Argonne National Laboratory

Laboratory Information

Name: Argonne National Laboratory
Location: Argonne, Illinois; Idaho Falls, Idaho
Contractor: University of Chicago
Budget: $594 million (FY 95)

DOE Programs

Energy Research, Nuclear Energy, Environmental Management, Energy Efficiency, Nonproliferation and National Security

Description

Argonne National Laboratory is a multiprogram laboratory established by the Atomic Energy Act of 1946 as successor to the Metallurgical Laboratory of the Manhattan Project. The Laboratory's initial mission was fission reactor technology for power generation and supporting science, and Argonne conceived most of the reactor systems in use today. In the 1960s, the Laboratory established its role as an operator of major national research facilities after designing and constructing the Zero Gradient Synchrotron for high energy physics research. In the 1970s, the Laboratory began work on nonnuclear energy technologies and their environmental consequences. Current work on energy-efficient technologies focuses on the transportation and industrial sectors. The Advanced Photon Source is a major national research facility that will provide super-intense x-ray beams meeting research needs in virtually all scientific disciplines and in many critical technology areas.

Major Facilities

Advanced Photon Source: Produces the Nation's most powerful "hard" x-rays to study a wide variety of materials in all sciences.

Structural Biology Center: A frontier biological research facility at the Advanced Photon Source.

Intense Pulsed Neutron Source: The Nation's most productive facility of its kind for neutron-scattering research.

Argonne Tandem-Linac Accelerator System: The Nation's leading center for research on nuclear structure using heavy ions, up to and including uranium.

High-Voltage Electron Microscope Tandem Accelerator Facilities: Electron microscopes are uniquely set up to study the effects of ion beam irradiation.

Cloud and Radiation Testbed: Argonne operates the world's most densely instrumented atmospheric research site for the study of weather and phenomena such as global warming.

Nuclear Facilities: Unique fuel conditioning and hot-fuel examination facilities.

Electrochemical Analysis and Diagnostics Laboratory: Facility supporting development of the next generation of batteries.

Key Research and Development Activities

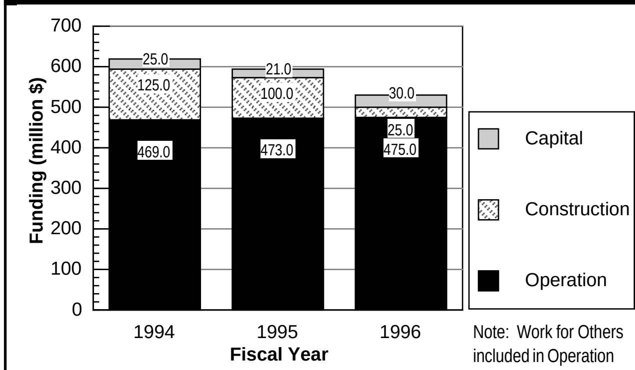
Science: X-ray science—Radiation sources, advanced optics and detectors, synchrotron radiation science and technology; Neutron science—Spallation sources, instrumentation, studies of materials structure and dynamics; High- and low-temperature superconductivity, magnetic materials, radiation damage, and ceramics; Radiation chemistry and photochemistry, heavy-element separation, and photosynthesis; Nuclear structure physics of heavy-ion reactions, superconducting accelerator technology; Atmospheric science.

Energy Resources: Electrometallurgical technology for treating DOE spent nuclear fuel; International nuclear safety center; Transportation technologies, batteries and fuel cells, and superconductivity; Industrial process technologies and recycling.

Environmental Quality: Site characterization, bioremediation and restoration technology; Environmental assessment—Risk analysis and modeling of contaminant transport.

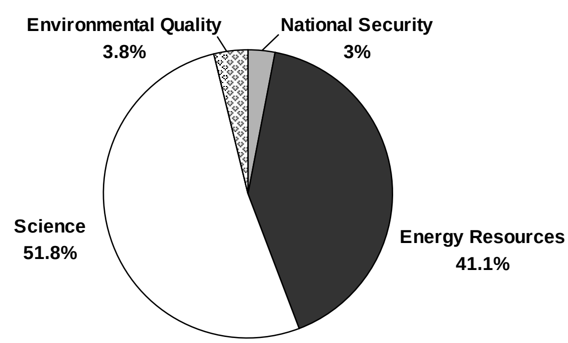
National Security: Reduced-enrichment fuel for research and test reactors to reduce the risk of nuclear proliferation.

Funding History



Note: Work for Others included in Operation

DOE Mission Footprint



Note: Does not include Work for Others

FY 1995 Data

Argonne National Laboratory

Distinctive Competencies

Argonne National Laboratory has 4,600 employees, of whom 865 have Ph.D.s and more than 3,100 have scientific or technical skills. Salient areas of laboratory competence include the following:

- Materials and chemical synthesis and processing.
- Accelerator physics and technology.
- Comprehensive science and engineering expertise in fission reactor systems.
- Modeling, simulation, and visualization of complex systems.
- Mechanistic (molecular) biology and biotechnology.

Partnerships and Collaborations

Strong Midwest role: 42 percent of Argonne's 332 industrial partners (cooperative research and development agreements, superconductivity agreements, work for others) are in six Midwestern states; an innovative Chicago community development project is based on laboratory technology.

Work for other Federal agencies:

- Nuclear Regulatory Commission, National Institutes of Health, Department of Defense, Environmental Protection Agency, Department of Agriculture, NASA, Department of Transportation, Department of Commerce, State Department, and Federal Emergency Management Agency.
- $70 million per year in research support.

Argonne is participating in 115 cooperative research and development agreements:

- $130 million in cost-shared research.
- Major multilab partnerships with U.S. industry (Advanced Battery Consortium, Partnership for a New Generation of Vehicles, and American Textile Industry Consortium).

Argonne is a partner in two National Science Foundation Science and Technology Centers: Superconductivity and Parallel Computation.

At the Advanced Photon Source, more than 500 researchers from more than 100 institutions (including 28 companies) have raised $200 million to construct and operate 40 beamlines. The State of Illinois supports user residence facilities construction and beamline instrumentation.

Argonne is a participant in an array of international collaborations:

- Industrial Partnering Program with defense-related institutes in the former Soviet republics to develop and commercialize nonmilitary technologies.
- International reactor safety center for Soviet-designed reactors.
- High energy physics: ZEUS detector at HERA (Hamburg), polarized proton experiments at CEN (Saclay), ATLAS detector at the Large Hadron Collider (Geneva).

Argonne has the largest educational program of any DOE national laboratory; more than 1,000 university faculty members conduct research there each year.

Argonne National Laboratory

Significant Accomplishments

Building and Commissioning the Advanced Photon Source: The $812-million Advanced Photon Source (APS) produces exceptionally bright x-rays for scientific research—one of only three such facilities in the world, and the only one in the United States. As many as 2,000 scientists each year from industry, universities, medical schools, and national laboratories will carry out frontier research using APS super-intense x-ray beams. All APS accelerator systems are now operational and beams of x-rays are being provided to research stations around the 3/4 mile-circumference experiment hall.

High-Performance Computing—Building an I-WAY and Exploring a CAVE: Computational scientists at ANL are joining colleagues nationwide in creating the foundation of the next-generation Internet, called the I-WAY, and refining a virtual-reality “cave” that allows researchers to examine and control their experiments from inside the virtual environment. The I-WAY connects more than a dozen supercomputers and virtual-reality devices over 10 networks of varying bandwidths, protocols, and routing and switching technology. That approach allows an application to run on all I-WAY supercomputers simultaneously.

Electrometallurgical Technology for Treatment of Spent Nuclear Fuels: Argonne, a leading nuclear reactor lab throughout its 50-year history, is now taking the lead in developing new technologies and techniques to help the Nation deal with disposal of spent nuclear fuel. Argonne’s nuclear technology program demonstrated a nuclear-fuel electrorefining process in 1995 that could save taxpayers billions of dollars. Electrorefining removes and separates the two major types of waste found in spent fuel: the short-lived radioactive byproducts of uranium fission (such as cesium and strontium) and the long-lived transuranic elements (such as plutonium and other heavy elements).

Rapid Commercialization of High Temperature Superconductivity: As the home of the Nation’s largest publicly funded high-temperature superconductor program, ANL is devising methods to provide cleaner, less expensive power than is available from the conventional electrical systems, and is working to transfer this superconductor technology to the marketplace. Argonne was the first to make coils of the brittle ceramic wire, which were then used in the first high-temperature superconducting, wire-wound electric motor, the forerunner of a series of motors. In collaboration with two manufacturers, Argonne produced flexible, high-current-density, silver-clad, high- temperature superconducting tapes in lengths to 1 kilometer. In addition, Argonne developed simple, inexpensive methods to produce the superconductor levitators needed for applications such as flywheels.

Sequencing-by-Hybridization Genome Research: Argonne researchers are developing a new super-efficient “biochip” that could help scientists decipher nature’s genome code for building and operating all organisms, including humans, animals, plants, and bacteria. The chip could lead to a new “holistic” biology that would supersede the current divisions in the study of life. The biological microchip can sequence DNA thousands of times faster than current methods.

Brookhaven National Laboratory

Laboratory Information

Name: Brookhaven National Laboratory
Location: Upton, New York
Contractor: Associated Universities, Inc.
Budget: $406 million (FY 95)

DOE Programs

Energy Research: High energy and nuclear physics, basic energy sciences, life sciences, and medical applications.

Description

Brookhaven National Laboratory (BNL) is a multiprogram laboratory established in 1947. Its mission is to carry out basic and applied research in the physical, biomedical, and environmental sciences and in selected energy technologies. To fulfill its mission as a multiprogram laboratory, BNL conceives, designs, builds, and operates large, complex research facilities for fundamental scientific studies and carries out both basic and applied research in energy-related physical, life, and environmental sciences.

Major Facilities

National Synchrotron Light Source is the premier facility providing high-intensity x-ray, ultraviolet, and infrared light of 85 beamlines for the physical, biological, and materials sciences.

High-Flux Beam Reactor is a very intense neutron source with 15 beamlines and a cold neutron moderator for studies in the structural biology, chemistry, materials, and nuclear sciences.

Alternating Gradient Synchrotron is a proton synchrotron that provides intense beams of secondary particles for high energy physics and relativistic heavy ion studies. It will serve as the injector to the Relativistic Heavy Ion Collider.

Relativistic Heavy Ion Collider will collide beams of ions as heavy as gold, creating conditions which previously existed only at the time of the "Big Bang." It can also collide beams of polarized protons.

Key Research and Development Activities

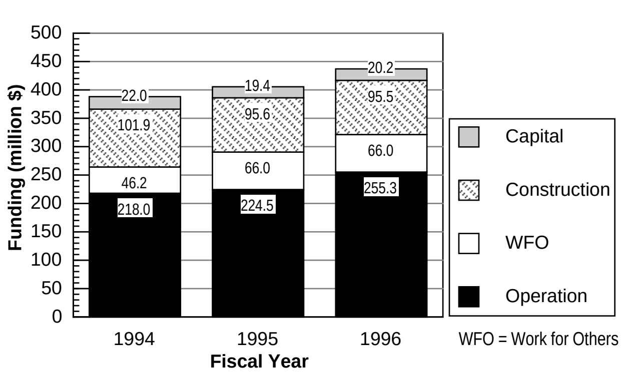
Science: Physics of relativistic heavy ions, including quark gluon plasmas; High energy physics fixed-target experiments, particularly studies of extremely rare processes; Advanced accelerator concepts; Structure and properties of surfaces, interfaces, and novel materials; Chemical science of molecular photochemistry and reactions; Structural biology and development of high-volume gene sequencing; Medical imaging, therapy, and radioisotope production; Boron neutron capture cancer therapy.

Energy Resources: Superconducting and magnetic materials processing; Safety analysis and health effects in complex systems.

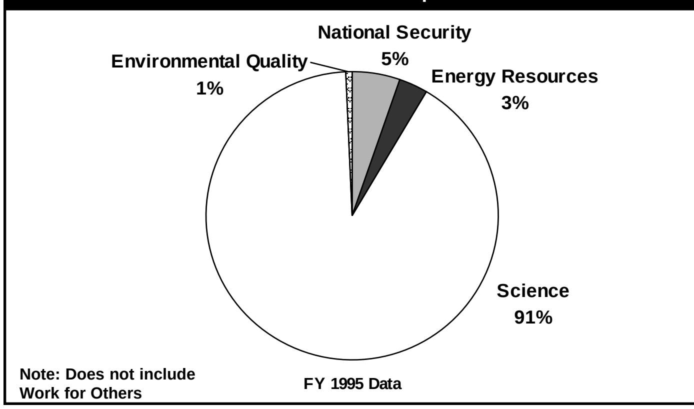
Environmental Quality: Atmospheric and oceanographic studies; Biological technologies; Bioremediation, pollution containment and abatement.

National Security: Nonproliferation and International Atomic Energy Agency technical support.

Funding History



DOE Mission Footprint



Brookhaven National Laboratory

Distinctive Competencies

Expertise in the design, construction, and operation of leading-edge, user-oriented accelerators and reactors.

Existing expertise in factory for producing large-scale superconducting magnets.

Structural studies of materials (superconductors and magnets using neutrons and positrons at the High-Flux Beam Reactor, photons at the National Synchrotron Light Source) and electron microscopy.

Collocation of High-Flux Beam Reactor, National Synchrotron Light Source, STEM, and protein data bank to study biological systems.

Expertise in advanced instrumentation for research.

Expertise in probabilistic risk assessment.

Ability to form integrated teams of basic and applied researchers.

Partnerships and Collaborations

User Programs:
- Alternating Gradient Synchrotron: 800 experimentalists from 100 institutions.
- Relativistic Heavy Ion Collider: 840 experimentalists from 88 institutions.
- High-Flux Beam Reactor: 190 experimentalists from 80 institutions.
- National Synchrotron Light Source: 2,300 experimentalists from 360 institutions (of which 70 are industrial institutions).

Current number of thesis students: 635.

Number of participating research teams at National Synchrotron Light Source and High-Flux Beam Reactor constructing and operating beamlines: 50.

Collaboration with hospitals and medical centers on radiation therapies for cancer and on brain imaging in neurological disease and substance abuse. Founder of organizations to improve industrial relationships (Long Island Research Institute, North East Waste Management Enterprise).

Strong connections with other Government agencies (Nuclear Regulatory Commission, NASA, National Institutes of Health, State Department, International Atomic Energy Agency). Major programs supporting these agencies in the fields of nonproliferation and reactor safety.

Extensive international agreements at governmental and institutional level (Japan, China, Russia, Korea, Germany, and France).

Brookhaven technology has been licensed to more than 215 companies.

Cooperative research and development agreements with more than 68 companies.

Cooperative programs with 7 (K–12) school districts and 10 colleges.

Significant Accomplishments

The Alternating Gradient Synchrotron (AGS) has been one of the most productive high energy facilities in the world. Over the years it has been in operation, the machine intensity has continued to increase so that the user community could explore new and exciting areas of particle physics. Significant contributions to our understanding of the nature of matter have been made. All experiments make important contributions to this mission. Of particular significance:
- Nobel Prize for discovery of a violation of a fundamental symmetry principle in the decay of neutral K mesons.
- Nobel Prize for discovery of the j / psi particle.
- Nobel Prize for work that suggested parity violation in weak interactions.
- Nobel Prize for demonstration of the existence of two kinds of neutrinos.
- Discovery of the Omega minus hyperon and of charm baryons.

The Relativistic Heavy Ion Collider (RHIC) is presently under construction, scheduled for completion in 1999. At that time, the AGS complex will be the basic injector for heavy ions into the collider rings. This new complex will provide the scientific community the means to recreate the unique conditions that existed in the universe at the earliest moments of its creation. New frontiers of science will be open.

The National Synchrotron Light Source (NSLS) is one of the largest user facilities in the world providing x-ray, ultraviolet, and infrared radiation for research in biology, chemistry, geology, material science medicine, metallurgy, and physics. The 85 beam lines provide resources to university, laboratory, and industrial users.

The High Flux Beam Reactor (HFBR) continues to be a major source for neutron studies in solid state nuclear physics, chemistry, and structural biology. The beam lines are complementary to those at the NSLS.

In the early years, BNL medical scientists developed the L-dopa protocol for the treatment of Parkinson's disease. This was one of the first available treatments for this debilitating affliction. The program in medicine and biology continued to move forward with the expanding production of radioisotopes for use by the medical community for diagnostics and treatment.

We are also moving in the direction of research that addresses problems in diagnosis and treatment of diseases. On-site resources such as Positron Emission Tomography (PET) and the Single Photon Emission Computed Tomography (SPECT) have already made major advances in these areas.

Clinical trials of a relatively new therapy for the treatment of brain cancer, Boron Neutron Capture Therapy (BNCT) are also under way.

Idaho National Engineering Laboratory

Laboratory Information

Name: Idaho National Engineering Laboratory

Location: Idaho Falls, Idaho

Contractor: Lockheed Martin Idaho Technologies

Budget: $802 million (FY 95)

DOE Programs

Environmental Management—Research, Technology Development, Applied Engineering, Site Restoration and Waste Management; Nuclear Energy; Energy Efficiency; Energy Research; and Defense Programs

Description

Idaho National Engineering laboratory (INEL) is a multipurpose laboratory with a distinctive role in applied engineering. It also conducts basic science, research and development, and complex facility operations. INEL addresses national needs by applying expertise in environmental management research (for example, prevention, remediation, and waste management); applied engineering and systems integration; nuclear operations and materials disposition; and transfer of derived-use energy and environmental technologies.

INEL, established in 1949, operates on an 890-square-mile tract in eastern Idaho. In 1994, DOE selected Lockheed Martin Idaho Technologies to manage the Laboratory. In partnership with DOE, Lockheed Martin has consolidated five separate operations, reduced costs, implemented a voluntary force reduction, established performance-based contracting, and chartered a new strategic direction for the Laboratory.

Major Facilities

INEL Research Center: Complex of multidisciplinary research and development facilities, including biotechnology, chemistry, materials, physics, optics, and nondestructive evaluation, serving government and industry customers. The newest facility, built for technology development and engineering demonstrations, is now operational.

Radioactive Waste Management Complex: Advanced research and engineering facilities for evaluating, testing, treating, and temporarily storing the radioactive and hazardous wastes from defense and research programs.

Specific Manufacturing Complex: Unique automated facility for engineering, development, and manufacturing of special materials like depleted uranium.

Idaho Chemical Processing Plant: Advanced facilities for research, examination, and temporary storage of spent nuclear fuel.

Advanced Test Reactor: World's largest and most versatile test reactor used for irradiating and testing advanced materials and producing isotopes.

National Environmental Research Park: One of five in the Nation where scientists conduct ecological studies.

Key Research and Development Activities

Developing technology and serving as DOE leader for the Mixed Waste, Low-Level Waste, TRU Waste, Spent Nuclear Fuel, and Plutonium programs.

As DOE's Center of Excellence for Systems Engineering, developing systems engineering techniques for Environmental Management.

Developing and demonstrating new environmental remediation technologies along with innovative use of private-sector capabilities.

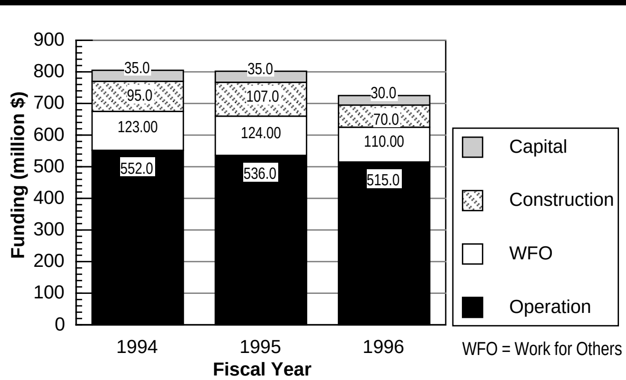
Conducting special materials development and production, for example, for Army tank armor that excelled in the Persian Gulf.

Developing technologies for interim and final storage of spent nuclear fuel.

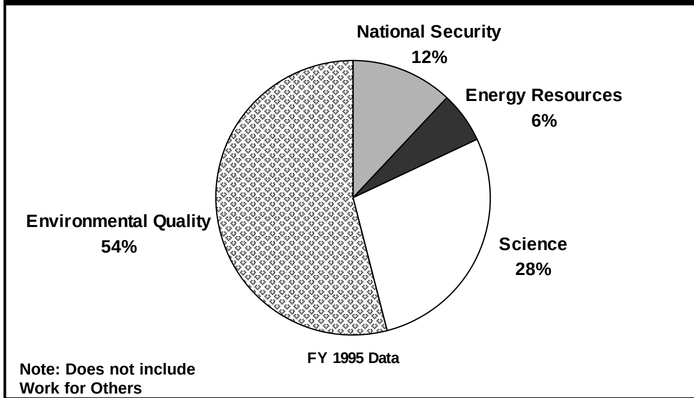
Conducting research and development in multiple disciplines for DOE's national security, energy, and science programs.

Directing a variety of technology partnerships worth more than $40 million, including a major neutron-based cancer treatment program.

Funding History



DOE Mission Footprint



Idaho National Engineering Laboratory

Distinctive Competencies

INEL core competencies are:

- Applied Environmental Science, Engineering, and Technology Demonstration
  —Environmental monitoring and characterization
  —Designing environmentally benign processes for DOE and Industry
- Processing and Management of Radioactive and Hazardous Materials
  —Processing and stabilizing spent fuel and hazardous/radioactive waste
  —Environmental remediation and restoration
- Engineered Systems and Processes; Development, Modeling, Testing, and Validation
  —Thermal hydraulic code development and reactor safety analysis research
  —Probabilistic risk analysis development and severe accident research
  —Nuclear plant aging and life extension research
- Complex Engineering-Economic Systems Analysis and Integration
  —Systems engineering integration for disciplined problem solving

INEL's core competencies are based upon outstanding capabilities in a wide range of technical disciplines, including bioprocessing, chemical separations and processing, materials and structural integrity, robotics and intelligent control, sensing and diagnosis, earth science, nuclear science, information resources science, systems simulations, systems engineering, project management, and other engineering disciplines.

Partnerships and Collaboration

National Programs: INEL partners with other DOE laboratories and external entities as the lead lab for the Mixed Waste, Low-Level Waste, and Spent Nuclear Fuel programs.

DOE-Industry Environmental Partnerships: In projects like PIT 9, INEL collaborates with private partners in DOE environmental technology development and demonstration programs.

DOE-Agriculture-Industry Partnerships: INEL, through its leadership role in the cooperative agreement between DOE and the U.S. Department of Agriculture, uses its engineering resources to provide innovative technologies to solve the production problems of the agriculture and food sectors. Through both government and industry partnerships, INEL is working to reduce the energy and environmental impacts of food and fiber production.

DOE-Industry-Government Partnership: Government and industry are forming a consortium to raise the investment capital to construct a large demonstration facility for full-scale structures testing with simulated natural hazards and hostile actions.

DOE-Industry-Region-State Partnerships: Through the DOE Office of Propulsion, industry's Partnership for a New Generation of Vehicles, and the Idaho Transportation Consortium, INEL is a resource for transportation technology development and deployment in areas such as materials, alternative fuels, and manufacturing processes. INEL is active in numerous government-industry partnerships serving market sectors including defense, textiles, oil and gas, and manufacturing.

DOE-Justice-National Institute of Justice Partnership: INEL, the Department of Justice, and the National Institute of Justice are developing and applying the latest technologies to solve specific law-enforcement problems. Through the newly established Center for the Advancement of Law Enforcement Technology, INEL introduces new technologies and assists regional law-enforcement agencies.

Isotope Partnerships: INEL works with DOE and its medical, defense, and industrial customers to produce vital radioactive isotopes and develop new methods for producing isotopes.

Nuclear Reactor Partnerships: INEL has an ongoing partnership with regulators and industry, in the United States and abroad, to assure and improve nuclear reactor safety. Through the International Thermonuclear Experiment Reactor project, INEL provides program leadership and technical expertise related to fusion reactor safety, environmental protection, and standards development. INEL provides staff to the International Atomic Energy Agency in Vienna, Austria, to conduct fusion safety development, and also provides program leadership and technical expertise to the International Criticality Safety Benchmark Evaluation Project, a part of the Organization for Economic Cooperation and Development's Nuclear Energy Agency.

Education, Research, and Technology Development: INEL sponsors a multimillion-dollar annual research and development program. An innovative component of this program is the newly established University Research Consortium, headed by Massachusetts Institute of Technology. INEL also supports students and faculty from the elementary school level through the post graduate level, amounting to 4,400 students in outreach programs and 323 researchers in laboratory programs.

Idaho National Engineering Laboratory

Significant Accomplishments

RELAP: INEL developed and continually updates the world renowned, state-of-the-art computer code for nuclear reactor safety analysis, RELAP/MOD3. A leader in nuclear reactor thermal-hydraulics, INEL developed analytical modeling techniques for predicting the behavior of reactors under transient and accident conditions. The wide acceptance of RELAP5 as the world's standard is signified by the number of countries that had entered into bilateral agreements as of the end of 1995: Argentina, Belgium, Bulgaria, Czech Republic, Finland, Germany, Hungary, Italy, Korea, Lithuania, Netherlands, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, and the United Kingdom.

Pit 9: Pit 9 is the first privatized environmental remediation demonstration project of its kind at a DOE facility. INEL will demonstrate the use of remote retrieval technologies to safely remove soils and waste from Pit 9, separate radionuclides and hazardous chemical wastes from soils, destroy the organics, and transform the remaining waste into a glass-like material that exceeds waste disposal requirements. The technologies, with little or no modification, may be applied to similar wastes buried and stored at other DOE facilities, thereby reducing the cost of technology development. Modular facilities successfully demonstrated at INEL will also eliminate the need for designing and constructing permanent remediation facilities at each DOE site. Secretary O'Leary has emphasized that this is DOE's first step in cleaning up the buried waste at INEL. The Pit 9 contract provides DOE several significant advantages, including cost savings, demonstrating technologies that may be applicable to other DOE sites and achieving a more rapid cleanup of waste sites.

Nuclear Medicine: Boron Neutron Capture Therapy (BNCT) is an experimental radiotherapy that offers significant promise of a more effective treatment for certain highly malignant, refractory brain tumors that currently are uniformly fatal within a few months of diagnosis. INEL made significant contributions to the national BNCT research effort, with notable roles in chemistry, physics, and biophysics. INEL is a national resource for analytical boron chemistry and for computational dosimetry and treatment planning of BNCT. Treatment planning for the currently ongoing series of human clinical BNCT trials at Brookhaven National Laboratory is performed using INEL developed software. Independent dosimetry computations are performed at INEL for each Brookhaven patient. INEL support to these clinical trials was recently acknowledged in a letter of commendation from Secretary O'Leary.

Nonproliferation and Counterproliferation Sensors: INEL has developed sensors and applied its sensor expertise to the problems of the nonproliferation and counterproliferation community in combating weapons of mass destruction (i.e., nuclear, chemical, and biological). Examples of INEL sensors include the Portable Isotopic Neutron Spectroscopy (PINS) sensor, which can determine the chemical contents of containers without opening them; the Secondary Ion Mass Spectrometry (SIMS) sensor, which can detect and identify minute traces of chemicals on the surface of materials; and the Fission Assay Tomography System (FATS), which can nonintrusively detect the presence and location of special nuclear materials. The INEL PINS sensor system has been applied many times within the United States and Russia and has been adopted by several agencies to verify arms control agreements.

Integrated Environmental Management: INEL established the EM Integration Office and introduced the systems engineering methodology to develop and implement the Environmental Management Integrated Plan (EMIP). The INEL Plan is the first in the complex to integrate activities from the DOE Office of Waste Management, the DOE Office of Environmental Restoration, the DOE Office of Technology Development, and the DOE Office of Facility Transition and Management. The strength of the systems engineering analysis led to a $31 million increase in scope over the DOE target during the initial FY 97 Internal Review Board. In the Plan, INEL makes major waste streams "road ready," satisfies the Waste Isolation Pilot Plant operations window, and achieves a $7 billion savings when compared with Baseline Environmental Management Report (BEMR) activities over the next 35 years. In the Plan, INEL also achieves a maximum volume reduction of waste destined for repositories, satisfies regulatory requirements, moves the waste out of Idaho in a timely manner, and significantly reduces the risk to people and the environment.

Ernest Orlando Lawrence Berkeley National Laboratory

Laboratory Information

Name: Ernest Orlando Lawrence Berkeley National Laboratory

Location: Berkeley, California

Contractor: University of California

Budget: $292 million (FY 95)

DOE Programs

Energy Research, Energy Efficiency and Renewable Energy, Environmental Management, Civilian Radioactive Waste Management

Description

The Ernest Orlando Lawrence Berkeley National Laboratory was established in 1931. Its mission is to perform leading-edge multidisciplinary research in the energy sciences, general sciences, and biosciences; to develop and operate unique national experimental facilities; to educate and train future generations of scientists and engineers; and to foster productive relationships among universities, industries, and national laboratories.

Major Facilities

Advanced Light Source: Produces the Nation's brightest beams of soft x-rays and ultraviolet light for research in the physical, chemical, biological, and earth sciences.

National Energy Research Supercomputer Center and the Energy Sciences Network: Providing leading-edge computational resources and the national network for the energy research community.

88-Inch Cyclotron: Produces the widest range of high-intensity and heavy ions in the U.S. for nuclear science.

Gammasphere: The premier national gamma ray detector with the world's highest resolving power.

National Center for Electron Microscopy: High-voltage and atomic resolution microscopes.

Biomedical Isotope Facility: Provides short-lived tracers for highest resolution PET and NMR medical imaging.

Key Research and Development Activities

Science

- Genome sequencing and structural biology; molecular and cell biology.
- Detector systems for high energy and nuclear physics.
- Molecular design, synthesis, and characterization of materials.
- Computer science and high-speed networks for scientific information systems, imaging, and visualization; virtual laboratories; remote experimentation and databases.
- Fundamental chemistry and chemical physics and reaction dynamics; surface science and catalysis.
- Materials physics and chemistry.

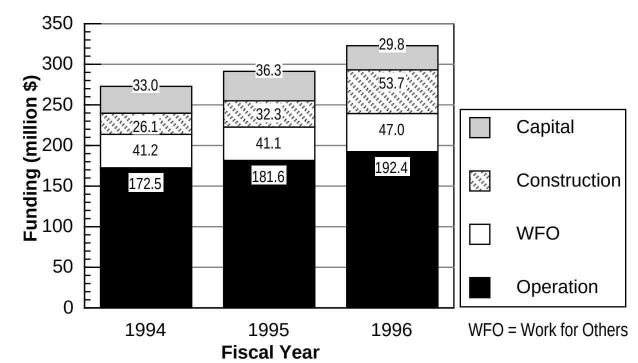
Energy Resources and Efficiency

- Buildings energy efficiency—window and lighting systems.
- Heavy ion drivers for inertial fusion energy.
- Electrochemical energy storage.

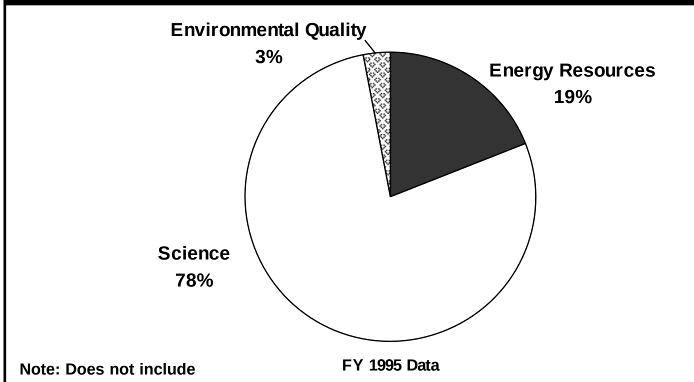
Environmental Quality

- Geosciences and georesources—subsurface characterization.
- Contaminant transport, fate, and effects.
- Environmental biotechnology.

Funding History



DOE Mission Footprint



Ernest Orlando Lawrence Berkeley National Laboratory

Distinctive Competencies

Bioscience and Biotechnology: Structural biology, genome research, bioinstrumentation, molecular cytogenetics, medical imaging, biology of human diseases, biomolecular design.

Particle and Photon Beams: Analysis and design of accelerators; beam dynamics; high-brightness ion, electron, and photon sources; advanced magnet design and R&D; high-frequency radiofrequency technology; x-ray optics and lithography; induction linacs and neutral beam for fusion energy.

Characterization and Synthesis of Materials: Advanced spectroscopies and microscopies based on photons, electrons, and scanning probes; ceramics; alloys; heterostructures; superconducting, magnetic, and atomically structured materials; bio-organic synthesis.

Advanced Technologies for Energy Supply and Energy Efficiency: Subsurface resources and processes, building technologies, electrochemistry, fossil fuel technologies, energy analysis.

Chemical Dynamics, Catalysis, and Surface Science: Reaction dynamics; photochemistry of molecules and free radicals; surface structures and functions; heterogeneous, homogeneous, and enzymatic catalysis.

Advanced Detector Systems: Major detectors for high energy physics, nuclear science, and astrophysics; scientific conception and project leadership; advances in particle and photon detection; implementation of new concepts in detector technology.

Environmental Assessment and Remediation: Advanced instrumentation and methods for environmental characterization and monitoring, human health and ecological risk assessment, indoor air quality, subsurface remediation of contaminants, geologic isolation of high-level nuclear waste, actinide chemistry.

Computation and Information Management: High-speed networking and distributed computing, processing and analysis of scientific images, data-acquisition and analysis systems, scientific information systems, and database technology.

Partnerships and Collaborations

Universities
- University of California, Berkeley: Genome sequencing, computational sciences, particle astrophysics and nanomaterials research.
- University of California, San Francisco: Breast cancer research and genetic probe development: advanced medical imaging.
- University of Utah: Mathematical programs for Single Photon Emission Computerized Tomography (SPECT).

Other Federal Agencies
- National Institutes of Health: Genomics, structure and metabolism of lipoprotein subclasses, red cell membrane studies.
- NASA: Specialized Center for Research and Training in Radiation Health, applicable to assessment of the radiation risk on extended space missions.
- Department of Defense: Molecular Design Institute for novel approaches in designing materials and devices.
- International Technical Assistance Program: low-cost UV-based water purification technology for remote area disaster relief.

State Agencies
- California Air Resources Board: Indoor sources of volatile organic compounds, emission rates and techniques for reducing exposures.
- California Institute of Energy Efficiency: Consortium research in energy efficiency and environmental impacts of energy use.

Industry
- Intel: New metrologies at the Advanced Light Source for ensuring defect-free silicon wafers for the next generation of semiconductor devices.
- AMTEX: A partnership of the U.S. fibers, textiles, and fabricated products industry and DOE, other government agencies, and universities.
- Spectrum Sciences: Ion implanter for very shallow (sub-100nm) semiconductor junctions for high-speed integrated circuits.
- Amgen: Develop biological factors that lead to new drugs for tendon and ligament healing.
- Dupont: Exploring catalytic mechanisms for reducing chlorofluorocarbons.
- Advanced Lithography Group: Development of an ion source for use in Ion Projection Lithography.
- Advanced Computational Technology Initiative (ACTI): Working with petroleum companies to improve reservoir simulations and production.
- Fusion Lighting: Next generation of fluorescent lamps and fixtures.

International
- Leadership in the ATLAS high energy physics detector at CERN.

Total annual collaborative research funding is approximately $50 million per year. The laboratory hosts more then 3,000 participating guests annually from around the world.

Ernest Orlando Lawrence Berkeley National Laboratory

Significant Accomplishments

Primordial Seeds From the Big Bang: Berkeley Lab announced the observation of ripples in the radiation afterglow of the primeval explosion that began the universe. These ripples are “hot” and “cold” regions in space, more than 100 million light years across with temperature differences of a hundred-thousandth of a degree. They are thought to be the primordial seeds from which our present-day universe grew. The ripples, discovered by astrophysicist George Smoot and his research team, came from data collected by the team’s experimental equipment mounted inside NASA’s Cosmic Background Explorer (COBE) satellite.

A Key to Breast Cancer: What may prove to be the single most important discovery in the fight against breast cancer is the ECM theory. This theory holds that there is a direct link between the development of breast cancer and a network of fibrous and globular proteins surrounding breast cells called the “extracellular matrix” or ECM. If the theory is true, then ECM is crucial to the normal functioning of cells and loss of or damage to the ECM can lead to malignancy. Each new ECM experiment has yielded valuable knowledge about both normal and breast cancer cells.

Catalytic Antibodies: Research that effectively expanded the genetic code from the 20 amino acids that nature provides to an exotic and potentially limitless array of synthetic amino acids won the Department of Energy’s Lawrence Memorial Award for the Berkeley Lab. Berkeley chemist Peter Schultz invented a technique that, for the first time, made possible the incorporation of unnatural amino acids with novel physical and chemical properties into proteins by combining important features of catalytic antibodies and hybrid enzymes that he synthesized.

Top Quark Detection: The discovery of the top quark, the last of the six quarks predicted by the Standard Model of particle physics and one of the fundamental building blocks of matter, was a project that involved Berkeley Lab scientists and engineers in both of the project’s experiments—the Collider Detector Facility (CDF) and the D-Zero. One of the most important contributions of Berkeley Lab was the design of a sophisticated microchip for the Silicon Vertex Detector, an extremely high resolution instrument in the central CDF detector system.

Discovering Radon Exposure: Berkeley Lab was where the threat to American homes posed by radon was discovered. Studies headed by Berkeley Lab’s Anthony Nero have shown that radon enters buildings through cracks and pores in foundations. Exposure to radon gas in U.S. homes is thought to account for as many as 10,000 cases of lung cancer each year. Reliable predictions of the danger areas are needed for a cost-effective nationwide remediation program.

Predicting the Performance of Materials: Berkeley Lab scientists created the first-ever harder-than-diamond crystals and proved that computer models can play an effective role in the development of new materials. The new superhard crystal, a compound of carbon and nitrogen, was made from a recipe arrived at solely by theoretical calculations. Marvin Cohen, a solid-state physicist, was able to calculate that substituting carbon for silicon in the crystal structure of silicon-nitride would yield a superhard carbon-nitride. Without Cohen’s model, experimentalists might never have tried carbon nitride.

The Multicast Backbone (M-Bone): An amazing new technology called the Multicast Backbone or M-Bone was developed by a three-man team that included computer scientist Van Jacobson of Lawrence Berkeley Lab. M-Bone makes possible a virtual Internet, an electronic window through which users worldwide can not only see and talk to one another, but can work together on a shared “whiteboard.” M-Bone is designed to dynamically construct what are called “information distribution trees” using the shortest and most efficient routes.

Lawrence Livermore National Laboratory

Laboratory Information

Name:	Lawrence Livermore National Laboratory
Location:	Livermore, California
Contractor:	University of California
Budget:	$945 million (FY 95)

DOE Programs

Defense Programs, Energy Research, Nonproliferation and National Security, Environmental Restoration and Waste Management

Description

Lawrence Livermore National Laboratory (LLNL) is a multiprogram laboratory established in 1952. Its mission is focused on national security, with additional programs in energy, the environment, and bioscience, and a special scientific responsibility for the Nation's nuclear weapons through their full life cycle. Livermore applies an unmatched capability in laser science and technology, from x-rays to microwaves, to these programs. It has used the technical expertise acquired in defense work to achieve major national innovations ranging from uranium enrichment to space technology. In September 1995, the President announced his decision that the continued vitality of the three nuclear weapons laboratories was essential to meeting the challenge of ensuring the safety and reliability of the Nation's nuclear weapons stockpile.

Major Facilities

Nova Laser: Inertial fusion research.

High Explosives Applications Facility: Energetic materials research.

Flash X-ray Facility: Hydrodynamic tests.

Conflict Simulation Laboratory: Unit-scale simulation of regional, urban, and incident-based conflict situations.

Atomic Vapor Laser Isotope Separation Facility: Plant-scale demonstration of uranium enrichment.

Livermore Computer Center: Supercomputer center.

National Energy Research Supercomputer Center (1975 to 1996).

Atmospheric Release Advisory Capability and Global Climate Modeling Center.

Center for Accelerator Mass Spectrometry: Micro-trace analysis for biology, archeology, climatology, and environmental analysis.

Forensics Laboratory: Intelligence and incident analysis.

Characterized Environmentally Remediable Site: Characterized in geology, hydrology, and contaminants for remediation technology demonstrations.

Large Optic Diamond Turning Machine: Precision machining of metals and optics.

Key Research and Development Activities

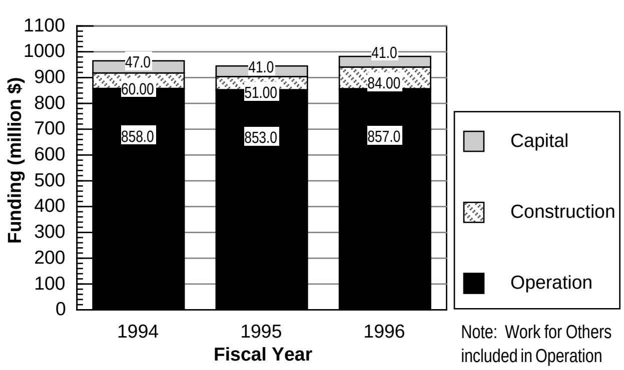
National Security: Stewardship of the nuclear weapons stockpile; Arms control, nonproliferation, and treaty verification technology; Dismantlement and disposition; Inertial fusion; Advanced conventional weapon technologies.

Energy: Inertial fusion; Magnetic fusion and the International Thermonuclear Experimental Reactor; Atomic vapor laser isotope separation; Nuclear systems safety; Fossil energy; Hydrogen energy; Conservation; Advanced manufacturing and transportation technology; Advanced process technology.

Environmental Quality: Environmental research and environmental technology; Global climate and atmospheric release modeling; Dynamic stripping and bioremediation; Civilian radioactive waste disposal; Mixed waste treatment.

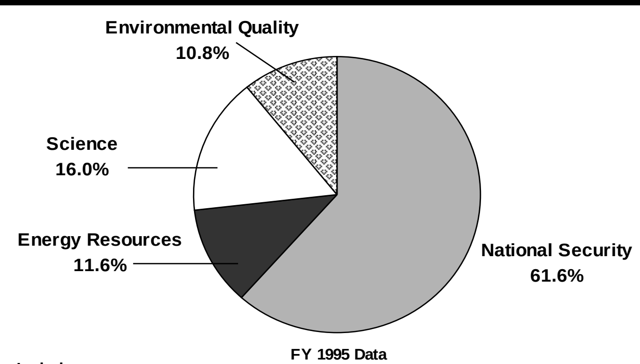
Science: Basic energy sciences; Materials; Astrophysics and high energy physics; Geophysics; Optical sciences and systems; Satellite technology; Biomedical science, including a National Genome Research Center; Healthcare technology; Forensic science; Atmospheric and oceanic sciences; Industrial ecology; Manufacturing and transportation technology; Metrology and nondestructive evaluation; Industrial partnering; University research collaborations; Science education.

Funding History



Note: Work for Others included in Operation

DOE Mission Footprint



Note: Includes Work for Others

Lawrence Livermore National Laboratory

Distinctive Competencies

We have 7,300 employees, of whom more than 1,200 have Ph.D.s and more than 5,100 have scientific, engineering, technician, or craft skills in fields ranging from physics and chemistry to computer science, all engineering disciplines, biology, and environmental science. We identify the following as specific areas of competency:

- Nuclear Science and Technology: Nuclear weapon physics, design, and test; nuclear arms control, nonproliferation, and counterproliferation; high energy density plasma physics; thermonuclear and fission physics and engineering; astrophysics; nuclear system safety; nuclear waste management.
- Lasers and Electro-optics: Laser technology and systems for fusion, isotope separation, radar, medical, and commercial applications; glass, crystal, diode, gas, metal vapor, dye, and free electron lasers.
- Computer Simulation of Complex Systems: Models with experimental validation of basic phenomena, processes, and engineered systems, from biomolecules to global climate, from tomography and military conflict to satellite and laser systems.
- Advanced Sensors and Instrumentation: Detection, signal processing, and visualization of biological, thermonuclear, hydrodynamic, astrophysical, and global/planetary phenomena; ultrasensitive chemical and extreme spatial, temporal, and wavelength resolution detectors.
- Biotechnology: Cell and chromosome sorting and diagnostics; genetics, genomics, and DNA mapping and sequencing; molecular biology; disease susceptibility; carcigenicity; healthcare technology.
- Advanced Process and Manufacturing Technology: Chemical, biological, and photon processes; advanced materials production and utilization; precision machining; microfabrication; nondestructive evaluation; automation; hazardous and special materials handling and processing; advanced energy and transportation systems.

Partnerships and Collaborations

Worked closely with Los Alamos, Sandia, and DOE Defense Programs to define the science, technology, and facility requirements and plan for the Stockpile Stewardship and Management Program.

Have completed or ongoing more than 200 projects with the former Soviet Union nations involving civilian technology commercialization and environmental cleanup—for example, a mobile environmental monitoring station for Belarus and robots for the cleanup of Chernobyl.

Developed the sensors and compact satellite technology for the successful DOD-DOE-NASA Clementine mission (also involving NRL and several private-sector partners), launched in 1994, which mapped the entire Moon and inventoried the Moon's surface minerals.

Formed a consortium of national laboratories, industry, and universities to plan, construct, and then utilize the National Ignition Facility to study thermonuclear physics and hopefully achieve ignition and energy gain from inertial fusion.

Designing and building accelerator systems to investigate the nature of matter and antimatter at the SLAC B Factory with Stanford University and Berkeley Laboratory, and particle detectors with Brookhaven Laboratory for the Relativistic Heavy Ion Collider and the Alternating Gradient Synchrotron.

Founded both the Alameda Center for Environmental Technologies and the California Environmental Enterprise with Sandia and Berkeley Laboratories, local universities, local government agencies, and private-sector firms to commercialize environmental technology.

Transferring Atomic Vapor Laser Isotope Separation technology to the U.S. Enrichment Corporation, the largest technology commercialization in DOE history, to provide the Nation with the opportunity to regain market dominance in the multibillion-dollar world market for reactor fuel.

Work for DOD, NASA, the U.S. Enrichment Corporation, NIH, and other federal and non-federal agencies accounts for about 21 percent of our activities; work for other DOE contractors is about 9 percent.

Provide research opportunities for more than 600 university researchers each year through 13 special facilities and institutes ranging from planetary physics and astronomy to human genetics. One such collaboration has now identified massive compact halo objects (MACHOs) as containing at least half of the universe's mysterious dark matter.

Have spawned more than 100 companies. Currently have 182 cooperative research and development agreements with 200 U.S. companies, ranging from agile manufacturing to zero-pollution automobiles. Approximately 90 patents per year are issued for our work. Our micropower impulse radar alone is generating the most commercial licensing income ever received by a DOE laboratory.

Lawrence Livermore National Laboratory

Significant Accomplishments

Stockpile Stewardship and Management: Working with DOE Defense Programs, we have responded to the challenge issued by the President and changing national security requirements by managing the dismantlement of retiring weapons and developing a comprehensive national program to assure confidence in the enduring stockpile without nuclear testing. The Stockpile Stewardship and Management Program, developed in an intense effort over the last two years, enabled presidential decisions to pursue a CTBT with no permitted nuclear weapon tests and to ensure the safety and reliability of the stockpile through computer simulation and experimental programs at the three weapons laboratories.

Inertial Confinement Fusion: LLNL's Inertial Confinement Fusion (ICF) has met its technical performance objectives in all areas, setting the stage for demonstration of thermonuclear fusion ignition with the National Ignition Facility (NIF), which will be a cornerstone of the stockpile stewardship program. Supported by DOE Defense Programs, LLNL met established goals in target ignition physics, which provide the technical basis for the expectation of achieving ignition and gain at the NIF. Laser and optics technology development in our ICF program support performance, schedule, and cost goals of the NIF. In addition, about one-third of the Nova laser experiments performed at LLNL each year involve targets relevant to weapons physics.

Sensor Technologies for National Security and Scientific Applications: LLNL has developed ultratrace detection capabilities, unattended ground-based sensors, and remote sensing instrumentation used to map the moon, to monitor arms control treaties, and to reduce the dangers posed by proliferation. With support from the DOE Office of Nonproliferation and National Security, LLNL-developed detection capabilities and sensors are being used to verify arms control treaties, to support the U.N.'s monitoring program in Iraq, to identify and characterize foreign proliferation activities, to help secure nuclear materials in the former Soviet Union, and to detect nuclear smuggling. We also developed for the DOD Ballistic Missile Defense Organization the sensor suite for the Clementine Deep Space Experiment, which collected more than 1.7 million images of the moon and demonstrated technologies that provide the basis for a next generation of lightweight satellites for civilian and military missions.

Atomic Vapor Laser Isotope Separation (AVLIS) Development: The AVLIS technology has been successfully demonstrated at plant scale, and the United States Enrichment Corporation (USEC) has decided to take the first steps to construct and operate and AVLIS enrichment plant. USEC's decision to take steps to commercialize AVLIS is a critical milestone in a two-decade-long development and technology-transfer program at LLNL in which the DOE invested $1.4 billion. AVLIS will provide an economical, environmentally improved method to enrich uranium for light-water reactor fuel.

Mapping and DNA Sequencing of Human Chromosome 19: As a result of an intense 5-year effort that included the development of many new research and analytical techniques, we have assembled a high-resolution map of human chromosome 19. One of the most detailed maps completed to date, this unique resource helps researchers worldwide identify genes on chromosome 19 and to characterize the diseases with which they might be associated. Supported by DOE's Office of Health and Environmental Research, our efforts were enabled by key breakthroughs made by LLNL researchers that led to methods for high-speed sorting of individual chromosomes (flow cytometry) and for measuring distances between DNA markers (fluorescence in situ hybridization, or FISH).

Los Alamos National Laboratory

Laboratory Information

Name: Los Alamos National Laboratory
Location: Los Alamos, New Mexico
Contractor: University of California
Budget: $1,183 (FY 95)

DOE Programs

Defense Programs (Multiprogram Laboratory), National Security, Science and Technology, Environmental Quality, Energy Resources.

Description

Los Alamos National Laboratory (LANL) is a multiprogram laboratory established in 1943. Its central mission is reducing the global nuclear danger, which involves five areas: Stockpile Stewardship, Stockpile Support, Nuclear Materials Management, Non Proliferation and Counter proliferation, and Environmental Stewardship. A distinguishing feature of LANL is its work in nuclear science. The Laboratory is also responsible for maintaining the safety and operability of the physics package of the Nation's nuclear weapons. Los Alamos also applies its expertise to key conventional defense and civilian issues that are synergistic with its central mission and capabilities.

Major Facilities

TA–55 Plutonium Facility: Weapons stockpile stewardship, pit surveillance and dismantlement, actinide research, NASA fuel projects, nuclear waste management and treatment.

Laboratory Data Communication Center and Advanced Computing Laboratory: Central computing facility plus state-of-the-art laboratory for advanced, high-performance computing.

Neutron Science Center (LANSCE): National user facility. Includes the Lujan Neutron Scattering Center, the Weapons Neutron Research Facility, one of the world's most powerful proton linear accelerators, and the proton storage ring. LANSCE supports advanced materials science, nuclear science, particle-beam technology, nuclear weapons science, bioscience, and chemistry.

Chemistry and Metallurgy Research Facility: Plutonium metallurgy, advanced chemical diagnostics, nuclear and radiochemistry.

Materials Science Laboratory: Materials research and development center and user facility. Experiments in high-temperature superconductivity and materials modification and analysis, using ion beams and lasers.

Health Research Laboratory: Center for human genome studies, biological research, molecular biology, biochemistry, genetics.

Key Research and Development Activities

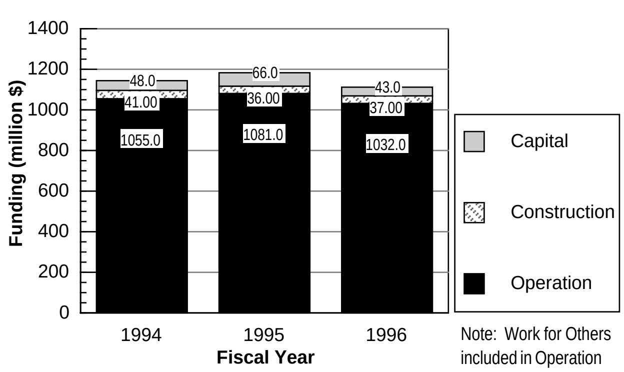
National Security: Weapons Stockpile Stewardship—Computation and Modeling, Weapons Stockpile Management and Support; Nonnuclear Configuration; Materials Support; Fissile Materials Disposition; Accelerator Production of Tritium; Proliferation Deterrence, Detection, and Response.

Science: *Note—these are only the activities that do not come under the other DOE mission areas.* Nuclear and High Energy Physics, such as research for neutrino oscillations; Basic Energy Sciences, such as development of advanced materials; Fusion Energy; Biological and Environmental Research, including the Human Genome Project; and the Science and Math Education Program, which gives students and teachers unique experiences by tying projects to lab programs and capabilities.

Environmental Quality: Environmental Restoration, Waste Management, Pollution Prevention, Independent Technical Assessments, Environmental Technology Development.

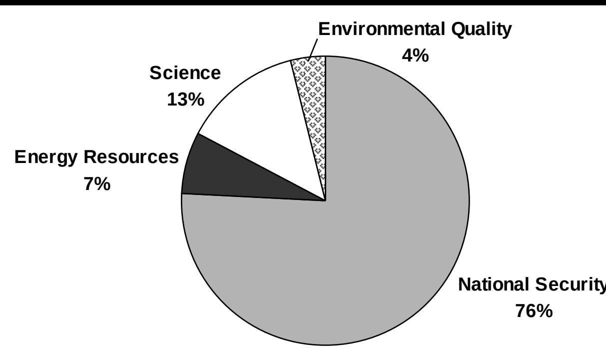
Energy Resources: Energy and renewable energy research such as high-temperature superconductivity, proton-exchange membrane for fuel cells, and advanced computer programs for designing cleaner combustion systems. Energy technology such as simulation of transportation systems, air quality, nuclear waste management (for example, characterizing the Yucca Mountain site), and medical isotope production.

Funding History



Note: Work for Others included in Operation

DOE Mission Footprint



Note: Does not include Work for Others

FY 1995 Data

Los Alamos National Laboratory

Distinctive Competencies

Theory, Modeling, and High-Performance Computing: Solving complex technical challenges by combining fundamental theory and numerical solution methods with the power of high-performance computing to model a broad range of physical, chemical, and biological processes.

Complex Experimentation and Measurements: Experiments involving novel sources (accelerators, high-power lasers, high explosives, and pulsed-power systems); measurements using multidisciplinary suites of diagnostics or unique measurement systems; special facilities for hazardous materials and processes.

Analysis and Assessment: Integrating basic theory and experimental data across disciplines into realistic simulation models, validating the models, and integrating them into computer programs for unbiased assessment of complex systems.

Nuclear and Advanced Materials: Synthesis, processing, and application of nuclear and advanced materials. Capabilities in metals, ceramics, polymers, and electronic materials in bulk and thin-film forms. Includes ability to cast, forge, extrude, draw, form, and machine materials into complex, microscopic to massive shapes.

Nuclear Weapons Science and Technology: Physics of nuclear weapons design; large-scale calculations of weapons and weapons phenomena; design, specification, and integration of weapons components; science of weapons materials and properties; experimental measurement, testing, and diagnostics.

Earth and Environmental Systems: Integrating discipline-oriented knowledge in earth, environmental, space, chemical, biological, physical, and engineering sciences with skills in theory, modeling, and measurement to solve environmental, energy, and national security problems.

Bioscience and Biotechnology: Integrating molecular and cellular biology, cytology, structural biology, theoretical biology, spectroscopy, biochemistry, biophysics, and biomedical engineering to study life processes, living organisms, and human health. Involves collaboration between experimentalists and theorists; interactions among physical sciences, life sciences, and engineering; outstanding computer facilities and expertise; and unique facilities.

Nuclear Science, Plasmas, and Beams: Nuclear and particle physics, astrophysics, nuclear chemistry, plasma physics, accelerator technology, laser science, and beam physics and applications (neutron scattering, transmutation technologies, plasma processing radiography, microphotography, inertial fusion, and defense applications). Integrates capabilities from the origin of the beam to its end-use.

Partnerships and Collaborations

Los Alamos is involved in collaborations with other Federal agencies, universities, and industry. This broad spectrum of partners reflects the fact that Los Alamos is truly a national laboratory.

Government agencies sponsoring research and development at Los Alamos include NASA, the National Institutes of Health, the Advanced Research Projects Agency, the Social Security Administration, the Environmental Protection Agency, the U.S. Postal Service, the Department of Transportation, the Internal Revenue Service, the Federal Bureau of Investigation, the National Science Foundation, the Department of Defense, and others. The National Institutes of Health sponsored 23 significant projects at Los Alamos in 1995, including studies of the immune system, tumor biology and therapy, respiratory system functions, and brain functions. NASA sponsored 39 significant projects, including analysis of data gathered by space probes, turbine engine development, and instrumentation for space probes. The Environmental Protection Agency sponsored research on removing pollutants from liquid waste streams and developing alternatives to processes that use hazardous solvents. A sampling of projects sponsored by other agencies includes development of components for flat-panel video displays, instrumentation for soil analysis, analysis of traffic flows in the Nation's transportation systems, development of a low-cost electrode fabrication process for electronics, developing processes to allow acid recycling, and the design and construction of a device to destroy air toxics.

Los Alamos carries out collaborative research with well over 230 universities worldwide. Of the Laboratory's 1,534 journal publications in 1995, at least 930 were coauthored with university faculty. University collaborations include participation in institutes such as the Institute of Geophysics and Planetary Physics and the Institute for Nuclear and Particle Astrophysics and Cosmology. In addition, 51 designated user facilities attract university and industry participants to the Laboratory.

Several dozen projects were sponsored by corporations and industrial organizations. A sampling of Industry-sponsored projects includes fuel cell studies for General Motors, integrated circuit manufacturing processes for Intel, and a process for producing nylon for DuPont. These sponsored programs are supplemented with other collaborative arrangements including, for FY 95, 159 technical assistance agreements, 37 cooperative research and development agreements, and 35 licenses.

Los Alamos also provides expertise to international partners and includes collaborations with Argentina, Brazil, Canada, China, Germany, Japan, Mexico, Ukraine, and the United Kingdom. It is the lead laboratory in the U.S.-Russian Nuclear Materials Protection, Control, and Accounting Program, involving five other DOE laboratories and more than eight Russian institutes and facilities. It plays a leading role in the development of the Industrial Partnering Program with the newly independent states of the former Soviet Union, involving more than 60 former Soviet institutes and more than 2,000 scientists. For example, LANL provides expertise that includes software, instrumentation, and training to provide foreign partners with the capability to ensure safe operation of nuclear reactors and institutes nuclear safeguards and verification techniques associated with the control, accountability, and protection of nuclear materials. LANL also collaborates in other technical areas, such as the work being performed for Mexicano Del Petroleo to understand sources and migration paths of air particulates and to identify options for particulate control and air quality management in Mexico City.

Los Alamos National Laboratory

Significant Accomplishments

Science-Based Capabilities for Stockpile Stewardship: The most important recent accomplishment of the Los Alamos nuclear weapons program is the development of the science base needed to ensure the safety and reliability of U.S. nuclear weapons in the absence of nuclear testing. This capability will allow the United States to enter into a zero-yield comprehensive test-ban treaty, a regime of great importance for world stability. Stockpile stewardship relies on three closely interconnected areas of technology to provide the basis for continued certification and reliability: surveillance technologies that allow us to examine and diagnose aging phenomena in stockpile weapons; calculational and experimental technologies that allow us to assess and evaluate the safety and performance of each weapon; and new manufacturing technologies that allow us to respond appropriately to the results of the assessments. The capability includes the restart of nuclear weapon pit surveillance with several new technologies, new developments in computational weapons simulation, accelerator production of tritium, the Dual-Axis Radiographic Hydrodynamic Test Facility, and demonstration of high-energy proton radiography. Results of this science-based stewardship include evaluation of the effect of an isolated defect in a stockpile weapon and a life-extension program for another system.

Lab-to-Lab Program: Working with our Russian counterparts on problems of common interest and concern is key to successfully reducing the nuclear danger. Los Alamos is leading a multi-laboratory effort that is rapidly improving nuclear materials protection, control, and accountability (MPC&A) in Russia. Under the lab-to-lab program, we are working with the two nuclear weapons design laboratories in Russia, Arzamas-16 and Chelyabinsk-70, as well as at the Kurchatov Institute and nuclear production institutes. Multi-laboratory steering groups have been formed in both countries to oversee the MPC&A improvement program and to unite the six US national laboratories and eight Russian technical institutes participating in the program. The U.S. laboratories, under Los Alamos leadership, have been the principal instrument for managing the program and providing technical support and equipment. Enhanced MPC&A systems already have been demonstrated and implemented at several of the Russian institutes during the short life of this program.

Environmentally Benign Plutonium Recovery System: Essential to reducing the nuclear danger is maintaining the minimum-necessary inventory of stockpile materials while safely storing the surplus and planning for its disposal. In pursuing options for disposition of plutonium, Los Alamos has developed the hydride/dehydride process for converting surplus plutonium pits into a stable, unclassified, assayable form not directly usable in nuclear weapons, but suitable for long-term storage. Winner of a 1995 R&D 100 Award, the low-waste process and relatively simple hardware are being used in the disposition of surplus U.S. nuclear weapons and may well play a significant role in both disarmament and nonproliferation.

High-Temperature Superconductors: The Laboratory's materials science researchers have developed a new fabrication technique for high-temperature superconductors, now under commercial license. In 1995 Los Alamos scientists achieved world-record current densities of more than 1 million amperes per square centimeter at liquid nitrogen temperature (77 degrees Kelvin) in a flexible, high-temperature superconductor. These results were a 100-fold increase over the previous record. Subsequently, they developed a revolutionary high-temperature superconductor wire technology. The thick-film technology utilizes YBCO layers on an oriented buffer layer on a substrate to produce thick films capable of carrying current density of more than 1 million amperes per square centimeter. These current densities were the highest reported to date. Los Alamos continues to be a leader in thick-film technology, collaborating with industrial partners on the development and application to electric power systems. This technology represents a new milestone in superconductivity and is a giant step toward applications in national security and environmental stewardship, as well as in commercial applications ranging from medical diagnosis to mass transportation.

Geodynamic Simulation: In 1995 a Los Alamos researcher, in partnership with a colleague from the University of California at Los Angeles, performed a complex, self-consistent, three-dimensional simulation of the Earth's magnetic field, starting from first principles, that for the first time predicts reversal of the field. They were able to simulate a magnetic field that is stable for more than 40,000 years with a reversal of the polarity of the field occurring near the end of the simulation. This work has become internationally recognized as the leading computer modeling study of the generation of the Earth's magnetic field. It contributes directly to the Laboratory's core competencies in theory, modeling, and high-performance computing and in earth and environmental systems, which strongly support the Laboratory's national security mission.

Oak Ridge National Laboratory

Laboratory Information

Name: Oak Ridge National Laboratory
Location: Oak Ridge, Tennessee
Contractor: Lockheed Martin Energy Research Corp.
Budget: $548 million (FY 95)

DOE Programs

Energy Research, Environmental Management, Energy Efficiency and Renewable Energy, Nuclear Energy, Defense Programs, Environment, Safety, and Health, Fossil Energy

Description

Oak Ridge National Laboratory (ORNL) is a multiprogram laboratory focusing on national and global energy and environmental issues. Founded in 1943, ORNL pioneers the development of new energy sources, technologies, and materials and the advancement of knowledge in the biological, chemical, computational, engineering, environmental, physical, and social sciences. ORNL's mission is to conduct basic and applied research and development to advance the Nation's energy resources, environmental quality, and scientific knowledge and to contribute to educational foundations and industrial competitiveness.

Major Facilities

High-Flux Isotope Reactor: World's highest neutron flux; isotopes for industry, medicine, and research; excellent source of neutrons for condensed-matter investigations.

Holifield Radioactive Ion Beam Facility: First U.S. radioactive ion beam facility devoted to low-energy nuclear structure and nuclear astrophysics research.

Mouse Genetics Facility: Houses 200,000 mice; unique strains, including lines developed to model human diseases.

High-Temperature Materials Laboratory: Collaborative research on advanced ceramics and alloys; extensive capabilities for materials characterization.

Oak Ridge National Environmental Research Park: Total of 21,500 acres for environmental research and education.

Center for Computational Sciences: Intel Paragon XP/S 150 is among the world's most powerful computers.

Buildings Technology Center: Allows U.S. building industry access to a unique collection of testing and analysis capabilities.

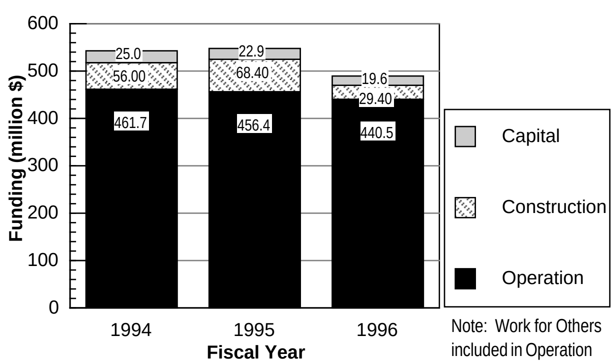
Key Research and Development Activities

Science: Materials science and engineering—High-temperature intermetallic alloys and advanced ceramics; Neutron science—neutron source design, neutron scattering, neutron activation analysis; Analytical and separation chemistry; Biomedicine, biotechnology, and genetics research; Nuclear physics and astrophysics with radioactive ion beams.

Energy Resources: Energy-efficient technologies for buildings, industrial, transportation, and utility end-use; Biomass—renewable energy feedstock and conversion technology; Fossil Fuel—applied materials and turbines; Fusion science and technology; Nuclear technology and safety.

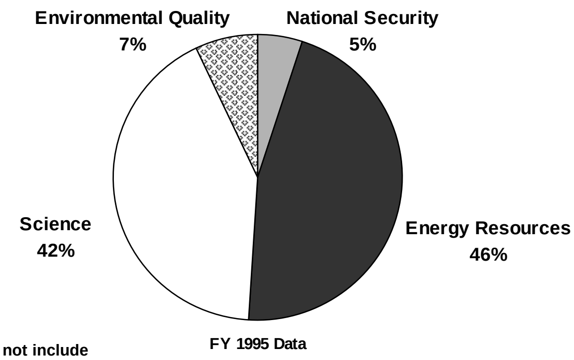
Environmental Quality: Health effects of energy-related substances; Environmental systems, risk assessment, and technology; World climate and carbon data analysis for international community.

Funding History



Note: Work for Others included in Operation

DOE Mission Footprint



Note: Does not include Work for Others

Oak Ridge National Laboratory

Distinctive Competencies

Integration of basic and applied R&D with broad partnership base: biological, environmental, and social sciences; physical, chemical, and materials sciences; engineering science; computational science and informatics.

Extensive high-performance computing capability with specific application to modeling and simulation of complex systems.

Socioeconomic and technology impact analysis and R&D for sustainable development.

Advanced instrumentation (biological, chemical, nuclear): electronics, photonics, imaging, and signal processing.

Control, robotics, and manufacturing technology.

Partnerships and Collaborations

ORNL's programs are characterized by extensive collaboration. ORNL interacts with many other Department of Energy national laboratories. Research contracts are in place with more than 100 universities from more than 35 states. More than 1,000 companies and representatives from more than 80 countries also collaborate with ORNL. More than 70 percent of ORNL's journal publications are coauthored with other institutions.

- In FY 1995, ORNL hosted more than 4,000 guests (those staying two weeks or longer), including 1,600 from industry. ORNL's 14 user facilities provide the focus for many interactions.
- ORNL has more than 220 cooperative research and development agreements with partners ranging from large corporations to small companies, with a dollar value exceeding $200 million. Multiorganization ventures include the following:
  - The Partnership for a New Generation of Vehicles, a cooperative venture involving seven Federal agencies and the Big Three automakers.
  - The American Textile Partnership involves 10 national laboratories; ORNL is the lead laboratory for Computer-Aided Fabric Evaluation and On-Line Process Control.
  - The High-Temperature Superconductivity Consortium has resulted in 35 collaborative agreements generating $17 million in program cost sharing from industry.
  - Industries of the Future involves partnerships with the chemical, pulp and paper, metals, glass, and petroleum refining industries.
  - The Buildings Technology Center has established industrywide partnerships to develop advanced heat pumps and chlorine-free refrigerants, and to test components of the building envelope.
- ORNL places a strong emphasis on regional collaboration. ORNL and the University of Tennessee are partners in the Science Alliance, and joint institutes covering both research and education exist for computational science, heavy ion science, energy and environmental science, and molecular-based engineering. Other regional partners include the Knoxville Police Department, the Tennessee Valley Authority, the Oak Ridge Institute for Science and Education, the Appalachian Regional Commission, minority educational institutions, and area primary and secondary schools. For example, a partnership with a local cancer research center produced a laser technique for nonsurgical biopsy.
- The Oak Ridge Centers for Manufacturing Technology—itself a collaborative effort with the Oak Ridge Y–12 Plant—responded to more than 380 requests for technical assistance in FY 1995 and provided training for more than 5,000 workers.
- ORNL carries out research for the Department of Defense (all branches), the Departments of Transportation and Health and Human Services, the Environmental Protection Agency, NASA, the Nuclear Regulatory Commission, the National Science Foundation, and other Government agencies. Interagency partnerships in global climate change research and high-performance computing and communications also draw on ORNL's capabilities.
- International partners include the European Union, Japan, and Russia. Major programs include the IEA-sponsored Atomic Data Center, the IAEA-sponsored Nuclear Data Center, the Radiation Shielding Information Center, and engineering design activities for the International Thermonuclear Experimental Reactor. Important collaborations exist with the European Spallation Source, Japan Atomic Energy Research Institute, and Korea Atomic Energy Research Institute.

Oak Ridge National Laboratory

Significant Accomplishments

Atomic Imaging: Using the Z-contrast imaging technique developed at Oak Ridge National Laboratory in combination with the world's highest resolution scanning transmission electron microscope, researchers have produced the first direct images of the structure and chemical identity of atoms at critical regions inside solids. Unexpected structures for grain boundaries in semiconductors, ceramics, and superconductors have been discovered. This brings unique insights into the macroscopic properties of these materials and points the way to methods for engineering improvements. The technique is applicable to a vast range of advanced materials, including structural and high-temperature materials, optical and electronic materials, and magnetic materials.

High-Temperature Superconductors: A process developed at Oak Ridge produces substrates for practical superconducting wires with record high critical current density. The process, called RABiTS, uses low-cost textured metal substrates in combination with thin-film superconductors to produce superconducting tapes. An yttrium-barium-copper oxide tape produced using RABiTS had a measured critical current density of 700,000 amperes per square centimeter at a temperature of 77 kelvin. (For comparison, standard household wires typically carry less than 1,000 amperes per square centimeter.) This performance far exceeds that of bismuth-based powder-in-tube wires and is most important for applications in transformers, motors, and generators.

High-Temperature Materials Development: Basic and applied research at Oak Ridge has led to the development of two new classes of structural materials—whisker-toughened ceramics and ductile intermetallic alloys—and to new processes and products with significant economic impact. Whisker-toughened ceramics are now sold as cutting tools and beverage-can die assemblies. Gelcasting, a process for making high-quality ceramic parts in complex shapes, is used in manufacturing turbine rotors, thermal insulation for engine exhaust manifolds, and magnet rings for particle accelerators. The Exo-Melt process saves time and energy in the manufacture of nickel aluminides (used for furnace equipment such as trays, belts, and rollers) and iron aluminides (used for hot-gas filters and heating elements). A ceramic composite filter developed in collaboration with the 3M Company is lighter, more reliable, and more efficient than conventional filters in removing particulates from hot gas streams in fluidized-bed combustion systems and coal gasification plants.

Biological and Environmental Research: Oak Ridge accomplishments in the biological sciences include an intelligent computer system, GRAIL, for identification of genes from DNA sequences; physical maps of regions of the mouse genome that correspond to the human genome; advanced techniques for detecting gene mutations; and mouse models for several human diseases. A new pathway for photosynthesis has been discovered, and advances have been made in cryopreservation. In environmental research, achievements include ecosystem studies of the impacts of climate change on forests; management of massive databases for global change research; and monitoring, assessment, and remediation of chemically contaminated ecosystems.

High-Performance Computing: Oak Ridge National Laboratory is one of the most powerful computing sites in the world, a leader in high-performance storage systems, and a focal point for the solution of complex problems in a variety of fields. The Intel Paragon computers of the Center for Computational Sciences are the focus for the development of advanced computational applications for scientific research and improvements in computing tools and technologies. The Laboratory has become a world leader in distributed computing research by developing algorithms, paradigms, and tools such as PVM (Parallel Virtual Machine) that permit a heterogeneous collection of computers to be used as a single large parallel computer.

Pacific Northwest National Laboratory

Laboratory Information

Name: Pacific Northwest National Laboratory

Location: Richland, Washington

Contractor: Battelle Memorial Institute

Budget: $574 million (FY 95)

DOE Programs

Energy Research, Environmental Management, Nuclear Energy, Energy Efficiency and Renewable Energy, Nonproliferation and National Security, Environmental Safety and Health, Office of Science Education and Technical Information

Description

Pacific Northwest National Laboratory (PNNL) was established as a multiprogram laboratory in 1965 as part of a reconfiguration of the Hanford site. PNNL became an Energy Research laboratory in 1984. Its mission is to conduct research and development in environmental science which contributes to the fundamental understanding of the physical sciences and natural systems that provide the foundation for effective environmental technology. It delivers technologies to mitigate environmental damage and existing hazards, prevent pollution, and minimize waste. PNNL also applies its capabilities to support DOE's national security and energy missions in selected areas.

Major Facilities

Environmental Molecular Sciences Laboratory: Collaborative research facility that includes the Molecular Science Computing Facility, the High-Field Magnetic Resonance Facility, the High-Field Fourier Ion Cyclotron Resonance Facility, the Research Molecular Beam Epitaxy System, the Surface Microscopy Facility, and the Environmental Interfaces Research Facility.

Process Science Engineering Complex: Bench- and pilot-scale facilities for development of vitrification, separations, slurry transport, and other waste-processing technologies.

Subsurface Environmental Research Facility: To simulate conditions in the earth's subsurface environments.

Research Aircraft: An airborne lab used to investigate atmospheric chemical and sediment/contaminant transport.

Marine Sciences Laboratory: Laboratory and research vessel for study of hydrogeologic processes and sediment/contaminant transport.

National Environmental Research Park: A 570-square-mile area at Hanford for studying environmental biology and ecosystem functions.

Atmospheric Radiation Measurement (ARM) Experiment Center: Data collection point for Cloud and Radiation Testbed (CART) sites.

Key Research and Development Activities

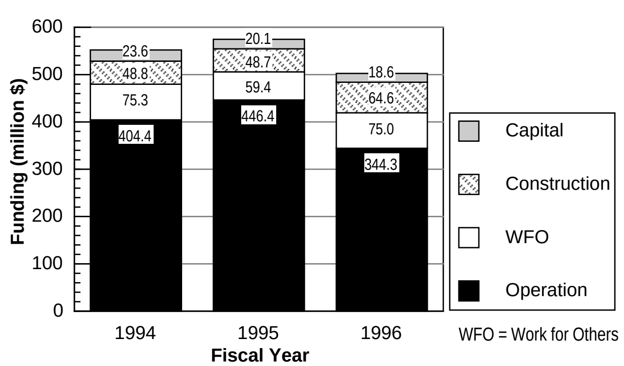
Science: Environmental Sciences—Chemical behavior and biological stress in terrestrial and subsurface systems, Transport and fate of atmospheric and marine contaminants, Climate research; Molecular Sciences—Chemical structure and dynamics, Theory modeling and simulation, Environmentally relevant materials and interfaces, Macromolecular structure and dynamics; Microbial Biotechnology—Molecular and cellular biology, Human and microbial genome sciences, Computational and structural biology, Advanced engineering processes. Material Sciences—Materials research for fusion energy systems.

Environmental Quality: Management and Remediation of Hazardous Wastes—Remediation technology for radioactive waste tanks and subsurface contaminants, Handling of spent nuclear fuels, Risk assessment; Inherently Clean Process Technology—Basic science for environmentally conscious processing and pollution prevention.

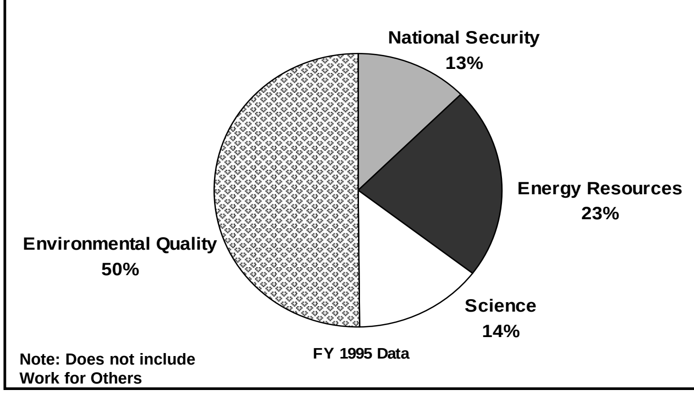
Energy Resources: Building energy standards and design tools, Energy-efficient building operation and maintenance, Energy transmission and distribution, Distributed energy systems.

National Security: Nonproliferation and arms control verification technology.

Funding History



DOE Mission Footprint



Pacific Northwest National Laboratory

Distinctive Competencies

Molecular Science: Selected aspects of theoretical and experimental chemistry, chemical physics, materials science, and molecular biology.

Environmental Sciences: Atmospheric, marine, and subsurface research capabilities.

Process Science and Engineering: Chemical engineering, waste processing, and environmental interactions.

Engineering Sciences: Sensor development and integration; robotics; electronic, optical, and imaging systems.

Computer and Information Technologies: Large-scale databases and information systems; collaborative computer-based research environments.

Integrated Technology Policy Analysis: Analysis of the economic, political, and social impacts of technology.

Partnerships and Collaborations

Much of the research carried out at Pacific Northwest National Laboratory is conducted through formal and informal partnerships with university investigators, researchers at other national laboratories, or private firms. PNNL also participates in a broad array of partnerships aimed at enhancing science and engineering education. Current major partnerships include the following:

- ARM (Atmospheric Radiation Measurement) includes 9 multiprogram laboratories, 18 universities, 13 other Federal laboratories, foreign participants, and private companies in a long-term field measurement program to improve the understanding of processes that control the distribution of energy and water in the climate system.
- USCAR (U.S. Council for Automotive Research): Umbrella partnership including the Partnership for a New Generation of Vehicles, which involves Ford, Chrysler, General Motors, and automotive product manufacturers.
- AMTEX (American Textile Industry Partnership): Consortium of 11 DOE laboratories, the integrated textile industry (approximately 100 companies), and 5 universities working to enhance the economic performance of the U.S. textile industry.
- The International Nuclear Safety Program, involving several of the DOE laboratories and a number of U.S. firms, is designed to reduce the risks of operating nuclear reactors in the former Soviet Union by working cooperatively with host countries on nuclear safety and supporting technical infrastructure.
- Pacific Northwest National Laboratory also maintains roughly 75 formal educational and research partnerships with colleges and universities for collaborative research and development and to provide research opportunities for students and faculty. The Laboratory also works with the Associated Western Universities, a consortium of 62 universities administering research fellowships for students, teachers, and faculty.

Significant Accomplishments

Advanced Materials: Materials science research at PNNL has yielded new insights into the processes through which ceramics and thin films are formed. PNNL is designing complex composites and synthetic materials tailored for specific applications and is developing energy-efficient, low-waste manufacturing processes to create them.

Atmospheric Radiation Measurement Program: Under DOE's Atmospheric Radiation Measurement Program, PNNL and academic and national laboratory collaborators have created, as part of the Climate Change Program, a world-class experimental facility that allows the testing of key elements of general circulation models in unprecedented detail.

Environmental Molecular Sciences Laboratory: Research conducted in the Environmental Molecular Sciences Laboratory (EMSL) will focus on developing a molecular-level understanding of the physical, chemical, and biological processes that underlie environmental remediation, waste processing, and health and ecological effects. The laboratory will begin operations in 1997. One of the EMSL's projects is development of the world's most powerful nuclear magnetic resonance instrument—the cornerstone of the Magnetic Resonance Facility. This instrument, the first nuclear magnetic resonance spectrometer to exceed 900 MHz, will provide unprecedented capability to study the molecular structure of biological molecules as they relate to bioremediation processes, and to obtain a better understanding of contaminant effects on human health.

Subsurface Science: PNNL scientists are providing new insights into the processes by which contaminants are transported and chemically or biologically changed in the subsurface environment. This knowledge is leading to new technologies for characterizing and cleaning up radioactive and chemical wastes and is laying the foundation for bioremediation—the use of natural or engineered microorganisms for cleanup. Technology developments include an instrument to measure the permeability of surface and subsurface sediments, a technique for using complex natural interactions between geochemical and microbial processes to control contaminant behavior, and a sensor that detects *in situ* organic liquids and vapors in soil.

Vitrification: For more than two decades, researchers at Pacific Northwest have been exploring the concept of vitrification as a safe, long-term solution to the problem of hazardous waste disposal. Vitrification, the process of turning mixtures of materials into glass, is an effective, economical, and environmentally sound technology that destroys or immobilizes wastes, decreases waste volumes, lowers disposal costs, and contains waste for extremely long periods—all reducing risk to humans. Several techniques to either immobilize contaminants in place or to safely store them have been invented.

Sandia National Laboratories

Laboratory Information

Name: Sandia National Laboratories
Location: Albuquerque, New Mexico; Livermore, California
Contractor: Lockheed Martin Corporation
Budget: $1,384 million (FY 95)

DOE Programs

Defense Programs: Research, development, and testing related to nuclear weapons, arms control and nonproliferation technologies, hazardous wastes, and energy and environmental technologies

Description

Sandia National Laboratories (SNL) is a multiprogram laboratory established in 1949 to perform the research, engineering development, and production oversight associated with nuclear weapons. Due to the multidisciplinary challenges of its nuclear-weapons responsibilities, SNL has acquired technical capabilities in many fields of engineering and science. This broad technical base has permitted the Laboratory to evolve into a multiprogram research and development facility with responsibilities in national security, energy, and environmental research and development. SNL bases its technical work on an integrated science and technology base that encompasses research, development, and engineering design and testing. This science and technology base is continuously applied to provide solutions to compelling national needs.

Major Facilities

Computing, Simulation, and Test Facilities: System design and development.

Microelectronics Development Laboratory: Research and development on semiconductor materials and fabrication.

Combustion Research Facility: Combustion science and laser spectroscopy.

Advanced Manufacturing Processes Laboratory: Quality and reliability; rapid prototyping.

Intelligent Systems and Robotics Center: Intelligent and agile manufacturing.

Pulsed Power Accelerators: Testing and development of defense components.

Solar Thermal and Photovoltaic Test Facilities: Prototype evaluation and experiments.

Massively Parallel Computing Research Laboratory: Engineering and scientific applications (currently holds world computational speed record).

Integrated Materials Research Laboratory: Semiconductor and other specialized materials research.

Key Research and Development Activities

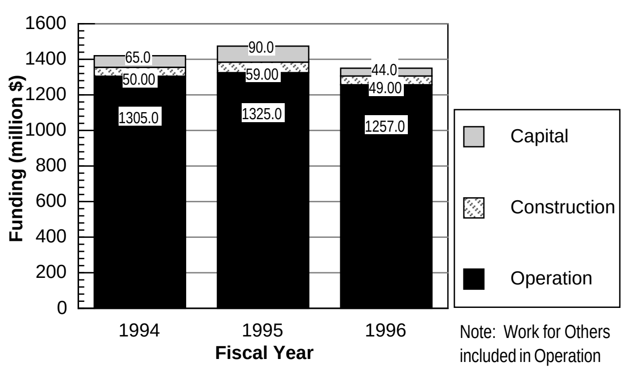
National Security: Stewardship responsibility for every nuclear weapon in the U.S. stockpile; Systems engineering; Component design engineering and manufacturing engineering; Dismantlement and disposition; Arms control, nonproliferation, and treaty verification; Inertial confinement fusion; Advanced conventional weapon technologies; Technologies for intelligence functions.

Energy Resources: Solar, geothermal, and storage systems; Transportation; Fossil energy conversion and combustion; Nuclear reactor safety and radioactive waste storage technology.

Environmental Quality: Nuclear program waste site remediation and supporting R&D; Environmentally conscious manufacturing and industrial ecology.

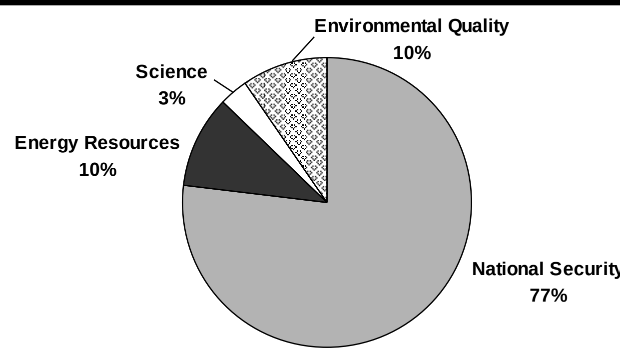
Science: Basic energy sciences—chemical, material, geophysical, and computational; Magnetic fusion materials and components.

Funding History



Note: Work for Others included in Operation

DOE Mission Footprint



Note: Does not include Work for Others

FY 1995 Data

Sandia National Laboratories

Distinctive Competencies

Engineered Materials and Processes: Synthesis, characterization, and processing of metallic, ceramic, organic, and composite materials. A distinguishing strength is the development of advanced materials and processes tailored to meet the needs of specific applications.

Computational and Information Sciences: Technology to advance state-of-the-art computer use while maintaining the accuracy, security, and accessibility of information. Distinguishing strengths include development of computational methods and software for emerging computer technologies (for example, massively parallel processing), mathematical techniques for information surety and security, computer-based techniques for intelligent machines, and advanced computing facilities and networks.

Microelectronics and Photonics: Development, fabrication, and production of microelectronic and photonic devices and circuits, microsensors, and intelligent microelectromechanical systems. Distinguishing strengths include materials growth and development, digital and radiofrequency device design, fabrication technologies for silicon and compound semiconductor devices, and radiation-hardened microelectronics.

Engineering Sciences: Fluid and thermal sciences, solid and structural mechanics, radiation transport, aerospace sciences, geosciences, and combustion sciences. A distinguishing strength is development of interdisciplinary capabilities and an integrated computational and experimental approach to solving complex engineering problems.

Advanced Manufacturing Technology: Improved manufacturing methods in the nuclear weapons complex and for U.S. industry, including concurrent engineering, intelligent machines for hazardous and flexible operations, and environmental protection and control.

Pulsed-Power Technology: An integrated capability encompassing repetitive pulsed-power technologies, x-ray and energetic beam sources, and electromagnetic and radiation-hydrodynamic computational capacity. Applications include nuclear survivability of weapons systems, weapons physics research, light-ion-beam inertial confinement fusion, materials processing, waste product sterilization, and food treatment.

Partnerships and Collaboration

Almost 25 percent of the FY 95 operating funding for Sandia National Laboratories came from entities other than DOE. This included work for the Department of Defense, the Department of Transportation, NASA, the Nuclear Regulatory Commission, other Federal agencies, and industrial partners under cooperative research and development agreements.

Sandia is working with other Lockheed Martin-managed national laboratories (Oak Ridge National Laboratory and Idaho National Engineering Laboratory) to effect cost savings through shared administrative functions.

Sandia is using a computer network service known as The Community of Science to continuously identify expertise in universities around the Nation for possible collaborative efforts.

More than 25 percent of Sandia's laboratory-directed R&D projects have one or more academic collaborators. Laboratory-directed R&D funding for such collaborations increased from $10 million in FY 94 to $17.6 million in FY 96.

Approximately $32 million of Sandia's funding has been committed to universities in more than nine states for the performance of research vital to meeting the needs of Sandia's customers.

Sandia is a major participant in the Advanced Materials Laboratory with Los Alamos National Laboratory, the University of New Mexico, and industry.

Los Alamos and Lawrence Livermore National Laboratories (as well as industry) participate at Sandia in the National Center for Advanced Information Components Manufacturing under the sponsorship of the Advanced Research Projects Agency.

Sandia is the DOE principal in the FASTCAST consortium with industry to shorten the cycle time for prototype castings and in the Specialty Metals Consortium to improve production processes of specialty alloys for high-tech applications.

Sandia is a partner with SEMATECH, working to enhance the U.S. position in microelectronics technology.

In FY 95, Sandia provided technical assistance to 284 small businesses and entered into 20 user facility agreements with a total value of $735,000. Through the end of FY 95, Sandia had entered into 266 cooperative research and development agreements with a cumulative value of $772 million.

In the context of its mission responsibilities, Sandia spends approximately $700 million per year with industry and university partners.

Sandia National Laboratories

Significant Accomplishments

Stewardship of the Nuclear Weapons Stockpile: Sandia has maintained the reliability, safety, security, and operational readiness of the complete nuclear weapon stockpile during a time of rapid transition in the size and makeup of the stockpile. This effort has involved system-level design for weapon dismantlement (which included managing the proper disposal of materials for four major weapon systems removed last year from the nuclear stockpile) and consolidated production responsibilities for the weapons complex. This accomplishment has helped ensure our national security through a Defense Programs responsibility.

Solar Thermal Electric Power System: As part of a joint-venture program, Sandia provides technical expertise on solar thermal electric generating systems to Cummins Power Generation, Inc. The technology uses the dish-Stirling solar electric system (supported by DOE since the 1970s) to reach peak net efficiencies of more than 29 percent. These systems will provide power to remote power markets and to the larger electric utility market. This program is helping U.S. electric utility companies to more rapidly reach their goal of making solar thermal electric power economically competitive by the end of the decade. The program will also help the U.S. develop safer, cleaner, more affordable energy — one of DOE's Energy and Environment objectives.

Advanced Synthetic Aperture Radar and Automatic Target Recognition Technology: Sandia has developed an advanced generation of synthetic aperture radar and automatic target recognition technology for intelligence, arms control, and battlefield applications. This technology is used to create digital elevation maps (with a height accuracy of a few centimeters) and could be used in cruise missile guidance systems (with better than 3-meter accuracy) and for land-use planning and oil spill monitoring. This research helps accomplish DOE's mission to develop technologies to mutually benefit government agencies and private industry.

Integrated Detection System for Intelligence, Arms Control, and Battlefield Assessment: Sandia has implemented an integrated suite of satellite and ground station detection systems. For example, on a "proof-of-concept" basis, Sandia is receiving data from remote monitoring equipment installed (under a cooperative agreement) in direct-use material storage facilities at Russia's Kurchatov Institute and at Argonne National Laboratory's Idaho facility. This work, which helps ensure national security, fits into DOE's mission to develop arms control, nonproliferation, and counterproliferation technologies.

Revolutionary Airbag Development: A revolutionary automotive airbag design—which reduces the volume and weight of the current bag by 60 percent, allowing more airbags to be used in vehicles—resulted from one of the 277 cooperative research and development agreements Sandia has signed in the last five years. This development, expected to have a major impact on the airbag market, is an excellent example of how Sandia cooperates with the private sector to advance federally developed technologies, processes, and expertise for mutual benefit.

Massively Parallel Processing Records: Sandia and Intel Corporation have continued to set massively parallel supercomputing speed records, establishing U.S. leadership in high-performance computing. The achievement (currently 281 gigaflops) will affect many Sandia research areas (for example, synthetic aperture radar, molecule design, 3-D fluid dynamics analyses, and conventional weapon penetrators). This research helps Sandia find solutions to problems of national importance through partnering with industry.

Record-Breaking X-Ray Generation with Pulsed Power Machines: Sandia's recent record-breaking x-ray outputs (currently 85 terawatts from the Saturn accelerator) are vital for simulating the extreme conditions generated by a nuclear weapon detonation. These simulations are increasingly important as the U.S. maintains a credible nuclear deterrent while observing a worldwide nuclear test ban. The increased radiation outputs will also aid studies of radiation hardness, to ensure that electronics and other components will work as expected in hostile environments. This program will serve future nuclear weapon surety requirements, fulfilling a key DOE nuclear weapon program goal.

Micro-Machine Development: Sandia has developed a new generation of silicon-based micro-machines using the technology resident in our microelectronics competency. These machines are smaller than the diameter of a human hair, can generate useful power, and operate at hundreds of thousands of revolutions per minute. Current applications of these devices include the development of miniature coded locks that control the operation of nuclear weapopns. Future potential uses for these devices may include hormone regulation in humans and other biomedical uses.

Ames Laboratory

Laboratory Information

Name: Ames Laboratory
Location: Ames, Iowa
Contractor: Iowa State University
Budget: $30.2 million (FY 95)

DOE Programs

Energy Research, Environmental Management, Fossil Energy

Description

Ames Laboratory was officially founded in 1947, following work done by its predecessor laboratory under the Manhattan Project. Its mission includes fundamental research in the physical, chemical, materials, mathematical, engineering, and environmental sciences that underlie energy generation, conversion, and transmission technologies; development of new analytical techniques and instrumentation; and advancement of environmental restoration and waste management initiatives and infomatics.

Major Facilities

Materials Preparation Center: Unique capabilities in the preparation, purification, and characterization of advanced materials. The Iowa Companies Assistance Program offers access to the Center to Iowa companies with technical assistance needs.

Information Resources: The Materials Referral System and Hotline offers the general research community information about specialized materials accessed from more that 2,000 companies. The Center for Rare Earths and Magnetics provides scientific and technical information concerning the rare earths to government, industry, and academia through a database and a collection of more than 78,000 publications. The *High-T_c Update*, a twice-monthly newsletter, provides a centralized means for rapid dissemination of up-to-date information on high-temperature superconductivity research.

Scalable Computing Laboratory: Develops and utilizes advanced tools to assess the performance of scalable systems and facilitate design decisions.

Ames Laboratory's Photoemission Beam Line at the synchrotron in Stoughton, Wisconsin, has the world's highest resolution.

Key Research and Development Activities

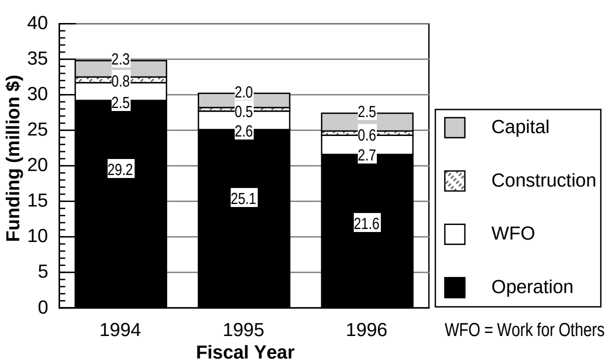
Science: Synthesis, processing, and characterization of materials; High-temperature superconductivity and magnetism; Fundamentals of catalysis; Analytical instrumentation; High-performance computing and information management.

Energy Resources: Coal-cleaning technology; Biomimetic solar energy conversion technologies; Photosynthesis research.

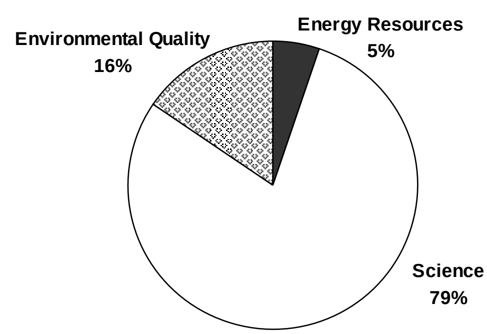
Environmental Quality: Field analytical approach for expediting waste-site characterization; Spectrometric techniques for on-line analysis of solid materials.

National Security: Laser-based technology for decontamination of surfaces and bulk materials.

Funding History



DOE Mission Footprint



Note: Does not include Work for Others

Ames Laboratory

Distinctive Competencies

Focused programs on magneto-optic, photonic bandgap, and quasicrystalline materials.

Laser technology for studying the chemical and physical aspects of chemical carcinogenesis and genome sequencing.

Application of parallel computation to problems in condensed matter theory and chemical physics.

Partnerships and Collaborations

Iowa State University: Ames Laboratory is operated for the Department of Energy by Iowa State University, Ames, Iowa.

U.S. Universities: More than 900 users from approximately 169 U.S. universities in 21 States.

International Institutions: More than 270 users from approximately 16 foreign institutes, universities, and laboratories and more than 35 countries.

U.S. Laboratories: Users from 12 Department of Energy laboratories; collaboration on the Partnership for a New Generation of Vehicles and the Relativistic Heavy Ion Collider; design of beam sector, organization of team, and construction of instrumentation for research at the Advanced Photon Source at Argonne National Laboratory.

Industry: Cooperative research and development agreements; licensing agreements; conferences; personnel exchanges; work for other national laboratories and Federal agencies; small business innovation and technology transfer activities.

Education: One of every seven persons granted a Ph.D. by Iowa State University works at Ames Laboratory as a graduate student.

Significant Accomplishments

Materials Sciences Awards: Ames Laboratory scientists have won three of only nine of these national awards given by DOE. A team of 11 researchers (Paul Canfield, Alan Goldman, Constantine Stasis, David Johnston, Bruce Harmon, Ferdinando Borsa, David Lynch, Lance Miller, Clifford Olson, David Torgeson, and Jerel Zarestky) has won the award for “outstanding scientific accomplishment” in solid state physics. A team of four researchers (Alan Goldman, Bill McCallum, Matt Kramer, and Tom Lograsso) has won the award for “sustained outstanding research” in solid state physics. Senior Chemist John Corbett won the award for “sustained outstanding research” in materials chemistry.

R&D 100 Awards: Ames Laboratory researchers won a 1995 R&D 100 award for a new computer benchmark called HINT (Hierarchical INTegration) that determines the amount of work a computer can perform over time. John Gustafson and Quinn Snell developed the process that cuts through different computer languages, precisions, speeds and designs to provide a more accurate measure of a computer’s full range of performance. This is Gustafson’s third R&D 100 award and the Laboratory’s 11th since 1984.

X-ray Liquid-Surface Reflectometer: Constructed an x-ray liquid-surface reflectometer to probe the structures of organic monolayers on water. The reflectometer was designed for eventual installation at the Advanced Photon Source, a new synchrotron facility at Argonne National Laboratory that will produce brilliant x-ray beams for research.

Expedited Site Characterization: Expedited Site Characterization (ESC) is a process that unites various technologies for faster, more effective, and less expensive characterization of hazardous waste sites than is currently achievable through conventional methods. Ames Laboratory demonstrated ESC at a site in St. Louis, Missouri, in September to environmental technology providers, regulators, government officials, and concerned citizens.

Materials Experiment: Ames Laboratory helped design a materials experiment that was placed on board the space shuttle Endeavor. The experiment was designed to determine how particles distribute during solidification in near-zero gravity.

Virtual Reality: Ames Laboratory is developing a new approach to virtual reality that will produce a computer program and hardware that provide physically true images, increasing the sophistication of virtual reality and opening many new uses for this fledgling technology.

Aluminum-Matrix Composites: Ames is developing a process for producing aluminum-matrix composites to be used in the drive trains of automobiles. The major thrust of the work is fully developing a new gas atomization reaction synthesis (GARS) process for producing aluminum and aluminum alloy powders.

Quasi Crystal Project: Ames is spearheading a project designed to provide a fundamental understanding of how quasi crystals achieve their desirable properties and will lead to optimized fabrication of quasi crystalline coatings for various industrial applications.

Partnership for a New Generation of Vehicles: Ames Laboratory scientists are pursuing the development of new lightweight materials to decrease vehicle weight in engine and drive-train parts for the Partnership for a New Generation of Vehicles.

Bettis Atomic Power Laboratory

Laboratory Information

Name: Bettis Atomic Power Laboratory

Location: West Mifflin, Pennsylvania; Idaho Falls, Idaho

Contractor: Westinghouse Corp.

Budget: $350 million (FY 95)

DOE Programs

Nuclear Energy—Naval Nuclear Propulsion Program

Description

Bettis Atomic Power Laboratory (BAPL) is a government-owned, contractor-operated laboratory dedicated solely to naval nuclear propulsion work. Its mission is to develop safe, militarily effective nuclear propulsion plants and ensure the continued safe and reliable operation of existing naval reactors. The mission is achieved through continuous testing, verification, and refinement of reactor technology. BAPL and Knolls Atomic Power Laboratory provide complementary capabilities necessary to accomplish this mission. The efforts of these two laboratories have directly contributed to the achievement of more than 100 million miles safely steamed by nuclear-powered warships.

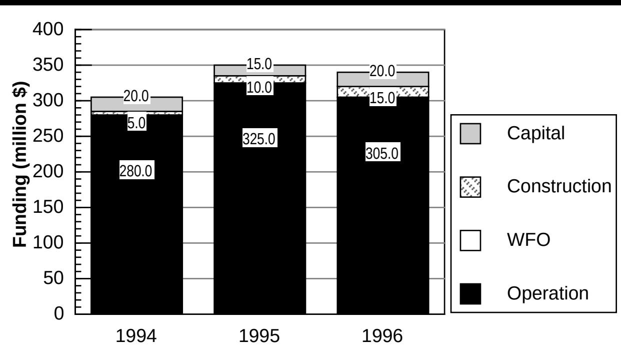
Major Facilities

Examples of unique facilities include a specialized testing facility for full-scale steam generator testing; a facility for component noise testing; a component manufacturing development and test specimen fabrication capability; a control drive mechanism test facility; a shock test facility; and the expended core facility for examination of spent nuclear fuel, which provides data on performance and for design of future reactor cores.

Key Research and Development Activities

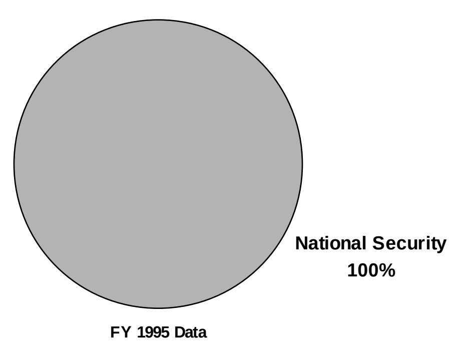
National Security: Provide the Navy with advanced, long-lived reactor plants and ensure the viability of operating naval nuclear reactors while meeting high safety and environmental standards.

Funding History



Note: Approximately 56 percent of funding is subcontracted to industry.

DOE Mission Footprint



Note: Does not include Work for Others

Bettis Atomic Power Laboratory

Distinctive Competencies

BAPL and Knolls Atomic Power Laboratory have a combined staff of about 5,800 that includes scientists, engineers, technicians, and supporting personnel. The two laboratories support the Navy's nuclear-powered warships, which comprise 40 percent of the combatant fleet and use 130 reactor plants, and are responsible for developing new reactor plants to meet Navy needs. Together, they provide vital technical competition and confirmation capabilities to help ensure the reliability and safety of operating plants and the adequacy of designs as well as unique experience and knowledge of specific plant types. Areas of competency include nuclear physics, materials, reactor design, analytical modeling, and manufacturing and inspection methods related to the design and development of naval nuclear reactors.

Partnerships and Collaborations

The classified nature of the work at BAPL precludes joint undertakings with industry or academia. However, design and development efforts are undertaken in conjunction with naval nuclear industrial base suppliers.

Significant Accomplishments

The efforts of Bettis and Knolls Atomic Power Laboratories have directly contributed to the Navy's superb safety, operational, and environmental record for nuclear powered warships. Accomplishments include:

- Designing and developing more than 30 different reactor designs used, and in use, in more than 200 nuclear-powered warships. Today, efforts continue to ensure safe and reliable operation of more than 130 operating reactors of diverse plant types through continuous testing, verification, and refinement of reactor technology. In addition, development efforts continue to meet the Navy's need for advanced, durable, long-lived reactor plants, including the advanced fleet reactor for the SEAWOLF Class attack submarine and the next-generation reactor for the new attack submarine.
- Verifying and supporting operation of the Navy's nuclear reactors, which have accumulated 4,600 reactor-years of operation (compared with 2,100 reactor-years for U.S. commercial nuclear reactors and 5,000 reactor-years for commercial nuclear reactors worldwide), demonstrating continued safety and technical excellence. As a result, U.S. nuclear-powered warships have safety steamed more than 100 million miles.
- Employing careful engineering and stringent standards in development efforts—vital components in maintaining a proven environmental and safety record that allows U.S. nuclear powered ships to operate worldwide, including territorial waters and more than 150 ports and harbors in more than 50 countries and dependencies, and that facilities retention and recruitment of personnel to serve aboard nuclear-powered vessels.
- Increasing core life from two years for the NAUTILUS to more than 30 years for the new attack submarine, achieving significant military and cost benefits while also dramatically reducing the radioactive waste and personnel radiation exposure associated with refueling.
- Engineering refueling equipment and establishing methods that have supported more than 340 safe and successful refuelings and defuelings of the Navy's nuclear reactor plants.
- Conducting careful, extensive validation and improvement efforts to allow operation of Naval nuclear plants beyond their design lifetimes and allow the Navy to project keeping ships in service for up to 45 years vice original expectation of 20 years.

Fermi National Accelerator Laboratory

Laboratory Information

Name: Fermi National Accelerator Laboratory
Location: Batavia, Illinois
Contractor: Universities Research Association, Inc.
Budget: $251 million (FY 95)

DOE Programs

Energy Research

Description

Fermi National Accelerator Laboratory (Fermilab) was established in 1968 to provide the resources for research in the field of elementary particle physics. Its mission is to advance the understanding of the fundamental nature of matter and energy by providing leadership and resources for qualified researchers to conduct basic research at the frontiers of high energy physics and related disciplines.

Major Facilities

Tevatron: Four-mile superconducting synchrotron is world's highest energy particle accelerator. As collider, accelerates protons and antiprotons to 1,000 GeV and brings them into collision for high energy particle physics experiments. As source of extracted 800-GeV protons, produces world's highest energy fixed-target beams.

Antiproton Source: Creates and stores intense beams of antiprotons to collide with protons in the Tevatron.

CDF and DZero Detectors: Two 5,000-ton detectors track and record data from Tevatron particle collisions. These detectors provide data for two 450-member collaborations of particle physicists.

Particle Beams: 800-GeV proton beams extracted from the Tevatron produce eight distinct secondary beams of high energy subatomic particles for fixed-target experiments.

Neutrinos at the Main Injector: Proposed long-baseline neutrino mass experiment will use high-intensity neutrino beams from Fermilab Main Injector (under construction), with detectors at Fermilab and 460 miles away at Soudan, Minnesota.

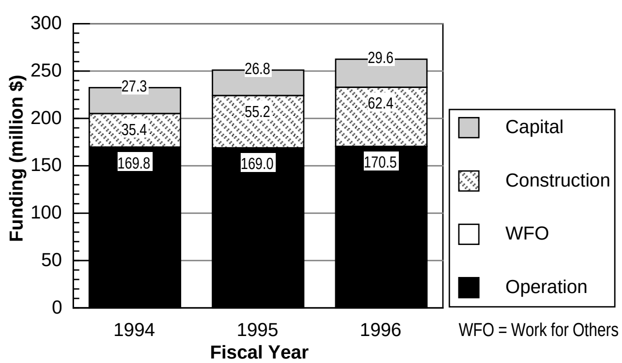
Key Research and Development Activities

Promotes advances in the understanding of the fundamental nature of matter and energy by providing leadership and resources for qualified researchers to conduct basic research at the frontiers of high energy physics and related disciplines.

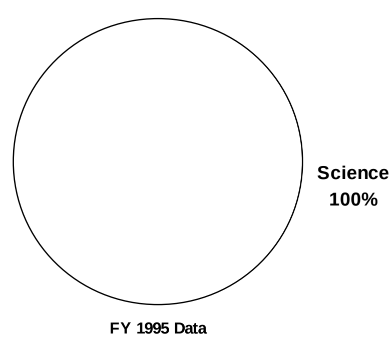
Provides accelerator, detectors, computing, and support for international research facility used by experimenting particle physicists.

Advances the art and science of proton accelerators and storage rings, particle detectors, and related data-acquisition systems.

Funding History



DOE Mission Footprint



Note: Does not include Work for Others

Fermi National Accelerator Laboratory

Distinctive Competencies

Experimental and theoretical high energy physics.

Superconducting magnet research, design, and development.

High-performance computing and high-speed computer communication networks.

Experimental and theoretical astrophysics.

Partnerships and Collaborations

Universities Research Association, Inc., a consortium of 86 U.S. and foreign research universities, operates Fermi National Accelerator Laboratory under contract with the Department of Energy.

U.S. universities: High energy physics user partnerships with 1,398 users from 97 U.S. universities and laboratories in 35 states.

International institutions: 647 users from 82 foreign universities and laboratories in 19 countries. Collaboration at particle physics laboratories in Germany, France, Japan, Switzerland, and Russia.

U.S. laboratories: Users from eight DOE laboratories. Collaboration with other DOE labs on accelerator and detector development.

Industry: Cooperative research and development agreements, licensing agreements, conferences, personnel exchanges.

Significant Accomplishments

Discovery of the Top Quark: On March 2, 1995, the CDF and DZero collaborations at Fermilab, each with about 450 university and laboratory physicists, publicly announced the discovery of the top quark, the last remaining undiscovered quark, completing the third generation of matter postulated by the Standard Model. The announcement ended a search that began with the discovery of the bottom quark at Fermilab almost two decades ago. The discovery was made at Fermilab's Tevatron, the only collider that can reach the energy needed to produce a top quark. The theoretical framework that provides the best explanation of the properties of quarks and leptons would be incomplete and incomprehensible without the sixth quark. While the top quark fits comfortably within expectations, its discovery sharpens interest in a fundamental unanswered question of physics: Why do quarks have mass? Why is the top quark more than 50,000 times heavier than its sister, the up quark?

Mass of the W Boson: In 1995, Fermilab experimenters made the most accurate measurements to date of the mass and width of the force-carrying particle called the W boson. The determination of the mass of the W boson is one of the critical measurements for hadron collider experiments. The W lives for a very short time, which means that its energy is intrinsically spread over a range of possible values, a range referred to as the particle's width. Both CDF and DZero measured the mass and width of the W. Understanding the W has great significance, because combining precise new information about the W with new knowledge about the top will reveal characteristics of the Higgs boson, and more about the mystery of mass.

Tevatron Luminosity: The heart of any particle physics laboratory is its accelerator, and in 1995, Fermilab's accelerator had its best year. In Collider Run Ib, the Tevatron collider routinely operated at 15 times its design luminosity, creating 15 times as many high-energy particle collisions as it was designed to provide. On May 10, 1995, the Tevatron set a new peak luminosity record that was five times the highest peak luminosity of Run Ia. These numbers indicate that more data than ever before was gathered, delivered from the world's highest energy particle accelerator to Fermilab's two collider detectors, CDF and DZero. A number of critical accelerator improvements, including the installation of new linear accelerator in the Fermilab injection chain, produced the luminosity that not only broke accelerator records but allowed the discovery of the top quark.

Knolls Atomic Power Laboratory

Laboratory Information

Name: Knolls Atomic Power Laboratory
Location: Niskayuna, New York; West Milton, New York
Contractor: Lockheed Martin, Inc.
Budget: $290 million (FY 95)

DOE Programs

Nuclear Energy—Naval Nuclear Propulsion

Description

Knolls Atomic Power Laboratory (KAPL) is a government-owned, contractor-operated laboratory dedicated solely to naval nuclear propulsion work. Its mission is to develop safe, militarily effective nuclear propulsion plants and ensure the continued safe and reliable operation of existing naval reactors. The mission is achieved through continuous testing, verification, and refinement of reactor technology. KAPL and Bettis Atomic Power Laboratory provide complementary capabilities necessary to accomplish this mission. The efforts of these two laboratories have directly contributed to the achievement of more than 100 million miles safely steamed by nuclear-powered warships.

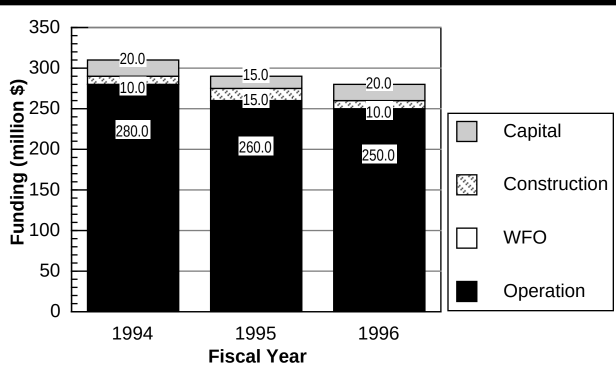
Major Facilities

Examples of unique facilities include examination equipment for irradiated test specimen examination, an electromagnetic test facility, fuel manufacturing development capabilities, unique thermal-hydraulic testing capabilities, and two test nuclear propulsion plants for operational testing of new designs and technologies under typical operating conditions prior to introduction to the fleet.

Key Research and Development Activities

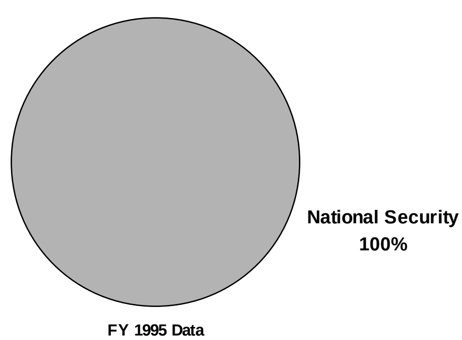
National Security: Provide the Navy with advanced, long-lived reactor plants and ensure the viability of operating naval nuclear reactors while meeting high safety and environmental standards.

Funding History



Note: Approximately 56 percent of funding is subcontracted to industry.

DOE Mission Footprint



Note: Does not include Work for Others

Knolls Atomic Power Laboratory

Distinctive Competencies

KAPL and Bettis Atomic Power Laboratory have a combined staff of about 5,800 that includes scientists, engineers, technicians, and supporting personnel. The two laboratories support the Navy's nuclear-powered warships, which comprise 40 percent of the combatant fleet and use 130 reactor plants, and are responsible for developing new reactor plants to meet Navy needs. Together, they provide vital technical competition and confirmation capabilities to help ensure the reliability and safety of operating plants and the adequacy of designs as well as unique experience and knowledge of specific plant types. Areas of competency include nuclear physics, materials, reactor design, analytical modeling, and manufacturing and inspection methods related to the design and development of naval nuclear reactors.

Partnerships and Collaborations

The classified nature of the work at KAPL precludes joint undertakings with industry or academia. However, design and development efforts are undertaken in conjunction with naval nuclear industrial base suppliers.

Significant Accomplishments

The efforts of Knolls and Bettis Atomic Power Laboratories have directly contributed to the Navy's superb safety, operational, and environmental record for nuclear powered warships. Accomplishments include:

- Designing and developing more than 30 different reactor designs used, and in use, in more than 200 nuclear-powered warships. Today, efforts continue to ensure safe and reliable operation of more than 130 operating reactors of diverse plant types through continuous testing, verification, and refinement of reactor technology. In addition, development efforts continue to meet the Navy's need for advanced, durable, long-lived reactor plants, including the advanced fleet reactor for the SEAWOLF Class attack submarine and the next-generation reactor for the new attack submarine.
- Verifying and supporting operation of the Navy's nuclear reactors, which have accumulated 4,600 reactor-years of operation (compared with 2,100 reactor-years for U.S. commercial nuclear reactors and 5,000 reactor-years for commercial nuclear reactors worldwide), demonstrating continued safety and technical excellence. As a result, U.S. nuclear-powered warships have safety steamed more than 100 million miles.
- Employing careful engineering and stringent standards in development efforts—vital components in maintaining a proven environmental and safety record that allows U.S. nuclear powered ships to operate worldwide, including territorial waters and more than 150 ports and harbors in more than 50 countries and dependencies, and that facilities retention and recruitment of personnel to serve aboard nuclear-powered vessels.
- Increasing core life from two years for the NAUTILUS to more than 30 years for the new attack submarine, achieving significant military and cost benefits while also dramatically reducing the radioactive waste and personnel radiation exposure associated with refueling.
- Engineering refueling equipment and establishing methods that have supported more than 340 safe and successful refuelings and defuelings of the Navy's nuclear reactor plants.
- Conducting careful, extensive validation and improvement efforts to allow operation of Naval nuclear plants beyond their design lifetimes and allow the Navy to project keeping ships in service for up to 45 years vice original expectation of 20 years.

Morgantown Energy Technology Center

Laboratory Information

Name:	Morgantown Energy Technology Center
Location:	Morgantown, West Virginia
Contractor:	None (Government owned and operated)
Budget:	$599.6 million (FY 95)

DOE Programs

Fossil Energy, Environmental Management

Description

Morgantown Energy Technology Center (METC) was established in 1954 under the U.S. Department of the Interior and is now a principal program implementation arm of the U.S. Department of Energy's Office of Fossil Energy. METC is federally owned. It is operated by a staff of 300 Federal employees with supporting contractors.

METC is a technology management center with advanced power systems, fuels resources, and environmental and waste management business sectors. It uses virtual organization concepts and partnering with industry to provide technology options to facilitate the implementation of desirable energy and environmental policies while maximizing value in other areas of the economy and society. Its services are being used to bring industry-based cleanup technologies into the cleanup and restoration of DOE facilities.

Major Facilities

High-Pressure/Temperature Gasification/Cleanup Facilities: A fluid-bed coal gasifier operating up to 500 psia, delivering coal gas to a multipurpose bench-scale chemical and particulate cleanup test facility; a 1,000-psi, 3000° F. entrained coal reactor; a 400-psia, 1400° F. hot gas desulfurization process development unit (under construction) and associated syngas generator.

High-Pressure/Temperature Combustion Research Facility: A multipurpose facility for turbine combustors up to 10 million Btu per hour, with a 700-psig air supply.

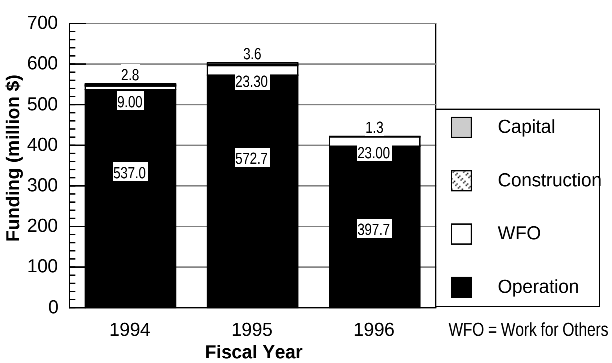
Power Systems Development Facility: Under construction in Wilsonville, Alabama, this is a multi-unit, pilot-scale particulate test facility operating at pressures to 360 psia, with a gasifier, topping combustor, pressurized fluid-bed gasifier, and multiple particle control test vessels.

Key Research and Development Activities

Energy Resources: Demonstration of clean-coal technologies for advanced industrial applications and for electrical power generation using gasifiers or pressurized fluidized-bed combustors integrated with combined-cycle turbine systems and advanced atmospheric fluidized-bed combustors. Pilot-scale testing of advanced chemical sorbents and emission controls for power systems. Development and scaleup of molten carbonate and solid-oxide fuel cells. Improved high-temperature particulate barrier systems. Completing the Power Systems Development Facility. Development and testing of very high-efficiency, ultra-low NO_x advanced turbine systems.

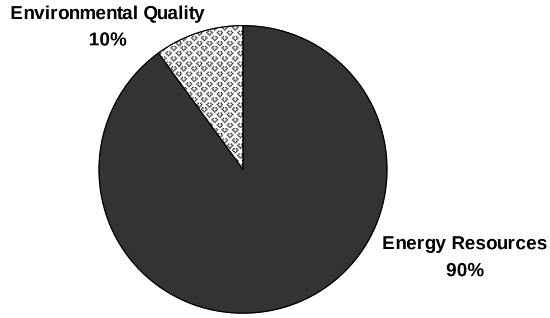
Environmental Management: Testing and early deployment of analytical and cleanup systems for nuclear production sites. Initiation of Decontamination and Demolition Focus activities. Initiation of the Rapid Commercialization Initiative.

Funding History



WFO = Work for Others

DOE Mission Footprint



FY 1995 Data

Note: Does not include Work for Others

Morgantown Energy Technology Center

Distinctive Competencies

Understanding the market-driven goals and needs of private-sector customers and using virtual organization concepts and partnerships to serve them.

Maintaining expert knowledge of business requirements and management of intellectual property to ensure successful development and commercialization of advanced technologies.

Using systems engineering determinations of technical and economic performance to drive the research and development on fossil energy power and fuel systems and environmental management technologies.

Providing technical management services to Government and private-sector partners and customers using total quality management concepts.

Maintaining, applying, and transferring an expert knowledge base for commercializing fossil energy extraction, energy conversion and utilization technologies, and environmental management technologies for site restoration and remediation.

Partnerships and Collaborations

Management of the university program for development of a technology base for advanced turbine systems (South Carolina Energy Research and Development Center).

Coordination of materials research for Advanced Turbine Systems (Oak Ridge National Laboratory, Office of Energy Efficiency).

Management coordination of advanced turbine systems R&D programs (Office of Energy Efficiency and Renewable Energy, Office of Fossil Energy).

Fuel Cells Climate Change/Market Stimulus Program (Department of Defense, West Virginia High-Technology Consortium).

Fuel Cells R&D Management Coordination Team (Electric Power Research Institute, Gas Research Institute, Office of Energy Efficiency and Renewable Energy, Office of Fossil Energy).

Partner for research support in selected technologies (Ames Laboratory).

Technologies for remote village energy production (Doyan Native Group, University of North Dakota Energy and Environmental Research Center).

“Teaming to Win” small business promotion (Small Business Administration, National Contract Management Association).

Management of construction projects for field sites (Army Corps of Engineers, Office of Environmental Restoration and Waste Management, Office of Fossil Energy Clean Coal Technologies Program).

Incubator for commercializing environmental technologies (West Virginia University, West Virginia High-Technology Consortium).

Development and operation of the Power Systems Development Facility (Southern Services Co., Electric Power Research Institute).

Coordination of gas supply R&D programs (Gas Research Institute).

Deep drilling projects (Gas Research Institute, Office of Energy Efficiency and Renewable Energy, U.S. Geological Survey, Office of Energy Research).

Implementation of the Rapid Commercialization Initiative (Department of Defense, Environmental Protection Agency, Department of Commerce, Western Governors Association, various State organizations).

Global Environmental Technology Enterprise for commercializing environmental technologies developed in DOE laboratories. (Office of Environmental Restoration and Waste Management, Department of Defense, White House Office of Science and Technology Policy).

Sixteen Clean Coal Technology cooperative agreements (various electrical utilities, technology vendors, and industrial organizations).

R&D partnership in support of Fossil Energy and Office of Environmental Restoration and Waste Management programs (University of North Dakota Energy and Environmental Research Center, Western Research Institute).

Numerous agreements with industry to jointly fund and manage R&D projects in power systems.

Agreements (67 currently) with schools for training students, teachers, and researchers.

Member of the Office of Environmental Restoration and Waste Management Technology Division’s Management Steering Committee (Office of Environmental Restoration and Waste Management and three site operations offices)

Development of solid-waste disposal technology (Savannah River Operations Office)

Human-effects impact of advanced technology on work safety and health (Union of Operating Engineers; Office of Environment, Safety and Health; Department of Defense; Office of Environmental Restoration and Waste Management).

Morgantown Energy Technology Center

Significant Accomplishments

Pressurized-Fluidized Bed Combustion: Under METC's management, demonstration of the first pressurized-fluidized bed combustion plant in the United States under the Clean Coal Technology program was successfully conducted. The plant demonstrated that the technology could meet efficiency and environmental performance targets at large-scale operation, providing a superior future option for clean, affordable power from coal for the partner utility and others in the United States and offshore. Concurrent technology development gave improvements in hot particle filtering, a process key to the technology's success. The project successfully met METC's mission to develop clean, low-cost, reliable and efficient products for the energy sector.

Clean Coal Demonstration Power Plants: Through a multi-year program of research with industry, METC has brought Integrated Gasification Combined-Cycle (IGCC) systems to the verge of commercialization. With efficiencies 50 percent higher than conventional power plants and superior emissions control, IGCC systems can be a preferred supplier of clean, affordable electrical power to the Nation, providing a technology package that U.S. companies can market around the world. METC currently has one IGCC demonstration plant in operation, two in construction, and two more planned. These plants will offer a variety of system options to use coal cleanly from sources anywhere in the world.

Fuel Cell Power Plants: A vigorous research and development program, managed by METC, has moved the United States toward world leadership in the commercialization of fuel cell power plants. Gas-fired fuel cells offer some of the highest efficiencies and almost zero emissions. Five years ago, leadership was in the hands of foreign countries, especially Japan and Northern Europe. Now, one type of fuel cell is being marketed commercially by a U.S. company, and two other types are in early demonstration with industry. Fuel cells are considered one of the best options for dispersed power generation, and gaining the market lead will enable U.S. companies to sell them around the world.

Improved Natural Gas Collection Technologies: METC's long-term gas research program has developed confidence that the United States has a large natural gas resource that can be produced at favorable prices. Increased production is coming from gas in "tight" formations, where the geologic character of the rock makes it difficult for the gas to move to producing wells. Over the past few years, METC has conducted field tests using directionally drilled boreholes turned to run horizontally along the formation that contains the gas. These tests have used advanced instruments to guide the drill through the resource, novel drilling fluids like air and foams rather than conventional fluids that tend to plug up the rock, and new techniques to fracture the reservoir rock and improve gas collection. This suite of technologies is now being practiced commercially to deliver abundant affordable gas to U.S. users.

Performance Measurement/Quality Award: METC adopted total quality principles and a focus to please the customer before these became major themes for "making a government that works better." An early team effort to devise a methodology to measure METC's total organizational performance toward meeting its mission was a success, including measurements, verified externally to METC, of programmatic and institutional goals. The methodology won METC a Government Performance and Reporting Act pilot project award, one of only four received within the Department on the first round. A unique aspect of the measurement system is the use of risk reduction to measure progress on long-term R&D projects. A successful pilot could interest other government organizations in the methodology.

National Renewable Energy Laboratory

Laboratory Information

Name: National Renewable Energy Laboratory

Location: Golden, Colorado

Contractor: Midwest Research Institute, Kansas City, Missouri

Budget: $237 million (FY 95)

DOE Programs

Energy Efficiency and Renewable Energy

Description

The National Renewable Energy Laboratory (NREL) was established by the Solar Energy Research, Development and Demonstration Act of 1974 as a national center for federally sponsored solar energy research and development. Its mission is to lead the Nation toward a sustainable energy future by developing renewable energy technologies, improving energy efficiency, advancing related science and engineering, and facilitating commercialization.

Major Facilities

Solar Energy Research Facility: Completed in 1993, houses 42 laboratories for research in photovoltaics, superconductivity, and related materials science.

Field Tests Laboratory Building: NREL's first permanent research facility houses 41 laboratories for research in alternative fuels and industrial processes.

National Wind Technology Center: Completed in 1994, this facility houses all of NREL's wind-energy research activities.

Alternative Fuels User Facility: This new facility provides dedicated laboratory space for research on ethanol, methanol, and other alternative fuels. It includes a pilot plant for evaluating biofuel production technologies.

Outdoor Test Facility: State-of-the-art laboratory building and outdoor test area are used to analyze photovoltaic devices.

Thermal Test Facility: Scheduled for completion in 1996, this facility will provide research space for thermal testing of ventilation and active and passive solar systems.

High-Flux Solar Furnace: This National User Facility is used for high-temperature experimentation—for example, in ceramics.

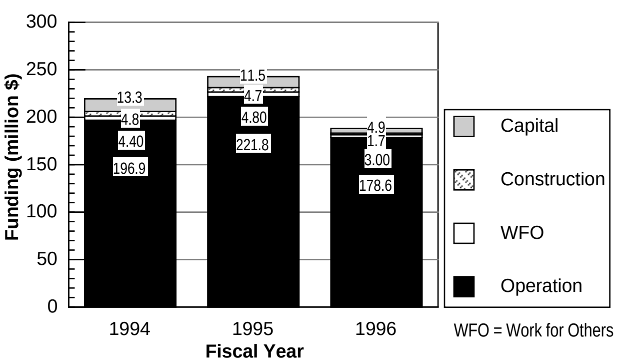
Key Research and Development Activities

Science: Materials science, superconductivity, chemical sciences, biotechnology.

Energy Resources: Biofuels—biochemical and thermochemical conversion, feedstock development, fuels utilization; Advanced vehicle technologies—electric and hybrid electric vehicles; Solar industrial technologies—solar process heat and advanced materials processing; Photovoltaics; Wind-power technologies—advanced wind-turbine development, resource evaluation, fatigue research; Solar thermal technologies; Biomass power technologies; Hydrogen energy systems; Geothermal energy technologies; Renewable energy resource assessment; Building energy technologies.

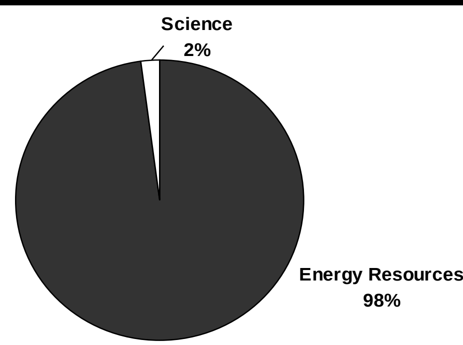
Environmental Quality: Waste management, utilization, and conversion; solar detoxification; water desalination and purification; Clean Cities Program; alternative-fuel vehicles.

Funding History



WFO = Work for Others

DOE Mission Footprint



Note: Does not include Work for Others

FY 1995 Data

National Renewable Energy Laboratory

Distinctive Competencies

Development and characterization of renewable energy technologies, energy efficiency, and waste conversion processes and technologies.

Systems and process engineering and integration for renewable energy and energy efficiency technologies.

Advanced materials science, engineering, and characterization.

Partnerships for market and technology development for renewables and energy efficiency technologies.

Partnerships and Collaborations

Thirty-six cooperative research and development agreements, totaling $74 million in combined DOE/industry funding, including:

- Amoco Corp., to demonstrate technology for turning landfill waste and other feedstocks into ethanol.
- New Energy Co., to demonstrate an innovative technology for converting corn to ethanol.
- Rockwell International, to develop and commercialize technology to reduce environmental impacts of hazardous waste incineration.
- Sierra Research, to develop high-temperature superconducting materials for solid-state cooling technologies.
- International Technology Corp., to test the effectiveness of photocatalytic oxidation for destruction of volatile organic compounds.
- AlliedSignal Inc., to evaluate the commercial potential of recycling waste carpet using NREL's selective pyrolysis process.
- Advanced Battery Consortium, for the development of advanced insulation for high-performance batteries.
- Benteler Industries, for the development of the next generation of catalytic converters.
- Energy Conversion Devices, for photovoltaic module characterization and measurement.
- Golden Technologies Company, Inc., for the production of biodegradable plastics from waste materials.
- Core Ceramics, for the manufacture of low-cost ceramics powders.
- IST/Federal Bureau of Prisons, for a solar thermal demonstration project at a federal correctional institute in Phoenix, Arizona.

One-half of NREL's annual budget is spent to support subcontracts with industry, colleges, and universities, including:

- $22 million in cost-shared subcontracts for 11 companies involved in the Photovoltaic Manufacturing Technology Project, designed to improve photovoltaic manufacturing processes.
- Negotiations with 10 States under the Sustainable Technology Energy Partnerships Program to accelerate the commercialization of wind-energy technology.
- Cost-shared subcontracts with three wind-energy companies—Kenetech Windpower, Inc., Zond Iowa Development Corp., and Waverly Light and Power—to construct wind turbine power plants in Wyoming and Iowa.
- An agreement with Zond Systems, Inc., to improve wind-turbine technology.

A partnership with the U.S. State Department, Energy Conversion Devices, and a Russian photovoltaic production company to make thin film amorphous silicon solar modules in Moscow.

A project to bring electricity to rural villages in Brazil for the first time through an agreement with the Brazilian government to provide photovoltaic systems for homes and schools.

National Renewable Energy Laboratory

Significant Accomplishments

Genetic Engineering of *Zymomonas mobilis*: About 35 to 50 percent of the feedstock used in the production of ethanol is collulose that hydrolyzes to form glucose and other six-carbon sugars. Another 20 to 35 percent of these biomass materials is hemicellulose that typically releases zylose, arabinose, and other five-carbon sugars. Although many organisms readily ferment six-carbon sugars to ethanol, native organisms can not ferment five-carbon sugars to ethanol, and the low yields of ethanol that result from their use make the overall process uneconomical. Researches in NREL's Biomass program significantly enhanced the commercial prospects for biomass-derived ethanol by genetically engineering the bacterium *Zymomonas mobilis* to enable it to ferment both five-carbon and six-carbon sugars. The development of *Zymomonas mobilis* significantly improves the economics of producing ethanol from biomass by allowing joint processing of the cellulose and hemicellulose fractions of biomass feedstocks.

Improved Photelectric Devices: Researchers have long been aware of the potential of gallium arsenide (GaAs) and related compounds for use in high-performance photoelectric devices. The challenge is to fabricate cost-efficient devices. NREL scientists focused on tandem structures in which a top cell of gallium indium phosphide (GaInP) is grown on top of a bottom cell made of GaAs so that the two cells operate in tandem and optimally convert incoming light to electricity (and vice versa). Early progress on developing GaInP/GaAs tandem structures was slowed by the research communities' general lack of understanding of the basic science of GaInP materials and processing involving these materials. An NREL-led team composed of theoretical physicists applied fundamental principles of quantum mechanics, thermodynamics, and solid-state physics to develop a theoretical description of how GaInP materials behave. NREL scientists developed spectroscopic techniques that have resulted in record-breaking sunlight-to-electricity efficiencies.

Thin-film Solar Cells: The two-part challenge of thin-film photovoltaic (PV) solar cells is to achieve sunlight-to-electricity conversion efficiencies comparable to traditional PV technologies based on crystalline silicon wafers, and to do so without increasing the complexity of the devices and/or the fabrication processes so as to erode the inherent low-cost production advantages of thin films. Research into the basic materials science of copper indium selenide (CuInSe2) revealed that copper-rich layers grown at sufficiently high temperatures under seleuim-rich conditions benefit from the fluxing action of liquid copper selenide, yielding large crystallite grain sizes preferred for optimal electronic properties. The indium-rich layers yield the surface compostions and morphologies necessary for proper electronic junction formation. Careful grading of the gallium content can yield optimal electric field profiles in completed thin-film devices. By combining these insights with advanced, automated vacuum processing techniques, NREL researchers were able to use the multcomponent nature of the materials to tailor the properties needed for high-efficiency thin-film solar cells.

Advanced Airfoils and Blades for Horizontal Wind Turbines: One of the key goals of NREL's Wind program is the development of high-efficiency wind turbines capable of cost-effective power generation in a wide range of wind resource situations. Advanced airfoil and blade designs developed by NREL and an industrial partner convert wind energy into mechanical energy in a much more efficient manner than previously available wind turbine blades. A key design feature of the airfoils is that they minimize energy looses due to roughness effects as the blades become soiled with insect accumulation and airborne pollutants. Further performance improvement is achieved by tailoring the airfoil's performance characteristics for the blade root, midspan, and tip-region. NREL's advanced foils improve average annual wind energy capture for all three major types of wind turbines: stall-regulated, variable-pitch, and variable-RPM.

Silicon Carbide Ceramic Powder: NREL has developed an innovative two-step process for forming silicon carbide ceramic powder that promises to provide a low-cost domestic source of high-performance ceramics, replacing expensive imported materials and opening up a wide range of cost-effective applications of silicon carbide ceramics. Ceramic materials provide high-temperature strength retention, resistance to oxidation and wear, and low thermal expansion. With their light weight, they are the material of choice for many high-temperature load-bearing applications. Of the ceramic materials on the market today, silicon carbide has the highest resistance to wear and corrosion. Collaborative work by researchers at NREL and an industrial partner developed a new ceramic powder production process that promises to sharply reduce silicon carbide power production costs. The two-step process involves coating inexpensive silicon oxide particles with carbon from a heated hydrocarbon gas and subsequently reacting the carbon-coated silica to form silicon carbide. The resulting product is higher in quality and will likely be one-quarter to one-half the cost of competing powders.

Oak Ridge Institute for Science and Education

Laboratory Information

Name: Oak Ridge Institute for Science and Education
Location: Oak Ridge, Tennessee
Contractor: Oak Ridge Associated Universities
Budget: $35.3 million (FY 95)

DOE Programs

Energy Research; Office of Science Education and Technical Information; Environment, Safety and Health; Environmental Management; Defense Programs; Nonproliferation and National Security; Nuclear Energy; Civilian Radioactive Waste Management

Description

Oak Ridge Institute for Science and Education (ORISE) carries out national and international programs in science and engineering, training and management systems, energy and environmental systems, and medical sciences. Its mission is to develop and provide capabilities critical to the Nation's science and technology infrastructure, particularly in energy, education, health, and environment. ORISE enhances the quality of science and mathematics education at all levels and helps provide properly educated scientists and engineers for the Nation's future needs; conducts basic and applied biomedical research on human health and disease and provides technical assistance and training in occupational and environmental medicine; develops, manages, and operates programs in training, human resources management, technology transfer, and information management systems; and develops, analyzes, and evaluates policies and regulations affecting energy and environmental issues, carries out field surveys and assessments of hazardous material sites, and develops techniques for resource protection and enhancement.

Major Facilities

Radiation Emergency Assistance Center and Training Site: Unique, internationally recognized center for training, emergency response, and medical assistance in radiological accidents and emergencies.

University Radioactive Ion Beam Consortium: International consortium of universities that provides experimental facilities and an environment for conducting basic nuclear research by scientists of its members and other institutions.

Center for Epidemiological Research: Principal research site for descriptive epidemiologic studies of mortality and morbidity of the DOE and contractor workforce and communities surrounding DOE sites. Database of nearly 500,000 DOE contractor workforce records.

Radiation Internal Dosimetry Information Center: A long-time collaboration of DOE, the Food and Drug Administration, and the Nuclear Regulatory Commission for Government, academic, and private-sector nuclear medicine researchers and practitioners needing dosimetry calculations and information about radiation dose from radionuclides in the human body.

Center for Human Reliability Studies: A DOE Center of Excellence for technical assistance, training, and research and analysis in human reliability and personnel security issues

Key Research and Development Activities

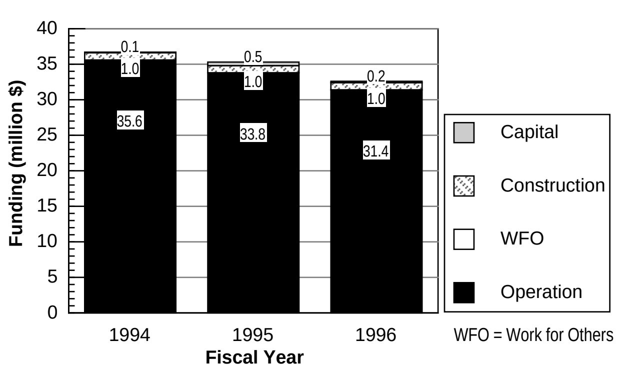
Science: Research and training in radiation medicine and response to radiation accidents; Pre-college science and education programs; Research participation programs and fellowships at DOE facilities; Structure and decay of unusual atomic nuclei.

Energy Resources: Research participation programs at Fossil Energy Technology Centers; Economic analyses of large, energy-related facilities.

Environmental Quality: Independent radiological site verification of current and former DOE sites; Technical expertise in safety, health, and quality assurance.

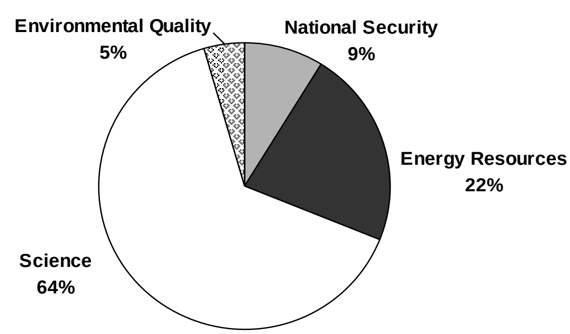
National Security: Policy analysis; Design and delivery of security education and personnel security training; Emergency preparedness and training.

Funding History



WFO = Work for Others

DOE Mission Footprint



Note: Does not include Work for Others

FY 1995 Data

Oak Ridge Institute for Science and Education

Distinctive Competencies

Development and implementation of science education and fellowship programs.

Internationally recognized expertise in emergency preparedness, management, and response.

Research in human health effects of radiation and other byproducts of energy-related technologies.

Management of Training Resources and Data Exchange network.

Assessment and characterization of environmental hazards.

Design, delivery, and evaluation of human resources development training.

Partnerships and Collaborations

Operated by Oak Ridge Associated Universities, a consortium of 88 colleges and universities. UNIRIB is a consortium of 14 U.S. and British universities.

Regional: Oak Ridge National Laboratory, Y–12, University of Tennessee, Tennessee Valley Authority, local community colleges, East Tennessee Science Bowl, and local public school systems

National: NAACP, American Indian Higher Education Consortium, Hispanic Association of Colleges and Universities, 11 other Federal agencies, several private pharmaceutical firms, and more than 1,700 fellowship appointments at 50 Federal laboratories.

International: World Health Organization, International Atomic Energy Agency, Institute of Biophysics of the Russian Federation, Nachi-Katsuura Onsen Hospital, Finnish Center for Radiation and Nuclear Safety, and the Latvian Ministry of Health.

Significant Accomplishments

Medical and Environmental Sciences

Beryllium Worker Surveillance Program: ORISE's Center for Epidemiologic Research (CER) provides accurate and timely data collection of information from approximately eight different locations on the number of ORNL employees exposed to beryllium dust. In addition, CER performs descriptive epidemiologic surveillance on the data. ORISE, a small, independent laboratory focused on the occupational health issues critical to DOE and its contractor workforce and to surrounding communities, is now the only DOE laboratory with a broad expertise in all areas of occupational epidemiology.

Response To Phosphorus-32 Contamination Incidents: The Nuclear Regulatory Commission contacted ORISE for emergency assistance in support of possible phosphorous-32 contamination incidents at Massachusetts Institute of Technology and the National Institutes of Health. Environmental assessment staff provided immediate radiochemical analyses of bioassay samples that generated the data necessary to determine whether or not laboratory researchers had been contaminated with phosphorous-32.

Project Sapphire: Project Sapphire transferred approximately 600 kilograms of weapon-grade uranium from the Republic of Kazakhstan to the United States to keep terrorists, black marketers, and other hostile powers from taking nuclear-grade weapon material out of Kazakhstan's Ulba Metallurgical Facility. ORISE staff participated in this successful secret mission to bring the material to the DOE's Y–12 facility in Oak Ridge.

Education and Training

Training Resources and Data Exchange: DOE's Training Resources and Data Exchange (TRADE) network has helped DOE and its contractors overcome a bias toward individual action by offering technical personnel and a platform for training in order to share training materials, resolve common problems, and jointly develop generic materials so that each site can easily adapt to its specific needs. Individual site reports of cost avoidance suggest that DOE's investment in TRADE has been leveraged many times over. A few examples:

- The Strategic Petroleum Reserve Office estimated in FY 93 that the Occurrence Reporting Special Interest Group had saved SPRO about $550,000.
- By the end of FY 95, the cumulative savings reported from the use of the TRADE-developed and revised course, "Emergency Management in the DOE," had approached $3 million.

Educational and Outreach Programs That Target Minorities: In designing educational programs that reach out to minorities, ORISE gives participants information about job opportunities. Program goals are designed to increase the number of minority students seeking careers in science and technology.

Pittsburgh Energy Technology Center

Laboratory Information

Name: Pittsburgh Energy Technology Center

Location: Bruceton, Pennsylvania

Contractor: None (Government owned and operated)

Budget: $226 million (FY 95)

DOE Programs

Fossil Energy, Energy Efficiency and Renewable Energy, Environmental Restoration and Waste Management

Description

Pittsburgh Energy Technology Center (PETC) is one of the Federal Government's principal fossil energy research centers, responsible for the technical and administrative management of fossil energy-related research and development programs. Its origins date back to 1910, when Congress created the U.S. Bureau of Mines.

PETC has changed along with the country's needs, beginning with a mission related to basic coal research and evolving to research and development of synthetic fuel technology and technologies designed to use fossil fuels in a more efficient and environmentally acceptable manner.

Major Facilities

National Coal Preparation Process Research Facility: Provides high-quality, bench-scale data on the performance of innovative cleaning and separation technologies.

Combustion and Environmental Research Facility: Evaluates the combustion performance of advanced, highly processed fuel forms.

Particulate Flow Analysis Facility: Examines flows related to combustion performance in boilers, separation methods for dry and liquid materials, and flue-gas desulfurization systems.

Life-Cycle Test System: Tests the performance of various flue-gas cleanup sorbents processes.

Hydrocarbon Direct Conversion and Upgrading Facility: Studies coal liquefaction, coal and oil and waste coprocessing, coal liquids or heavy oil upgrading, and catalyst performance.

Specialized Analytical Laboratories: Magnetic resonance studies; high-resolution mass spectroscopy; optical and scanning electron microscopy; x-ray diffraction; surface sensitive spectroscopies such as x-ray photoelectron spectroscopy; electrokinetic analyses; flow calorimetry; electron paramagnetic resonance spectroscopy; and laser diagnostics.

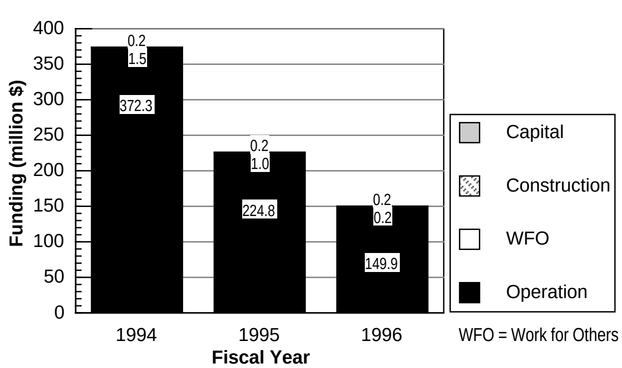
Key Research and Development Activities

PETC's two main program areas, Advanced Power Systems and Advanced Fuel Systems, address the entire fuel cycle through the following four research areas:

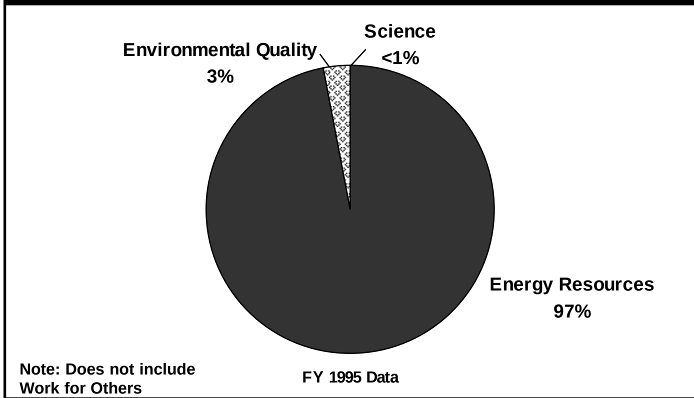
- Coal Preparation and Beneficiation—Removal of impurities from coal to yield cleaner burning, stable coal products that are easily transported and stored.
- Coal Utilization—Improvement of combustion efficiencies.
- Environmental Control—Development of technologies that yield lower emissions of sulfur dioxide and nitrogen oxides, which are known contributors to acid rain and the global warming gas carbon dioxide.
- Coal Conversion—Conversion of coal into various liquid and solid fuels, as well as value-added end products.

PETC also plans and implements 25 cooperative agreements between private-sector participants and the Federal Government under the Clean Coal Technology Program. This multiyear, multibillion-dollar cost-shared partnership is designed to demonstrate a new generation of innovative coal technologies offering improved environmental benefits, higher efficiencies, and lower costs.

Funding History



DOE Mission Footprint



Pittsburgh Energy Technology Center

Distinctive Competencies

PETC's major programs cover the entire cycle of coal use—from coal preparation to advanced combustion to flue gas cleanup. The emphasis of the work is on improving the environmental acceptability of the Nation's vast supplies of coal.

PETC also oversees research on improved processes to use U.S. coal resources to produce liquid transportation fuels and chemicals. The Center complements its contract management with an in-house program of fundamental, exploratory, and applied research. Using state-of-the-art equipment and expertise, PETC scientists and engineers not only conduct hands-on research, but also provide technical expertise to evaluate and monitor R&D contracts with industry and universities.

PETC also maintains an integrated set of core competencies that include managing technical programs for the Office of Fossil Energy; managing 678 active research and development contracts, grants, and cooperative agreements with industry and universities; providing direct support to U.S. industry to supply the global economy with energy and environmental products and services, creating value-added American jobs; managing the physical plant, real and personal property, and environmental health and safety concerns for other DOE facilities; and providing administrative services to DOE elements such as procurement, finance, legal, human resources, planning, communications, and safeguards and security.

Partnerships and Collaborations

PETC supports the transfer of Federal technology to private industry, State and local governments, foundations, and academic institutions through 31 cooperative research and development agreements with a combined industry/government value of more than $5 million. These arrangements enable outside organizations to access PETC's research facilities and staff expertise.

While most of PETC's projects deal with coal or other energy sources, one cooperative research and development agreement involved the University of Pittsburgh Medical Center and a NOVACOR left-ventricular assist device—an artificial heart pump. PETC's expertise in flow dynamics was used to design, model, and improve an artificial heart pump. A special clear plastic pump was created to observe the flow of simulated blood as it passed through the pump. This enabled researchers to see where potential clots could occur and then modify the design. The process won a Federal Laboratory Consortium Award of Excellence in Technology Transfer and an R&D 100 award. Because this project was so successful, testing is currently under way on an artificial lung project.

PETC is working with private industry, under the Combustion 2000 Program, to develop two kinds of advanced, coal-fired electric power generation systems that will have significantly higher thermal efficiency, superior environmental performance, and a lower cost of electricity than current coal-fired plants.

PETC also administers the University Coal Research Program and the Historically Black College and University Education and Training Program, both of which provide grants for student-teacher projects in coal science and technology.

PETC sponsors internships and fellowships for college students and faculty from across the Nation. PETC also has close ties with the Pittsburgh educational community. The Center sponsors programs for local teachers and students and provides assistance in improving educational curricula in science and mathematics.

PETC's technical expertise in fossil technologies, coupled with its research personnel, facilities, and business, international, contracting, and legal capabilities, make it ideally suited to accomplish the Office of Fossil Energy's international mission. PETC implements a number of international cooperative agreements for DOE, including agreements with Canada, England, India, Italy, Japan, Mongolia, Poland, the People's Republic of China, the Republic of Korea, and Ukraine. For example:

- PETC is managing a $20 million program to reduce the air pollution in Krakow, Poland.
- A process patented by PETC researchers is expected to be used in China to reduce total mineral impurities.
- Under PETC's technical and management coordination, state-of-the-art pilot-scale combustion facilities, patterned after a similar facility at PETC, were designed and erected in India and South Korea.
- As part of a $2.4 million cooperative U.S.-Ukraine project financed by the U.S. Agency for International Development, PETC is identifying cost-effective ways of burning indigenous coal without the need for supplementary imported fuels.

Pittsburgh Energy Technology Center

Significant Accomplishments

Wet Limestone Scrubbers: PETC completed demonstrations for two advanced wet limestone scrubber projects for SO_2 control, and operations commenced on a third. Taken together, these scrubbers span a variety of scrubber types and construction materials that have been at the technological forefront in terms of Clean Air Act compliance. Demonstration features have been widely adopted by other scrubber vendors and, more importantly, the U.S. electric utility industry. These PETC projects have driven the scrubber market toward larger and more reliable absorber vessels, saleable byproducts, increased competition, and better equipment guarantees. The resultant savings to U.S. electricity consumers from these and other demonstration features amounts to billions of dollars in reduced Clean Air Act compliance costs.

Low-NO_x Burners and Overfire Air: Several PETC projects have assisted in the commercialization of low-NO_x burners, overfired air, reburning, selective catalytic reduction, and selective noncatalytic reduction technology. Low-NO_x burners and overfire air have been particularly successful in penetrating the utility market. It is estimated that by the year 2000, every coal-fired power plant in the United States will be equipped with these combustion modification technologies, which are enjoying strong international sales as well. PETC scientists and engineers provide valuable technical data to regulators at the Environmental Protection Agency on subjects ranging from NO_x control to air toxics emissions. The air toxics data helped to avert regulations that otherwise might have relied upon faulty, older data, thereby resulting in significant cost savings to industry and the Nation.

Advanced Solid-Fuel Technology: PETC's vigorous research and development program in advanced solid-fuel technology is helping to put the United States in a leadership role for advanced coal cleaning. The Micro-Mag Process, part of an advanced physical coal-cleaning process utilizing innovative dense-media cyclones and finely sized magnetite, was developed by researchers at PETC and licensed for demonstration and commercialization as part of the Department's Clean Coal Program. PETC has also developed a dry novel coal beneficiation technology, triboelectrostatic separation, that precludes the need for water when deeply cleaning high-ash, high-sulfur coal. The dry nature of the process makes it very attractive as a powerplant retrofit for rejecting ash and pyritic sulfur downstream of the plant's existing coal pulverizers.

Indirect Coal Liquefaction: Following more than 10 years of PETC-sponsored research in indirect coal liquefaction, a $35 million, first-of-a-kind facility is under construction that will demonstrate a cost-effective, environmentally friendly route for producing liquid fuels and chemical feedstocks from coal. PETC's long-term efforts will begin to be realized when production of 80,000 gallons per day of methanol from coal-derived synthesis gas begins in early 1997. Managed by PETC, this process is expected to enhance the economics and efficiency of integrated gasification combined cycle (IGCC) electric power generation. These combined technologies will provide one of the cleanest and most efficient of 21st-century power-generating options and will be able to accommodate local needs for electric power, transportation fuels, and manufactured chemical products from a domestic (and locally produced) resource.

Clean Coal: PETC has led the development of advanced technologies that make better use of the energy value of coal in the form of cost-competitive solid and liquid fuels. An innovative PETC-supported technology called Microcel™ can produce cleaner coals for electricity generation and can recover some of the estimated 2 billion tons of fine coal from refuse ponds. A PETC-developed dry beneficiation technology for cleaning coal is very attractive to utilities as a retrofit technology. PETC is leading the way in developing an advanced waste coprocessing program to convert fossil fuels and landfill wastes into premium transportation fuels and chemical feedstocks. The PETC-developed and patented GranuFlo process, which recovers what once was considered waste coal fines, is being tested at a large coal company and won a Federal Laboratory Consortium Award for Excellence in Technology Transfer.

Princeton Plasma Physics Laboratory

Laboratory Information

Name: Princeton Plasma Physics Laboratory

Location: Princeton, New Jersey

Contractor: The Trustees of Princeton University

Budget: $99.5 million (FY 95)

DOE Programs

Energy Research, Environmental Management

Description

Princeton Plasma Physics Laboratory (PPPL) grew out of Project Matterhorn, the controlled fusion program initiated in 1951 by Princeton University Professor Lyman Spitzer. Its mission is the development of magnetic fusion energy as a safe, inexhaustible, and environmentally acceptable means of generating electricity for the long term. The Laboratory operates one of the world's largest magnetic fusion devices, the Tokamak Fusion Test Reactor (TFTR), and two smaller fusion experiments. Staff are involved in the design of the Tokamak Physics Experiment and the International Thermonuclear Experimental Reactor. Knowledge gained in magnetic fusion research is applied to other theoretical and experimental areas, including the plasma processing of semiconductor devices and the study of beam-surface interactions.

Major Facilities

Tokamak Fusion Test Reactor: One of the world's most advanced magnetic fusion devices. Has set a number of records in fusion research, including the highest controlled fusion power output (10.7 MW) ever attained. Conducting the first extensive studies of plasma composed of 50-50 deuterium-tritium, the fuel mix required for practical fusion power production.

Princeton Beta Experiment Modification: Advanced-concept tokamak designed to explore opportunities for improving the attractiveness of the tokamak reactor concept.

Current Drive Experiment Upgrade: One of the few devices in the world capable of studying compact plasmas that may offer enhanced confinement and greater stability.

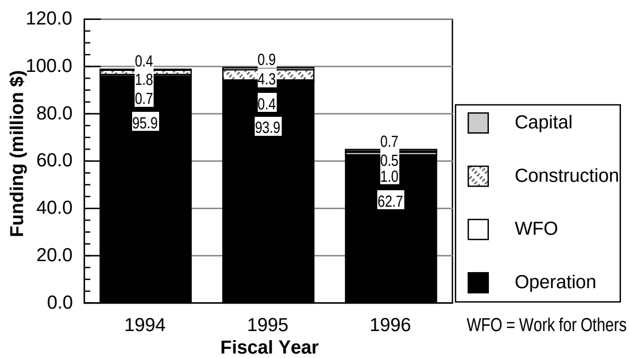
Magnetic Reconnection Experiment: Configured to study fundamental plasma processes with relevance to fusion research, as well as to the physics of the earth's magnetosphere and solar flare evolution.

Hyperthermal Atomic Beam Source: Facilities for the study of interactions between surfaces and hyperthermal neutral atoms. Applications include the evaluation of erosion rates for spacecraft materials and low-damage processing of semiconductor materials for microelectronics manufacturing.

Key Research and Development Activities

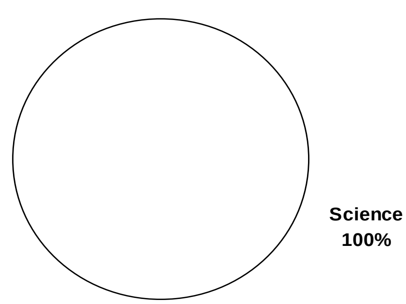
Science: Develop the scientific and technical foundations for fusion as a plentiful, safe, economical, and environmentally attractive energy source. Provide strong national leadership in research and development aimed at realizing the full potential of fusion energy. Associated missions include frontier research on the physics of plasmas, diverse practical applications of plasma science, and high-quality education in plasma science and related technologies.

Funding History



WFO = Work for Others

DOE Mission Footprint



FY 1995 Data

Note: Does not include Work for Others

Princeton Plasma Physics Laboratory

Distinctive Competencies

Highly respected experimental and theoretical scientific teams.

Very capable and experienced engineering design team.

World-class facilities for operation of fusion research devices, including 500,000 square feet of high-quality laboratory and support space; 4.5 GJ motor-generator energy storage; 250-MW, 200-sec line power, upgradable to 500-MW steady; well-shielded bay areas; extensive plasma diagnostic capabilities; proven tritium capability; and neutral-beam and radiofrequency plasma-heating facilities.

Extensive capabilities for design, fabrication, and testing of electrical devices, magnets, and diagnostic systems.

One of the world's leading graduate programs in plasma physics.

Partnerships and Collaborations

PPPL actively collaborates on fusion experiments and plasma science research activities with more than 100 institutions around the world. These joint efforts link PPPL's researchers with those at other laboratories, educational institutions, and industry. In addition, PPPL is teamed with a variety of academic and industrial organizations in six cooperative research and development agreements totaling more than $500,000. Apart from DOE, other Government agencies, such as NASA and the National Science Foundation, sponsor research at PPPL.

Scientific collaborations are performed in a variety of ways, including hosting visiting researchers at PPPL, sending Laboratory personnel to other institutions to participate in research, and, increasingly, through electronic telecommunications. Researchers visiting PPPL take part in experiments on the Tokamak Fusion Test Reactor (TFTR) and the Current Drive Experiment Upgrade, as well as small basic plasma science experiments. A significant number of visiting researchers collaborate on plasma theory and modeling activities. These partners include Argonne, Oak Ridge, Lawrence Livermore, Sandia, and Los Alamos National Laboratories; the Universities of Wisconsin, Maryland, California (at Los Angeles, San Diego, Irvine), Texas, Illinois; Massachusetts Institute of Technology; Columbia University; the A.F. Ioffe and Efremov Physical Technical Institutes, St. Petersburg, Russia; the Association Euratom-CEA, Cadarache, France; the Institute of Plasma Physics, Academia Sinica, Hefei, China; the Japan Atomic Energy Research Institute; and General Atomics.

Laboratory personnel visiting other institutions provide expertise to fusion research programs on all the world's major tokamak facilities, which include the Doublet III-D at General Atomics in San Diego, the Alcator C-Mod at Massachusetts Institute of Technology, the Joint European Torus in the United Kingdom, the Japanese Tokamak-60U in Japan, and a number of others. PPPL is also assuming a greater role in engineering design activity for the International Thermonuclear Experimental Reactor (ITER) program, which is a four-party effort with Europe, Japan, and Russia to design a multibillion dollar research facility for burning plasma physics and technology.

A sampling of PPPL's cooperative research projects with industry include teaming with a small business to develop a sapphire-to-metal bonding technique for use in manufacturing high-intensity lamps, a collaboration with Xerox Corporation to model charge transport for laser xerography, and a joint effort with AT&T Bell Laboratories to use numerical simulations to design an electron lithography technique to pattern semiconductors.

PPPL has a long history of working with the surrounding community in support of science education. There is an ongoing partnership with the Trenton Public School System, and the Laboratory conducts summer research programs and "Science on Saturday" lectures for secondary students, parents, and teachers.

Princeton Plasma Physics Laboratory

Significant Accomplishments

Use of Tritium in Fusion Experiments: In December 1993, after two years preparation, the Tokamak Fusion Test Reactor (TFTR) produced record levels of fusion power in the world's first experiments using a 50–50 mix of deuterium and tritium. TFTR is currently the only magnetic fusion device in the world capable of using tritium safely on a routine basis. As a result, PPPL scientists and their TFTR collaborators in the United States and abroad have published the largest number of referenced journal articles resulting from a single magnetic fusion device. The knowledge obtained from the analysis of this extensive data will lead eventually to the production of practical amounts of fusion power in more advanced machines.

World Fusion Power and Plasma Temperature Records: In November 1994, using a 50–50 deuterium-tritium fuel mixture, TFTR produced 10.7 million watts of controlled fusion power—a new world record. In the same series of experiments, TFTR produced 510 million degrees centigrade—the highest temperature ever produced in a laboratory and well in excess of the 100 million degrees centigrade required for practical fusion power.

Science of Plasmas Confined by Magnetic Fields: A new fundamental mode of plasma confinement, theorized earlier, was discovered on TFTR. The enhanced reversed shear technique involves a novel magnetic field configuration that dramatically reduces plasma turbulence. TFTR is now being used to explore the phenomenon in greater detail. If the enhanced reverse shear mode can be demonstrated over a broader range of plasma conditions, it could double TFTR's power output and lead eventually to smaller, more economical commercial fusion reactors.

Unsurpassed Computational Simulations of Magnetized Plasmas: PPPL developed state-of-the-art plasma physics codes that provide sophisticated modeling of magnetized plasmas for fusion and non-fusion applications. Two- and three-dimensional magnetohydrodynamics codes analyze macroscopic plasma equilibrium and stability, gyrokinetic and gyrofluid codes simulate plasma turbulence, and hybrid fluid and particle codes address effects of energetic particles on collective modes.

Experimental and Theoretical Tools to Study Alternative Fusion Options: PPPL developed small- to medium-scale experimental facilities for exploratory studies of innovative fusion plasma systems and of fundamental processes such as magnetic reconnection. PPPL's simulation tools provide capabilities for computationally prototyping new configurations for concept assessment and experiment design.

Savannah River Technology Center

Laboratory Information

Name: Savannah River Technology Center

Location: Aiken, South Carolina

Contractor: Westinghouse Savannah River Co.

Budget: $94 million (FY 95)

DOE Programs

Environmental Management: Scientific research and technology development and deployment focused on environmental and waste management issues.

Description

Savannah River Technology Center (SRTC), formerly known as the Savannah River Laboratory, was established in 1951 to support the production of nuclear materials for national defense at the Savannah River Site. An applied research and development laboratory, it continues to support national defense through its technologies and capabilities in nonproliferation and tritium processing. SRTC also is at the forefront of applying new technologies to stabilize and dispose of nuclear materials, clean up groundwater and soil polluted with industrial wastes, and explore alternative energy uses. Its mission also includes engaging in partnerships with industry, academia, and government agencies to increase U.S. industrial competitiveness and apply the most cost-effective and efficient solutions to the environmental legacy of the Cold War. In 1995, the landlord for the laboratory transferred from Defense Programs to the Office of Environmental Restoration and Waste Management.

Major Facilities

SRTC Technical Area: Facilities include the Weather Center, the Underground Counting Facility, the Ultra Low Level Counting Facility, Chemistry and Analytical Laboratories, Intermediate Cells and Shielded Cells, the Robotics Laboratory, the Thermal Fluids Laboratory, and the Scientific Computing Resource Center.

TNX Facility: Dedicated to applied R&D programs on site. TNX has the space and capability for full-size construction and testing of pilot facilities for site missions. Among other projects, TNX has been the R&D site for the glass vitrification process.

Field Facilities: The P and R Reactor Pond Environmental Laboratory, Biotechnology Laboratories in B-Area and TNX, and the Integrated Demonstration Site in M-Area focus on in situ bioremediation techniques and bioreactors.

TRAC (Tracking Radioactive Atmospheric Contaminants) Vehicle: Mobile radionuclide monitoring laboratory that uses state-of-the-art equipment and has the capability to measure and identify all forms of radioactivity in air, water, and soil samples.

Key Research and Development Activities

Environmental Remediation: Develop methods of detecting contamination in soils, groundwater, and wetlands and of eliminating or containing pollutants.

Material Stabilization: Convert nuclear materials to a more stable form for long-term storage and disposal. Integrate waste characterization, glass formulation, process design, modeling, pilot-scale testing, glass product qualification, and field support.

Waste Processing Technology: Plans and models for waste immobilization applications, such as low-level radioactive wastes, mixed wastes, actinides, contaminated asbestos, exchange resins, and medical wastes.

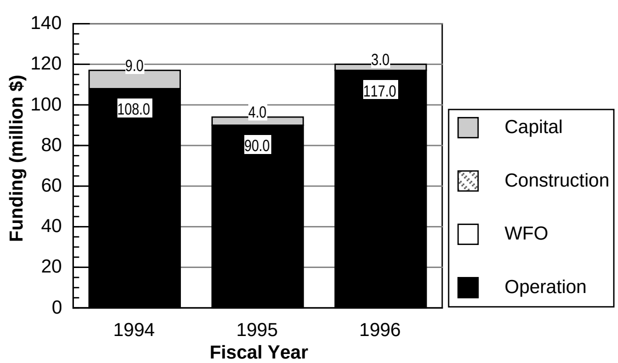
Hydrogen and Tritium Technology: Maintain proficiency.

Sensor Technology: Sensor systems for remote, real-time analysis of online chemical processes.

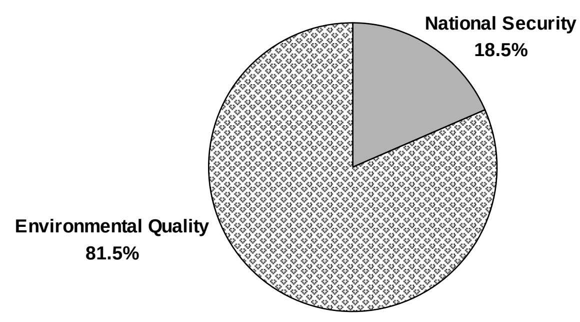
Remote Systems and Robotics: Develop remote systems utilizing commercially available robotics equipment to minimize personnel exposure to ionizing radiation and hazardous chemicals.

Nonproliferation Technology: Maintain and continue to expand capabilities for environmental hydrologic and atmospheric monitoring, high-sensitivity radiation detection and mapping, and remote multispectral sensing and imaging.

Funding History



DOE Mission Footprint



Note: Does not include Work for Others

Savannah River Technology Center

Distinctive Competencies

Environmental characterization and remediation technologies.

High-level radioactive, low-level radioactive, hazardous, and mixed waste characterization, processing, storage, and disposal, with specialized expertise in vitrification.

Arms control and nonproliferation.

Advanced measurement and sensing systems.

Tritium processing and alternative uses of hydrogen energy.

Applied remote and robotics systems for radioactive and hazardous environments.

Partnerships and Collaborations

Industry Alliances

- AMTEX (American Textiles Industry Partnership)
- National Center for Manufacturing Sciences
- National Advisory Panel on Electric Technology Transfer
- Technical Association of the Pulp and Paper Industry (TAPPI)

Government Alliances

- U.S. Forest Service, Savannah River Forest Station
- Southeastern Environmental Resources Alliance
- International Center for Applied Research

University Alliances

- Savannah River Ecology Laboratory (University of Georgia)
- South Carolina Universities Research and Education Foundation
- Education, Research, and Development Association (Georgia Universities)
- Center for Vitrification Research
- Nine subcontracts with colleges

Community Alliances

- Savannah River Regional Diversification Initiative
- Southern Technology Center
- Savannah River Research Campus

Savannah River Technology Center

Significant Accomplishments

Environmental Remediation

- R&D 100 award for SRTC-developed bioremediation technique that stimulates microbes to degrade chlorinated solvents in soils and ground water.
- Constructed the SOILS Facility, the first DOE permanent facility designed to use microbes to clean soil contaminated with petroleum products.
- 1996 National Federal Laboratory Consortium Award for Excellence in Technology Transfer for developing and encouraging widespread use of bioremediation methods to clean up groundwater and soils contaminated by industrial solvents and petroleum products.

Material Stabilization

- Developed and demonstrated the vitrification process used in the Defense Waste Processing Facility to convert frit and high-level waste to durable glass inside a stainless steel canister.
- Developed the Can-In-Canister process to stabilize surplus plutonium in Defense Waste Processing Facility canisters during production pours.
- Developed and deployed a Transportable Vitrification System for onsite remediation, thereby reducing any risks associated with transporting untreated wastes.

Waste Processing Technology

- Developed the Saltstone Process, which stabilizes low-level radioactive salt solutions by mixing them with cement, fly ash, and blast furnace slag and then pumping the mixture to a concrete vault to cure.
- Developed an industrial partnership to recycle slightly radioactive stainless steel into metal canisters and boxes used for disposal of nuclear wastes.

Hydrogen Technology

- Invented the Thermal Cycling Absorption Process, which separates hydrogen isotopes safely, efficiently, and cost-effectively using hydride technology.
- In conjunction with an industrial partner, developing a prototype public transport vehicle using hydrogen as the fuel.
- Valuable resource and participant in the international effort to develop an experimental fusion reactor (International Thermonuclear Experimental Reactor).

Sensor Technology

- Developed an R&D 100 award winning optical temperature sensor system that measures temperatures from –200 °C to 600 °C safely and accurately, even in extremely hazardous, corrosive, and high electromagnetic field environments. Deployed this system in an industrial partner's plant to continuously monitor a critical chemical reaction.

Remote Systems and Robotics

- Developed the Mobile Automated Characterization System, which independently navigates and monitors facilities for radioactive contamination.
- Developed a remote magnetic-wheeled wall crawler that ultrasonically inspects waste storage tanks for pitting and corrosion.
- Developed a pipe crawler to navigate contaminated ventilation piping and remove an elbow by cutting from the inside.
- Developed numerous remote video systems, including a camera system that must fit through a 4-inch diameter riser pipe for the inspection of waste storage tanks.

Nonproliferation Technology

- Developed RADMAPS, a portable RADiation MAPping System for detecting, locating, and characterizing nuclear materials when the presence of such material is not otherwise documented. This versatile, portable field unit records gamma or neutron radiation spectra and records its location using the Global Positioning System.
- Built and tested a small, portable, prototype electrostatic precipitator collector to collect atmospheric particles that can provide significant information about the processes that formed the material and can help identify nuclear proliferation activities.

Stanford Linear Accelerator Center

Laboratory Information

Name: Stanford Linear Accelerator Center

Location: Menlo Park, California

Contractor: Stanford University

Budget: $178 million (FY 95)

DOE Programs

Energy Research, Environmental Management

Description

Stanford Linear Accelerator Center (SLAC) was founded in 1962 as a national user facility for subatomic research using electron beams. Its fundamental mission is to design, construct, and operate frontier electron accelerator and experimental facilities for both high energy physics and synchrotron radiation research, and participate, along with a broad spectrum of users, in a first-rate research program at the frontiers of science and technology.

Major Facilities

Linac: This 2-mile electron linear accelerator, the world's highest energy linear accelerator, produces high-current beams of low-emittance electrons and positrons with energies up to 55 GeV. The electron beams can be highly polarized (up to 90 percent).

Stanford Linear Collider: The first example of an electron-positron linear collider, this collider runs at around 100 GeV center of mass energy (50 GeV per beam), studying the production and decay of the Z^o boson. The polarized electron beam and the extremely small size of the collider's beams support a unique research program.

PEP II: An asymmetric electron-positron collider, the first of its kind, designed to produce very large numbers of B mesons to study the matter-antimatter asymmetry in nature.

SPEAR: An x-ray synchrotron light facility that provides extremely intense x-ray and ultraviolet radiation.

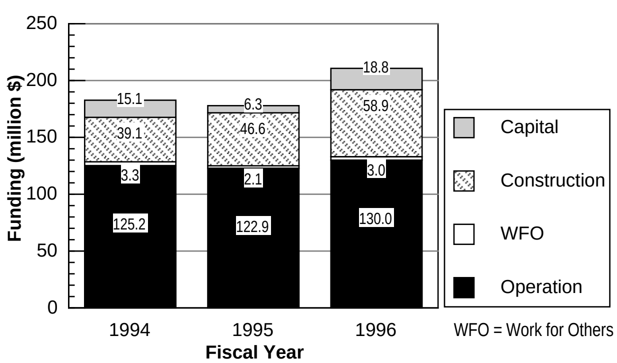
Key Research and Development Activities

Provide accelerators, detectors, instrumentation, and support for national user-oriented research programs in high energy physics (particularly with electrons) and synchrotron radiation.

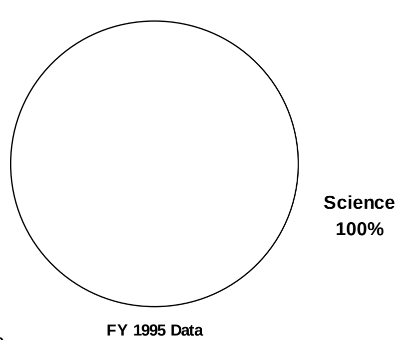
Advance the art of electron accelerators and related devices through the development of sources of high energy particles and synchrotron radiation, as well as new techniques for their exploitation.

Advance the critical technologies necessary to maintain leadership and excellence in electron accelerators, synchrotron radiation, and research programs in fundamental science.

Funding History



DOE Mission Footprint



Note: Does not include Work for Others

Stanford Linear Accelerator Center

Distinctive Competencies

High-intensity, low-emittance electron linear accelerator and storage ring technology.

High-power pulsed and continuous-wave microwave power sources.

Polarized electron sources.

Design, fabrication, and support of large-scale user facilities for high energy physics and synchrotron light sources.

Charged particle and x-ray high-order optics for beam lines.

Charged and neutral particle detector subsystems to support experiments in high energy physics and in synchrotron radiation science.

High energy experimental and theoretical physics.

Condensed matter physics, molecular environmental science, and structural biology.

Real-time computing, networking, and control systems.

Partnerships and Collaborations

Stanford University: Many of the scientific leaders at SLAC are also members of the University faculty.

High Energy Users Partnerships with 825 scientists from 61 universities, 11 Federal laboratories, and 13 foreign countries.

Synchrotron Light Users Partnerships with 910 scientists from 52 universities, 18 Federal laboratories, and 17 foreign countries.

Industry Partnerships on high-power radiofrequency tubes and microcontamination analysis.

International collaborations with 400 scientists from 19 foreign countries in high energy physics and synchrotron radiation experiments.

Collaboration with Japanese, European, and U.S. institutions on the design and R&D for advanced electron accelerators.

SLAC Users Groups representing the high energy physics and synchrotron radiation research communities.

Nine cooperative research and development agreements with U.S. industry, totaling $3.3 million.

Significant Accomplishments

Positron-Electron Storage Rings: Electron-positron storage ring technology and exploitation; continued evolution of colliders from the Stanford Positron-Electron Asymmetric Ring (SPEAR) to the Positron-Electron Project (PEP), and now to PEP II, the asymmetric B Factory. Research on SPEAR earned two Nobel Prizes: Burton Richter in 1976 and Martin Perl in 1995. Current development of PEP II and the B Factory with international collaboration continue the laboratory mission of accelerator physics research.

Linear Accelerators: High-energy elastic nucleon scattering to probe the internal structure of the proton and neutron. Earlier work in this area earned a Nobel Prize for Richard Taylor in 1990 with Kendall and Friedman of MIT. Research continues using spin polarized beams and targets to explore the spin structure of the nucleon.

Linear Colliders: Electron-positron linear collider technology and exploitation. The Stanford Linear Collider (SLC), the world's only linear collider, supports the experimental program on the Stanford Linear Detector (SLD) which is capable of precision measurements of the electro-weak interaction. The laboratory also supports a broad program developing the technology for a very high energy next-generation linear collider, being designed by an international collaboration for a site yet to be determined.

Environmental Remediation: The Stanford Synchrotron Radiation Laboratory (SSRL) is studying waste materials from Hanford tanks and other contaminated sites, analyzing solids using x-ray measurements obtained with a synchrotron beam. Other DOE laboratories involved in this research include Los Alamos and Pacific Northwest.

Biomedical Research: Provides critical technologies and user facilities to advance science and technology in biomedical applications. At SSRL, protein crystallography of viruses helps pharmaceutical companies find inhibitors to combat illness and disease. Similar projects involve collaborators from Harvard University, the University of Alabama, and BioCryst Pharmaceuticals, Inc.

Thomas Jefferson National Accelerator Facility

Laboratory Information

Name:	Thomas Jefferson National Accelerator Facility (formerly Continuous Electron Beam Accelerator Facility)
Location:	Newport News, Virginia
Contractor:	Southeastern Universities Research Association
Budget:	$71 million (FY 95)

DOE Programs

Energy Research

Description

The primary mission of the Thomas Jefferson National Accelerator Facility (TJNAF) is to discover the fundamental quark structure of nuclear matter. For this purpose, it develops and operates the superconducting electron accelerator and modern particle detectors specially designed in collaboration with the scientific community. The continuous electron beam accelerator, a 4-Gev electron accelerator serving three major, complementary experimental areas, was completed on schedule and within its cost estimate. Its physics program started in FY 95.

Major Facilities

TJNAF Superconducting Radiofrequency Accelerator: 4-GeV, 200-microamp, continuous beam electron accelerator, upgradable to 10+ GeV.

Endstation A: Two 4-GeV high-resolution magnetic spectrometers.

Endstation B: Large-acceptance superconducting toroidal magnet detector system for multiparticle final states.

Endstation C: 8-GeV magnetic spectrometer and 2-GeV short-orbit magnetic spectrometer.

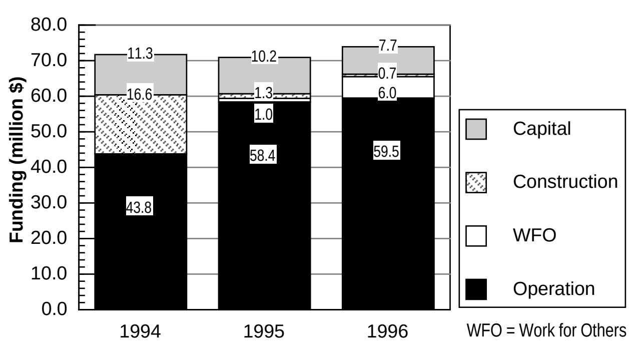
Superconducting Radiofrequency Facility: Superconducting accelerator cavity fabrication, surface treatment, and research facilities.

Free Electron Laser User Facility: Under construction; operational in 1998.

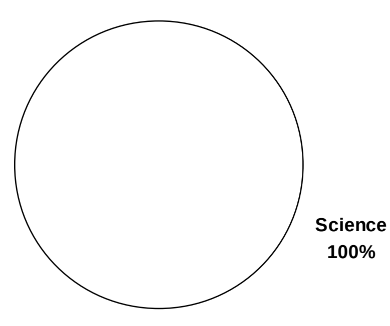
Key Research and Development Activities

Science: Explore and understand the quark-gluon structure of matter; Understand the origin and nature of the nucleon picture of the nucleus and discover its limits; Improve superconducting radiofrequency accelerator technology for research, industrial, and other uses; demonstrate high-average-power SRF free electron laser technology for research, defense, and industrial applications.

Funding History



DOE Mission Footprint



Note: Does not include Work for Others

Thomas Jefferson National Accelerator Facility

Distinctive Competencies

Nuclear and particle physics (experimental and theoretical).

Superconducting radiofrequency (SRF) technology.

Accelerator physics (experimental and theoretical).

Advanced detector and data acquisition technology.

2K cryogenics.

Very large real-time systems for process control.

Free electron lasers based on SRF.

Partnerships and Collaborations

The worldwide Thomas Jefferson National Accelerator Facility user community currently numbers more than 1,000 users from 119 institutions and 25 countries.

Universities, including minority institutions, with an emphasis on the Southeastern region, and the Virginia Physics Consortium.

The Commonwealth of Virginia and the City of Newport News.

Industries of the Laser Processing Consortium.

Local schools and businesses in support of K–12 education.

Significant Accomplishments

Construction Completed Within Cost and on Schedule: The Thomas Jefferson National Accelerator Facility (formerly the Continuous Electron Beam Accelerator Facility) completed construction in September 1995 within cost and on schedule. The quality of the electron beam surpasses design goals and the accelerator reliability, at greater than 80 percent, is astonishing for a new machine. The Jefferson Facility represents the largest installation of superconducting radiofrequency technology in the world. In addition, the Jefferson Facility's Central Helium Liquefier is the world's largest 2K liquid-helium refrigerator.

Experimental Physics Program Begins: The Jefferson Facility's experimental program began in November 1995 with the commissioning of one of its three experimental halls. The other two halls are being commissioned in 1996. The Jefferson Facility Users Group now involves more than 1,000 users from around the world, with three years of experiments approved to run in each of the three complementary experimental halls.

Free Electron Laser: The Jefferson Facility is applying its world-leading superconducting radio frequency (SRF) expertise to develop a free electron laser (FEL), which converts electron energy into laser light. An SRF-based FEL has many possible industrial and defense applications, with great advantages over existing technologies. The U.S. Navy and the Commonwealth of Virginia are jointly funding TJNAF construction of a demonstration infrared FEL as the first step toward the development of these new applications.