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 49 passenger motor vehicles for replacement only, including one ambulance and one bus, $5,416,114,000, to remain available until expended.

Office of Science

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2010 Current Appropriation	FY 2011 Continuing Resolution	FY 2012 Request
Office of Science			
Advanced Scientific Computing Research	383,199		465,600
Basic Energy Sciences	1,598,968		1,985,000
Biological and Environmental Research	588,031		717,900
Fusion Energy Sciences	417,650		399,700
High Energy Physics	790,811		797,200
Nuclear Physics	522,460		605,300
Workforce Development for Teachers and Scientists	20,678		35,600
Science Laboratories Infrastructure	127,600		111,800
Safeguards and Security	83,000		83,900
Science Program Direction	189,377		216,863
Small Business Innovation Research (SBIR)/ Small Business Technology Transfer (STTR) (SC funding)	107,352[a]		0
Subtotal, Office of Science	4,829,126		5,418,863
Congressionally directed projects	74,737		0
SBIR/STTR (Other DOE funding)	60,177[b]		0
Use of prior year balances	-153		-2,749
Total, Science Appropriation	4,963,887	4,903,710[c]	5,416,114

Preface

The FY 2012 budget request supports the Administration's *Strategy for American Innovation*, and is consistent with the goal of doubling funding at key basic research agencies, including the Office of Science. The FY 2012 Office of Science budget request supports the following objectives from the *Strategy*, including:

- Unleash a clean energy revolution
- Strengthen and broaden American leadership in fundamental research

[a] Reflects funding reprogrammed within the Science total to support the SBIR and STTR programs.
[b] Reflects funding transferred from other DOE appropriation accounts to support the SBIR and STTR programs.
[c] The FY 2011 Continuing Resolution (CR) column reflects a funding level for the P.L. 111–322 CR through March 4, 2011, annualized to cover a full year. Funding is equal to the FY 2010 appropriation level prior to transfers into the SBIR and STTR programs.

- Develop an advanced information technology ecosystem
- Educate the next generation with 21st century skills and create a world-class workforce

The Office of Science has long been a leader of U.S. scientific discovery and innovation. Over the decades, Office of Science investments have driven the modern biotechnology revolution and the transition in the 20th century from observational science to the science of control and directed design at the nanoscale. We have pushed the frontiers of our understanding of the origins of matter and the universe, and built and operated the large-scale scientific facilities that collectively form a major pillar of the current U.S. scientific enterprise. These investments and accomplishments have led to new technologies and created new businesses and industries, making significant contributions to our Nation's economy and quality of life.

In FY 2012, the Office of Science continues to support fundamental research for scientific discovery, and today our country needs to move strongly to solve our energy problems. Therefore, the central theme of this year's budget is research directed at approaches to creating new technologies for a clean energy future that address competing demands on our environment. These efforts, coordinated with the DOE technology programs and with input from the scientific community and industry, will emphasize research underpinning advances in non-carbon emitting energy sources, carbon capture and sequestration, transportation and fuel switching, transmission and energy storage, end-use efficiency, and critical materials for energy applications.

In the area of advancing non-carbon energy sources, the FY 2012 budget request will provide for new investments in the science of interfaces and degradation relevant to solar photovoltaics, basic actinide chemistry research relevant to advanced nuclear fuel cycles, and research in materials under extreme environments relevant to extreme nuclear technology environments. Carbon capture and sequestration research will focus on novel molecular design for materials and multiscale dynamics of flow and plume migration, respectively. The Office of Science will initiate an energy systems simulation research effort focused on predictive modeling of combustion in an evolving fuel environment in support of the Department's efforts in transportation and alternative fuels, as well as genomics-based research on biological design principles and synthetic biology tools to underpin bio-based energy solutions. Also underpinning transportation and fuel switching, as well as energy storage, the FY 2012 request will support an Energy Innovation Hub for Batteries and Energy Storage. Research in enabling materials sciences will support needs of future electricity transmission systems and novel building materials to improve building efficiencies.

The FY 2012 budget request also provides for foundational science in condensed matter and materials physics, chemistry, biology, climate and environmental sciences, applied mathematics, computational and computer science, high energy physics, nuclear physics, plasma physics, and fusion energy sciences; and provides for research facilities and capabilities that keep U.S. researchers at the forefront of science. FY 2012 request supports targeted increases in areas such as computational materials and chemistry by design, nanoelectronics, and advanced scientific applications and integrated application-hardware-software co-design for exascale, which position the U.S. to secure a competitive advantage in high-tech industries and maintain international leadership in scientific computing. Underlying these investments is the education and training of thousands of scientists and engineers who contribute to the skilled scientific workforce needed for the 21st century innovation economy.

Mission

The Office of Science mission 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 and advances national goals by supporting:

- *The Frontiers of Science*, 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;
- *Energy and Environmental Science*, 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
- *The 21st Century Tools of Science*, national scientific user facilities 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.

Program Overview

The Office of Science is the largest federal sponsor of basic research in the physical sciences, supporting about 27,000 investigators at about 300 U.S. academic institutions and at all of the DOE laboratories. The Office of Science also provides the Nation's researchers with state-of-the-art user facilities—the large machines of modern science. These facilities offer capabilities unmatched anywhere in the world and enable U.S. researchers and industries to remain at the forefront of science, technology, and innovation. About 26,000 researchers from universities, national laboratories, industry, and international partners are expected to use the Office of Science scientific user facilities in FY 2012.

The Office of Science is responsible for the oversight of ten 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), Basic Energy Sciences (BES), Biological and Environmental Research (BER), 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).

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. Today, advances in mathematics and computing are providing the foundation for models and simulations that permit scientists to gain new insights into problems ranging from bioenergy and climate change to exploring the inner workings of a supernova. 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 forefront high performance computing systems and networks. A particular challenge of this program is fulfilling the science potential of emerging computing systems and other novel computing architectures. Delivering on the promise of exascale computing will require significant modifications to today's tools and techniques. The FY 2012 ASCR budget focuses on coordinated efforts to address the fundamental changes taking place in the computing industry to deliver hybrid, multi-core computing systems up to the exascale: positioning the U.S. to maintain international leadership in scientific computing and simulation over the next decade. In FY 2012, ASCR supports

new co-design research efforts in Computational Partnerships; these efforts are aimed at developing applications capable of utilizing multi-petaflop resources while influencing the development of exascale resources to ensure these systems meet the demands of science and engineering applications. New research efforts will also be supported in key application areas in energy, environment, and national security. The FY 2012 request supports continued operations of the Oak Ridge Leadership Computing Facility, one of the world's most powerful computers at 2.33 petaflops, and the Argonne Leadership Computing Facility, which will be upgraded in FY 2012 to the next generation IBM Blue Gene/Q, with peak capability of approximately 10 petaflops. The National Energy Research Scientific Computing (NERSC) facility at Lawrence Berkeley National Laboratory will provide a total capacity of just over one petaflop. The Energy Sciences network (ESnet) will begin to deliver 100–400 gigabit per second connections among the Office of Science laboratories in FY 2012.

The *Basic Energy Sciences* program supports fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support the DOE mission in energy, environment, and national security. 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 provide researchers unique tools to advance a wide range of sciences. These large-scale user facilities consist of a complementary set of intense x-ray sources, neutron scattering centers, electron beam characterization capabilities, and research centers for nanoscale science to probe materials in space, time, and energy with the appropriate resolutions that can interrogate the inner workings of matter to answer some of the most challenging science questions. In FY 2012, BES will expand basic research efforts in focused areas that underpin advances in non-carbon emitting energy sources, carbon capture and sequestration, transportation and fuel switching, transmission and energy storage, efficiency, and critical materials for energy applications, aligned with the President's commitment to clean energy R&D. BES will also support two interagency coordinated initiatives—computational materials and chemistry by design and nanoelectronics. In FY 2012, BES continues support for the Energy Frontier Research Centers initiated in FY 2009 and the Fuels from Sunlight Hub initiated in FY 2010, and will initiate a new Hub on Batteries and Energy Storage. Construction of the National Synchrotron Light Source II (NSLS-II) at Brookhaven National Laboratory continues in FY 2012 and will be fully supported. In addition to supporting the continuation of two ongoing major item of equipment (MIE) projects at the Spallation Neutron Source, BES will initiate three new MIEs in FY 2012—the NSLS-II Experimental Tool project; the Advanced Photon Source Upgrade; and the Linac Coherent Light Source Expansion (LCLS-II) to improve the x-ray spectral range of the LCLS and expand the experimental capacity.

The *Biological and Environmental Research* program supports fundamental research focused on three scientific drivers: exploring the frontiers of genome-enabled biology; discovering the physical, chemical, and biological drivers and environmental impacts of climate change; and seeking the geological, hydrological, and biological 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 critical 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. BER's 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 2012, increased funding will support new research to identify, characterize, and articulate general biological design principles, and for the development of new synthetic molecular toolkits improved understanding of natural systems in order to predict, design, construct, and test new, multiscale natural and hybrid biological systems for clean energy and environmental solutions. Support continues for the three DOE Bioenergy Research Centers and for the Joint Genome Institute, which will support grand challenge projects related to large scale genome comparisons in soil environments and plant-microbe associations. In FY 2012, BER will expand its arctic climate research activities, including developing new observation capabilities for clouds, aerosols, and the terrestrial carbon cycle in this globally important and climatically sensitive region, which will support existing BER atmospheric process studies and modeling activities for evaluating and improving climate simulations. A new Atmospheric Radiation Measurement Climate Research Facility (ARM) fixed site will be developed in the Azores to provide critical long-term observations for marine clouds and aerosols. The Environmental Molecular Sciences Laboratory (EMSL) equipment refresh will continue to keep EMSL at the state of the art, including enhancement of leading capabilities in proteomics and advanced magnetic resonance.

The *Fusion Energy Sciences* program supports research to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation needed to develop a fusion energy source. This is accomplished by studying plasma and its interactions with its surroundings across wide ranges of temperature and density, developing advanced diagnostics to make detailed measurements of its properties, and creating theoretical and computational models to resolve the essential physics principles. FES is the primary supporter of U.S. research in the field of plasma 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 2012 budget request funds the U.S. Contributions to the ITER project, including research and development of key components, long-lead procurements, and personnel and funds 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. FES provides a modest increase in FY 2012 for materials research related to near-term and longer term fusion devices and for U.S. participation in magnetic fusion research overseas to leverage international investments in unique facilities. 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 towards understanding how the universe works at its most fundamental level. This understanding is gained 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. HEP supports research focused on three scientific frontiers: the Energy Frontier, the Intensity Frontier, and the Cosmic Frontier. 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 Fermilab completes its planned program. In FY 2012, HEP will support the analysis needs of researchers to exploit the data obtained from the Tevatron's record-breaking performance over the past few years. Support for Large Hadron Collider (LHC) detector

operations, maintenance, computing, and R&D continues in FY 2012 in order to maintain a significant U.S. role in the LHC program. The Neutrinos at the Main Injector (NuMI) beamline at Fermilab will operate in its current configuration through mid-FY 2012 for ongoing experiments before a year-long beam power upgrade begins for the NuMI Off-Axis Neutrino Appearance (NOvA) experiment. In FY 2012, HEP will support project engineering and design for the Long Baseline Neutrino Experiment (LBNE) and the Muon to Electron (Mu2e) experiment that will use the NuMI beam and other auxiliary beamlines before the end of the next decade. Several projects to pursue questions in dark matter, dark energy, and neutrino properties continue in FY 2012, including endeavors with the National Science Foundation (such as VERITAS, Auger, DES, BOSS, and CDMS) and the National Aeronautics and Space Administration (Fermi Gamma-ray Space Telescope and AMS). In FY 2012, funding is requested for R&D and conceptual design efforts in support of new dark energy and dark matter experiments, in collaboration with other agencies. HEP also continues support for advanced accelerator and detector R&D to foster world-leading research in physics of particle beams and particle detection necessary for continued progress in high energy physics.

The *Nuclear Physics* program supports research to discover, explore, and understand all forms of nuclear matter. NP is the largest federal sponsor of basic research in nuclear science, supporting experimental and theoretical research—along with the development and operation of particle accelerators and advanced technologies—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. The program also supports basic research to advance important nuclear science applications, the development of advanced instrumentation and accelerator technology, and analytical and computational techniques that are needed for nuclear science research. The FY 2012 request includes investments in forefront facilities for new research capability, including the construction of the Continuous Electron Beam Accelerator Facility (CEBAF) 12 GeV Upgrade project and the continued engineering and design and long-lead procurements for the Facility for Rare Isotope Beams (FRIB). The request provides for near optimal levels of operations at three NP scientific user facilities: CEBAF, the Relativistic Heavy Ion Collider (RHIC), and the Argonne Tandem Linac Accelerator System (ATLAS); and supports funding for several ongoing MIE projects that address compelling scientific opportunities. NP also provides stewardship of isotope production, and the Isotope Development and Production for Research Applications program will continue focus on production of isotopes needed by stakeholders and research isotope priorities identified by the community. Funding is provided, along with support from HEP, to maintain options for the far detector for the Long Baseline Neutrino Experiment.

The *Workforce Development for Teachers and Scientists* program supports a range of activities for students and educators in science, technology, engineering, and mathematics (STEM) that help develop the skilled scientific workforce needed for the Office of Science mission and the Nation. WDTS programs focus on graduate research fellowships, undergraduate research internship programs that place students in world class research environments at the DOE laboratories, professional development opportunities for STEM educators, and a Nation-wide competition at the middle school and high school levels, the National Science Bowl®. In FY 2012, WDTS will support a new cohort of graduate fellows and increased participation in the undergraduate research internship programs. In response to the recommendation from the 2010 Committee of Visitors' review, the DOE Academies Creating Teacher Scientists and Pre-Service Teachers programs are discontinued in FY 2012 as WDTS reevaluates effective mechanisms of STEM teacher training.

The *Science Laboratories Infrastructure* program's focus is to ensure the continued mission readiness of Office of Science laboratories and facilities to maintain the capability of those assets to enable delivery of each laboratory's and facility's assigned scientific mission. 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, the Office of Science is ensuring its 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 the deferred maintenance backlog thereby improving the overall asset condition index across Office of Science laboratories.

American Recovery and Reinvestment Act

The Office of Science received $1,669,248,000 under the American Recovery and Reinvestment Act of 2009 (Recovery Act). 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. The Office of Science successfully obligated of its Recovery Act funds before the funds expired on September 31, 2010. Additionally, the Office of Science met its goal of costing 50 percent of Recovery Act funds by the end of calendar year 2010. 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/).

Office of Science Early Career Research Program

The Office of Science Early Career Research Program supports the development of individual research programs of outstanding scientists early in their careers and stimulates research careers in the areas supported by the Office of Science. This program provides competitively selected five-year research awards to researchers who have received a Ph.D. within the past ten years and who are untenured tenure-track assistant or associate 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 an annual program announcement. 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*.

Awards are based on merit review by external experts. FY 2010 was the first year of this program, with support for 69 research awards provided mostly through Recovery Act funds. The FY 2010 award abstracts can be found at http://science.doe.gov/SC-2/early_career.htm. In FY 2012, the Office of Science will support additional early career research awards. Those Office of Science program offices with similar early career research award programs prior to FY 2010, such as the Outstanding Junior

Investigator awards programs, are gradually integrating these programs into the Office of Science Early Career Research Program.

High-Risk, High-Reward Research[a]

The need for fundamental scientific and technological breakthroughs to accomplish DOE mission goals requires that the Office of Science support high-risk, high-reward research ideas that challenge current thinking yet are scientifically sound. The Office of Science programs incorporate high-risk, high-reward basic research elements in all of its research portfolios; each Office of Science research program considers a significant proportion of its supported research as high-risk, high-reward. 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.

The Office of Science's basic research is integrated within program portfolios, projects, and individual awards; as such, it is not possible to quantitatively separate the funding contributions of particular experiments or theoretical studies that are high-risk, high-reward from other mission-driven research in a manner that is credible and auditable. The Office of Science focuses on cultivating and improving the program management practices and policies that foster support for this aspect of its research portfolio. 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.

Likewise, several mechanisms are used by the Office of Science to identify and develop "high-reward" research topics, including Federal advisory committees, program and topical workshops, interagency working groups, National Academy 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: *Research at the Intersection of the Physical and Life Sciences*, by the National Academies (2010); *New Worlds, New Horizons in Astronomy and Astrophysics,* the astronomy and astrophysics decadal survey (Astro2010 report), by the National Research Council; *Next-Generation Photon Sources for Grand Challenges in Science Energy*, by the Basic Energy Sciences Advisory Committee (2009); *Accelerators for Americas Future* workshop report (2009); *Advancing the Science of High Energy Density Laboratory Plasmas* by the Fusion Energy Sciences Advisory Committee (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 the Nuclear Sciences Advisory Committee (2007).

In 2011, the Office of Science will work with other Federal agencies to identify best practices for encouraging and supporting high-risk, high-reward basic research.

[a] In compliance with the reporting requirements in the America COMPETES Act of 2007 (P.L. 110–69, section 1008).

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 conducted by the science and technology communities (e.g., national laboratories, universities, and private companies) that support the DOE mission. The Department's efforts have focused on improving communication and collaboration between federal program managers and increasing opportunities for collaborative efforts among researchers 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 enhanced through activities such as joint planning meetings and technical community workshops, joint annual contractor/awardee meetings, joint research solicitations, 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 are also means by which the Department facilitates greater communication and research integration within the basic and applied research communities. Specific collaborative activities are highlighted in the "Basic and Applied R&D Coordination" sections of each individual Office of Science program budget justification narrative.

Energy Innovation Hubs

The Office of Science oversees one of the three existing DOE Energy Innovation Hubs. The Hubs—large, multi-disciplinary, highly-collaborative teams of scientists and engineers working over a longer time frame to achieve a specific high priority goal—are built to accelerate the pace of scientific discovery and technology development; each is managed by a scientist-leader with the authority to assess results quickly and redirect funding within the Hub. The Hubs are designed to be large-scale efforts; funding over five years enables each Hub to mount R&D assaults on the scale required to make rapid progress towards development of transformative energy technology.

The Department's first three Energy Innovation Hubs, awarded in FY 2010, are tackling several challenges. The Office of Science's Fuels from Sunlight Hub is focused on developing the scientific knowledge and engineering tools to derive fuels directly from sunlight efficiently and economically. The mission of this Hub is to demonstrate a scalable and cost-effective solar fuels generator that, without use of wires or rare materials robustly produces fuel from the sun 10 times more efficiently than typical current crops. The Hub's integrated systems approach to the artificial photosynthesis challenge will consistently drive efforts towards the practical assembly and scale-up of these components to a working prototype. The Office of Nuclear Energy's Energy Innovation Hub for Modeling and Simulation is using modeling and simulation technologies to make leaps forward in nuclear reactor design and engineering. The Office of Energy Efficiency and Renewable Energy's Energy Efficient Building Systems Hub is working to develop and demonstrate highly efficient building components, systems, and models that are applicable to both retrofit and new construction.

The Department expects each Hub to become the unquestioned locus of scientific expertise in its given 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. Additional information on the Hubs can be found at http://www.energy.gov/hubs/index.htm.

In FY 2012, the Office of Science will initiate a Hub on Batteries and Energy Storage based on the same open, competitive award process used for the first three Hubs. The objective of this Hub is to develop electrochemical energy storage systems that will safely approach theoretical energy and power density

limits, while also achieving very high cycle life. The Hub will result in new materials, systems, and knowledge that will be critical to developing a robust industrial base leading to the next generation of energy storage technology. Additional information on the Batteries and Energy Storage Hub is found in the Basic Energy Sciences detailed budget justification.

Isotope Development, Production, and Research

Isotope production at the Department of Energy is primarily the responsibility of the Office of Science with three exceptions: plutonium-238 production by the Office of Nuclear Energy (NE), helium-3 production by NNSA, 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 the Office of Science's Nuclear Physics program offers more than 120 stable and radioactive isotopes for use in basic research and in medical diagnostics and 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 below cost. The Isotope program works in close collaboration with other federal agencies and the isotope-using communities to develop priorities for production. In April 2009, the Nuclear Science Advisory Committee issued its report establishing priorities for the production of research isotopes. A long-term strategic plan for the program came out in November 2009. Both reports were developed with federal, commercial, and research community input. The Isotope program has recently broadened its suite of production facilities to include university and other federal sites to optimize the availability of isotopes.

For nearly 50 years, NE's Space and Defense Power Systems program has been responsible for the design, development, production, and safe deployment 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 with NASA to re-establish domestic plutonium-238 production in order to assure continued availability of these power systems.

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.

Molybdenum-99, or Mo-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 Mo-99. As part of its nuclear nonproliferation mission, and in light of the current Mo-99 supply shortage, GTRI is working to accelerate the establishment of commercial Mo-99 production in the United States, without the use of HEU. GTRI is implementing projects to demonstrate the viability of non-HEU based technologies for large-scale commercial Mo-99 production, including accelerator technology, low-enriched uranium (LEU) target technology, LEU solution reactor technology, and neutron capture technology.

Scientific Workforce

The Office of Science (and its predecessors) has an over 50-year history in supporting the education and training of the skilled scientific workforce needed to tackle some of our Nation's most important societal challenges. Through its six research programs, the Office of Science supports the training of

undergraduates, graduate students, and postdoctoral researchers as an integral part of the ongoing sponsored research activities at universities and the 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 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, which complement the activities supported within the Workforce Development for Teachers and Scientists program, provide opportunities that 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 a leader in science and innovation.

Undergraduate activities include short 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; and summer graduate research internships in targeted areas such as genomic science, radiochemistry, accelerator physics, and nuclear physics. Opportunities directed towards K–12 educators, carried out primarily through the DOE national laboratories, 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.

Office of Science Education Crosscut

(dollars in thousands)

	FY 2010 Current Appropriation	FY 2012 Request
Undergraduate Programs		
Advanced Scientific Computing Research	250	300
Basic Energy Sciences	391	406
Biological and Environmental Research	100	100
Fusion Energy Sciences	365	395
High Energy Physics	0	0
Nuclear Physics	103	125
Workforce Development for Teachers and Scientists	5,261	8,000
Total, Undergraduate Programs	6,470	9,326
Graduate Programs		
Advanced Scientific Computing Research	6,014	6,014
Basic Energy Sciences	895	616
Biological and Environmental Research	1,499	105

(dollars in thousands)

	FY 2010 Current Appropriation	FY 2012 Request
Fusion Energy Sciences	1,371	864
High Energy Physics	823	755
Nuclear Physics	148	165
Workforce Development for Teachers and Scientists	5,106	16,100
Total, Graduate Programs	15,856	24,619
Educator Programs, K-12 Students		
Basic Energy Sciences	0	10
Biological and Environmental Research	250	250
Fusion Energy Sciences	839	852
High Energy Physics	745	666
Workforce Development for Teachers and Scientists	8,671	5,500
Total, Educator Programs	10,505	7,278
Office of Science		
Advanced Scientific Computing Research	6,264	6,314
Basic Energy Sciences	1,286	1,032
Biological and Environmental Research	1,849	455
Fusion Energy Sciences	2,575	2,111
High Energy Physics	1,568	1,421
Nuclear Physics	251	290
Workforce Development for Teachers and Scientists	19,038	29,600
Total, Office of Science	32,831	41,223

Office of Science

Funding by Site by Program

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Ames Laboratory		
Advanced Scientific Computing Research	900	0
Basic Energy Sciences	21,613	18,808
Biological and Environmental Research	675	675
Workforce Development for Teachers and Scientists	544	313
Safeguards and Security	1,185	950
Total, Ames Laboratory	24,917	20,746
Ames Site Office		
Science Program Direction	528	599
Argonne National Laboratory		
Advanced Scientific Computing Research	60,640	66,315
Basic Energy Sciences	212,919	246,726
Biological and Environmental Research	30,353	21,689
Fusion Energy Sciences	193	40
High Energy Physics	16,503	13,162
Nuclear Physics	29,643	28,935
Workforce Development for Teachers and Scientists	2,400	2,328
Science Laboratories Infrastructure	8,000	40,000
Safeguards and Security	9,163	8,983
Total, Argonne National Laboratory	369,814	428,178
Argonne Site Office		
Science Program Direction	3,418	4,149
Berkeley Site Office		
Science Program Direction	4,459	4,415

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Brookhaven National Laboratory		
Advanced Scientific Computing Research	1,180	300
Basic Energy Sciences	243,541	272,943
Biological and Environmental Research	21,118	17,152
High Energy Physics	61,487	44,044
Nuclear Physics	182,314	195,334
Workforce Development for Teachers and Scientists	1,200	2,123
Science Laboratories Infrastructure	44,387	15,500
Safeguards and Security	11,898	12,857
Total, Brookhaven National Laboratory	567,125	560,253
Brookhaven Site Office		
Science Program Direction	5,132	5,235
Chicago Office		
Advanced Scientific Computing Research	61,892	20,019
Basic Energy Sciences	290,554	243,241
Biological and Environmental Research	173,442	159,190
Fusion Energy Sciences	154,541	137,156
High Energy Physics	137,323	129,634
Nuclear Physics	88,854	71,538
Workforce Development for Teachers and Scientists	473	149
Science Laboratories Infrastructure	809	1,385
Safeguards and Security	988	133
Science Program Direction	35,961	32,238
Congressionally Directed Projects	73,765	0
SBIR/STTR	167,529	0
Total, Chicago Office	1,186,131	794,683

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Fermi National Accelerator Laboratory		
Advanced Scientific Computing Research	827	315
Basic Energy Sciences	183	35
High Energy Physics	412,737	393,425
Nuclear Physics	881	0
Workforce Development for Teachers and Scientists	483	146
Science Laboratories Infrastructure	0	0
Safeguards and Security	2,991	3,564
Total, Fermi National Accelerator Laboratory	418,102	397,485
Fermi Site Office		
Science Program Direction	2,279	2,601
Golden Field Office		
Workforce Development for Teachers and Scientists	485	161
Idaho National Laboratory		
Basic Energy Sciences	1,723	1,822
Biological and Environmental Research	1,972	1,310
Fusion Energy Sciences	2,242	2,222
Workforce Development for Teachers and Scientists	166	336
Congressionally Directed Projects	972	0
Total, Idaho National Laboratory	7,075	5,690
Lawrence Berkeley National Laboratory		
Advanced Scientific Computing Research	107,730	94,372
Basic Energy Sciences	152,988	162,019
Biological and Environmental Research	127,688	132,255
Fusion Energy Sciences	4,907	4,590
High Energy Physics	59,848	45,932
Nuclear Physics	31,249	20,244
Workforce Development for Teachers and Scientists	810	1,201
Science Laboratories Infrastructure	34,027	12,975
Safeguards and Security	5,184	5,096
Total, Lawrence Berkeley National Laboratory	524,431	478,684

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Lawrence Livermore National Laboratory		
Advanced Scientific Computing Research	16,765	4,257
Basic Energy Sciences	4,847	3,973
Biological and Environmental Research	17,240	12,880
Fusion Energy Sciences	12,902	12,577
High Energy Physics	1,877	739
Nuclear Physics	3,330	1,300
Workforce Development for Teachers and Scientists	161	273
Total, Lawrence Livermore National Laboratory	57,122	35,999
Los Alamos National Laboratory		
Advanced Scientific Computing Research	6,582	1,920
Basic Energy Sciences	41,077	42,379
Biological and Environmental Research	12,210	18,194
Fusion Energy Sciences	5,313	2,842
High Energy Physics	648	255
Nuclear Physics	12,930	15,528
Workforce Development for Teachers and Scientists	223	130
Total, Los Alamos National Laboratory	78,983	81,248
National Energy Technology Laboratory		
Workforce Development for Teachers and Scientists	678	275
National Renewable Energy Laboratory		
Advanced Scientific Computing Research	522	0
Basic Energy Sciences	13,231	12,611
Biological and Environmental Research	1,136	878
Workforce Development for Teachers and Scientists	65	501
Total, National Renewable Energy Laboratory	14,954	13,990
Nevada Site Office		
Basic Energy Sciences	244	244
New Brunswick Laboratory		
Science Program Direction	6,132	6,720
Safeguards and Security	33	0
Total, New Brunswick Laboratory	6,165	6,720

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Oak Ridge Institute for Science and Education		
Advanced Scientific Computing Research	1,765	0
Basic Energy Sciences	5,473	150
Biological and Environmental Research	7,653	4,170
Fusion Energy Sciences	1,935	1,450
High Energy Physics	1,137	0
Nuclear Physics	1,086	608
Workforce Development for Teachers and Scientists	9,418	18,278
Safeguards and Security	1,626	1,642
Science Program Direction	8	0
Total, Oak Ridge Institute for Science and Education	30,101	26,298
Oak Ridge National Laboratory		
Advanced Scientific Computing Research	104,871	96,955
Basic Energy Sciences	343,956	350,862
Biological and Environmental Research	74,024	70,777
Fusion Energy Sciences	153,756	118,716
High Energy Physics	79	0
Nuclear Physics	34,864	38,483
Workforce Development for Teachers and Scientists	0	21
Safeguards and Security	9,320	9,053
Total, Oak Ridge National Laboratory	720,870	684,867
Oak Ridge National Laboratory Site Office		
Science Program Direction	4,619	4,416
Oak Ridge Office		
Science Laboratories Infrastructure	5,214	5,493
Safeguards and Security	19,708	20,604
Science Program Direction	38,714	40,510
Total, Oak Ridge Office	63,636	66,607

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Office of Scientific and Technical Information		
Advanced Scientific Computing Research	204	0
Basic Energy Sciences	389	83
Biological and Environmental Research	491	392
Fusion Energy Sciences	198	125
High Energy Physics	255	122
Nuclear Physics	216	125
Workforce Development for Teachers and Scientists	390	200
Safeguards and Security	508	465
Science Program Direction	11,501	9,277
Total, Office of Scientific and Technical Information	14,152	10,789
Pacific Northwest National Laboratory		
Advanced Scientific Computing Research	6,908	2,274
Basic Energy Sciences	25,337	23,423
Biological and Environmental Research	111,578	120,460
Fusion Energy Sciences	1,396	3,838
Nuclear Physics	849	104
Workforce Development for Teachers and Scientists	1,224	499
Safeguards and Security	11,840	11,520
Total, Pacific Northwest National Laboratory	159,132	162,118
Pacific Northwest Site Office		
Science Program Direction	5,463	5,771
Princeton Plasma Physics Laboratory		
Advanced Scientific Computing Research	478	0
Fusion Energy Sciences	75,362	70,517
High Energy Physics	292	227
Workforce Development for Teachers and Scientists	505	193
Safeguards and Security	2,265	2,222
Total, Princeton Plasma Physics Laboratory	78,902	73,159
Princeton Site Office		
Science Program Direction	1,747	1,981

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Sandia National Laboratories		
Advanced Scientific Computing Research	10,697	7,236
Basic Energy Sciences	45,386	41,079
Biological and Environmental Research	1,674	4,148
Fusion Energy Sciences	3,786	2,414
Workforce Development for Teachers and Scientists	255	196
Total, Sandia National Laboratories	61,798	55,073
Savannah River National Laboratory		
Basic Energy Sciences	500	500
Biological and Environmental Research	363	0
Workforce Development for Teachers and Scientists	75	80
Total, Savannah River National Laboratory	938	580
SLAC National Accelerator Laboratory		
Advanced Scientific Computing Research	300	100
Basic Energy Sciences	188,672	218,324
Biological and Environmental Research	4,660	4,215
High Energy Physics	93,783	76,771
Workforce Development for Teachers and Scientists	170	305
Science Laboratories Infrastructure	6,900	24,110
Safeguards and Security	3,293	2,709
Total, SLAC National Accelerator Laboratory	297,778	326,534
SLAC Site Office		
Science Program Direction	2,871	2,845
Thomas Jefferson National Accelerator Facility		
Advanced Scientific Computing Research	100	0
Basic Energy Sciences	900	900
Biological and Environmental Research	600	600
High Energy Physics	2,354	1,232
Nuclear Physics	113,864	160,370
Workforce Development for Teachers and Scientists	488	273
Science Laboratories Infrastructure	27,687	12,337
Safeguards and Security	1,445	1,448
Total, Thomas Jefferson National Accelerator Facility	147,438	177,160

(dollars in thousands)

	FY 2010 Current Approp.	FY 2012 Request
Thomas Jefferson Site Office		
Science Program Direction	2,069	2,098
Washington Headquarters		
Advanced Scientific Computing Research	838	171,537
Basic Energy Sciences	5,435	344,878
Biological and Environmental Research	1,154	148,915
Fusion Energy Sciences	1,119	43,213
High Energy Physics	2,488	91,657
Nuclear Physics	22,380	72,731
Workforce Development for Teachers and Scientists	465	7,619
Science Laboratories Infrastructure	576	0
Safeguards and Security	1,553	2,654
Science Program Direction	64,476	94,008
Total, Washington Headquarters	100,484	977,212
Total, Science	4,964,040	5,418,863

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, acquisition, installation, and testing of the IBM Blue Gene/Q 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

- **High Energy Physics**: The Tevatron Collider program is planned to complete operations in 2011 after a very successful run extending over a decade. The Fermilab accelerator complex will be shutdown for 6 months to install upgrades to the Neutrinos at the Main Injector beamline as well as reconfigure some elements of the Tevatron complex for the future Intensity Frontier research program. Fabrication and design for experiments which will make use of this new accelerator capabilities will be a major effort of the laboratory.

Oak Ridge National Laboratory

- **Nuclear Physics**: The funding increases required for the construction of two high priority major projects, the 12 GeV CEBAF Upgrade and the Facility for Rare Isotope Beams, have required

strategic decisions within the Nuclear Physics program that include the closure of the Holifield Radioactive Ion Beam Facility (HRIBF) at ORNL in FY 2012.

SLAC National Accelerator Laboratory

- **High Energy Physics**: In FY 2012, SLAC's program in electron accelerator-based research will continue to be phased out as the laboratory's experimental high energy physics focus shifts largely towards non-accelerator-based projects. The laboratory's expertise in developing and deploying advanced detector systems, high-speed electronics, and data acquisition systems will be preserved to the extent possible and applied to these new efforts.
- **Science Laboratories Infrastructure:** The SLAC Science and User Support building is initiated. This facility will serve as the main entrance to the laboratory, the first stop for all visitors and users at SLAC, and will bring together many of the laboratory's visitors, users, and administrative services. This will enhance the scientific productivity and collaboration that supports the laboratory's cutting-edge discoveries and exceptional user research program.

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). 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**: The Safeguards and Security (S&S) program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at Ames. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

Ames Site Office

The Ames Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the Ames Laboratory. The site office is responsible for project management of construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal

representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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). The average age of 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 relevant to hybrid, multi-core computing systems including future exascale systems. ANL also participates in a spectrum of SciDAC activities. 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 will be upgraded to a 10 petaflop IBM Blue Gene/Q 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 (APS), the Center for Nanoscale Materials (CNM), and the Electron Microscopy Center (EMC) 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 **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.
  - The **Electron Microscopy Center for Materials Research** has an emphasis on in-situ capabilities and measurements, including observation of samples in magnetic fields, under ion beam irradiation, and within a range of environments. A variety of instruments and approaches are available including an electron microscope with unique capabilities for correction of chromatic lens aberrations, which affords users the possibility of pursuing 3-D chemical imaging for characterization of buried interfaces and the study of hard/soft materials at low voltages below the displacement damage threshold. Research at EMC 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.
- **Biological and Environmental Research**: ANL conducts genomic, metagenomics, and computational research in microbes and soil microbial communities to understand the molecular-level processes that influence the mobility and transformations of contaminants or regulate carbon cycling and environmental interactions. ANL's Structural Biology Center operates beamlines for macromolecular crystallography at the APS.

In support of climate change research, ANL is a member of a multi-laboratory team that coordinates the overall infrastructure operations of Atmospheric Radiation Measurement Climate Research Facility (ARM) sites and mobile facilities. ANL manages the development and operation of an ARM mobile 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.

- **Fusion Energy Sciences**: ANL contributes a small effort in basic plasma science. In addition, ANL has participated 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. Major ANL activities include working on the ATLAS (A Large Toroidal LHC Apparatus) experiment at the Large Hadron Collider, participating in the Fermilab neutrino program, completing the analysis of Tevatron data, 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 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 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; research in the production of radioisotopes for medical applications; data compilation and evaluation activities as part of the National Nuclear Data program; and, in collaboration with the Office of Nuclear Energy, measurement of actinide reaction rates and cross sections for nuclear fuel irradiated in the Idaho Advanced Test Reactor.
    - 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, as well as a percentage of 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 430 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 is being commissioned in FY 2011, as a source to provide new capabilities in neutron-rich radioactive beams. The Helical Orbital Spectrometer, employs a new concept to study reactions with radioactive beams from CARIBU.

- **Science Laboratories Infrastructure**: The SLI program supports DOE research initiatives by funding the line item construction needed to maintain mission ready infrastructure at ANL. 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**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at ANL. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

Argonne Site Office

The Argonne Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the Argonne National Laboratory. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

Berkeley Site Office

The Berkeley Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the Lawrence Berkeley National Laboratory. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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 operates major facilities that are 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 advanced networking. It also participates in a limited spectrum of SciDAC activities.
- **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 macromolecular crystallography at the National Synchrotron Light Source for use by the national biological research community and research into new technologies for biological structure determination. 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 (ARM) External Data resource that provides atmospheric system research investigators with data from non-ARM sources, including satellite and ground-based systems. BNL is the lead for multi-institution research to address issues of model evaluation, development, and understanding of atmospheric processes.

  Scientists at BNL continue final analysis and closeout of the Free-Air Carbon Dioxide Enrichment (FACE) experiment at the Duke Forest which explored 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 with many and varied scientific applications. 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. 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 extremely high brightness electron beams, 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), 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. Accelerator and detector upgrades continue to support second generation measurements to more fully understand and characterize the matter produced in RHIC collisions.

  - The **Alternating Gradient Synchrotron** (AGS) accelerator 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. In addition, it has the capability to provide high intensity pulsed proton beams up to 33 GeV on fixed targets.

  - 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 were completed in FY 2010 and are replacing the Tandem Van de Graaff accelerators that 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** 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. The BLIP is also used to perform irradiation tests for neutrino experiments.

- **Science Laboratories Infrastructure**: The SLI program supports DOE research initiatives by funding the line item construction needed to maintain mission ready infrastructure at BNL. SLI 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, Nuclear Physics, and High Energy Physics. Final funding for construction of the Interdisciplinary Science Building, Phase I project was provided in FY 2010. This project will provide high accuracy laboratories (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**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at BNL. S&S provides planning, policy, implementation, and oversight in the areas of program management, protective force officers, and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

Brookhaven Site Office

The Brookhaven Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the Brookhaven National Laboratory. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

Chicago Office

The Chicago (CH) Office provides support (procurement, legal, financial management, human resources, and facilities and infrastructure) to headquarters program sponsors and to site offices responsible for program management oversight of six management and operating laboratories—the

Ames Laboratory, Argonne National Laboratory, Lawrence Berkeley National Laboratory, Brookhaven National Laboratory, Fermilab, and Princeton Plasma Physics Laboratory—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 Financial Assistance center, administering grants to about 300 colleges and universities in all 50 states, Washington, D.C., and Puerto Rico.

- **Advanced Scientific Computing Research**: Funds research at over 70 academic institutions located in 34 states.
- **Basic Energy Sciences**: Funds research at 170 academic institutions located in 50 states.
- **Biological and Environmental Research**: Funds research at over 200 institutions, including colleges, universities, private industry, and other Federal and private research institutions located in 48 states and Washington, D.C.
- **Fusion Energy Sciences**: Funds research grants and cooperative agreements at more than 60 colleges, universities, and industries located in approximately 30 states.
- **High Energy Physics**: Supports research groups at more than 100 colleges and universities located in 36 states, Washington, D.C., and Puerto Rico.
- **Nuclear Physics**: Funds research grants at 90 colleges and universities located in 35 states and Washington, DC.
- **Safeguards and Security**: S&S provides funding to the Chicago Office for federal field personnel security investigations.

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 only to CERN–the European Laboratory for Particle Physics in size. 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 advanced networking research.
- **High Energy Physics**: Fermilab is the principal HEP experimental facility in the Nation. 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 Collider program is planned to complete operations in 2011 after a very successful run that extended over a decade. The Fermilab accelerator complex will run in FY 2012 for six months supporting the neutrino program and then be shutdown for 6 months to install upgrades and reconfigure some elements of the Tevatron complex for the future Intensity Frontier research program.

- 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) project will upgrade the NuMI beamline in FY 2012 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 also 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.
- With an active program in particle astrophysics and cosmology, Fermilab has led the development and fabrication of a camera to be used in the Dark Energy Survey. It has significant participation in research on the direct detection of dark matter and ultra high energy cosmic rays, and is conducting 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.

- **Safeguards and Security**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at Fermilab. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

Fermi Site Office

The Fermi Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at Fermilab. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principle representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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 subsurface biogeochemical research related to clean up of the nuclear weapons complex with an emphasis on understanding the control of mineral precipitation reaction fronts and 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 development of the domestic fusion safety database using existing collaborative arrangements to conduct work on international facilities. In addition, INL has expanded its 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 (ATR) 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. In collaboration with the Office of Nuclear Energy, nuclear fuel irradiated in the ATR is being analyzed at ANL to provide accurate data on actinide reaction rates and cross sections as part of the National Nuclear Data program.

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 relevant to hybrid multi-core computing systems including future exascale systems. LBNL manages the Energy Sciences network (ESnet), one of the world's most effective and progressive science-related computer networks, which provides worldwide access and communications to Department of Energy facilities. LBNL is 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. LBNL also participates in a spectrum of SciDAC activities.
- **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 **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 includes, and provides users with access to the TEAM I instrument, the most advanced scanning transmission electron microscope in the world with unparalleled lateral spatial resolution of under 50 picometers. NCEM's focus and major impact is in the following areas of research: defects and deformation; mechanisms and kinetics of phase transformations in materials; nanostructured materials; surfaces, interfaces and thin films; and microelectronics materials and devices.
- 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. LBNL also operates BER-supported beamlines for life science applications, emphasizing small-angle x-ray scattering, infrared spectromicroscopy, x-ray tomography, and soft x-ray spectroscopy at the ALS for use by the national and international biological research community. LBNL plays a key role in the science supporting climate and environmental system prediction, and on biological and ecological responses to climate and atmospheric changes.
  - LBNL conducts systems-level research to advance fundamental understanding of DOE-relevant microbes and environmental interactions and how subsurface biogeochemical processes impact contaminant transport and behavior across multiple spatial and temporal scales. LBNL research on carbon cycling involving terrestrial ecosystems contributes towards understanding the processes controlling the exchange of CO_2 between terrestrial ecosystems and the atmosphere.
  - The laboratory also develops scalable implementation technologies that allow widely used climate models to run effectively and efficiently on massively parallel processing supercomputers. LBNL leads a multi-laboratory activity to study and quantify the risks of abrupt climate change during the 21st century. LBNL conducts research on regional climate modeling, including efforts to advance aerosol and cloud parameterizations, and carry out model diagnostics and evaluations.

- The **Joint BioEnergy Institute** (JBEI) at LBNL, one of three DOE Bioenergy Research Centers, is focused on developing systems biology approaches for production of next generation (i.e. non-ethanol) liquid biofuels using well characterized microbes such as *E. coli* and yeast that lend themselves to metabolic engineering. JBEI researchers also study the basic characteristics of biomass synthesis pathways in model plant species, prospect rainforest soils for more efficient cellulose degrading enzymes and microorganisms, and examine the potential of ionic liquids for biomass deconstruction.

- **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 had a leading role in developing and implementing advanced particle detectors for the ATLAS experiment at the LHC, and now participates in the research program of the ATLAS detector. LBNL also has a leading role in providing the software and computing infrastructure for ATLAS. LBNL staff is also involved in neutrino physics research using reactor-produced neutrinos, and provides 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 NP's low energy and heavy ion subprograms. This include fabrication of a next-generation gamma-ray detector system, the Gamma Ray Energy Tracking In-Beam Nuclear Array (GRETINA); research with the STAR detector located at BNL's RHIC facility; and development and fabrication of major components for the STAR Heavy Flavor Tracker at RHIC. Also included are operation of the National Energy Research Scientific Computing Center's (NERSC) Parallel Distributed Systems Facility (PDSF) aimed at providing computation resources for the STAR heavy ion experiment at RHIC, a Tier-2

U.S. site on the computing grid to manage storage and processing of experimental data from the A Large Ion Collider Experiment (ALICE) experiment at the LHC, and low energy physics computation; fabrication of a detector upgrade for ALICE detector heavy ion program at the LHC; and analysis of data from the KamLAND detector in Japan that performed 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 supports DOE research initiatives by funding the line item construction needed to maintain mission ready infrastructure at LBNL. SLI is currently funding the Seismic Life-Safety, Modernization, and Replacement of General Purpose Buildings, Phase II project at LBNL, which will replace seismically-poor buildings and trailers with a new general purpose laboratory/office building supporting multidisciplinary science, seismically upgrading the site-wide Hazardous Waste Handling Facility, and upgrading and modernizing an existing Life Sciences building (Building 74).
- **Safeguards and Security**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at LBNL. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses 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, as well as advanced computing software tools relevant to hybrid, multi-core computing systems including future exascale systems. LLNL also participates in a spectrum of SciDAC activities.
- **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). LLNL is also a critical player to advance climate and environmental prediction systems. LLNL conducts research to study structure and function of microbial communities, including development of enabling novel technologies.
    - 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. LLNL conducts research to develop metrics

and diagnostics for ultra-high resolution simulations. The laboratory also supports the ARM Climate Research Facility through the development and support of data sets designed for modelers. Through the Program for Climate Model Diagnosis and Intercomparision, LLNL provides the international leadership to develop and apply diagnostics tools to evaluate and improve the performance of climate models; every climate modeling center in the world participates in this unique program.

- LLNL conducts 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 neutrinoless 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. LLNL has partnered with LBNL's National Energy Research Scientific Computing Center (NERSC) to establish a Tier-2 U.S. site on the computing grid to manage storage and processing of experimental data from the ALICE experiment.

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 relevant to hybrid, multi-core computing systems including future exascale systems. LANL also participates in a spectrum of SciDAC activities.
- **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 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 includes 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. LANL also participates in critical components designed to advanced climate and environmental predicition capabilities.

  - 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 is a member of a multi-laboratory team that coordinates the overall infrastructure operations of Atmospheric Radiation Measurement Climate Research Facility (ARM) sites and mobile facilities. LANL manages the deployment and operation of an ARM mobile facility.

  - LANL also has a crucial role in the development, optimization, and validation of coupled sea ice and oceanic models for implementation on massively parallel computers. The laboratory 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.

- **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. LANL also supports the tritium processing activities needed for ITER.

- **High Energy Physics**: HEP supports theoretical and experimental physics research at LANL, using unique capabilities of the laboratory in high-performance computing for advanced simulations and expertise in particle astrophysics, neutrino physics, and advanced accelerator concepts.

- **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 leading the fabrication of the RHIC Forward Vertex Tracker (FVTX) detector for BNL; 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. LANL scientists are participating in 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 (IPF), 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** 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 operations and operates in parallel to LANSCE. NP also supports isotope production research using higher energy proton beams available at LANSCE (e.g., the production of actinium-225 by the irradiation of thorium-232 with 100-800 MeV protons).

National Renewable Energy Laboratory

The National Renewable Energy Laboratory (NREL) is an Energy Efficiency and Renewable Energy 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 ANL in Illinois, is a government-owned, government-operated laboratory that serves as a DOE Center of Excellence in analytical chemistry and the science of measuring nuclear materials. In this role, NBL performs measurements of the elemental and isotopic compositions for a wide range of nuclear materials. NBL is the U.S. Government's Certifying Authority for nuclear reference materials and DOE's central technical authority for nuclear material measurements (primarily for safeguards purposes). NBL also functions as a Network Laboratory for the International Atomic Energy Agency. NBL is administered through and is a part of the Chicago Office (CH). NBL consists of one 52 year-old building (90 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 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 Fusion Energy Sciences (FES) program peer reviews. It also acts as an independent and unbiased agent to administer the FES Postgraduate Fellowship programs.
- **High Energy Physics**: ORISE provides support in the area of program planning and review.
- **Nuclear Physics**: ORISE has supported the Holifield Radioactive Ion Beam Facility (HRIBF) and its research program through a close collaboration with university researchers using HRIBF; HRIBF operations cease in FY 2012. ORISE also provides support to the Nuclear Physics program in the area of merit peer review.
- **Workforce Development:** ORISE provides administrative support to the Office of Science Graduate Fellowship Program, including developing the on-line application and on-line review system, updating the program websites, and providing logistic support for the on-site review. ORISE provides administrative support to an interagency program by DOE, National Institute of Health (NIH), and National Science Foundation (NSF) for sponsoring U.S. graduate delegates to attend the Lindau Meeting with Nobel Laureates in Germany. ORISE also provides the administrative support for the National Science Bowl® and other WDTS programs, and serves as the education office for Oak Ridge National Laboratory
- **Safeguards and Security**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at ORISE. S&S provides planning, policy, implementation, and oversight in the areas of program management, patrol and response officers, and information security. In addition, the S&S program addresses 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 24,000-acre reservation at Oak Ridge, Tennessee. The laboratory's 1,100-acre main site contains 237 buildings (3.7 million gross square feet of space). The average age of 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 relevant to hybrid, multi-core computing systems including future exascale systems. ORNL also participates in a spectrum of SciDAC activities. The Leadership Computing Facility at ORNL is operating one of the world's most powerful high performance computers, 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), the 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, but 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** (SHaRE) makes available state-of-the-art electron beam microcharacterization facilities for collaboration with researchers from universities, industry, and other government laboratories. Particular emphases include compositional analysis via spectroscopic and other techniques, including state-of-the-art atom probe tomography. Most SHaRE projects seek correlations at the microscopic or atomic scale between structure and properties in a wide range of metallic, ceramic, and other structural materials. Diverse research projects have been conducted, such as the 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 both the ecological aspects of global environmental change and bioenergy.
  - The laboratory houses the Carbon Dioxide Information Analysis Center and Atmospheric Radiation Measurement Climate Research Facility (ARM) archive. ORNL leads a multi-laboratory activity to quantify and reduce critical uncertainties associated with carbon cycle-climate system feedback and to develop high resolution global climate simulations.
  - ORNL leads a multi-institutional effort to understand carbon cycling in permafrost soils and to predict the impact of a changing climate on cold region carbon budgets.
  - ORNL leads a multi-institutional team conducting field-scale research that is focused on understanding the coupled hydrologic, geochemical, and microbiological processes that control the mobility of mercury, uranium, technetium, and other contaminants across a range of scales.
  - 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. ORNL activities in structural biology include operation of a station for Small Angle Neutron Scattering at the High Flux Isotope Reactor for the national biological research community.
  - ORNL conducts Genomic Science microbial systems biology research in order to understand the interactions between plants and microbes, leading to development of more sustainable biofuel production.
  - The **BioEnergy Science Center** (BESC) at ORNL, one of three DOE Bioenergy Research Centers, is studying two prime candidate bioenergy feedstocks, the poplar tree and switchgrass, to understand plant properties that make biomass so resistant to deconstruction and identify less recalcitrant natural variants. BESC also emphasizes discovery and improvement of microbes capable of converting cellulosic biomass directly to ethanol or butanol while withstanding high temperatures and product toxicity involved in consolidated biomass processing approaches.
- **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 has also been the site of the Controlled Fusion Atomic Data Center and its supporting research programs, which are being closed out in FY 2012. 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 have included the research, development, and operations of the Holifield Radioactive Ion Beam Facility (HRIBF), which is closed in FY 2012, and 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, 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 addition, 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 neutrinoless 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 Development 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. R&D to re-establish a stable isotope production capability is being pursued. The High Flux Isotope Reactor is supported for the production of select isotopes for the NP Isotope Program, including tungsten-188, an isotope with medical applications such as cancer therapy, and selenium-75, a commercial isotope used in radiography. The Isotope Program is responsible for programmatic activities in Building 4501, 7920, 7930, 3025E, and chemical and materials laboratories in Building 5500.

- **Holifield Radioactive Ion Beam Facility** is the only radioactive nuclear beam facility in the U.S. to using the Isotope-Separator On-Line method, and one of only three such facilities in the world. HRIBF has been used annually by about 260 scientists for studies in nuclear structure, dynamics, and astrophysics using radioactive beams. The HRIBF ceases operations in the FY 2012 in order to provide support for higher priority activities in NP, including the 12 GeV CEBAF Upgrade and the Facility for Rare Isotope Beams (FRIB). These strategic investments in new research capability, the first in over a decade, will maintain U.S. leadership in the scientific frontier of quantum chromodynamics (QCD), and secure U.S. leadership in nuclear structure and nuclear astrophysics. The 12 GeV CEBAF Upgrade will allow scientists to detect and study exotic and excited bound systems of quarks and gluons with unprecedented accuracy, illuminating the force which binds quarks and gluons into protons and neutrons. In the case of FRIB, the capability to study nuclear structure at the limits of nuclear existence, in particular for neutron rich nuclei, will be world leading, providing a major advance in research capability for the U.S. nuclear structure and nuclear astrophysics communities. The 12 GeV CEBAF Upgrade and FRIB construction were recognized as the two highest priorities for investments in new research capability by the nuclear science community in the 2007 NSAC Long Range Plan.
- **The Fundamental Neutron Physics Beamline** at the Spallation Neutron Source was completed in FY 2010 to provide high intensity pulsed beams of cold and ultracold neutrons for fundamental research with neutrons.
- The **National Isotope Development Center** (NIDC) is a virtual service organization that supports 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 community outreach efforts. It also manages the Isotope Business Office which is located at ORNL.

▪ **Safeguards and Security**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at ORNL. S&S provides planning, policy, implementation, and oversight in the areas of program management and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

Oak Ridge National Laboratory Site Office

The Oak Ridge National Laboratory Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the Oak Ridge National Laboratory. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principle representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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—Oak Ridge National Laboratory, Pacific Northwest National Laboratory, SLAC National Accelerator Laboratory, and Thomas Jefferson National Accelerator Facility. 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 the buildings is 51 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**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets and oversight in the areas of program management, protective force officers, and information security. S&S provides oversight for SC's only category I, special nuclear materials facility, building 3019. S&S also provides funding to the Oak Ridge Office for federal field personnel security investigations.

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 as well as the Open Government Directive to encourage collaboration and increase transparency. 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 65 countries. OSTI consists of one 63 year-old building (135 thousand gross square feet of space).

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 consists of seven buildings (470 thousand gross square feet of space.) The average age of the buildings is three years.

- **Advanced Scientific Computing Research**: PNNL conducts research in applied mathematics and computer science, as well as research in advanced computing software tools relevant to hybrid, multi-core computing systems including future exascale systems. PNNL also participates in a spectrum of SciDAC activities.
- **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 the **Environmental Molecular Science Laboratory** (EMSL), a national scientific user facility that provides integrated experimental and computational resources. In addition, PNNL carries out research in support of climate, environmental, and genomic sciences.
  - EMSL supports discovery and technological innovation in the environmental molecular sciences. EMSL provides more than 50 leading-edge instruments and a supercomputer to users from academia, DOE laboratories, and industry. EMSL enables users to undertake molecular-scale experimental and theoretical research on aerosol chemistry, biological systems, biogeochemistry, and interfacial and surface science.
  - PNNL conducts research on the molecular mechanisms of cellular responses to low doses of radiation and the development of new technologies and high-throughput approaches for characterizing cellular components. PNNL conducts Genomic Science microbial systems biology research to gain a predictive understanding of the interactions and functions of associated bacterial species in natural environments. PNNL is one of the national laboratory partners that support the JGI, the principal goal of which is high-throughput DNA sequencing.
  - PNNL leads two multi-institutional field projects focused on developing a better understanding of the processes that impact reactive transport and mobility of contaminants such as uranium, technetium, and plutonium.
  - The Atmospheric Radiation Measurement Climate Research Facility (ARM) technical office is located at PNNL, and has the project management responsibility for all ARM engineering activity and the conduct of ARM fixed site-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 research on climate modeling improves the simulations of precipitation and aerosols effects to represent human-earth system interdependencies and assess the impacts of climate change
- **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 Nation. NP also supports R&D efforts towards a next generation detector to search for neutrinoless double beta decay.
- **Safeguards and Security**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or

destruction of Departmental assets at PNNL. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses 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 completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at PNNL. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or

destruction of Departmental assets at PPPL. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

Princeton Site Office

The Princeton Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the Princeton Plasma Physics Laboratory. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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 relevant to hybrid, multi-core computing systems including future exascale systems. SNL also participates in a spectrum of SciDAC activities.
- **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 is a member of a multi-laboratory team that coordinates the overall infrastructure operations of Atmospheric Radiation Measurement Climate Research Facility (ARM) sites and facilities. SNL conducts climate modeling research 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.

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 the buildings is 32 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 Lightsource (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 Lightsource** 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.
- **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.

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**: SLAC participates in the accelerator-based research program of the ATLAS detector at the LHC, is leading several efforts at the Cosmic Frontier of particle astrophysics, and is one of the primary national laboratories for research and development of particle accelerator technologies.
  - 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 incorporates a next-generation ground-based dark energy experiment as part of a broad program in astronomy and astrophysics. 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 the host for the **Facility for Advanced Accelerator Experimental Tests (FACET)**, which will study plasma acceleration, using short, intense pulses of electrons to create a plasma wakefield accelerator. 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 supports DOE research initiatives by funding the line item construction needed to maintain mission ready infrastructure at SLAC. SLI 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**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or destruction of Departmental assets at SLAC. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

SLAC Site Office

The SLAC Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the SLAC National Accelerator Laboratory. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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 61 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.
- **Basic Energy Sciences:** BES supports the development of superconducting radio frequency (SRF) cavities at TJNAF that will ultimately be used for the next generation light sources.
- **Biological and Environmental Research**: BER supports the development of advanced imaging instrumentation at TJNAF that will ultimately be used in 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 1,300 researchers. Polarized electron beams with energies of up to 6.0 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, will be used 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 and has contributed to other SC facilities such as the SNS at Oak Ridge National Laboratory.
    - The **12 GeV CEBAF Upgrade Project** which started construction in FY 2009 and is scheduled to complete in FY 2015, will double the energy of the accelerator. In addition to upgrading the energy and the capability of the existing Halls A, B, and C, the project is constructing a new Hall D and detector, which will provide researchers with the opportunity to study quark confinement, one of the greatest mysteries of modern physics. Operations of the existing facility will be limited in FY 2012 to support project installation activities.
- **Science Laboratories Infrastructure**: SLI supports DOE research initiatives by funding the line item construction needed to maintain mission ready infrastructure at TJNAF. SLI is currently funding 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.
- **Safeguards and Security**: The S&S program supports DOE research missions by ensuring appropriate levels of protection against unauthorized access, theft, diversion, loss of custody, or

destruction of Departmental assets at TJNAF. S&S provides planning, policy, implementation, and oversight in the areas of program management, access control officers, and information security. In addition, the S&S program addresses cyber, personnel security, security systems, and material control and accountability issues.

Thomas Jefferson Site Office

The Thomas Jefferson Site Office completes evaluation and acceptance of contractor deliverables and performs oversight and evaluation of contractor performance against contract requirements and ensures delivery of government required services, items, and approvals at the TJNAF. The site office is responsible for project management of line-item and other construction projects, as well as budget formulation, execution, and financial management and integrity. The site office also serves as the Department's principal representative for local, state, and regional Tribal government interactions and communications with other local stakeholders.

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.