

Sandia National Laboratories

OVERVIEW

2007



Exceptional
Service
in the
National
Interest



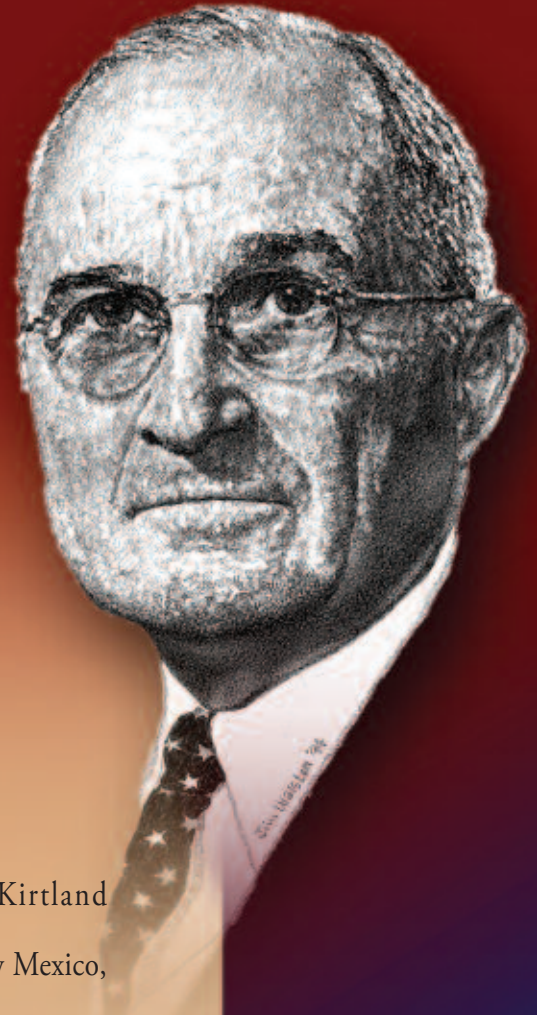
Sandia
National
Laboratories

A Department of Energy
National Nuclear Security
Administration Laboratory

Sandia National Laboratories

OVERVIEW

Summer 2007



Sandia was established on Kirtland Air Force Base in Albuquerque, New Mexico, in 1945 during the Manhattan Project as a division of the Los Alamos Laboratory to provide engineering design, production, assembly, and field testing of nonnuclear components of nuclear weapons. At President Harry Truman's request, Sandia became an independent laboratory on Nov. 1, 1949, and opened its Livermore, California, facilities in 1956. Sandia is now a multi-program national security laboratory.

Sandia at a Glance

Missions: Sandia's missions meet national needs in four key areas:

- Nuclear Weapons — Ensuring the nation's stockpile is safe, secure, reliable, and can support our nation's deterrence policy.
- Defense Systems and Assessments — Supplying advanced, engineered systems and assessment capabilities to the defense and national security communities.
- Energy, Resources, and Nonproliferation — Enhancing the safety, security, and reliability of energy and water through the application of science and technology.
- Homeland Security and Defense — Helping Americans maintain their freedom, security, and quality of life in the face of worldwide terrorism and natural disasters and protecting our armed forces and their physical assets at home and abroad.

Underpinning all of Sandia's mission areas is the drive to develop new understanding of relevant processes through mission-focused science, technology, and engineering and to integrate results to provide the necessary technology that supports engineering and product realization. Sandia's science, technology, and engineering efforts focus on these areas:

- Computational and informational sciences
- Engineering sciences
- Materials and process sciences
- Microelectronics and photonics
- Pulsed power sciences
- Biosciences and technology

Employees: About 8,600 (full-time equivalents).

Locations: Main facilities in Albuquerque, New Mexico, and Livermore, California; missile test ranges in Tonopah, Nevada, and Kauai, Hawaii; the Pantex Plant weapons facility near Amarillo, Texas; the Carlsbad, New Mexico, Field Office, which leads the nation's transuranic waste disposal efforts, and the Las Vegas, Nevada office, where Sandia is the lead laboratory for the Yucca Mountain nuclear waste repository.

Annual Budget: About \$2.28 billion (FY07 estimated).

Management: Sandia is managed by a subsidiary of Lockheed Martin Corporation for the Department of Energy's (DOE) National Nuclear Security Administration (NNSA). Sandia also works for and partners with other DOE agencies, the Department of Defense (DoD), the Department of Homeland Security (DHS), other federal, state, and local agencies and governments, private industry, and academic institutions to accomplish our missions.

Headquartered in Albuquerque, New Mexico, Sandia has a second principal site at Livermore, California, and facilities in Carlsbad, New Mexico; Las Vegas and Tonopah, Nevada, and Kauai, Hawaii.



National Security is Our Business

Sandia began in the mid-1940s with a single mission around nuclear weapons design and production and has since grown into a broad national security laboratory encompassing a variety of technologies and programs. Sandia's core purpose today is to help our nation secure a peaceful and free world through technology. Our national security missions span four key areas, listed on the previous page and explained beginning on page 4.

Sandia's Red Storm Supercomputer has a speed of more than 124 trillion operations per second and is ranked as one of the world's fastest and most efficient. Its architecture has been copied by supercomputing centers around the world.

A U.S. missile defense target rocket lifts off from Sandia's Kauai Test Facility. Sandia provides launch support for various Missile Defense Agency programs.



In brief, we develop technologies to sustain, modernize, and protect our nuclear arsenal, prevent the spread of weapons of mass destruction, protect our infrastructures, defend our nation against terrorism, provide new capabilities to our armed forces, and ensure the stability of our nation's energy and water supplies. Our science, technology, and engineering program ensures the nation will maintain national technological superiority and preparedness — keys to national defense, homeland security, and our economic well-being.

We not only respond to national security needs as they develop, we “think in the future tense” about new types of threats that may develop soon or even years down the road — and work to develop solutions before those threats become reality.

Examples of Sandia-developed national security technologies:

Throughout our 60-year history, Sandia has developed and refined numerous national security technologies and innovations. Notable examples include:

- Thousands of advancements that have made modern nuclear weapons increasingly safe, secure, and reliable.
- MicroChemLab™, a handheld system that quickly and accurately detects and identifies harmful chemical and biological agents.
- Synthetic aperture radar, an all-weather, day/night imaging technology that enables mapping with a precision thousands of times greater than today's maps for both military and civilian applications.
- PAN Disrupter™, which disables and dismantles explosive devices (without detonation) by defeating the physics of the device.
- Decontamination foam, a nontoxic substance that can be sprayed quickly over wide areas, rendering harmless many dangerous chemical and biological agents.
- Intelligent machines and robotics that perform many security and law-enforcement tasks effectively and efficiently without putting humans in harm's way.
- Collective intelligence, the integration of computers, sensors, and robotic systems into highly refined systems that are able to collaboratively carry out highly complex tasks such as guarding a perimeter or searching a building for intruders or harmful substances.
- Cybersecurity systems that use software agents, much like white blood cells patrolling our vascular network, to detect and defend against computer hacking.
- Remote sensing for intelligence gathering, with platforms that range from unattended ground sensors, to unmanned aerial vehicles, to new, smaller satellites that can communicate information in real time.



Sandia robotic researcher interacts with Sandia robot, known as M2.

Developed by Sandia and industrial partners to help prevent battle casualties from friendly fire, the Athena Radar-Responsive Tag can be used by close air support and other allied forces to identify coalition and U.S. forces in a combat situation.



Four National Security Mission Areas

1. Nuclear Weapons: This is Sandia's biggest and most enduring mission. We are responsible for the research, design, and development of more than 90 percent of the 3,000 to 6,500 components of a modern nuclear weapon. These components include security systems, arming and fuzing mechanisms, safety systems, instrumentation, parachute systems, and aerodynamic design. We also conduct survivability tests, develop robotic systems to dismantle retired weapons, help clean nuclear waste sites, and test containers to ensure they protect nuclear materials during transport.

Sandia uses highly sophisticated computer simulations and conducts nuclear fusion research to understand and model the behavior of nuclear weapons.

2. Defense Systems and Assessments:

This mission is to provide America's armed forces with the capabilities and technologies to help them defeat the enemy and keep themselves safe from harm. DS&A also contributes to national security through remote sensing and verification, using space-based payloads and platforms; supports the Missile Defense Agency; specializes in development of high-energy systems, such as electromagnetic launchers; and addresses growing challenges in information systems security.

3. Homeland Security and Defense: Sandia contributes to homeland security in many ways. We work with a variety of agencies to develop a strategy to protect our basic infrastructure elements against terrorism and natural disasters. We develop countermeasures and detection systems for threats involving radiological, nuclear, chemical, biological, and high-explosive materials. We support programs in threat assessment and analysis, border and transportation security, critical infrastructure protection, cyber security, and nuclear incident response for DHS. Sandia actively supports improved physical security for



Sandia has tested two types of cruise missiles, which carry the W80-3 warhead, in a variety of electromagnetic environments. The qualification work is part of a W80 life extension program.

our armed forces at home and abroad. We support first responders with technology development and training under real-world conditions.

4. Energy, Resources, and Nonproliferation: The ERN organization looks at national security in a broad context and develops and applies technologies in a wide range of areas including nuclear nonproliferation, energy surety, and water. While much of our energy work in fossil fuels, wind, solar, and hydrogen is focused nationally, ERN also manages much of Sandia's international work. This includes major programs in nonproliferation, critical resources, energy efficiency, and nuclear energy.



Sandia is working with the Air Force and the defense industry to apply a variety of Sandia technologies to advanced fighter aircraft, including the F-22 Raptor (seen here) and the Joint Strike Fighter.

Sandia researcher adjusts equipment in aerosolization chamber where dispersal patterns are studied for dirty bomb research.



Sandia's annular core research reactor is used in various weapons and energy testing programs.



The Hound handheld sniffer is being tested by law enforcement agencies for screening vehicles at border checkpoints for illegal drugs. The system was originally developed at Sandia for explosives detection.


Research & Development

Sandia scientists and engineers conduct a broad range of research and development projects. These projects usually are in one of our six research foundations:

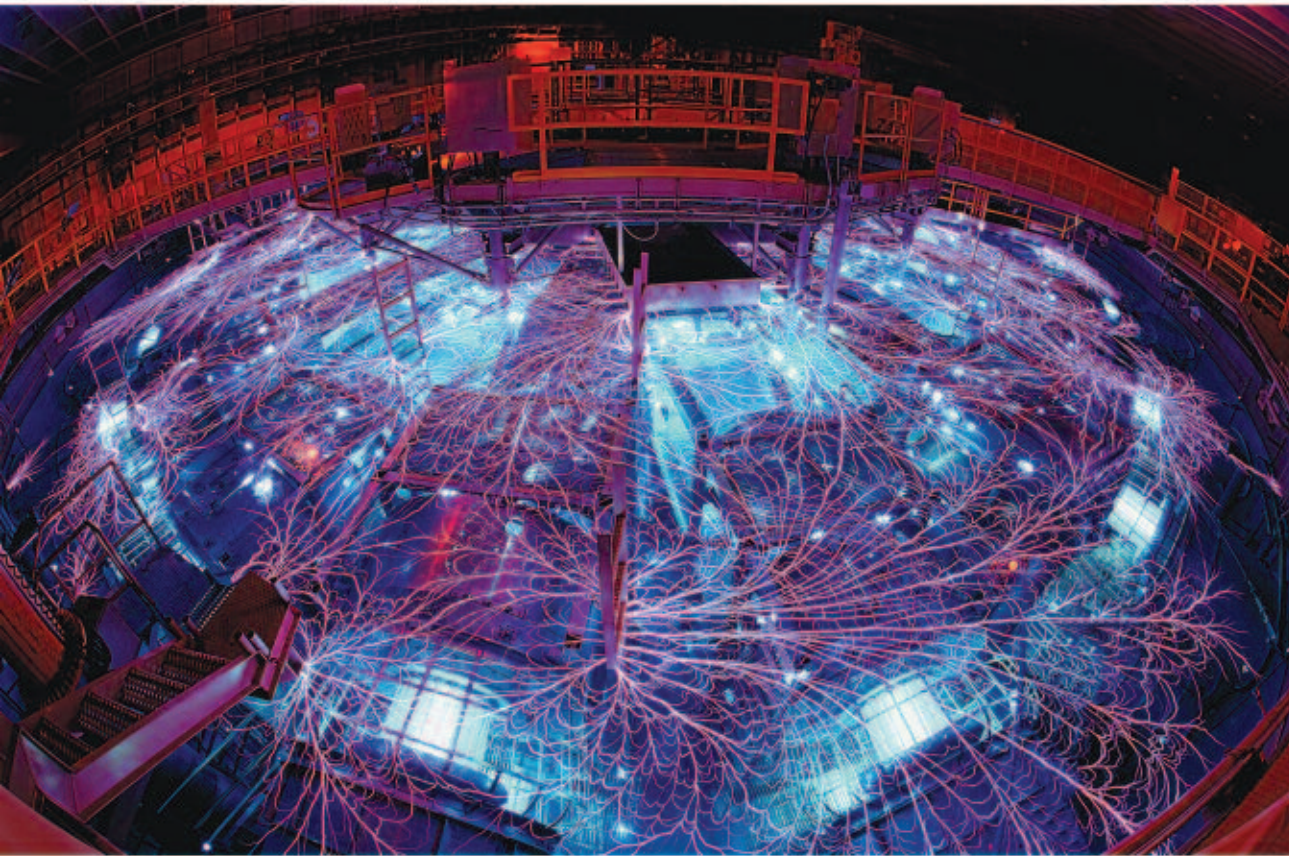
- 1. Materials and process sciences:** Provides the scientific basis for technical options and decisions about polymers, ceramics, and metals and the interfaces among these material combinations in stockpile and other applications.
- 2. Computational and informational sciences:** Develops technology to revolutionize scientific studies and engineering practices via greater reliance on modeling and simulation.
- 3. Microelectronics and photonics:** Provides the underlying science and technology to ensure state-of-the-art implementation of Sandia's electronics systems.
- 4. Engineering sciences:** Supports core research, development, and applications that ensure the highest caliber of experiments, theory, and computations in support of our missions.



New Microsystems and Engineering Sciences Applications (MESA) laboratory and fabrication facilities opened early in 2006. The buildings are designed to bring together experts in microelectronics (silicon and compound semiconductors) and computer visualization.



The new Distributed Information Systems Laboratory (DISL) at Sandia's Livermore, California, site, enables development of technologies for collaborative, high-performance computational work across the nuclear weapons complex. DISL is also designed to foster collaboration with industry and universities on distributed information technology research and development, and provides a secure environment where weapons engineering teams prototype use of these technology advances.



The world's most powerful X-ray generator, Sandia's Z machine is used to test the effects of radiation on weapon components and for fusion energy research. The Z machine routinely heats deuterium pellets to temperatures that exceed those of the sun.

5. Pulsed power sciences: Applies scientific and technological advances to a broad range of missions for the Department of Energy, National Nuclear Security Administration, Department of Defense, other federal agencies, and other customers.

6. Biosciences and technology: The integration of traditional inorganic sciences — physics, engineering, and chemistry — with biology is making new and complex types of research possible. Sensors, computing, nanoscience, robotics, and materials science at Sandia are all benefiting from the influx of biotech.

Sandia has also identified emerging areas that may be future research foundation candidates: manufacturing sciences, surety sciences, chemical and earth sciences.

Safety research at Sandia's Airworthiness Assurance Center is carried out on a variety of aircraft.



Technology Commercialization

Sandia has developed and helped commercialize many technologies.

The laminar-flow cleanroom, used worldwide for manufacturing microelectronics, pharmaceuticals, food products, and for hospital surgery, was invented at Sandia in 1960. The technology uses a uniform flow of filtered air from the ceiling to the floor grates, or wall to wall, to remove contaminants from the air.

Over the past decade, Sandia's groundbreaking work on wind turbine blades has garnered national attention, as the popularity of wind power grows. A recent multiyear project involving universities and industry partners to develop advanced blade concepts culminated in a design that better withstands wind gusts and allows rotors to sweep greater areas and capture more energy without increasing loads or costs. Several blade manufacturers are currently in negotiation to commercialize the blade design.

A team of Sandia researchers is testing different arsenic removal strategies as part of the Labs' water initiative.



Sandia is doing 3-D modeling of salt domes along the Gulf Coast as part of an effort to expand the U.S. Strategic Petroleum Reserve.

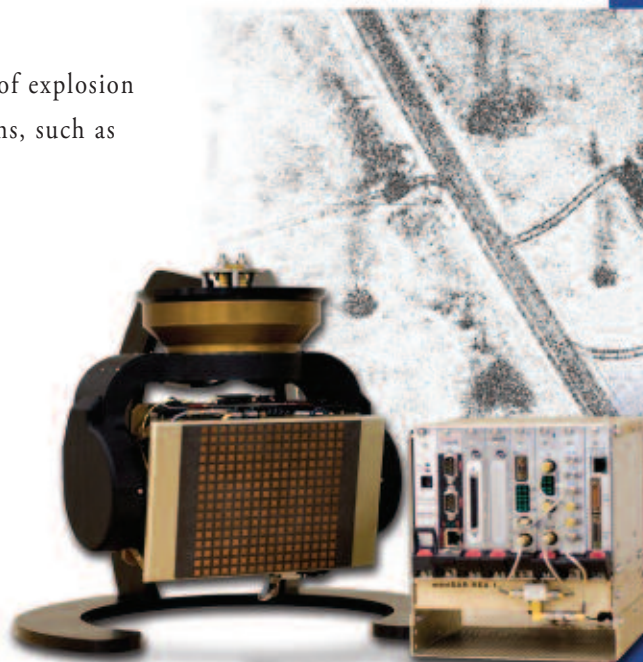
Other commercialized technologies include:

- A walk-through explosives detection portal, developed for the Federal Aviation Administration to screen passengers for explosives.
- Bomb disablement technologies that allow bomb technicians to “render safe” both crude and sophisticated terrorist-type explosive devices without having to approach the bombs.
- A family of risk assessment methodologies (RAMs) that can be used for dams (RAM-D), power transmission systems (RAM-T), and water distribution systems (RAM-W) to identify and correct vulnerabilities.
- Gunpowder residue detector field kits that help police and military personnel instantly determine if someone has recently fired a weapon.
- Lithium battery anode material that may double the energy storage capacities of current anodes, leading to rechargeable lithium-ion batteries with more power, longer life, and smaller sizes.
- A spread-spectrum 2-D barcode that is more secure, reliable, and inexpensive than standard barcodes. The entire message can be read even when a significant fraction of the barcode is occluded or damaged.
- Jess™ (Java Expert System Shell) is a rule engine that can build Java software with the capacity to “reason” using knowledge supplied by the user. Jess is one of the fastest rule engines available.
- Hydrogen getter materials that reduce the risks of explosion when hydrogen mixes with oxygen in sealed items, such as electronics, heat-exchange equipment, vacuum maintenance, and battery-operated devices by irreversibly scavenging unwanted hydrogen gas.
- Handheld and unmanned vehicle-carried MicroChemLab™ systems that can detect and signal chemical/biological agents for homeland security, defense, and environmental applications.



A Sandia explosives expert demonstrates a Labs-developed instant shooter ID kit that has been commercialized by a Sandia partner, Law Enforcement Technologies, Inc.

Sandia is advancing U.S. capabilities in synthetic aperture radar technology to provide battlefield and other imaging despite cloud cover or darkness.



Sandia has worked with Phoenix-based Stirling Energy Systems (SES) to develop a network of dish-engine solar platforms to generate electricity.

SES has an agreement with Southern California Edison for a 4,500-acre solar generating plant in the Mojave Desert using the technology.



Business Partnerships

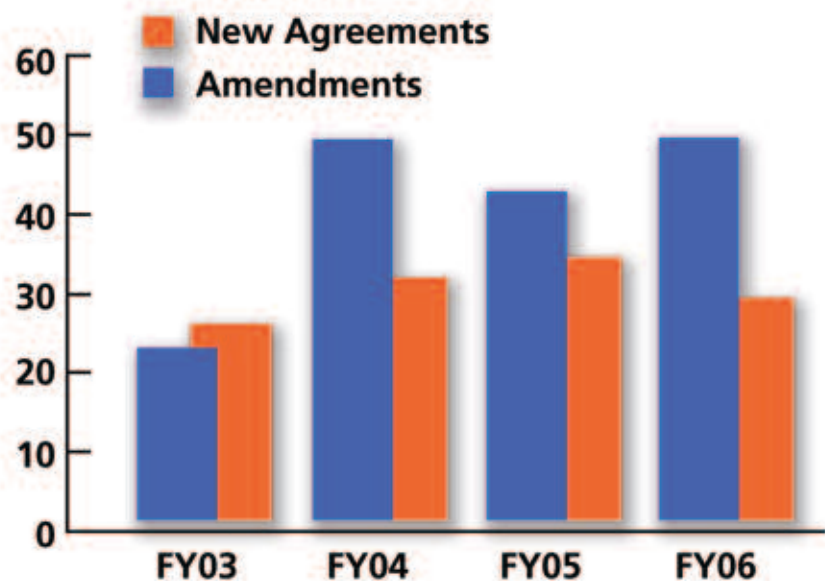
Sandia works closely with industry, universities, and government agencies to bring new technologies to the marketplace. Much of Sandia's technology commercialization results from such partnerships. Sandia has been partnering with industry to commercialize technologies for more than three decades. Partnerships

with industry create a crucial supplier base for Sandia-developed technologies, import best business and engineering practices from industry into Sandia, and support U.S. industry.

Sandia negotiates technology commercialization agreements to allow collaboration with industry on mutually beneficial research. Other options include commercial licensing agreements, technical assistance, use of unique Sandia user facilities (see page 12), technical personnel exchanges, and memoranda of understanding for pursuing shared interests.

Numbers of new and amended cooperative research and development agreements (CRADAs) have remained steady in recent years, with a slight decrease in the number of new CRADAs being formed.

Sandia CRADA Activity



Among Sandia's many successful collaborations are those with:

- The Goodyear Tire and Rubber Co. to reduce tire cost and production time.
- Ford Motor Co. to evaluate the effectiveness of a cold-spray deposition process for powertrain components, engine bores, and tooling applications.
- EMCORE Corp. to develop high-speed optical transceiver modules that promise to make short-haul fiber optic communications faster and less expensive.
- General Atomics to perfect the day/night, all-weather synthetic aperture radar and to develop solid-state, high-operating-temperature, environmentally safe batteries.
- Lockheed Martin to develop sensors, power systems, data transmission and communications, high-performance electronics and photonics, and optical computing.

Technology Ventures Corp. (TVC), established by Lockheed Martin Corp. in 1993, works with Sandia to identify technologies with commercial potential, coordinates the development of business capabilities, and seeks sources of risk capital. TVC has helped capitalize and launch more than 87 businesses, created more than 9,000 jobs, and brought in more than \$712 million in investments.

Sandia Science and Technology Park, a 200-acre business-campus just outside Kirtland Air Force Base in Albuquerque, is home to 24 companies, more than 1,450 employees, and a state-of-the-art infrastructure.

Business and industry can tap into Sandia and other technical entities along the New Mexico Technology Corridor, which stretches from Los Alamos National Laboratory northwest of Santa Fe to New Mexico State University just north of the Mexican border. Other institutions within the corridor include Sandia, the U.S. Air Force Research Laboratory Phillips Research Site, the University of New Mexico, White Sands Missile Range, the Lovelace Respiratory Research Institute, and the New Mexico Institute of Mining and Technology.



A breakthrough photovoltaic cell design and fabrication process has reduced costs of manufacture and led a Sandia researcher to a new startup company, Advent Solar.


User Facilities

Many of Sandia's unique research and development facilities are available for use by U.S. industry, universities, other laboratories, government agencies, and the scientific community.

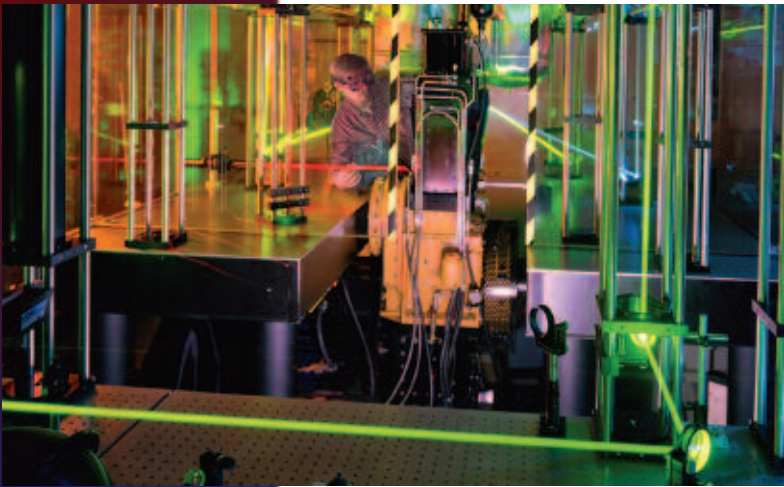
User facility agreements, which can be executed in as few as seven days, require a statement of work prepared by technical representatives from Sandia and the sponsor. Each project must show benefit to the Department of Energy as well as to the user. A company representative performs the work at the facility, and Sandia provides support staff for maintenance and safety procedures.

The agreements allow use of the physical facilities, equipment, instrumentation, scientific expertise, and necessary operational personnel. Among the facilities available are:

- Advanced Battery Engineering Facility
- Center for Integrated Nanotechnologies
- Center for Security Systems
- Combustion Research Facility
- Design, Evaluation, and Test Facility
- Electronic Technologies User Facility
- Intelligent Systems and Robotics Center
- Ion Beam Materials Research Laboratory
- Manufacturing Science and Technology
- Materials and Process Diagnostics Facility
- Mechanical Test and Evaluation Facility
- National Solar Thermal Test Facility
- Nuclear Facilities Resource Center
- Orpheus Test Range (oil/geothermal drilling)
- Photovoltaic Laboratories
- Plasma Materials Test Facility
- Primary Standards Laboratory
- Pulsed Power and Systems Validation Facility
- Radiation Detector Analysis Laboratory
- Shock Technology and Applied Research (STAR) Facility
- Engineering Sciences Experimental Facilities
- Explosive Components Facility
- Geomechanics Laboratory



This solar furnace at Sandia's National Solar Thermal Test Facility is one of many facilities available to industry, universities, and others in the scientific community.



Sandia/Caterpillar Optical Research Engine Lab in California is used to develop understanding to reduce pollutants and enhance efficiency of diesel engines. The lab is part of the Combustion Research Facility.

For more information:

Gary J. Jones, [gjones@sandia.gov](mailto:gjjones@sandia.gov)

Our People

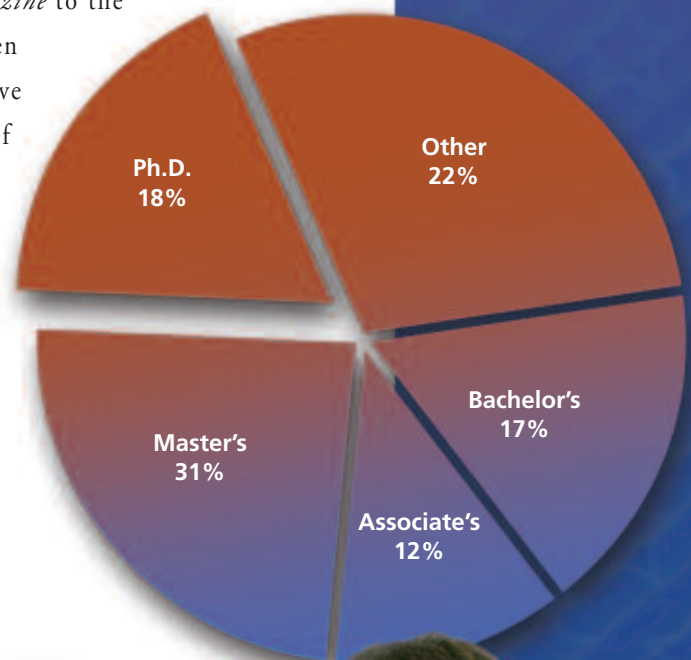
Sandia has about 8,600 (full-time equivalent) employees, located primarily in Albuquerque, New Mexico, and Livermore, California. Sandians also work at the Pantex Plant near Amarillo, Texas, the Waste Isolation Pilot Plant near Carlsbad, New Mexico, the Kauai Test Facility in Hawaii, the Tonopah Test Range and the Las Vegas Yucca Mountain Project Office in Nevada. The workforce consists of highly educated and highly skilled engineers, scientists, technologists, and administrative staff. Among the Labs' employees, almost 1,500 hold doctoral degrees and about 2,700 have master's degrees.

Sandians each year are recognized for a variety of breakthrough technologies, technical excellence, lifetime achievements, and contributions to national security. Through 2006, Sandians had received 75 R&D 100 Awards, presented by *R&D Magazine* to the developers of the year's most significant technical developments. Seven Sandians have received prestigious E. O. Lawrence Awards and six have received Distinguished Associate Awards from the U.S. Department of Energy. Sixteen Sandia individuals or teams have won Lockheed Martin Corp. Nova Technology Awards. In addition, many Sandians each year are recognized by their peers and with awards presented by professional organizations.

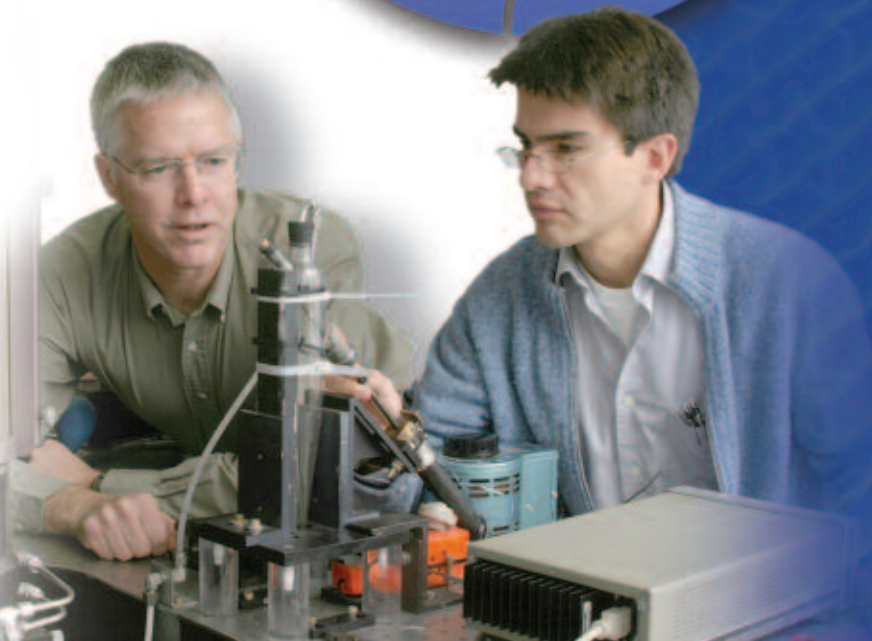
Sandia is committed to being an employer of choice, emphasizing quality of life as well as career opportunities that include developing cutting-edge technologies and working on national security challenges under the mentorship of some of America's best and brightest scientists and engineers.

Sandia is an equal opportunity employer.

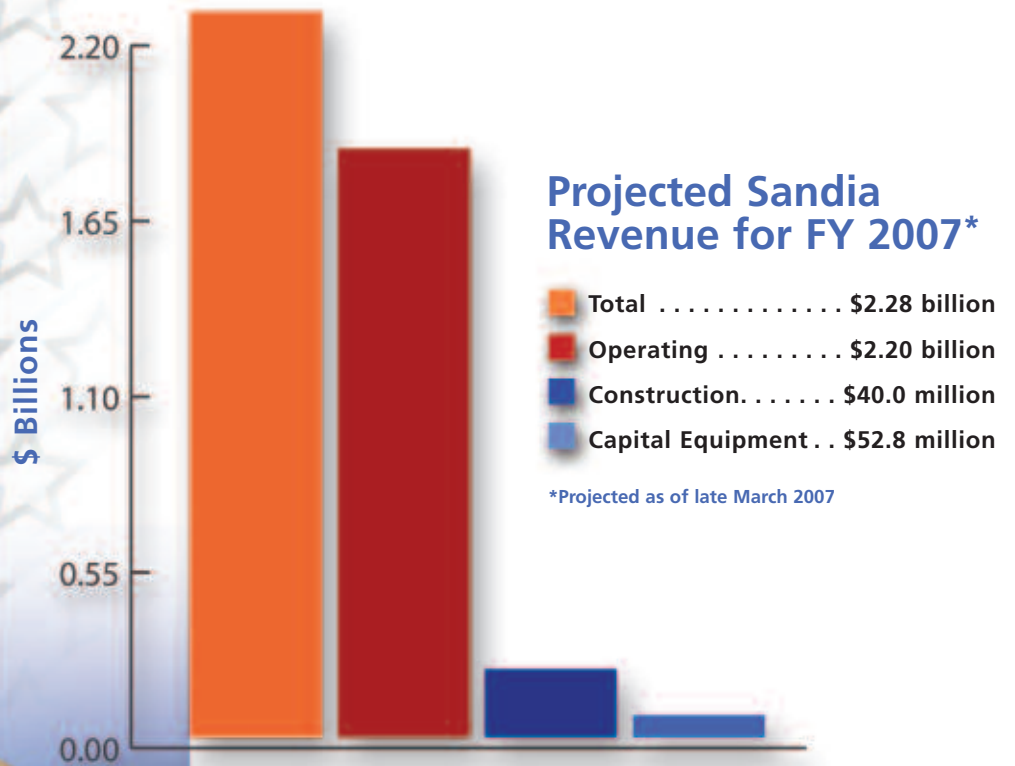
Regular Workforce by Degree Level



Researchers at Sandia's Combustion Research Facility in Livermore, California, study an experiment to optimize the burning of coal.



Budget



A Sandia volunteer aligns a newly framed wall at a Habitat for Humanity house completed in Albuquerque by Sandia employees and retirees.

Community Involvement

Sandians have long maintained a tradition of community service. We believe community involvement is an important part of being a good corporate citizen.

Sandia's community involvement focuses on workforce development, youth education, transportation issues, leadership programs, business development, and strong contributions programs. Sandia provides major economic benefits locally, regionally, and nationally through its approximately 8,600 employees, who generate a payroll of about \$821 million in direct salaries.

Sandia as a corporation and Sandians as individuals are known for their commitment to building the health of their communities through contributions of personal time and resources. This tradition is strongly supported by Lockheed Martin. Sandians annually volunteer tens of thousands of hours to helping others.

Sandia employees and retirees contribute about \$3.2 million to

charitable organizations through the Laboratories' annual giving campaigns — the Employee Contribution Plan for United Way of Central New Mexico and the Sandia Helps And Reaches Everyone program in California.

Employees support many other good causes with money, gifts, and time, particularly during the end-of-year holiday season. One such holiday-season program — now a 50-year tradition — is the Shoes for Kids program, which each year provides shoes for hundreds of needy Albuquerque-area elementary-school-aged children. Make a Difference Day, a national day of volunteering, prompts many Sandians, retirees, and their families to pack holiday food boxes, paint and repair homes of the elderly, and offer assistance to local charitable organizations.


Sandia's commitment to education focuses on educational outreach programs that help set the stage for scholastic success. Sandians each year judge science fairs, speak at career events, help teach in classrooms, and serve as mentors and tutors. Sandia's National Atomic Museum offers educational programs that touch thousands of schoolchildren each year.

Sandia internships bring nearly a thousand students to the Albuquerque and Livermore sites each year to work on Sandia projects and learn about the Labs.

Kids at Cuidando Los Niños are all smiles as they check out the new bus provided in part with funds raised by Sandia's unions, with help from management and Lockheed Martin.



Family Science Night provides an opportunity for elementary school children and their parents to work together on simple, inquiry-based science activities. Sponsored by Sandia and Lockheed Martin, the events are held in Albuquerque and Livermore California, area schools.

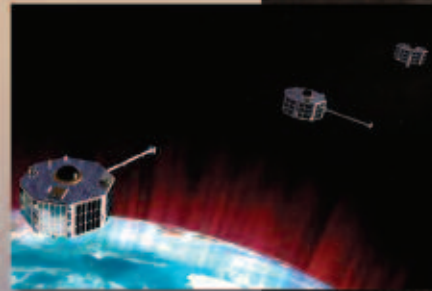


Project leader Jeb Flemming holds a test version of the ElectroNeedle device, which could one day eliminate the need for diabetes patients to draw blood to test glucose levels.

Did You Know?

- Sandia designs and develops more than 90 percent of the 3,000 to 6,500 components in a modern nuclear weapon. Since 1993, Sandia has also manufactured some of the most complex nuclear weapon components.
- Sandia played a key role in helping NASA determine that foam debris impacting the orbiter wing during launch most likely caused the 2003 space shuttle *Columbia* disaster.
- Sandia is building major new facilities to enable the laboratory to become a world leader in nanotechnology and microsystems engineering.
- Sandia and Lockheed Martin jointly developed the SnifferStar™ chemical sensor that operates on unmanned aerial vehicles and relays reports on chemical detections within 20 seconds of air sampling.
- Sandia invented the clean room in 1960, helping to spark today's multibillion-dollar microelectronics industry.
- Sandia's pulsed power program is bringing science a giant step closer to understanding and realizing the development of fusion as an energy source.
- Sandia developed technology that can electronically "sniff" airline passengers before they board and determine whether they have handled explosives recently.
- Sandia research has spawned a number of medical advancements, including novel micron-sized needles, which penetrate painlessly into the skin, providing a way to measure glucose levels or other molecules in the body.
- Sandia operates one of the world's most advanced robotics and intelligent machines facilities.
- Sandia's major full-scale testing facilities include a two-mile-long rocket sled track, centrifuges, solar tower, and burn areas. A new thermal test facility will allow burn tests for large objects in a contained structure.

- Sandia and Law Enforcement Technologies, Inc., jointly developed a tool that allows police officers and military personnel to instantly determine on the scene whether a suspect has recently fired a gun.
- For more than 40 years, Sandia has designed sensors and other systems for satellites that continuously monitor the globe for clandestine nuclear tests.
- Five generations of Sandia-developed radiation-hardened microchips have ensured that electronics in defense and space hardware can operate in high-radiation environments.
- Sandia modeling efforts supported and helped guide the National Transportation Safety Board to confirm that the TWA 800 accident of July 1997 most likely was the result of an unintended ignition of the fuel-air mixture in a fuel tank.



Sandia offers design and implementation services with the Lab-developed MicroChemLab™ system to evaluate security and establish safety systems at bioscience facilities around the world.



Sandia fabricated louver-laden wafers with moving grillworks of shutters, six microns wide and 1,800 microns long. The microshutters were used to help control temperatures in small NASA satellites in space.

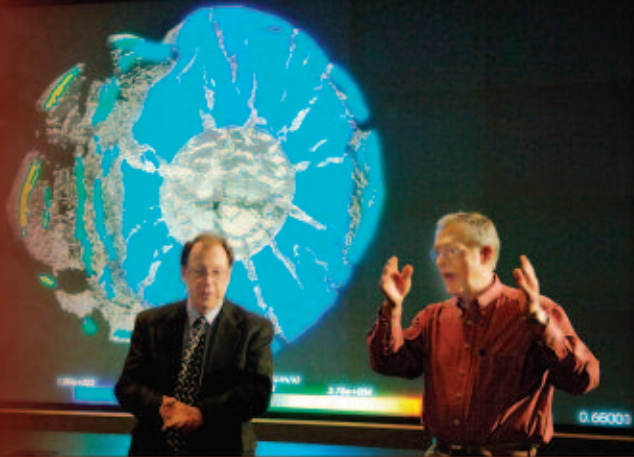
For more information about Sandia, contact the Public Relations and Communications Center at (505) 844-4902 or visit our website at www.sandia.gov for Sandia/New Mexico and www.ca.sandia.gov for Sandia/California.





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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND2007-1925P. CreativeArts.LW.4/07