capabilities in the areas of superconducting magnet R&D, engineering and detector technology, the design of advanced electronic devices, computational resources, and the design of modern, complex software codes for HEP experiments. LBNL participates in the research of the ATLAS detector at the Large Hadron Collider, and has a leading role in providing the software and computing infrastructure for ATLAS. LBNL physicists are also involved in neutrino physics research using reactor-produced neutrinos, and provide management expertise to the Reactor Neutrino experiment at Daya Bay, China.

  The Laser Optics and Accelerator Systems Integrated Studies group has begun work on the Berkeley Lab Laser Accelerator (BELLA) project whose goal is the development of the 10-GeV laser-wakefield accelerator module using a petawatt laser.

  LBNL also has an active program in particle astrophysics and cosmology, providing leadership in the development of innovative detector technologies and in the application of high energy physics analysis methods to astronomical observations. LBNL physicists lead ongoing studies of dark energy using supernovae and baryon acoustic oscillations, and continues R&D for a space-based dark energy mission. LBNL operates the Microsystems Laboratory where new detector technologies have been developed for collider physics research and new devices to study dark energy and the cosmic microwave background. LBNL is also host to the Particle Data Group, which annually coordinates compilation and synthesis of high-energy physics experimental data into compendia which summarize the status of all major subfields of HEP.

- **Nuclear Physics**: LBNL supports a variety of activities focused primarily on the low energy and heavy ion NP subprograms. These include fabrication of a next-generation gamma-ray detector system, Gamma Ray Energy Tracking In-Beam Nuclear Array (GRETINA); research with the STAR detector located at BNL's RHIC facility; and development of future detector systems for RHIC. Also included are operation of the Parallel Distributed Systems Facility aimed at heavy ion and low energy physics computation; fabrication of a detector upgrade for the A Large Ion Collider

Experiment (ALICE) detector heavy ion program at LHC; research at the KamLAND detector in Japan that is performing neutrino studies. In addition, development and fabrication of next generation neutrino detectors, including leading the effort on U.S. participation in the Cryogenic Underground Observatory for Rare events (CUORE) experiment in Italy; and a theory program with an emphasis on relativistic heavy ion physics are conducted. Data compilation and evaluation activities supporting the National Nuclear Data Center at BNL; and R&D of electron-cyclotron resonance ion sources for the Facility for Rare Isotope Beams are also conducted at LBNL. The 88-Inch Cyclotron at LBNL is a facility for testing electronic circuit components for radiation "hardness" to cosmic rays, supported by the National Reconnaissance Office and the U.S. Air Force, and for a small in-house research program supported by NP.

- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure and the cleanup and removal of excess facilities at LBNL. The SLI program is currently funding the Seismic Life-Safety, Modernization, and Replacement of General Purpose Buildings, Phase II project at LBNL that will replace seismically-poor buildings and trailers with a new general purpose laboratory/office building supporting Life Sciences, seismically upgrading the site-wide Hazardous Waste Handling Facility, and upgrading and modernizing an existing Life Sciences building (Building 74).
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory (LLNL) is a multiprogram laboratory located on 821 acres in Livermore, California. This laboratory was built in Livermore as a weapons laboratory 42 miles from the campus of the University of California at Berkeley to take advantage of the expertise of the university in the physical sciences.

- **Advanced Scientific Computing Research**: LLNL conducts research in applied mathematics and computer science. LLNL also participates in several SciDAC science application teams and both SciDAC Centers for Enabling Technologies and SciDAC Institutes that focus on specific software challenges confronting users of petascale computers.
- **Basic Energy Sciences**: LLNL conducts research in focused areas related to extreme environments and the limits of length and time scales within materials sciences and geosciences.
- **Biological and Environmental Research**: LLNL is one of the major national laboratory partners supporting the Joint Genome Institute (JGI), the principal goal of which is high-throughput genome sequencing and analysis.
    - LLNL conducts research including development of novel technologies to study structure and function of environmental microbial communities.
    - Through the program for Climate Model Diagnosis and Intercomparison, LLNL provides the international leadership to develop and apply diagnostic tools to evaluate and improve the performance of climate models. Virtually every climate modeling center in the world participates in this unique program. It also conducts research to improve understanding of the climate system, particularly the climate effect of clouds and aerosol properties and processes and climate change feedbacks on carbon cycling.

- LLNL is improving model representation of the main processes, clouds, aerosols and the cryosphere, that drive the rapid decrease in Arctic ice cover as well as examining the implications of those decreases on future climate. It also is the task lead for studying the clathrate hypothesis in the LBNL-led multi-laboratory effort on Abrupt Climate Change.
- LLNL also supports the ARM Climate Research Facility through the development and support of data sets designed for modelers.
- LLNL supports subsurface biogeochemistry research on the fate and transport of plutonium and other actinide contaminants in the environment.
- LLNL is a partner in the LBNL-led Joint BioEnergy Institute.

- **Fusion Energy Sciences**: LLNL works with LBNL and PPPL through the Heavy-Ion Fusion Virtual National Laboratory in advancing the physics of heavy ion beams as a driver for high energy density laboratory plasmas and inertial fusion energy sciences. It also conducts research on fast ignition concepts for applications in research on high energy density physics and inertial fusion energy sciences. The LLNL program also includes collaborations with General Atomics on the DIII-D tokamak and benchmarking of fusion physics computer models with experiments such as DIII-D. LLNL carries out research in the simulation of turbulence and its effect on transport of heat and particles in magnetically confined plasmas. In addition, LLNL carries out research in support of plasma chamber and plasma-material interactions.
- **High Energy Physics**: HEP supports experimental physics research and technology R&D at LLNL, using unique capabilities of the laboratory primarily in the areas of engineering and detector technology and advanced accelerator R&D.
- **Nuclear Physics**: The LLNL program supports research in relativistic heavy ion physics as part of the PHENIX collaboration at RHIC and the ALICE experiment at LHC, in nuclear data and compilation activities, in R&D for neutrino-less double beta decay experiments, nuclear structure with radioactive ion beams, research on super heavy nuclei, and in theoretical studies in the areas of nuclear structure studies, low energy nuclear reactions, and lattice QCD.

Los Alamos National Laboratory

Los Alamos National Laboratory (LANL) is a multiprogram laboratory located on 30,413 acres in Los Alamos, New Mexico.

- **Advanced Scientific Computing Research**: LANL conducts research in applied mathematics and computer science and in advanced computing software tools. LANL also participates in several SciDAC science application teams and both SciDAC Centers for Enabling Technologies and SciDAC Institutes, which focus on specific software challenges confronting users of petascale computers.
- **Basic Energy Sciences**: LANL is home to research efforts in materials sciences to control functionality, chemical sciences, and geosciences.

  LANL is also the site of two BES supported user facilities: the Manuel Lujan Jr. Neutron Scattering Center (Lujan Center) and the Center for Integrated Nanotechnologies (CINT).

  - The **Manuel Lujan Jr. Neutron Scattering Center** provides an intense pulsed source of neutrons to a variety of spectrometers for neutron scattering studies. The Lujan Center features instruments for measurement of high-pressure and high-temperature samples, strain measurement, liquid studies, and texture measurement. The facility has extensive experience in

handling actinide samples. The Lujan Center is part of the Los Alamos Neutron Science Center (LANSCE), which is comprised of a high-power 800-MeV proton linear accelerator, a proton storage ring, production targets to the Lujan Center and the Weapons Neutron Research facility, and a variety of associated experiment areas and spectrometers for national security research and civilian research.

- The **Center for Integrated Nanotechnologies** is devoted to establishing the scientific principles that govern the design, performance, and integration of nanoscale materials. Through its core facility in Albuquerque, New Mexico, and its gateways to both Sandia National Laboratories and Los Alamos National Laboratory, CINT provides access to tools and expertise to explore the continuum from scientific discovery to the integration of nanostructures into the microworld and the macroworld. CINT supports five scientific thrusts that serve as synergistic building blocks for integration research: nano-bio-micro interfaces, nanophotonics and nanoelectronics, complex functional nanomaterials, nanomechanics, and theory and simulation.

- **Biological and Environmental Research**: LANL is one of the major national laboratory partners that support the JGI, the principal goal of which is high-throughput genome sequencing and analysis. One of LANL's roles in the JGI involves the production of high quality "finished" DNA sequence.
  - LANL conducts research on the genomic analysis of complex microbial communities from environmental soil samples.
  - Activities in structural biology include the operation of an experimental station for protein crystallography at LANSCE for use by the national biological research community.
  - In support of BER's climate change research, LANL manages the day-to-day operations at the Tropical Western Pacific Atmospheric Radiation Measurement Climate Research Facility (ACRF) site. In addition, LANL manages the deployment and operation of the ACRF mobile facility.
  - LANL also has a crucial role in the development, optimization, and validation of coupled sea ice and oceanic general circulation models and coupling them to atmospheric general circulation models for implementation on massively parallel computers.
  - LANL is improving representation of the main processes, clouds, aerosols and the cryosphere, that drive the rapid decrease in Arctic ice cover as well as examining the implications of those decreases on future climate.
  - LANL leads a SciDAC effort for simulating subsurface biogeochemical processes impacting uranium transport in groundwater using high performance computers and is the task lead for developing ice-sheet models in the LBNL-led multi-laboratory effort on Abrupt Climate Change.

- **Fusion Energy Sciences**: LANL has developed a substantial experimental system for research in magnetized target fusion, an important innovative confinement concept, and a thrust area in magnetized high energy density laboratory plasmas. The laboratory leads research in a high-density, compact plasma configuration called field reversed configuration. LANL supports the creation of computer codes for modeling the stability of magnetically confined plasmas, including tokamaks and innovative confinement concepts. The work also provides theoretical and computational support for the Madison Symmetric Torus experiment, a proof-of-principle experiment in reversed field pinch at the University of Wisconsin in Madison. LANL develops advanced diagnostics for fusion experiments, such as the rotating magnetic field as a current drive mechanism for the Field Reversed Configuration Experiment at the University of Washington in Seattle. The laboratory is also doing

research in inertial electrostatic confinement, another innovative confinement concept. LANL also supports the tritium processing activities needed for ITER.

- **High Energy Physics**: HEP supports theoretical physics research at LANL, using unique capabilities of the laboratory in high-performance computing for advanced simulations.
- **Nuclear Physics**: NP supports a broad program of research at LANL. These activities include a research and development effort in relativistic heavy ions using the PHENIX detector at RHIC and development of next generation instrumentation for RHIC. Research on the quark substructure of the nucleon in experiments at Fermilab and the "spin" structure of nucleons at RHIC using polarized proton beams; measurement of oscillations of anti-neutrinos with the Mini Booster Neutrino Experiment (MiniBooNE) and R&D directed at future studies of the properties of neutrinos are also conducted. Participation in the fabrication of an experiment to search for the electric dipole moment of the neutron, to be located at the Fundamental Neutron Physics Beamline at the Spallation Neutron Source; a modest program of neutron beam research that utilizes beams from the LANSCE facility for fundamental physics measurements are also conducted at LANL. A broad program of theoretical research, nuclear data, and compilation activities as part of the U.S. Nuclear Data program; operations of the Isotope Production Facility, which produces research and commercial isotopes in short supply; and a research and development effort of new isotope production and processing techniques are conducted as well.
    - At LANL, the 100-MeV **Isotope Production Facility (IPF)** produces various radioactive isotopes, including germanium-68 (a calibration source for positron emission tomography PET scanners); strontium-82 (the parent of rubidium-82, used in cardiac PET imaging); and arsenic-73 (used as a biomedical tracer). The IPF is dependent on LANSCE and operates in parallel to LANSCE.

National Renewable Energy Laboratory

The National Renewable Energy Laboratory (NREL) is a program-dedicated laboratory located on 632 acres in Golden, Colorado. NREL's focus is on renewable energy technologies such as photovoltaics and other means of exploiting solar energy. It is the world leader in renewable energy technology development. Since its inception in 1977, NREL's mission is to develop renewable energy and energy efficiency technologies and transfer these technologies to the private sector.

- **Advanced Scientific Computing Research**: NREL participates in SciDAC science application teams including efforts focused on computational nanoscience and computational biology.
- **Basic Energy Sciences**: NREL conducts fundamental research in the chemical sciences, biosciences, and materials sciences, which are primarily devoted to the conversion of solar energy to electricity and fuels.
- **Biological and Environmental Research:** NREL conducts research on the biological production of hydrogen and is a partner in the Oak Ridge National Laboratory-led Genomic Science BioEnergy Science Center.

New Brunswick Laboratory

The New Brunswick Laboratory (NBL), located at the Argonne National Laboratory in Illinois, is a government-owned, government-operated center for analytical chemistry and measurement science of nuclear materials. In this role, NBL performs measurements of the elemental and isotopic compositions for a wide range of nuclear materials. The NBL is the U.S. Government's Nuclear Materials

Measurements and Reference Materials Laboratory and the National Certifying Authority for nuclear reference materials and measurement calibration standards. NBL provides reference materials, measurement and interlaboratory measurement evaluation services, and technical expertise for evaluating measurement methods and safeguards measures in use at other facilities for a variety of Federal program sponsors and customers. The NBL also functions as a Network Laboratory for the International Atomic Energy Agency. The NBL is administered through and is a part of the Chicago Office. NBL consists of one 58 year-old building (85 thousand gross square feet of space).

Oak Ridge Institute for Science and Education

The Oak Ridge Institute for Science and Education (ORISE), operated by Oak Ridge Associated Universities (ORAU), is located on a 179-acre site in Oak Ridge, Tennessee. ORISE has 12 buildings (116 thousand gross square feet of space). The average age of all the buildings is 53 years. Established in 1946, ORAU is a university consortium leveraging the scientific strength of major research institutions to advance science and education by partnering with national laboratories, government agencies, and private industry. ORISE focuses on scientific initiatives to research health risks from occupational hazards, assess environmental cleanup, respond to radiation medical emergencies, support national security and emergency preparedness, and educate the next generation of scientists.

- **Advanced Scientific Computing Research**: ORISE provides administrative support for panel reviews, site reviews, and Advanced Scientific Computing Advisory Committee meetings. It also assists with the administration of topical scientific workshops.
- **Basic Energy Sciences**: ORISE provides administrative support for panel reviews and site reviews. It also assists with the administration of topical scientific workshops and provides administrative support for other activities such as for the reviews of construction projects.
- **Biological and Environmental Research**: ORISE coordinates activities associated with the peer review of research proposals and applications.
- **Fusion Energy Sciences**: ORISE supports the operation of the Fusion Energy Sciences Advisory Committee and administrative aspects of some FES program peer reviews. It also acts as an independent and unbiased agent to administer the FES Graduate and Postgraduate Fellowship programs.
- **High Energy Physics**: ORISE provides support in the area of program planning and review.
- **Nuclear Physics**: ORISE supports the Holifield Radioactive Ion Beam Facility (HRIBF) and its research program through a close collaboration with university researchers using HRIBF. ORISE also provides support to the NP program in the area of merit peer review.
- **Workforce Development:** ORISE manages the DOE-National Science Foundation (NSF) program supporting graduate students to attend the Lindau Meeting of Nobel Laureates.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Oak Ridge National Laboratory

The Oak Ridge National Laboratory (ORNL) is a multiprogram laboratory located on a 21,000-acre reservation at Oak Ridge, Tennessee. The laboratory's 1,100-acre main site on Bethel Valley Road

contains 237 buildings (3.7 million gross square feet of space). The average age of all the buildings is 40 years.

- **Advanced Scientific Computing Research**: ORNL conducts research in applied mathematics and computer science, as well as research in advanced computing software tools. ORNL also participates in several SciDAC science application teams and both SciDAC Centers for Enabling Technologies and SciDAC Institutes that focus on specific software challenges confronting users of petascale computers. The Leadership Computing Facility at ORNL is operating the world's most powerful high performance computer, a two-petaflop Cray Baker system which makes computationally intensive projects of the largest scales possible.
- **Basic Energy Sciences**: ORNL is home to major research efforts in materials and chemical sciences emphasizing fundamental understanding of materials behavior and interfacial phenomena with additional programs in geosciences. It is also the site of four BES supported user facilities—the Spallation Neutron Source (SNS), the High Flux Isotope Reactor (HFIR), Shared Research Equipment User Facility, and the Center for Nanophase Materials Sciences.
  - The **Spallation Neutron Source** is a next-generation short-pulse spallation neutron source for neutron scattering that is significantly more powerful (by about a factor of 10) than any other spallation neutron source in existence. The SNS consists of a linac-ring accelerator system that delivers short (microsecond) proton pulses to a target/moderator system where neutrons are produced by a process called spallation. The neutrons produced are then used for neutron scattering experiments. Specially designed scientific instruments use these pulsed neutron beams for a wide variety of investigations. There is initially one target station that can accommodate 24 instruments; the potential exists for adding more instruments and a second target station.
  - The **High Flux Isotope Reactor** is a light-water cooled and moderated reactor to provide state-of-the-art facilities for neutron scattering, materials irradiation, and neutron activation analysis and is the world's leading source of elements heavier than plutonium for research, medicine, and industrial applications. The neutron scattering experiments at HFIR reveal the structure and dynamics of a wide range of materials. The neutron-scattering instruments installed on the four horizontal beam tubes are used in fundamental studies of materials of interest to solid-state physicists, chemists, biologists, polymer scientists, metallurgists, and colloid scientists. A number of improvements at HFIR have increased its neutron scattering capabilities to 12 state-of-the-art neutron scattering instruments on the world's brightest beams of steady-state neutrons.
  - The **Shared Research Equipment User Facility** makes available state-of-the-art electron beam microcharacterization facilities for a wide diversity of user research focused on atomic scale correlation of structure, chemistry, and properties in a wide range of metallic, ceramic, and other structural materials including characterization of magnetic materials, catalysts, semiconductor device materials, high temperature superconductors, and surface-modified polymers.
  - The **Center for Nanophase Materials Sciences** integrates nanoscale science with neutron science; synthesis science; and theory, modeling, and simulation. Scientific themes include macromolecular complex systems, functional nanomaterials, nanoscale magnetism and transport, catalysis and nano building blocks, and nanofabrication.
- **Biological and Environmental Research**: ORNL has a leadership role in research focused on the ecological aspects of global environmental change. It supports basic research through ecosystem-scale manipulative experiments in the field, laboratory experiments involving model ecosystems exposed to global change factors, and development and testing of computer simulation models

designed to explain and predict effects of climatic change on the structure and functioning of terrestrial ecosystems.

- ORNL is the home of a Free-Air CO_2 Enrichment experiment which facilitates research on terrestrial carbon processes and the development of terrestrial carbon cycle models.
- ORNL, in conjunction with ANL, PNNL, and six universities, plays a principle role in the Carbon Sequestration in Terrestrial Ecosystems consortium which is focusing on research to enhance the capacity, rates, and longevity of carbon sequestration in terrestrial ecosystems.
- ORNL houses the Carbon Dioxide Information Analysis Center and Atmospheric Radiation Measure Climate Research Facility (ACRF) archive, providing data to carbon cycle and atmospheric system research scientists respectively.
- ORNL has an active research program to improve climate predictions and enhance scientific understanding of climate impacts and adaptation opportunities through strengthening the coupling between Earth System Models and Integrated Assessment Models. ORNL scientists provide improvement in formulations and numerical methods necessary to improve climate models.
- ORNL scientists make important contributions to the subsurface biogeochemical research activities, providing special leadership on mercury biogeochemical studies. ORNL also manages a field site for environmental research to advance an understanding and predictive capability of coupled hydrologic, geochemical, and microbiological processes that control the mobility of radionuclides across a range of scales in the environment.
- ORNL is one of the major national laboratory partners that support the JGI, the principal goal of which is high-throughput genome sequencing and analysis. One of ORNL's roles in the JGI involves the annotation (assigning biological functions to genes) of completed genomic sequences.
- ORNL conducts microbial systems biology research as part of Genomic Science.
- The **BioEnergy Science Center** at ORNL, one of three Genomic Science Bioenergy Research Centers, is focusing attention on two prime candidate feedstock plants, the poplar tree and switchgrass, as well as engineering microbes to enable more efficient biomass conversion by combining several steps.

- **Fusion Energy Sciences**: ORNL develops a broad range of components that are critical for improving the research capability of fusion experiments located at other institutions and that are essential for developing fusion as an environmentally acceptable energy source. The laboratory is a leader in fusion materials science, in the theory of heating of plasmas by electromagnetic waves, antenna design, and design and modeling of pellet injectors to fuel the plasma and control the density of plasma particles. The laboratory is also the site of the Controlled Fusion Atomic Data Center and its supporting research programs. ORNL is also a leader in stellarator theory. ORNL hosts the U.S. ITER Project Office and is the lead laboratory managing the U.S. Contributions to ITER major item of equipment project.
- **Nuclear Physics**: NP supports a diverse program of research at ORNL. These activities include: the research, development, and operations of the Holifield Radioactive Ion Beam Facility (HRIBF) that is operated as a national user facility; a relativistic heavy ion group that is involved in a research program using the PHENIX detector at RHIC and ALICE at LHC. The development of and research with the Fundamental Neutron Physics Beamline (FNPB) at the Spallation Neutron Source,

including the lead role of the prime experiment for FNPB, the neutron electric dipole moment experiment MIE; a theoretical nuclear physics effort that emphasizes investigations of nuclear structure and astrophysics; and nuclear data and compilation activities that support the national nuclear data effort are also conducted. In additiona, accelerator core competencies in rare isotope beam development and high power targets; research on the possible existence of super heavy nuclei; R&D efforts in development of next-generation neutrino-less double beta decay experiments; isotope processing capabilities; R&D efforts associated with radioisotope and stable isotope production and processing; and the operations of the National Isotope Data Center are provided for. Enriched stable isotopes are processed at ORNL materials and chemical laboratories and radioactive isotopes are chemically processed and packaged in hot cells in a radiochemical laboratory and the Radiochemical Engineering Development Center.

- The **Holifield Radioactive Ion Beam Facility** is the only radioactive nuclear beam facility in the U.S. to use the Isotope Separator On-Line method and is used annually by about 260 scientists for studies in nuclear structure, dynamics, and astrophysics using radioactive beams. HRIBF accelerates secondary radioactive beams of fission fragments to higher energies (up to 10 MeV per nucleon) than any other facility in the world with a broad selection of ions. HRIBF conducts accelerator R&D on targets and ion sources and low energy ion transport for radioactive beams. The fabrication of a second source and transport beam-line for radioactive ions will improve efficiency and reliability when it begins commissioning in FY 2010.
- The **Fundamental Neutron Physics Beamline** at the Spallation Neutron Source, which is scheduled to be completed in FY 2010, will provide high intensity pulsed beams of cold and ultracold neutrons for fundamental research with neutrons. A new external building as part of the facility will accommodate precision instrumentation to measure the electric dipole moment of the neutron. ORNL staff plays the lead role in the fabrication of the neutron electric dipole moment experiment, which could lead to the discovery of new physics beyond the Standard Model.
- The **National Isotope Data Center** (NIDC) is located at ORNL and is a virtual full service organization that supports all isotope development and production sites in the community supported by NP. NIDC coordinates the production, sales, and distribution of isotopes across the Nation, and the development and coordination of a suite of community outreach efforts.

- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure at ORNL. SLI is currently funding construction of a new chemical and material sciences facility under the Modernization of Laboratory Facilities project. Final funding for this project was provided in FY 2009.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues. Protective force services are provided under a contract with the Oak Ridge Office.

Oak Ridge National Laboratory Site Office

The Oak Ridge National Laboratory Site Office provides the single federal presence with responsibility for contract performance at ORNL. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Oak Ridge Office

The Oak Ridge (OR) Office directly provides corporate support (procurement, legal, financial management, human resources, and facilities and infrastructure) to site offices responsible for program management oversight of four major management and operating laboratories—ORNL, PNNL, SLAC, and TJNAF. The administrative, business, and technical expertise of OR is shared SC-wide through the Integrated Support Center concept. The OR Manager is also the single federal official with responsibility for contract performance at the Oak Ridge Institute for Science and Education (ORISE). The Manager provides on-site presence for ORISE with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations. OR also oversees the OR Reservation and other DOE facilities in the City of Oak Ridge. Together on the Reservation and in the City of Oak Ridge there are 35 buildings (237 thousand square feet). The average age of all the buildings is 50 years.

- **Science Laboratories Infrastructure**: The Oak Ridge Landlord subprogram maintains Oak Ridge Reservation infrastructure such as roads outside plant fences as well as DOE facilities in the town of Oak Ridge, payment in lieu of taxes (PILT), and other needs related to landlord responsibilities.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, protective force officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, and security systems. This program includes funding for SCs only category I, special nuclear materials facility, 3019.

Office of Scientific and Technical Information

The Office of Scientific and Technical Information (OSTI) fulfills the Department's legislative mandate to provide public access to the unclassified results of DOE's research programs. OSTI also collects, protects, and provides secure access to DOE's classified research outcomes. OSTI has built broad collaborations both within the U.S. and internationally to enable a single point of access to nearly 400 million pages of scientific information. Within the U.S., Science.gov offers simultaneous searching of federal science databases and websites, while WorldWideScience.org performs the same functionality across the R&D results of over 50 countries. OSTI consists of one 63 year-old building (135 thousand gross square feet of space).

- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure at OSTI.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL) is a DOE multiprogram laboratory located in Richland, Washington that supports DOE's science, national security, energy, and homeland security missions. PNNL operates the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL)—a 224 thousand square foot national scientific user facility constructed by DOE.

- **Advanced Scientific Computing Research**: PNNL conducts research in applied mathematics and computer science, as well as research in advanced computing software tools. PNNL also participates in several SciDAC science application teams and both SciDAC Centers for Enabling Technologies

and SciDAC Institutes that focus on specific software challenges confronting users of petascale computers.

- **Basic Energy Sciences**: PNNL supports research in interfacial and surface chemistry, inorganic molecular clusters, analytical chemistry, geosciences, and applications of theoretical chemistry. Materials research emphasizes synthesis science, mechanical properties, and radiation effects.
- **Biological and Environmental Research**: PNNL is home to EMSL, a national scientific user facility that provides integrated experimental and computational resource for discovery and technological innovation in the environmental molecular sciences. EMSL provides more than 50 leading-edge instruments and a supercomputer. EMSL enables users to undertake molecular-scale experimental and theoretical research on aerosol chemistry, biological systems, biogeochemistry, and interfacial and surface science.

  PNNL conducts a wide variety of subsurface biogeochemical research, with emphasis on the fate and transport of uranium, technetium, and plutonium. The research focuses on an integrated understanding of the coupled geochemical, microbiological, and hydrological processes that impact contaminant transport across scales in the environment. The research integrated computer modeling with experimentation to advance a predictive understanding of processes impacting contaminant mobility in the environment. PNNL manages two large field sites for integrated, multidisciplinary research on contaminant transport and leads a SciDAC effort to address computational challenges to linking models of biogeochemical processes impacting contaminant mobility at different scales.

  The Atmospheric Radiation Measurement Climate Research Facility (ACRF) technical office is located at PNNL, as is the project manager for the ACRF engineering activity; this provides invaluable logistical, technical, and scientific expertise for the program. The technical office is responsible for the development of new data products, measurement system engineering, and the conduct of aerial and ground-based field campaigns.

  PNNL provides expertise in research on aerosol properties and processes and in field campaigns for atmospheric sampling and analysis of aerosols. PNNL also conducts climate modeling research to improve the simulations of both precipitation through representation of sub-grid orography and the effect of aerosols on climate at regional to global scales. PNNL manages the Atmospheric Radiation Measurement Aerial Facility as well. PNNL also conducts research on improving atmospheric system research methods and models for assessing the costs and benefits of climate change and of various different options for mitigating and/or adapting to such changes. PNNL, in conjunction with ANL, ORNL, and six universities, plays an important role in the Carbon Sequestration in Terrestrial Ecosystems (CSiTE) consortium, focusing on the role of soil microbial processes in carbon sequestration. PNNL also conducts research on the integrated assessment of global climate changes. It also is the task lead for studying mega-droughts in the LBNL-led multi-laboratory effort on Abrupt Climate Change.

  PNNL is one of the major national laboratory partners that support the JGI, the principal goal of which is high-throughput DNA sequencing. One of PNNL's roles in the JGI involves proteomics research (identifying all the proteins found in cells). PNNL conducts research on the molecular mechanisms of cell responses to low doses of radiation and the development of high-throughput approaches for characterizing all of the proteins (the proteome) being expresses by cells under specific environmental conditions. PNNL conducts microbial systems biology research as part of Genomic Science.
- **Fusion Energy Sciences**: PNNL has focused on research on materials that can survive in a fusion neutron environment. Scientists and engineers at PNNL provide leadership in the evaluation of

ceramic matrix composites for fusion applications and support work on ferrite steels as part of the U.S. fusion materials team.

- **Nuclear Physics**: NP supports modest R&D efforts aimed at exploring production mechanisms for isotopes, and for the processing of select isotopes important to the U.S. NP also supports R&D efforts towards a next generation detector to search for neutrinoless double beta decay.
- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure at PNNL. The SLI program is currently funding construction of the new Physical Sciences Facility. Funding for this project was completed in FY 2009.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues. Protective force services are provided under a memorandum of understanding with the Department's Office of Environmental Management.

Pacific Northwest Site Office

The Pacific Northwest Site Office provides the single federal presence with responsibility for contract performance at PNNL. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Princeton Plasma Physics Laboratory

Princeton Plasma Physics Laboratory (PPPL) is a program-dedicated laboratory located on 88 acres in Plainsboro, New Jersey. The laboratory consists of 34 buildings (754 thousand gross square feet of space). The average age of the buildings is 36 years.

- **Advanced Scientific Computing Research**: PPPL participates in SciDAC science application teams related to fusion science.
- **Fusion Energy Sciences**: PPPL is the only DOE laboratory devoted primarily to plasma and fusion science. The laboratory hosts experimental facilities used by multi-institutional research teams and also sends researchers and specialized equipment to other fusion facilities in the United States and abroad. PPPL is the host for the National Spherical Torus Experiment (NSTX), which is an innovative toroidal confinement device, closely related to the tokamak. PPPL scientists and engineers have significant involvement in the DIII-D and Alcator C-Mod tokamaks and the NSF Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas, as well as several large tokamak facilities abroad, including the Joint European Torus in the United Kingdom, and the Korean Superconducting Tokamak Reactor Advanced Research in Korea. Research is focused on developing the scientific understanding and innovations required for an attractive fusion energy source. PPPL is a partner with ORNL in the U.S. Contributions to ITER Project with responsibility for design and fabrication of various plasma diagnostics and ITER's steady-state electric power system. PPPL scientists are also involved in several basic plasma science experiments, ranging from magnetic reconnection to plasma processing. PPPL has a large theory group that does research in the areas of turbulence and transport, equilibrium and stability, wave-plasma interaction, and heavy ion accelerator physics. PPPL, LBNL, and LLNL currently work together in advancing the physics of heavy ion drivers for research in high energy density laboratory plasmas through the Heavy Ion Fusion Science Virtual National Laboratory. Through its association with Princeton University, PPPL provides high quality education in fusion-related sciences, having produced more than 230 Ph.D. graduates since its founding in 1951.

- **High Energy Physics**: HEP supports a small theoretical research effort at PPPL using unique capabilities of the laboratory in the area of advanced accelerator R&D.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Princeton Site Office

The Princeton Site Office provides the single federal presence with responsibility for contract performance at PPPL. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Sandia National Laboratories

Sandia National Laboratories (SNL) is a multiprogram laboratory located on 3,700 acres in Albuquerque, New Mexico, with additional sites in Livermore, California and Tonopah, Nevada.

- **Advanced Scientific Computing Research**: SNL conducts research in applied mathematics and computer science, as well as research in advanced computing software tools. SNL also participates in several SciDAC science application teams and both SciDAC Centers for Enabling Technologies and SciDAC Institutes, which focus on specific software challenges confronting users of petascale computers.
- **Basic Energy Sciences**: SNL is home to significant research efforts in materials and chemical sciences with additional programs in geosciences. SNL has a historic emphasis on electronic components needed for the Office of Defense Programs. The laboratory has very modern facilities in which unusual microcircuits and structures can be fabricated out of various semiconductors. It is also the site of the Center for Integrated Nanotechnologies (CINT).
    - The **Center for Integrated Nanotechnologies** is devoted to establishing the scientific principles that govern the design, performance, and integration of nanoscale materials. Through its core facility in Albuquerque, New Mexico, and its gateways to both SNL and LANL, CINT provides access to tools and expertise to explore the continuum from scientific discovery to the integration of nanostructures into the microworld and the macroworld. CINT supports five scientific thrusts that serve as synergistic building blocks for integration research: nano-bio-micro interfaces, nanophotonics and nanoelectronics, complex functional nanomaterials, nanomechanics, and theory and simulation.
- **Biological and Environmental Research**: In support of BER's climate change research, SNL provides the site manager for the North Slope of Alaska ACRF site, who is responsible for day-to-day operations at that site. In addition, SNL conducts climate modeling research on modifying the Community Atmospheric Model to support new dynamical cores and improve its scalability for implementation on high-system computing systems. SNL is a partner in the LBNL-led Joint BioEnergy Institute.
- **Fusion Energy Sciences**: SNL plays a lead role in developing components for fusion devices through the study of plasma interactions with materials, the behavior of materials exposed to high heat fluxes, and the interface of plasmas and the walls of fusion devices. Material samples and prototypes are tested in SNL's Plasma Materials Test Facility, which uses high-power electron beams to simulate the high heat fluxes expected in fusion environments. Materials and components are

exposed to tritium-containing plasmas in the Tritium Plasma Experiment located in the STAR facility at INL. Sandia supports a wide variety of domestic and international experiments in the areas of tritium inventory removal, materials postmortem analysis, diagnostics development, and component design and testing. SNL serves an important role in the design and analysis activities related to the ITER first wall components, including related R&D.

Savannah River National Laboratory

The Savannah River National Laboratory (SRNL) is a multiprogram laboratory located on approximately 34 acres in Aiken, South Carolina. SRNL provides scientific and technical support for the site's missions, working in partnership with the site's operating divisions. The laboratory is a partner with ORNL in the U.S. Contributions to ITER Project with responsibility for design and fabrication of ITER's tokamak exhaust processing system.

- **Biological and Environmental Research**: SRNL scientists support environmental remediation sciences research program in the area of subsurface contaminant fate and transport.

SLAC National Accelerator Laboratory

The SLAC National Accelerator Laboratory is located on 426 acres of Stanford University land in Menlo Park, California. SLAC is a multipurpose laboratory for photon science, accelerator and particle physics research and astrophysics. SLAC operates the final third of its two mile linear accelerator for the Linac Coherent Light Source (LCLS). SLAC consists of 161 buildings (1.9 million gross square feet of space). The average age of all the buildings is 30 years.

- **Basic Energy Sciences**: SLAC is home to research activities in materials and chemical sciences that build on ultrafast and advanced synchrotron techniques and include an emphasis on materials for energy. It is the site of two user facilities—the Linac Coherent Light Source (LCLS) and the Stanford Synchrotron Radiation Light source (SSRL).
    - The **Linac Coherent Light Source** is a user facility that provides 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. The SLAC linac will provide high-current, low-emittance 5–15-GeV electron bunches at a 120 hertz repetition rate. A long undulator bunches the electrons and leads to self-amplification of the emitted x-ray radiation at the LCLS, which constitutes the world's first free electron laser user facility producing short pulses (from a few to 200 femtoseconds long) in the hard and soft x-ray regions. The x-ray laser light is utilized at several instruments located at six hutches to perform experiments in many areas of physics, chemistry, and biology.
- The **Stanford Synchrotron Radiation Light Source** is a DOE user facility for researchers from industry, government laboratories, and universities. These include astronomers, biologists, chemical engineers, chemists, electrical engineers, environmental scientists, geologists, materials scientists, and physicists. A research program is conducted at SSRL with emphasis in both the x-ray and ultraviolet regions of the spectrum. SSRL scientists are experts in photoemission studies of high-temperature superconductors and in x-ray scattering. The SPEAR 3 upgrade at SSRL provided major improvements that increase the brightness of the ring for all experimental stations. **Advanced Scientific Computing Research**: SLAC participates in SciDAC science application teams relevant to physics research, accelerator modeling, and distributed data.
- **Biological and Environmental Research**: SLAC operates nine SSRL beamlines for structural molecular biology. This program involves synchrotron radiation-based research and technology

developments in structural molecular biology that focus on protein crystallography, x-ray small angle scattering diffraction, and x-ray absorption spectroscopy for determining the structures of complex proteins of many biological consequences. Beamlines at SSRL also support a environmental science user community.

SLAC also investigates the fundamental molecular scale mechanisms controlling the stability and fate of metal and radionuclide contaminants in the subsurface at DOE sites.

- **High Energy Physics**: From 1999 to 2008, SLAC operated the **B-factory,** consisting of PEP-II, a high energy asymmetric electron-positron collider, and BaBar, a multi-purpose detector, for high-precision studies of CP symmetry violation in the B meson system. The BaBar collaboration is engaged in the analysis of the full data set collected at the B-factory over its nine years of operations. High precision results on CP violation, the parameters of the Standard Model, and the masses and properties of new heavy quark states are being accumulated and published. Ramp-down and decommissioning and decontamination activities started in FY 2009 and will continue for a number of years.

  SLAC participates in the research program of the ATLAS detector at the LHC, and is also working at the Cosmic Frontier of particle astrophysics. SLAC led construction of the primary instrument for the Fermi Gamma-ray Space Telescope (FGST) which was launched into earth orbit in 2008, and is home to the data operations center that manages the scientific data collection from the satellite. SLAC physicists and a user community will analyze the FGST data for several years. SLAC is leading the R&D for a camera to be used in the proposed Large Synoptic Survey Telescope, which is a next-generation ground-based dark energy experiment. SLAC and Stanford University are also home to the Kavli Institute for Particle Astrophysics and Cosmology, which brings together researchers studying a broad range of fundamental questions about the universe, from theoretical astrophysics to dark matter and dark energy. HEP supports research at Kavli aimed primarily at exploring astrophysical phenomena to test new ideas in particle physics.

  SLAC is a major contributor to the leadership and development of advanced accelerator technologies. The laboratory is at the forefront of damping ring and beam delivery designs, required to ensure the beam brightness and precision control needed for future accelerators. SLAC also represents the center of expertise for design, fabrication, and testing of radio frequency power systems used to energize the accelerator components. The laboratory also participates in R&D for advanced detector technologies, with emphasis on software, simulation, and electronics.

- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure and remove excess facilities at SLAC. The SLI program is currently funding the Research Support Building and Infrastructure Modernization project at SLAC to replace substandard modular buildings and trailers that are well beyond their intended useful life, and to modernize key existing buildings onsite.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

SLAC Site Office

The SLAC Site Office provides the single federal presence with responsibility for contract performance at SLAC. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Thomas Jefferson National Accelerator Facility

Thomas Jefferson National Accelerator Facility (TJNAF) is a Nuclear Physics program-dedicated laboratory located on 206 acres in Newport News, Virginia, focused on the exploration of nuclear and nucleon structure. The laboratory consists of 63 buildings (685 thousand gross square feet of space). The average age of the buildings is 18 years.

- **Advanced Scientific Computing Research**: TJNAF participates in SciDAC science application teams relevant to physics research, accelerator modeling, and distributed data.
- **Biological and Environmental Research**: BER supports the development of advanced imaging instrumentation at TJNAF that will ultimately be used in the next generation biological imaging systems.
- **High Energy Physics**: HEP supports an R&D effort at TJNAF on accelerator technology, using the unique expertise of the laboratory in the area of superconducting radiofrequency systems for particle acceleration.
- **Nuclear Physics**: The centerpiece of TJNAF is the **Continuous Electron Beam Accelerator Facility** (CEBAF), a unique international electron-beam user facility for the investigation of nuclear and nucleon structure based on the underlying quark substructure. The facility has an international user community of about 1,430 researchers. Polarized electron beams with energies of up to 5.7 GeV can be provided by CEBAF simultaneously to three different experimental halls. Hall A is designed for spectroscopy and few-body measurements. Hall B has a large acceptance detector, CLAS, for detecting multiple charged particles coming from a scattering reaction. Hall C is designed for flexibility to incorporate a wide variety of different experiments. Its core equipment consists of two medium resolution spectrometers for detecting high momentum or unstable particles. Also in Hall C, a new detector, Q-weak, is being fabricated to measure the weak charge of the proton by a collaboration of laboratory and university groups, in partnership with the NSF. TJNAF supports a group that does theoretical calculations and investigations in subjects supporting the experimental research programs in medium energy physics. TJNAF research and engineering staff are world experts in superconducting radiofrequency accelerator technology. Their expertise is being used in the construction of the 12 GeV CEBAF Upgrade Project, which started construction in FY 2009 and received funding to mitigate project risks under the Recovery Act. In addition to upgraded capability at the existing Halls A, B, and C, the project will construct a new Hall D, and will provide researchers with the opportunity to study quark confinement, one of the greatest mysteries of modern physics.
- **Science Laboratories Infrastructure**: SLI funds line item construction to maintain the general purpose infrastructure and remove excess facilities at TJNAF. The SLI program currently funds two projects at TJNAF. The first is the Technology and Engineering Development Facility project that will construct new industrial assembly, laboratory, and office space, and renovate existing space in the Test Lab Building. The second, the Utility Infrastructure Modernization project, will upgrade the power distribution, cooling water, and communications systems.
- **Safeguards and Security**: This program provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the Safeguards and Security program addresses the full range of cyber, personnel security, security systems, and material control and accountability issues.

Thomas Jefferson Site Office

The Thomas Jefferson Site Office provides the single federal presence with responsibility for contract performance at TJNAF. This site office provides an on-site SC presence with authority encompassing contract management, program and project implementation, federal stewardship, and internal operations.

Washington Headquarters

SC Headquarters, located in the Washington, D.C. area, is responsible for the Federal funds awarded to about 300 universities, all 17 DOE national laboratories, and private research institutions. HQ Program and Project Managers are responsible for scientific program development and management across a broad spectrum of scientific disciplines and program offices, as well as oversight of the design, construction, and operation of large-scale scientific user facilities at laboratories and universities. Program management and oversight includes regular rigorous evaluation of research programs, facilities, and projects by external peer review. Additional HQ policy, technical, and administrative support staff are responsible for budget and planning; general administration; information technology; infrastructure management; construction management; safeguards and security; and environment, safety, and health within the framework set by the Department.

Waste Isolation Pilot Plant

The Waste Isolation Pilot Plant is a deep geologic repository for the permanent disposal of radioactive waste and is located in Eddy County in southeastern New Mexico, 26 miles southeast of Carlsbad.