



Sandia National Laboratories

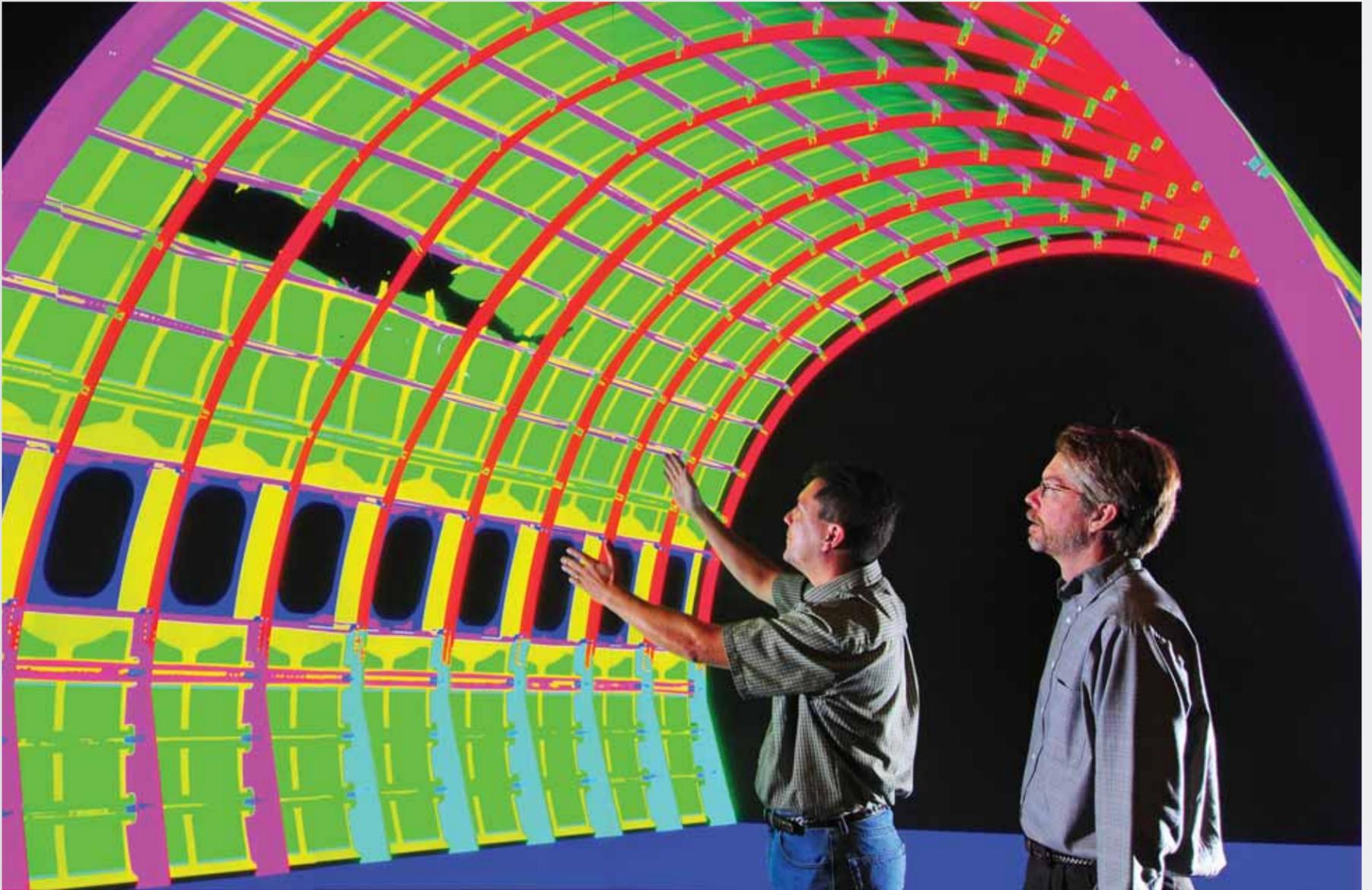
# Labs

# Accomplishments

# 2009



*Sandia LabNews*  
February 2009

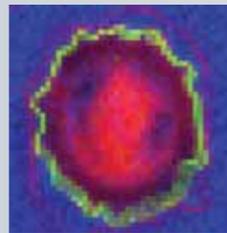
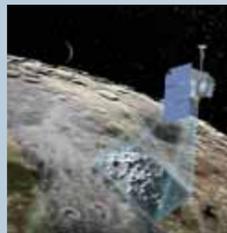
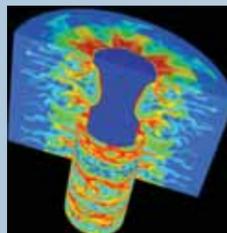


Sandia researchers Jeff Gruda (1524, left) and Jim Phelan (6418) use Sandia's Visualization Lab in the Joint Computational Engineering Lab to examine results of a computer simulation that models the effects of an explosion on an aircraft fuselage. The simula-

tion was conducted under NNSA's Advanced Simulation & Computing program for the Transportation Security Administration. The research is helping develop a scientific basis for aviation security requirements. See page 6. (Photo by Randy Montoya)

## Inside . . .

Nuclear weapons engineering . . . . . 3	Global security . . . . . 6	IT, networks, & facilities . . . . . 10
Engineering sciences . . . . . 3	Bioscience . . . . . 7	ES&H & security . . . . . 10
Product realization . . . . . 4	Microelectronics & microsystems . . . . . 7	Human resources . . . . . 11
Remote sensing . . . . . 4	Computing & information sciences . . . . . 7	Supply chain . . . . . 11
Military programs . . . . . 5	Materials . . . . . 8	Governance, leadership, & management . . . . . 11
Energy . . . . . 5	Pulsed power . . . . . 8	Community involvement . . . . . 11
Homeland security . . . . . 6	Partnerships & alliances . . . . . 9	



Sandia and Stirling Energy Systems set a new solar-to-grid system conversion efficiency record by achieving a 31.25 percent net efficiency rate on a Stirling dish system at Sandia. See page 5.

Cover photograph by Randy Montoya

This year's Labs Accomplishments publication recognizes some of Sandia's best work during 2008, as submitted by center offices and selected by division offices. Each citation is followed by the center numbers of centers that contributed most directly to the effort described.

An acronym after each accomplishment indicates which of Sandia's strategic management units (SMUs) or strategic management groups (SMGs) the work most directly supported. The SMG/SMU acronyms are:

- NW: Nuclear Weapons SMG & SMU
- ITS: Integrated Technologies & Systems SMG
- DS&A: Defense Systems & Assessments SMU
- ER&N: Energy, Resources, & Nonproliferation SMU
- HS&D: Homeland Security & Defense SMU
- ST&E: Science, Technology, & Engineering SMU
- IES: Integrated Enabling Services SMU



Bill Murphy • Lab News Editor  
 John German • Labs Accomplishments Editor  
 Michael Lanigan • Labs Accomplishments Production

<http://www.sandia.gov/LabNews>

Albuquerque, N.M. 87185 • Livermore, Calif. 94550  
 Tonopah, Nevada • Nevada Test Site • Amarillo, Texas  
 Carlsbad, New Mexico • Washington, D.C.

### Sandia National Laboratories

Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a subsidiary of Lockheed Martin Corporation and a prime contractor to the US Department of Energy's National Nuclear Security Administration.

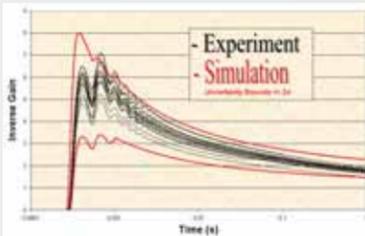
## Nuclear weapons engineering

The W87 Joint Test Assembly (JTA) team delivered to NNSA the first JTA4 production unit on schedule. This unit was later launched aboard a Minuteman III intercontinental ballistic missile — the culmination of a five-year multiagency program that included Sandia, Savannah River Site, Kansas City Plant, Pantex, Y-12, Lawrence Livermore National Laboratory, and the US Air Force. The JTA4 is an advanced telemetry system that collects DOE and DoD data that will be used for surveillance of the W87/Mk21 warhead. (1700, 2500, 2600, 2700, 2900, 5300, 8200, 12300) NW



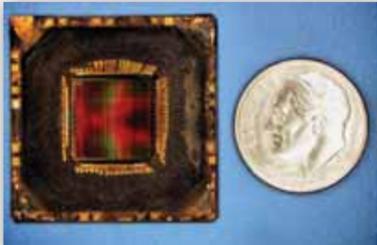
W87 JTA4 First Production Unit  
(1700, 2500, 2600, 2700, 2900, 5300, 8200, 12300) NW

The Qualification Alternatives to the Sandia Pulsed Reactor (QASPR) team combined theory, experiment, and advanced simulation and computing codes to **model the effects of fast-neutron pulses on the gain of silicon transistors**. This key milestone demonstrated that the QASPR methodology could be used to qualify Sandia components in the absence of fast-burst reactor testing. The predicted device response, with quantified margins of uncertainty, was found to be an excellent match to the experimental results gathered prior to the closure of SPR-III. (1100, 1300, 1400, 1500, 1700, 2100, 5300, 6300, 6700, 8000, 12300) NW



Comparison of predicted response and experimental results gathered prior to closure of the Sandia Pulsed Reactor (SPR-III).

Sandia designed and MESA fabricated the **“Eiger” radiation-hardened, structured, application-specific integrated circuit**, a user-configurable platform with function hardwired on the chip during the last stages of fabrication. Eiger’s open architecture enables design flexibility and reduces non-recurring engineering and development costs both for new designs and obsolescent parts. It was specifically developed for embedded applications with features to minimize power consumption, static current, and photocurrent. Eiger targets Sandia’s nuclear weapon mission with potential for such applications as deep-space missions and down-hole instrumentation. (1700, 2100, 5300) NW



Eiger rad-hard circuit

The Code Management System (CMS) for Use Control was implemented at the Pantex Plant. CMS significantly **improves the throughput of Permissive Action Link (PAL)-equipped weapons** at the Pantex Plant. The first unit was processed on May 15, 2008, and CMS now is



B83 Development Joint Test Assembly-1B test at the Tonopah Test Range

The B83 Development Joint Test Assembly-1B (DJTA-1B) was successfully flown at the Tonopah Test Range in July 2008. DJTA-1B provided critical data for verification and validation of computational simulation analyses for the B83 program. This newly designed high-fidelity flight test unit flew a unique profile and met all test requirements including an NNSA Level 2 milestone. To meet the flight test window, DJTA-1B required an aggressive schedule with close coordination among Sandia, Lawrence Livermore National Laboratory, Kansas City Plant, Pantex, NNSA, and the Air Force. (1500, 2600, 2900, 8200) NW

operational for all DoD operations and DOE production. CMS supports the B61, B83, W80, and W84 weapon systems and the Code Enabling Switch. (2100, 2900, 5600, 8200, 12300) NW

The Concurrent Design and Manufacturing (CDM) Program **delivered 57 different component lots for eight different technology areas** in FY08. The 57 component lots totaled 18,124 units delivered to the stockpile throughout the year. CDM achieved a customer delivery performance of 96 percent. Completed component lots included explosives components, magnetics, neutron generator timers, switch tubes, power sources, and microelectronics. (2500, 2700, 1700, 12300) NW

Sandia and Honeywell FM&T completed fabrication of an integrated prototype of an **optical initiation firing sub-system for weapon system applications**. The prototype is packaged in a form and volume appropriate for weapon applications and integrates the laser system, firing control electronics, built-in test capability, and functional energy-interrupting elements to accommodate unique-signal safety systems. This optical initiation project seeks to enhance safety by initiating detonators with a unique high-energy laser pulse and replacing traditional detonator cables with nonconductive fiber optics. (2600, 2100, 2400, 1100, 1700, 1800) NW

Minuteman III flight test **GT-194-1 was launched from Vandenberg Air Force Base** on Aug. 13, 2008, carrying two W78/Mk12A Joint Test Assembly (JTA) reentry vehicles — a high-fidelity

JTA5 and an instrumented JTA6. Both reentry vehicles traveled approximately 4,200 miles, hitting a predetermined target in the vicinity of Illeginni Island at the Ronald Reagan Test Site in the Pacific. The unique flight allows for direct comparisons of the high-fidelity and instrumented JTAs’ performances through the flight environments. (2100, 2900, 8100, 12300) NW



Minuteman III flight test in August 2008 allowing comparisons of performances of W78/Mk12A Joint Test Assemblies

Sandia made **substantial progress in NNSA-directed transformation of stockpile evaluation**, supporting enhanced confidence in annual assessments. In-flight testing, preflight temperature conditioning, expanded coverage of launch and release parameters, and new instrumentation provided data and validated structural models in rarely explored regimes. Laboratory testing incorporated vibration environments, combined temperature studies with signal variations, and employed new classified analysis. Expanded component evaluation programs were integrated into system plans, and quantification of margins and uncertainties and predictive models were employed to forecast performance. (2900, 2100, 8200, 2500, 2600, 2700, 1500, 1800) NW



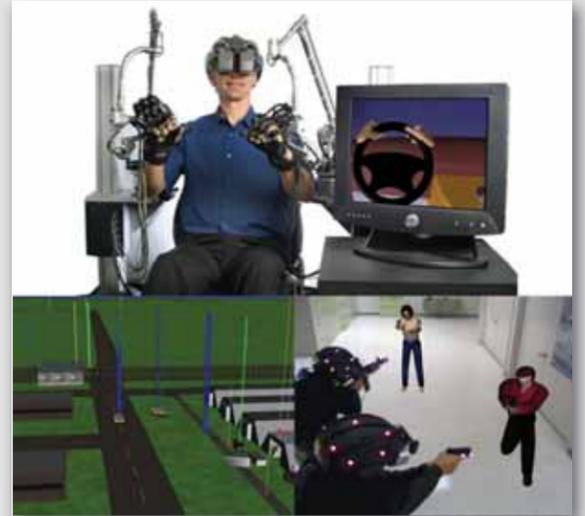
Shaker table at the Weapons Evaluation Test Laboratory for mechanical preconditioning



B-2 bomber delivers B61-11.

The **final flight test of a gravity bomb weapon** containing special nuclear materials occurred at the Tonopah Test Range on July 22, 2008. A Sandia-Air Force test team successfully delivered a B61-11 to a target from an altitude of 18,000 feet. A subterranean mining operation reaching depths of more than 20 feet retrieved the test article for post-test analysis, which confirmed nominal (expected) system performance. (2900, 2100, 4200) NW

Sandia/California infrastructure and weapons groups supported a study by the Institute for Defense Analysis (IDA) that **evaluated the costs, savings, risks, and benefits of six alternatives for Sandia/California site infrastructure operations**. Among the alternatives were operating “as is,” merging some operations with Lawrence Livermore National Laboratory, and moving the nuclear weapons mission to Sandia/New Mexico. IDA determined that continuation of current operations at Sandia/California meets mission requirements and found no compelling costs basis for other alternatives examined. (8000, 10500) NW



Two simulations of integrated security and use control allow real-time analyses in the Virtual Deliberate Unauthorized Use Assessment Facility (VDAF).

Security & Use Control Assessment Dept. 12334, in conjunction with Centers 2100, 6300, and 6400, delivered **two end-to-end simulations of integrated security and use-control design principles**. Three tools were brought into the Virtual Deliberate Unauthorized Use Assessment Facility (VDAF) to accomplish the simulations: a force-on-force analysis software tool, a close-quarters battle software tool using augmented reality, and a haptics interaction tool for manipulating CAD models. This work sets the stage for real-time analyses in the VDAF. (12300, 2100, 6300, 6400) NW

Sandia’s Systems Integration Technical Support Center 500 has provided the leadership allowing the **first integrated science, technology, and engineering (ST&E) planning** across NNSA Defense Programs. The products include a detailed synthesis and analysis of more than 20 extant plans, a short summary of the breadth of work, and a classified integrated description of work being done — all critical for ensuring an ST&E base for the nation as it moves into an uncertain future. (500) NW

Using the nuclear weapons risk-based perspectives provided by the Sandia Integrated Life Cycle Surety team, **strategies for improving the security of the nuclear weapons stockpile** were created. These strategies set forth a range of potential improvements in both physical security and weapon security features that could reduce the security risk of the stockpile. They will form the basis for Sandia participation in the development of a national surety strategy. (600, 12300, 8200, 6100, 2100, 200, 5600) NW

## Engineering sciences

Through Engineering Campaign funding, Engineering Sciences Center 1500 has developed a test capability to **simulate flight conditions of launch through reentry** into a single ground-based test. The combined environment test capability, named Superfuge, has demonstrated synergistic effects for several test units when environments such as vibration and acceleration were applied simultaneously. These effects were significant and indicate the need for such testing to capture correct system response. Also, the ability to perform margin assessment under more realistic flight conditions has been realized with this new capability. (1500) NW

A closely coupled effort between the weapons and science and technology communities has resulted in a multidisciplinary effort to develop a high-fidelity, three-dimensional **predictive modeling and simulation tool for neutron tube performance**. This effort is focused on capabilities addressing design, qualification, and issue resolution. As part of an Advanced Simulation & Computing Level 2 milestone, Sandia has completed the first three-dimensional neutron tube plasma transport simulations, enabling qualitative assessment of critical performance parameters. (1100, 1400, 1500, 2700, 9300) NW

## Product realization

The **W76-1/Mk4A First Production Unit** was delivered in September 2008. This milestone represents the most significant product delivery by the nuclear weapons complex in more than a decade, made more significant because Los Alamos National Laboratory was able to certify the warhead without an underground test. The delivery required



The W76-1/Mk4A was certified without an underground test.

significant contributions from across Sandia and was made possible by teaming with partners at Los Alamos and the nuclear weapons complex production agencies and working effectively with Sandia's NNSA and Navy customers. (2100, 1300, 1500, 1800, 1700, 5300, 2400, 2500, 2700, 2800, 2900, LANL, production agencies, NNSA, US Navy) NW

Developing and implementing the Realize Product SubSystem (RPSS) of the Nuclear Weapons Strategic Management Unit was a significant undertaking, affecting the way thousands of people perform their jobs. The **RPSS integrates thousands of requirements and practices** into approximately 130 mandatory procedures. The newly formed, director-level Realize Product Council ensures leadership engagement and continued sustainment and improvement of the system. The RPSS simplifies Sandia's approach to meeting requirements, improves consistency and reduces redundancy, accelerates learning for new employees, and provides a baseline for communication, training, and continuous improvement. (Supported by all NW centers) NW

Significant progress was made toward the use of one universal three-dimensional **computer-aided design (CAD) model for the MC4532 neutron generator project**. This concept will allow increased utilization of one model for all stakeholders, including design, manufacturing, and analysis, throughout the design life cycle. A top-down modeling approach was used by specifying design criteria, including parameterization, at the top-level assembly and passing those criteria down through the model structure. Because of this approach, incorporation of design changes was simplified, resulting in significant design-to-analysis cost and schedule savings. (1500, 2400, 2700, 2900) NW

Responsive Neutron Generator Product Deployment Center 2700 in July 2008 became the first public-sector organization to be awarded the **Shingo Prize for Operational Excellence**. The Shingo Prize recognizes excellence in using lean principles to achieve operational excellence and consistent business results. Center 2700 received the prize for demonstrated results in cost reduction, quality, and productivity by using lean tools; integrating the neutron generator life cycle from science, through development and production, to sustainment; and affecting a culture change toward lean thinking across the organization. (2700) NW

As part of the Tech Area 55 (TA-55) upgrade at Los Alamos National Laboratory to support manufacturing requirements, Sandia developed a **discrete-event simulation for plutonium processing** to analyze process and transport times within the machining and foundry areas, as well as a three-dimensional visualization to demonstrate proposed material transport scenarios within Wing 300. Both the simulation and 3-D visualization were used to evaluate proposed part transportation scenarios within the facility. The results of Sandia's Wing 300 production analysis were used to make recommendations to NNSA concerning facility upgrades. (6400) NW

The MC4082A Power Supply Product Realization Team concluded that massive updating was required for the MC4082A power supply drawing set. After six months, more than 2,700 person-hours, intense requirements mapping, and 331 drawing changes, the MC4082A was



The MC4082A power supply

manufactured to a **new set of 45 drawings and subsequently submitted for final product acceptance**, with no errors, issues, or findings. (12300, 2500) NW

A reliability assurance methodology was developed that addresses the need to **obtain highly reliable nuclear weapon components from small production builds**. The method combines fault tree and expert critique to identify a manageable number (typically about 20) of fatal defects that must be prevented, and identify controls that must be implemented. The method, which is both efficient and effective, focuses attention on what is essential and helps resolve conflicts. It has been successfully applied to reliability assurance of energetic components. (12300) NW

A **Sandia-invented, power-free leak tester** was implemented at Pantex. The Lightning-Immune Leak Tester is compact and easy to use and meets leak test requirements without the use of AC power, which enables weapons testing to continue even during lightning warnings. Recently a moisture sphere was incorporated, enabling efficient screening of moisture levels in weapons for component reuse decisions. Since implementation, significant savings (greater than \$10,000 per month) and reduced processing times contributed to a recent effort being completed two months ahead of schedule. (12300, 1800) NW



The Lightning-Immune Leak Tester

Sandia science, technology, and product realization expertise enabled the development, qualification, and delivery of the **first optical transceivers for space applications**. Sandia worked in concert with Peregrine Semiconductor, ULTRA Communications, and n-Light Corporation to deliver the final products. Once on orbit, each optical channel of these radiation-hardened devices will provide low-noise, 2.5 gigabit-per-second, bidirectional transmission of critical sensor data to onboard processors that configure data for satellite downlink. This revolutionary, high-bandwidth data processing capability is a key enabler for next-generation space-based remote sensing systems. (5700, 5300, 5500, 1800, 1700, 1500, 12300, 10200, 2400, Peregrine Semiconductor, ULTRA Communications, n-Light Corporation) DS&A

## Remote sensing

Working closely with NNSA and the US Air Force, a joint Sandia/Los Alamos National Laboratory team develops and launches **satellite payloads supporting the nation's nonproliferation and treaty verification programs**. Since 1983 the team has launched nuclear detonation detection payloads into orbit on the Global Positioning System (GPS) satellite. This year the team launched three payloads on GPS, including the 50th payload in March 2008. This program involves hundreds of scientists and engineers from Sandia and Los Alamos and is the backbone of the nation's nuclear detonation detection system. (5700, 5500, 5300, 2600, 1700) DS&A



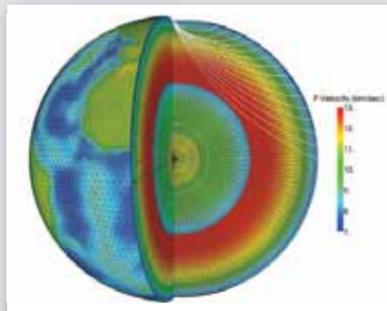
Global burst detector system being launched to medium Earth orbit from Cape Canaveral, Fla., on March 15, 2008.

Sandia and Rockwell Collins are increasing the functionality of unmanned aerial systems (UASs) by developing miniature aluminum nitride **microelectromechanical system filter banks for spectrally aware electronic systems**. Microresonator designs and fabrication processes developed at Sandia enable low-loss filters to operate over a wide frequency range in a small size (three square millimeters of die area). Continuing advancement of this technology will enable a new class of spectrally aware electronic systems with massive reductions in size and power consumption. (1700) DS&A

Sandia and Teledyne Imaging Sensors have developed and produced **2,000-by-2,000-pixel focal plane arrays**. These focal planes, BTB-2K, are among the first with onboard analog-to-digital conversion of electrical signals and represent a significant milestone in achieving higher levels of conversion efficiency. This technology advance will enable

greater sensitivity in signature collection, pushing the state of the art for large area arrays. (5700, 5500, 1700) DS&A

To meet emerging treaty monitoring requirements, Sandia's ground-based nuclear explosion monitoring team has developed a system to produce realistic three-dimensional **models of the Earth's seismic velocity distribution** based on the tomographic inversion of millions of seismic travel-time observations. Calculations are performed with a distributed computing platform based on the Java Parallel Processing Framework, providing a unique capability for this community. The system utilizes a dedicated set of multicore servers, as well as desktop machines, enabling researchers to exploit more than 200 processor cores. (5500, 5700) DS&A



Model of the Earth's seismic velocity distribution.

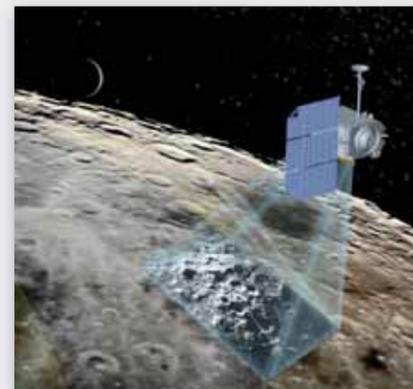
A multidisciplinary engineering team identified **architectural approaches to a national security space application**. To explore the relevant trade space, the team adapted established modeling and simulation capabilities, and combined it with newly created application-specific models. The modeling system was used to develop and refine an architectural solution to the specific problem. By combining Sandia's inherent modeling and simulation strengths with constellation-level system design skills, Sandia was able to explore critical trade space and identify previously overlooked options for solving critical national needs. (5300, 5400, 5500, 5700) DS&A

Real-time high-consequence systems require fluid, terse, intuitive communications among team members to maximize system performance. Extensive observation of on-going intelligence, surveillance, and reconnaissance (ISR) R&D activities at Sandia yielded evidence and theory showing how ISR systems **harness human psycholinguistic**

**mechanisms to process situational context and mission goals**. This empirical research in real mission environments provides original insights into ISR collaborative situational awareness and reasoning. Results have been shared with operations crews, managers, engineers, and policymakers, generating interest and accolades, and establishing a new design basis for future collaborative systems. (5500) DS&A

Sandia's Strategic Plan states: "When we achieve our highest goal, we are widely recognized as a national leader in preventing technological surprise..." Technological surprise is defined as the unexpected development of a game-changing technology among potential adversaries. Sandia's Defense Systems & Assessments Strategic Management Unit is developing **methodologies to understand the occurrence of such technologies**. Critical to this methodology is increased awareness and participation of the entire laboratory. Biweekly seminars, drawing speakers from throughout and outside the Labs, stimulate and initiate the cycle of understanding. DS&A

The Sandia "TriSAR" program is a multiagency, multi-corporation effort to develop a series of **small, low-cost, high-performance space-based imaging radar systems** to support lunar missions to find ice/water for manned space flight to the moon. Sandia delivered software and flight-qualified hardware of the Digital Receiver and Quadrature Waveform Synthesizer to NASA and the Johns Hopkins University Advanced Physics Laboratory. *Time* magazine named the NASA-sponsored Lunar Reconnaissance Orbiter (LRO) number three of the 100 top inventions for 2008. LRO is scheduled for launch in April 2009. (5300, 5900, 5700, 1500) DS&A



Lunar Reconnaissance Orbiter

## Military programs



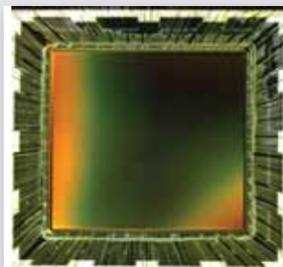
General Atomics and Sandia are reducing the size, weight, and power requirements of a new synthetic aperture radar (above) for unmanned aerial systems

General Atomics and Sandia are reducing the size, weight, and power requirements of a new synthetic aperture radar (SAR) system for unmanned aerial systems. The new Lynx II radar provides all-weather precision capability to detect time-sensitive targets and offers a long-range, wide-area surveillance capacity. Following successful Lynx II field tests, the General Atomics Radar Systems director stated that the Lynx II could not have happened without Sandia. General Atomics is to deliver 33 Lynx II radars in 2008 and 2009; the first six have been delivered to the Iraqi Air Force Intelligence, Surveillance, and Reconnaissance Program. (5300) DS&A

Sandia provided modeling and simulation to assist the US Missile Defense Agency and US Navy in **shooting down an errant satellite in February 2008**. The Missile Defense Agency asked Sandia to deliver in nine days the required "hit point" to prevent significant pieces of the satellite from reaching the Earth. The team delivered the calculations and supported real-time assessment of the event at Schriever Air Force Base, Colo., where decisions were made that a second intercept shot was not required. (5400, 1400, 1500, 2900, 5500, 5900, 9300) DS&A

The Key Data Processor (KDP) is a custom **microcircuit that securely provides the next-generation cryptography** mandated by the Joint Chiefs of Staff for all military Global Positioning System receivers. Sandia's trusted design center pioneered numerous external interfaces and

processes to develop this first major microelectronic product fabricated in DoD's IBM Trusted Foundry. Sandia demonstrated first-pass success with the 130-nanometer KDP-III system, which has been seamlessly integrated into two receiver platforms. Sandia now has generated a KDP-IV design on the 90-nanometer IBM process. (1700, 2600, 5600, 12300) DS&A



The Key Data Processor III securely provides next-generation cryptography for military Global Positioning System receivers.

A multidisciplinary team from across the Labs completed **Phase I of the DARPA Strategically Hardened Facility Defeat Program**, which seeks to develop an end-to-end system to defeat deeply buried strategic facilities. The team achieved **tenfold improvements in rock penetration performance**; developed new, high-accuracy algorithms for subsurface sensing; and demonstrated a novel compact power system. When integrated in Phases II and III, these enabling technologies will provide the long-sought nonnuclear strike capability to hold an adversary's most critical assets at risk. Phase II has been awarded to advance the feasibility demonstration system to an operational concept. (5400, 6300, 5300, 1800, 10600, 12300) DS&A



Strategically Hardened Facility Defeat system deployment test

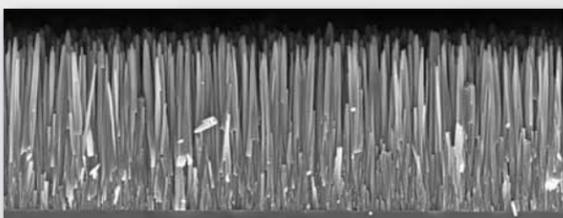
Sandia supported **eight missions in 2008 at the Kauai Test Facility (KTF)** for the US Missile Defense Agency and US military programs. Five missions were in support of the Navy's Ballistic Missile Defense Aegis program, two were in support of the Army's Terminal High-Altitude Area Defense program, and one was in support of a Navy fleet exercise. The schedule for 2009 shows the same amount of activity. Dual launch from the Kauai Test Facility at KTF. 2010 and beyond includes additional programs with the Army, Navy, and the University of Hawaii. (5400, 2600, 1500) DS&A



Dual launch from the Kauai Test Facility at KTF. 2010 and beyond includes additional programs with the Army, Navy, and the University of Hawaii. (5400, 2600, 1500) DS&A

## Energy

Oxide semiconductor/conjugated polymer composites couple the environmental stability of the oxide with economical solution-based organic semiconductor processing,



ZnO nanorod array structures deposited from solution as they would be for hybrid photovoltaic nanostructured devices

attractive for low-cost hybrid photovoltaic devices. Sandia researchers discovered that ZnO/P3HT [zinc oxide/poly (3-hexylthiophene)] **hybrid junctions improve in efficiency** with insertion of alkanethiol self-assembled monolayers. This observation is unexpected given alkanethiol's electrically insulating properties. The alkanethiol interfacial layer, however, increases the crystallinity of interfacial P3HT, increasing exciton diffusion length or hole mobility, thereby outweighing the added electron-tunneling barrier. This discovery suggests a path to engineering higher-efficiency hybrid photovoltaic devices. (1100, 1800) ER&N

The **Joint BioEnergy Institute (JBEI) became fully operational** at the Emeryville, Calif., location. The move was completed in July 2008 and more than 100 people are working at the facility. The first annual project review by DOE occurred in October and the entire team received outstanding feedback on FY08 accomplishments. Scientists working on the project published 15 peer-reviewed publications, filed seven patent applications, and presented their findings at 53 conferences. The project is on schedule to meet staffing and project milestones for FY09. (8600, 8300) ER&N



EmeryStation East in Emeryville, Calif., site of the Joint BioEnergy Institute

Sandia's **battery abuse research program is recognized internationally** as the leading research center of its type

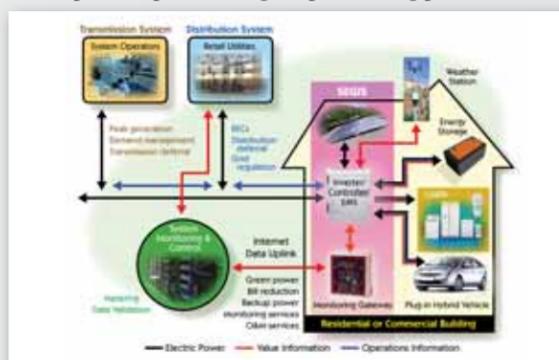
for electric vehicle applications. Sandia received the **Battery Power, Products, & Technology** magazine's Innova Award given to the company "that has shown a commitment to excellence and is a leading innovator in the battery industry." Sandia's program also had the highest aggregate score of 21 Advanced Technology Development projects evaluated during the annual merit review of DOE's Energy Efficiency and Renewable Energy (EERE) Office of Vehicle Technologies Program. (2500) ER&N



A lithium battery undergoing testing at the Sandia Abuse Test Facility

Sandia is part of a US-French team that successfully completed the first-ever demonstration of **hydrogen production under prototypic conditions from the sulfur-iodine cycle**. Sandia developed a unique bayonet-type heat-exchanger/reactor to decompose sulfuric acid at 850°C. Sulfur dioxide produced by the Sandia section was used in the French reactor to produce a heavy acid phase that was subsequently processed by the General Atomics reactor to produce hydrogen. It was the first demonstration of hydrogen production from the sulfur-iodine cycle at pressure using engineering materials of construction. (6700) ER&N

DOE is investing as much as \$24 million to develop solar energy products that will significantly **accelerate penetration of photovoltaic systems in the US**. The **Solar Energy Grid Integration Systems (SEGIS) projects** will provide critical research and development funding to develop less expensive, higher-performing products to



Depiction of the Solar Energy Grid Integration Systems (SEGIS) concept

enhance the value of photovoltaic systems to home and business owners. Sandia will provide project management support to these projects. (6300, 10200) ER&N

Sandia now supports the US Nuclear Regulatory Commission's Office of New Reactors in **performing license application reviews (multiple plant systems and sites) for early site permits**, design certifications, and combined construction and operating licenses for the next round of nuclear reactors in the US. Seventeen construction and operating license applications for 26 new reactors already have been submitted to the NRC, with an additional six applications for nine reactors expected through 2010. (6700) ER&N



Chuck Andraka in front of the Stirling dish array at Sandia (Photo by Randy Montoya)

Sandia and Stirling Energy Systems (SES) set a new **solar-to-grid system conversion efficiency record** by achieving a 31.25 percent net efficiency rate. In the SES system at Sandia, a solar dish generates electricity by focusing the sun's rays onto a receiver, transmitting the heat energy to a Stirling engine. The engine is a sealed system filled with hydrogen. As the gas heats and cools, its pressure rises and falls. The change in pressure drives the pistons inside the engine, producing mechanical power, which then drives a generator and produces electricity. The efficiency rating achievement earned a Breakthrough Award from *Popular Mechanics* magazine. (6300) ER&N

In partnership with General Motors, Sandia completed a **feasibility study of large-scale biofuel production in the US**. The study was uniquely constructed such that it considered least-cost pairing of biomass resources and conversion technologies, dynamic ramp-up of large-scale biofuel production, and constraints with respect to feedstock availability, land use, water requirements, energy use, and the biofuels distribution network. A system dynamics software product, the Biofuels Deployment Model, was developed to quantify complex interactions and sensitivities within the biofuel supply chain. (6300, 8100, 8300, 8600, 8900) ER&N

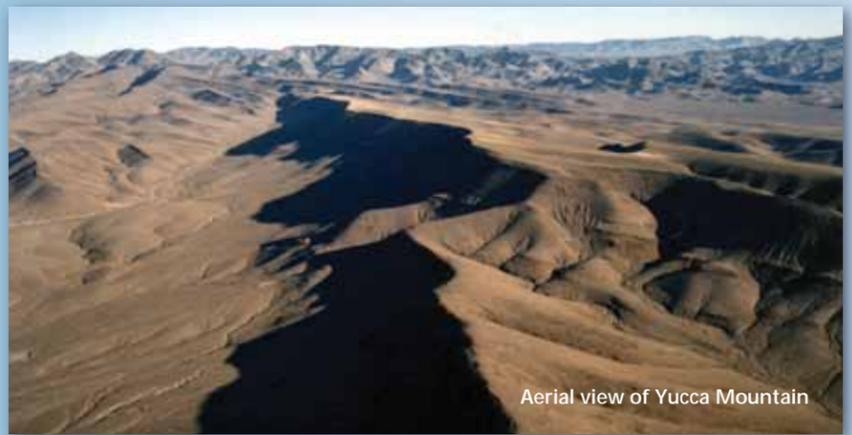
## Energy

DOE has committed to building 20 percent of the "First Wall" for the International Thermonuclear Reactor Experiment (ITER), a €10 billion collaborative effort among many nations. Sandia is tasked with developing critical manufacturing processes and has successfully **built and tested several First Wall qualification mockups** intended to measure the thermomechanical integrity of the beryllium-armored First Wall. The commercial manufacture of First Wall structures is expected to be worth well in excess of \$100 million to US industry. (8700, 8200, 1600, 1800) ER&N, ST&E



A First Wall qualification mockup consisting of three 80 mm beryllium tiles bonded to a copper alloy stainless steel base was fabricated and tested by Sandia. The mockup successfully passed thermal cycle testing for the International Thermonuclear Reactor Experiment (ITER).

On June 3, 2008, DOE's Office of Civilian Radioactive Waste Management submitted the Yucca Mountain Repository License Application to the US Nuclear Regulatory Commission. After a three-month review to determine the completeness of the application, it was docketed, officially starting the Yucca Mountain licensing process. As the Lead Laboratory for Repository Systems, Sandia was responsible for the development and preparation of the post-closure component of the safety analysis contained in the application and the development of the underlying technical basis. (6700, 6300, 9500, 10660, 10200) ER&N



Aerial view of Yucca Mountain



Workers deliver the Yucca Mountain License Application to the Nuclear Regulatory Commission office in White Flint, Md., on June 3, 2008.

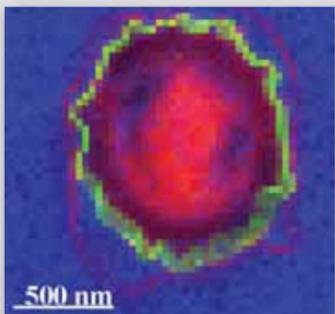
## Homeland security



Sandia researchers (left to right) Nerayo Teclmariam, Nate Gleason (both 8125), and David Franco (8114) review facility plans from a major US airport. Such materials, combined with decades of research, help BioWatch Indoor Reachback Center (BIRC) team members make accurate predictions for facility owners that can help secure and protect their buildings. (Photo by Randy Wong)

Sandia's BioWatch Indoor Reachback Center (BIRC) began full 24/7/365 operations in support of the Department of Homeland Security's BioWatch program, an early warning effort designed to detect trace amounts of biological materials. BIRC's role is to **provide scientific modeling support to decision makers** responding to a public release of a hazardous biological agent. BIRC's extensive database of facility information and analytical capabilities enable team members to rapidly generate information that facilitates emergency response, such as estimates of the size and location of the release. (8100) HS&D

After seven years of working in secret, Sandia was released from nondisclosure agreements with the FBI regarding a project in which the Labs applied advanced microanalysis tools, developed for nuclear weapons work, to **determine the distribution of elements in anthrax spore materials mailed in 2001** to several news media offices and two US senators. Highly detailed analyses were conducted on hundreds of samples, showing that the spore materials in the letters most likely came from the same source and that no chemical additives were used to make the spores more dispersible. (1800, 5900) DS&A



Elemental distributions in a spore from a letter mailed to a US senator

The Precision Aim Team developed and fielded a system to precisely **identify, target, and disable internal components of an improvised explosive device (IED)** while dramatically reducing an operator's time on target and preserving forensics evidence. The system is quicker, easier to use, and less expensive than existing systems and can be used by federal, state, and local emergency responders. It combines Sandia-developed technologies, including visual

tracking, pose estimation, stereo X-ray targeting, graphical model building, and model-based collision detection. (6400, 5900) NW

To assess the threat of onboard explosions from terrorist bombs, the Advanced Simulation & Computing program produced **visual assessments of airplane damage in response to detonations** (see photo on page 2). Computational modeling offers simulation-based confidence for explosive threats and myriad factors affecting structural vulnerability that cannot be determined solely from empirical tests. Hydrodynamic blast models were linked to finite-element structural-response models to generate blast effects. The Transportation Security Administration will use this work to revise requirements for future aviation security explosives detection technology. (6400, 1500, 5400) HS&D

Sandia conducted the first **systematic study of wide-area restoration** (tens of square miles, hundreds of buildings) following a large bioattack and guided government investment in bioremediation technology and policy. This work, supporting the Department of Defense and Department of Homeland Security collaborative Interagency Biological Restoration Demonstration program, determined the current state of science, technology, policy, and plans for wide-area bioremediation and identified key capability gaps to inform investment priorities. Sandia's analyses also helped government agencies reach consensus on changes in bioremediation policy. (8100, 6300, 1500) HS&D

A new "**cellular observatory**" enables novel imaging of live cells to unravel complex biological processes. Through the development of novel time- and frequency-resolved confocal microscopy, this instrument provides entirely new approaches for distinguishing multiple labeled proteins in cells and for confidently identifying interactions of cellular proteins. Applications range from energy security to homeland defense and include the engineering of enzymes and organisms to produce biofuels and the identification and mitigation of infectious disease pathways. (8300, 8600) HS&D

## Global security

Sandia's International Physical Protection Program supported **NNSA Global Threat Reduction Initiative efforts** to protect international radiological sites, secure nuclear materials at research reactors, and provide physical protection for the BN-350 spent nuclear fuel in Kazakhstan. The program began work to protect large radiological sources in Uganda, Tanzania, Tunisia, Mongolia, Romania, and Uruguay. It also completed physical protection upgrades at research reactor sites in Chile, Jamaica, Vietnam, and the storage location for the BN-350 spent fuel that contains significant amounts of highly enriched uranium and plutonium. (6700) ER&N

A formal five-day training course on **Controlling Laboratory Bio Risks** has been developed. The course uses the mock

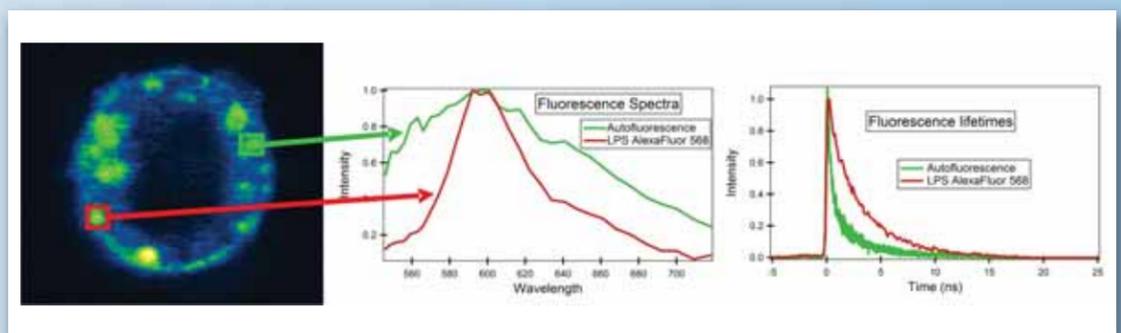
Biosafety Level 2 training laboratory located in Sandia's International Programs Building to train students through a combination of lecture and hands-on training. To date, participants have come from across



Egyptian scientists in a training laboratory

the United States and many countries. They have included scientists, public- and agricultural-health researchers, laboratory directors, law enforcement, and policy makers who need to be informed about the latest developments in lab biosecurity, bio safety, and containment-laboratory design. (6700) ER&N

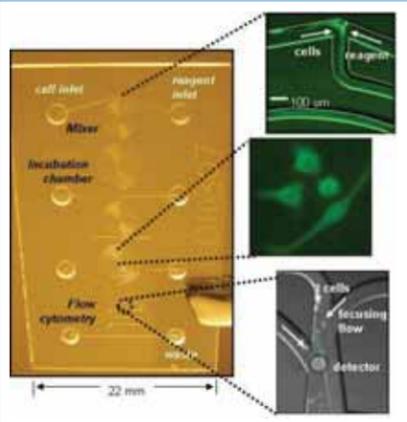
A cross-lab team sponsored by Institutional Development Center 12100 completed a set of in-depth technical studies to assess the implications of a renewed call for ratification of the **Comprehensive Test Ban Treaty**. The results of these studies provide a basis for laboratory leaders to assert the need for US global leadership in matters of a nuclear nature, options to continue to provide a credible nuclear deterrent for the indefinite future, and comprehensive monitoring and verification solutions. (12100, 240, 5900, 5700) NW, ER&N, DS&A



Cellular observatory image of a single, live macrophage cell exposed to lipopolysaccharide (LPS) endotoxin labeled with a dye. The unique red spectrum and lifetime identify the region in the image where the endotoxin has entered the cell in contrast to the other signals that result from natural fluorescence.

## Bioscience

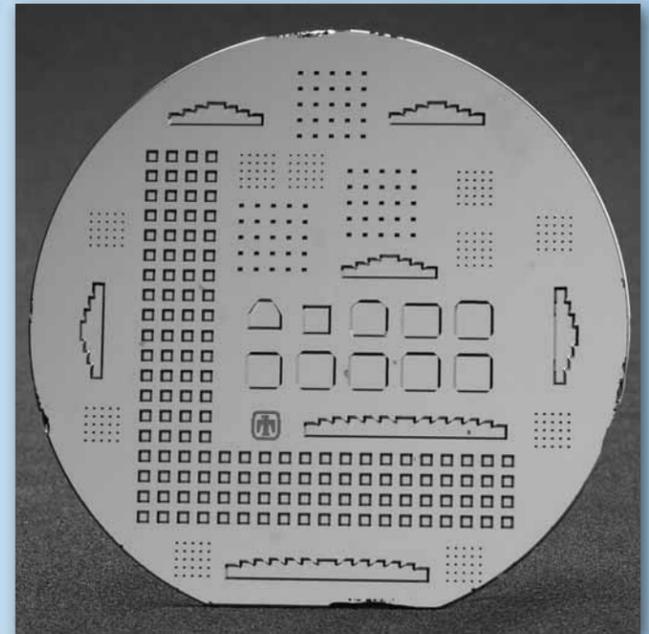
The **Microscale Immune Studies Laboratory (MISL) Grand Challenge** concluded at the end of FY08. Accomplishments of the MISL team include 14 papers published or manuscripts submitted, a recent *Biophotonics International* journal cover, eight technical advances, and several patents pending or in preparation. In addition to these technical accomplishments, MISL has led to a strategic partnership with the University of Texas Medical Branch (UTMB) and two funded National Institutes of Health projects (one Sandia-led, one UTMB-led). (8600, 1700, 1800, 1400) ST&E



The Microscale Immune Studies Laboratory (MISL) platform's integrated flow cytometry and imaging capabilities have allowed, for the first time, measurement of kinase activity and their translocation in the same population of cells.

## Microelectronics & microsystems

Hy Tran (2541), Meghan Shilling (2541), Andrew Oliver (former Sandian), and Andre Claudet (2614) won a 2008 R&D 100 award for developing a Silicon Micromachined Dimensional Calibration Artifact. The artifact has an innovative three-dimensional structure suitable for calibration of mesoscale measurement machines that use optical, tactile, or a combination of optical and tactile measurement methods. It is made from a single-crystal silicon wafer, patterned and then anisotropically etched to form dimensional features. The same artifact and geometrical features can be used to calibrate vision-based dimensional metrology systems, touch-probe based systems, and hybrid metrology systems. (2500, 2400, 1700) NW



The Silicon Micromachined Dimensional Calibration Artifact

## Computing & information sciences

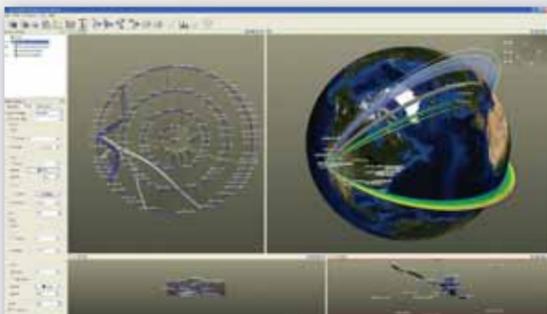


The Red Storm supercomputer aids in scientific discovery.

Co-architected by Sandia and Cray, the Red Storm supercomputer is Sandia's premier computing system. With funds from the Advanced Simulation & Computing (ASC) program, **Red Storm was successfully upgraded** to include 38,400 processing elements through the introduction of new quad-core AMD Opteron processors. The peak process-

ing power of Red Storm rose to 284 trillion operations per second, more than double its previous level. The system remained operational throughout the upgrade period and supported several Level 2 ASC milestones. It also is in the top 10 of the TOP500 list, and there are now 30 Red Storm-like installations worldwide. (9300, 1400, 1500) NW

Emerging national security challenges require techniques for extracting insight from large and complex data collections. Researchers from across the Labs are teaming to develop **novel analysis and visualization techniques** and to investigate new computer architectures for such problems. An early result of the Networks Grand Challenge LDRD was a prototype system for studying cyber attacks using advanced algorithms and tools. In a related development, Sandia has obtained one of the first "massively multithreaded" supercomputers, ideally suited for complex data analysis applications. (1400, 8900, 5600, 5900, 9300, 9500) NW



A prototype system for studying cyber attacks provides an unprecedented ability to do scalable analysis for cyber defense.

An LDRD research team from Cryptography & Information Systems Surety Dept. 5635 has **developed a new hash algorithm** and submitted it to the National Institute of Standards and Technology for consideration as a new national standard. Hash functions are extremely important for authenticating data. We use one every time we make an Internet purchase, for example. Recently the current standard family of hash functions used for Internet authentication was partially compromised by Chinese mathematicians, prompting the call for a competition to find a better solution. Sandia's entry is expected to be highly competitive. (5600) DS&A, ER&N

Sandia convened a meeting in Washington of 85 leaders from industry, government, and academia to confirm the need for **computation-based engineering (CBE) as a tool for US competitiveness**. Keynote addresses by Labs Director Tom Hunter and National Academy of Engineering President Charles Vest, as well as

talks by Sen. Kay Bailey Hutchison (R-Texas), former DOE Under Secretary for Science Ray Orbach, and National Science Foundation Director Arden Bement, were followed by discussions of collaborative ways to overcome barriers to CBE adoption throughout industry and government. (1, 1000, 1500) ST&E

Sandia is working with the US Nuclear Regulatory Commission (NRC) to assess and improve the design and implementation of digital instrumentation and control systems, responsible for ensuring **safe and secure operations at power generation plants**. Assessing these systems is necessary to determine the risks associated with employing them. Sandia also is helping the NRC ensure adequate cyber protection in nuclear digital safety networks, as these networks may be subject to attacks that attempt to modify configurations and disrupt safety functions. (5600, 6700) DS&A

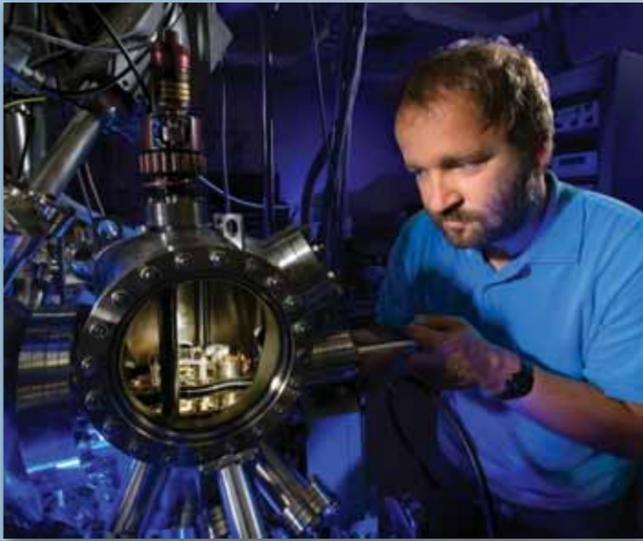
Funded under DOE's National SCADA Test Bed Program, Sandia released a new software tool, Advanced Network Toolkit for Assessments and Remote Mapping (ANTFARM), that will **aid energy utility owners in mapping and visualizing their control system networks**. Making this tool available is a critical first step in meeting the North American Electric Reliability Corporation's critical infrastructure protection standards. Sandia has made the source code and documentation available to all interested parties via an open-source repository website under a no-fee, general-purpose license agreement. (5600) DS&A

Sandia exercised a set of **risk analysis capabilities with energy control system owners**, operators, and stakeholders at its June 24, 2008, workshop "Cyber Attacks on Control Systems: Evaluating the Real Risk." As part of a project funded under DOE's National SCADA Test Bed Program, Sandia has developed these risk analysis tools using a threat-to-consequence framework. The capabilities will allow Sandia to help owners and operators prioritize risks, focus limited resources on the most pressing security issues, and build a business case for needed cyber security improvements. (5600, 6300) DS&A



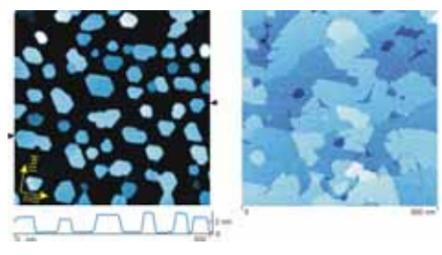
Sandia has developed a set of risk analysis tools that allow energy control system owners, operators, and stakeholders to prioritize cyber security improvements.

# Materials



Konrad Thürmer (8656) with the scanning tunneling microscopy (STM) chamber and (at right) STM images of ice films. The abrupt contrast changes are ice surface steps of molecular height, which have never been imaged before. (Photo by Randy Wong)

Knowledge of the structure of nanometer ice films has remained elusive due to a lack of imaging techniques. Electron microscopes have failed because their electron beams destroy the ice, and the insulating nature of ice has limited the imaging capabilities of scanning tunneling microscopy (STM) to one or two molecular layers. Two Sandians, Konrad Thürmer and Norm Bartelt (both 8656), discovered how to image ice multilayers using STM by extracting the electrons needed for imaging from the valence band of ice. This approach already has yielded new insights into water-solid interactions at the nanometer scale. (8600, 1100) ER&N



Two-dimensional bilayers, with electrons in one layer and holes in the other, are predicted to exhibit quantum Bose-Einstein condensation of excitons, which are usually generated optically. Sandia fabricated unique electron-hole bilayer semiconductor heterostructures to test this theory and quantified coupling between electron and hole layers using Coulomb drag measurements. An increase in drag resistance for a narrow barrier device at very low temperatures suggests pairing of electrons and holes into excitons. This is the first evidence that excitons can be electrically generated in such systems. (1100, 1700) ER&N



Sandia's Thunderbird emblem patterned on a silica wafer coated with a patternable superhydrophobic coating. The patterned image is invisible until placed in contact with water. As the water covers the wafer, it adheres to the hydrophilic areas, revealing the Thunderbird image.

Manufacturing Science & Technology Center 2400 and Honeywell FM&T have developed an innovative process to manufacture composite housings for weapon use-control devices and potentially many other applications.

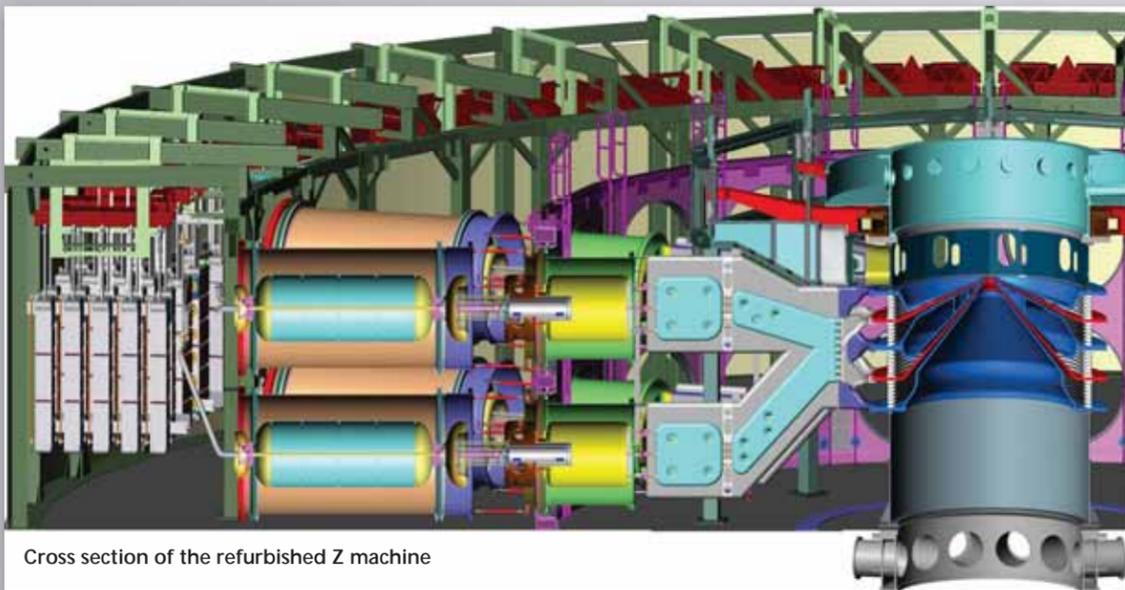
Composite housings use fibers in a polymer matrix to provide an attractive combination of high strength and low weight. Traditional methods for making such housings are labor-intensive and costly. The new process, now entering production, uses special molding compounds and foams to form complex internal features with fewer steps, resulting in a 60 percent time and cost reduction. (2400, Honeywell FM&T) NW



A use-control component housing after fabrication of the carbon-fiber composite shell (left) and after near-net-shape forming of the internal features (right) using a new process developed by Center 2400 and Honeywell FM&T.

Natural materials like the lotus leaf or carapace of the desert beetle have evolved self-cleaning and water-harvesting surfaces that repel or direct water movement in rolling drops. Sandia developed a simple, biomimetic-coating process that allows immediate formation of such "superhydrophobic" coatings on arbitrary surfaces. Water is not merely repelled; it literally jumps or rolls off. Unlike previous work, Sandia's process provides perfect transparency and requires no surface treatment. It can prevent corrosion, protect electronics and antiquities, avoid fogging or icing, and provide a new approach to water collection. (1000, 1800, 8600) ST&E

# Pulsed power

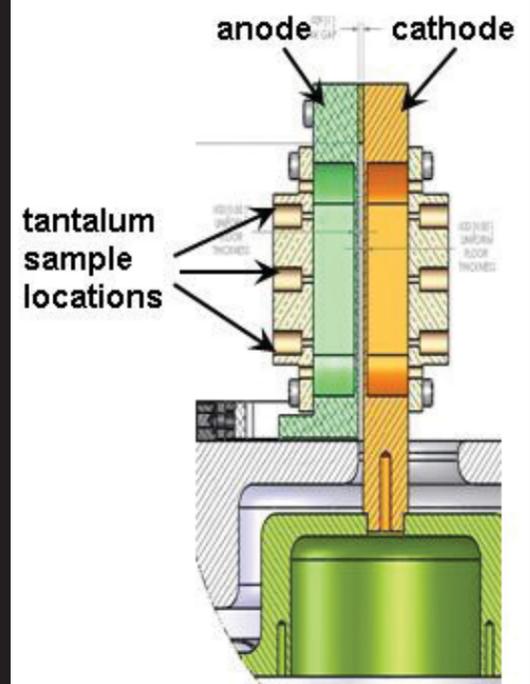
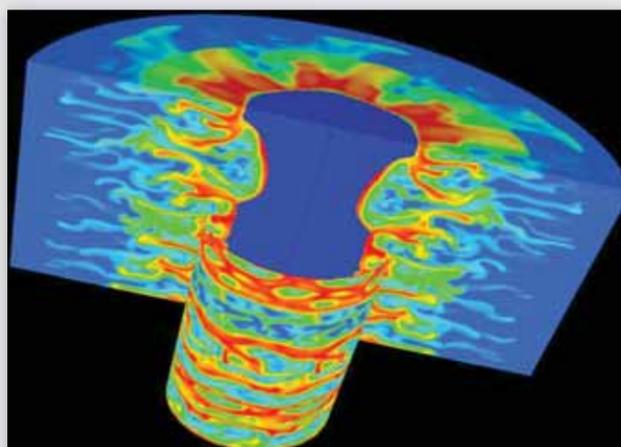


Cross section of the refurbished Z machine

In its first year of operations the refurbished Z facility reestablished experimental platforms, made key improvements to specific components, fielded new diagnostics, and conducted mission experiments for NNSA in several program areas. The new Z has better shot-to-shot reproducibility, more precise current shaping (pulse length can be varied by a factor of three), and higher peak currents. The new diagnostics significantly enhance measurements of the accelerator performance and the physics of the high-energy-density plasmas. (1600) NW, ST&E

Wire-array implosions on Z produce an approximately five nanosecond X-ray burst with approximately 200 trillion watt peak power. A three-dimensional computational model of Z-pinch implosions was developed using the radiation magneto hydrodynamics code ALEGRA. It is providing critical insights on scaling of wire-array sources to larger currents for fusion and weapon physics applications. Validation on the massively parallel Red Storm computer proved that the model produces a broad range of measurements when azimuthal asymmetries are included and predicts X-ray power within measurement uncertainties. (1600, 1400) NW, ST&E

Density plot showing complex 3-D structures that develop in the imploding plasma in Z



Drawing of experimental geometry used to obtain shockless compression data on the newly refurbished Z

Using Sandia's new Z facility, shockless compression data were obtained on tantalum to four megabar pressures, completing a high-level milestone with Los Alamos National Laboratory for NNSA's Science Campaign. This accomplishment required precise current pulse shaping, a new target geometry to obtain higher pressures and more accurate measurements, shielding of optical diagnostics in Z's harsh environment, and careful characterization of the time-dependent current loss. The federal program manager said the data "are a significant advance over any previous data available within the complex." (1600) NW, ST&E

## Partnerships & alliances

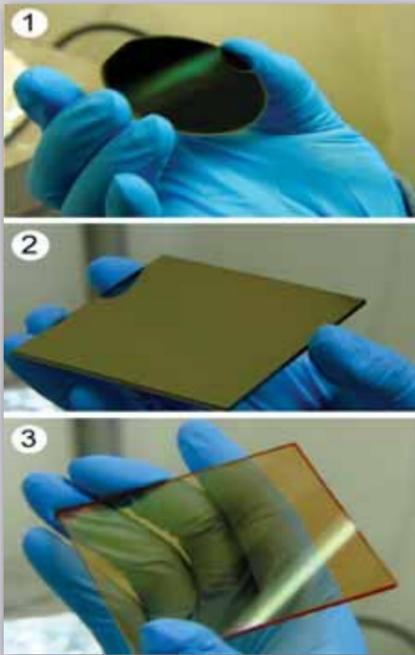
The National Institute for Nano-Engineering (NINE) is a Sandia/university/industry collaboration formed to help develop the next generation of nano-engineering innovation leaders for the nation. Research opportunities for students are enabled by Sandia's capabilities together with those of 12 university and six industry partners. This year NINE carried out 15 technical projects, student programs, and a technical workshop and worked with partners to form NINECO, the consortium's administrative arm. NINE is a prototype Discovery Science and Innovation Institute as envisioned in the America Competes Act of 2007. (1800, 1030) ST&E



NINE students and mentors  
(Photo by Randy Montoya)

Engineering Sciences Center 1500 provided an independent peer review of the structural analysis supporting the National Transportation Safety Board's investigation of the Minneapolis bridge collapse. On Aug. 1, 2007, the I-35W bridge across the Mississippi River collapsed suddenly, resulting in 13 deaths and 145 injuries. In a briefing to the NTSB chairman prior to public hearings on the investigation findings, the Sandia team substantiated the probable cause of failure as a design flaw rather than corrosion. (1500) NW

Providing support to Sandia's Work for Others/Other Federal Agency (WFO/OFA) customers, WFO/CRADA Agreements Dept. 10012 processed **1,145 WFO/OFA agreements in FY08**, a 24 percent increase from FY07, and 786 WFO/OFA proposals, an 8 percent increase. The total dollar value of agreements processed increased by 21 percent. (10000)



Nanoparticle thin film on 2 in. by 2 in. silicon wafer (top) and thin films on acrylic plates (middle and bottom)

Under the Lockheed Martin cooperative research and development agreement, Sandia developed a **new self-assembled thin film coating technology** that will generate economic, logistical, and environmental benefits for electronics and high-performance optical devices by assembling nanoparticles into engineered optical and electrical composite films at ambient conditions. The ability to repair coatings in the field reduces needs for spare parts and downtime. This application method is ideally suited for thermal management of aerostats and high-altitude airships and components such as adaptive micromirrors, which are extremely difficult to coat using conventional thin films. (1800, 300) ITS SMG

Two programs that leverage Sandia technologies to create jobs reached major milestones. **The Entrepreneurial Separation to Transfer Technology Program**, now in its 15th year, has created 3,100 jobs, started up Perma Works ([www.permaworks.com](http://www.permaworks.com)), and helped expand eSolar ([www.esolar.com](http://www.esolar.com)).

The Sandia Science & Technology Park celebrated its 10th anniversary with a series of events that recognized the park's 28 tenants employing 2,100 people. The park also was honored by the Greater Albuquerque Chamber of Commerce with its Small Business Advocate of the Year Award. (1030) ST&E



The eSolar power plant's small mirrors track the sun with high precision and reflect sunlight to tower-mounted receivers.



New sign at the Sandia Science & Technology Park

## IT, networks, & facilities



The \$518 million **Microsystems and Engineering Sciences Applications (MESA)** project was completed in August 2008, three years ahead of schedule and \$48 million under budget. The successful completion met an NNSA Defense Programs "Getting the Job Done" goal and represents the largest federal investment in microsystem technologies. In FY08 the MESA team was recognized with several awards, including the Secretary of Energy's Achievement Honor Award, the NNSA Defense Programs Award of Excellence, a DOE Environmental Management "Best in Class" Award, and a Lockheed Martin NOVA Award. (8400, 1500, 1700, 2400, 2600, 4100, 4200, 4800, 5300, 10200, 10600) NW

Sandia and Qwest Communications have **teamed to provide reliable high-speed network connectivity to the California site.** The system is capable of providing concurrent wide-area access to multiple government agencies and Internet service providers. The initial applications include a new California-New Mexico classified intersite link and a 10 gigabit per second network that supports site Advanced Simulation & Computing (ASC) applications. (8900) IES

The Sandia Wireless Handheld Communications Team and California-site Security Operations completed a proof of concept using the California badge swipe system, enabled with Diamond 2 software, to **disable selected BlackBerry device functions.** The Sandia default security policy changes to a PDA-mode policy upon entering the limited area and the PDA-mode security policy returns to normal during an outbound badge swipe. The proof of concept was successful and security policy changes occurred within a minute of using the badge swipe system. (8900, 8500) IES

FY08 was an exceptional year for **Sandia's Energy Management Program.** A collaborative effort among Facilities and line organizations resulted in improved employee awareness and construction projects that reduced the natural gas and electricity use per gross square foot for office and light lab buildings by 8.9 percent, which saved \$1 million; lowered greenhouse gas emissions by 10.46 percent; and reduced water use by 52 million gallons. The program cosponsored a site-wide Lights Out campaign, Energy Conservation Month events, Earth Day events, and a highly successful Earth, Wind, and Sun event. (04100, 04800) IES

The ailing 16-year-old New Mexico-to-California intersite network was in need of a rapid reengineering due to reliability and cost concerns. The reengineering team developed and deployed the **next-generation intersite network.** Typical sustained file movement performance improved by more than 40 times, and reliability improved significantly as well. The new path utilizes Sandia's existing Engineering Sciences Network (ESNET), saving more than \$100,000 annually from the previous system. (9300, 8900)

The **Decontamination and Demolition Program** completed the most ambitious year in its 15-year history, removing or demolishing more than 150,000 gross square feet of space. This included the removal of Bldg. 807, the end of a five-year effort to demolish the Bldg. 805/806/807 complex, and Bldg. 893, torn down as part of the Microsystems and Engineering Sciences Applications project. Removing these substandard facilities reduces annual maintenance costs by \$2.7 million and frees valuable land for new development to meet Sandia's current and future mission needs. (4800) IES



Bldg. 807 demolition

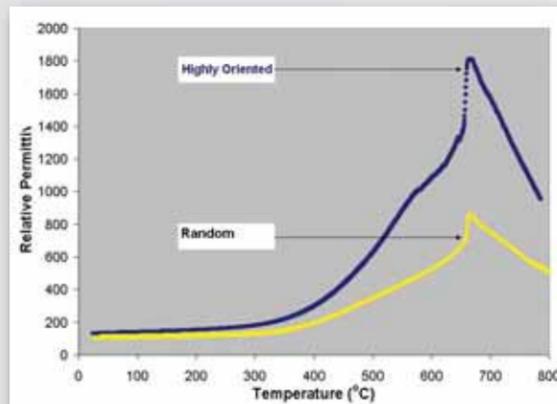
## ES&H & security



In February 2008 a Nuclear Assurance Corp. cask is loaded at Sandia's Tech Area 5 with a Sodium Reactor Fuel Debris experiment bound for treatment at the Idaho National Laboratory, part of special nuclear material de-inventory efforts.

**Special nuclear material de-inventory efforts** were substantial in 2008. Sandia was the first DOE site to move all security-sensitive material off-site, and it did so in significantly less time than the timeframe set by DOE. The first phase of the de-inventory project was completed in February 2008. This allowed Sandia to aggressively remove remaining items and close the Nuclear Material Storage Facility by the end of September 2008. (1300, 10200, 4200, 4300, 2900) NW

Lead-containing ceramics are used in ferroelectric weapon power supplies and in commercial applications. The lead greatly increases Sandia's costs to prevent worker exposure and for waste disposal. Lead-free alternatives previously have not achieved the required performance. A new production-scalable process has been developed to **manufacture ceramics with highly oriented microstructures** that dramatically enhance the electrical properties of some lead-free compositions, making them a viable alternative for selected applications. This reduces risk to workers and the environment while affording substantial cost savings. (2400, 1800, 1100) NW



New highly oriented lead-free ceramics offer substantially improved ferroelectric properties with the potential to replace lead-containing ceramics in some applications.

The Livermore Chamber of Commerce selected **Sandia/California as the recipient of its inaugural Environmental Spirit Award.** The award recognizes Sandia's environmental programs and ongoing commitment to protecting the environment, wildlife, and numerous species on the 400-acre site. Gary Shamber, manager of the site's Environmental Management Department, accepted the award during the chamber's annual community awards gala on Feb. 2, 2008. In his acceptance speech, Gary emphasized the growing importance of environmental stewardship by individuals, companies, and communities. (8500) IES

The success of Phase I of the special nuclear material de-inventory and the resulting change in security posture allowed Sandia to **redeploy equipment, materials, and nonpermanent upgrades** to several protective force, physical security, and technical security organizations throughout the DOE complex. Redeployed protective force equipment included weapons, breaching equipment, night vision equipment and scopes, armored vehicles, and ammunition. Physical and technical security equipment included an X-ray machine, metal detectors, camera towers, and microwave sensors, among other items. (4200) NW



Special nuclear material de-inventory activities and the resulting change in security posture allowed Sandia to redeploy protective force, physical security, and technical security equipment around the complex. (Photo by Randy Montoya)

On May 12, 2008, the **Oracle Explosive Inventory System (EIS) was released to production.** The Oracle EIS replaces a legacy system that was outdated in technology and process requirements. The Oracle EIS simplified and automated 21 processes and provides multiple data analysis tools and reports. The successful completion of the development project met an Office of Inspector General (OIG) finding and resulted from collaboration among Safety Engineering Dept. 4122, Oracle E-Business Suite System Dept. 9542, and the Sandia Explosive Safety Committee. (4100, 9500) IES

Among the **internal independent audits** performed by Sandia, two were particularly noteworthy for helping improve the safety of Sandians, contractors, and visitors. The pedestrian and traffic safety audit led to a decision to plan a renovation of the Bldg. 825 parking lot to improve drainage and walking safety for everyone using the lot to reduce slips, trips, and falls. The Saturn and HERMES audit led to the improvement of lighting in two large particle accelerators for the protection of workers at the facility. (12800, 1300, 6060, 4800) NW, ER&N

## Human resources

Health, Benefits, and Employee Services (HBE) deploys long-term **containment strategies to control escalating health care costs**. With careful management of off-site and on-site health care services and employee education, HBE (<http://hbe.sandia.gov>) encourages a healthy workplace culture where individual responsibility, informed consumerism, prevention, and disease management result in better health outcomes and savings. This year, HBE brought on new prescription and vision care vendors, implemented electronic medical records and an online consumer-to-provider portal, assessed organizational health, and educated employees within work groups. HBE also implemented a drug testing program for DOE. (3300)

## Supply chain



Workers install components during refurbishment of Sandia's Z machine. (Photo by Randy Montoya)

The **new staff augmentation contracts awarded in June 2008** use more than 1,300 contractor personnel and represent the largest contract workforce of any DOE contractor. Deploying the new contracts involved the largest transition of a contract workforce in Sandia history. Several industry leaders in the federal contractor sector are benchmarking Sandia's approach as a best-in-class model, including the Jet Propulsion Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Honeywell FM&T, Pacific Northwest National Laboratory, and Pantex. (10200, 3500, 9500, 4200) IES

## Governance, leadership, & management



Sandia's **Integrated Laboratory Management System (ILMS)** has undergone continuous improvement. FY08 improvements include formalized management reviews; establishment of the first integrated set of Labs-wide performance measures; implementation of updated assure, assess, and improve processes; deployment of new portal technology and corporate application upgrades; standardized Executive Office, Laboratory Leadership Team, Strategic Management Group, Strategic Management Unit, Division, and Policy Area pages and content; and a three-year, resource-loaded development plan for ILMS. (9700, 6300, 9500, 9600)

The Strategic Planning Department of the Institutional Development Center engaged laboratory leadership in a **new approach to strategic planning** — assumption-based planning. This approach articulates key assumptions about the external and internal environments, identifies load-bearing assumptions and uncertainties, and clarifies key shaping and hedging actions. This modified approach to strategic planning is intended to result in a more robust and integrated set of strategic actions as Sandia moves into the future. (12100)

NNSA Headquarters recognized Sandia in March 2008 with the first annual **Administration Award for Excellence in Internal Controls**. The award acknowledges Sandia's exceptional internal control activities as demonstrated within the Labs' implementation of OMB Circular A-123 and contractor assurance. These activities help ensure that Sandia is a sound steward of taxpayer dollars. The award was based on a complex-wide examination of contractor management assurance systems. Sandia was the only recipient in FY08. Chief Financial Officer & Business Operations VP Matt O'Brien accepted the award on behalf of Sandia. (12800, 10500) IES

A Sandia team played a leadership role in and provided integrated support for the NNSA **Nuclear Weapons Complex Supplemental Programmatic Environmental Impact Statement (SPEIS)** process. In the NNSA SPEIS record of decision: 1) Sandia retained the coordination and oversight of flight test operations at Tonopah Test Range; 2) major environmental test facilities are consolidated to Sandia/New Mexico; 3) the Sandia/California site continues its weapons non-nuclear design and support functions; and 4) high explosives R&D support functions, including use of energetic materials for environmental testing, continue at Sandia. (200, 2700, 2900, 1300, 1500, 8500) NW

In the triennial **DOE Counterintelligence Inspection**, Sandia received an "Excellent," the highest rating possible. The final inspection notes that "SNL Director Dr. Thomas Hunter and his executive management team are exceptionally supportive" of Sandia counterintelligence. In a congratulatory note, the NNSA administrator said, "The results of this inspection were quite impressive . . . in fact, I understand that this was one of the best overall results across the Department." (300)

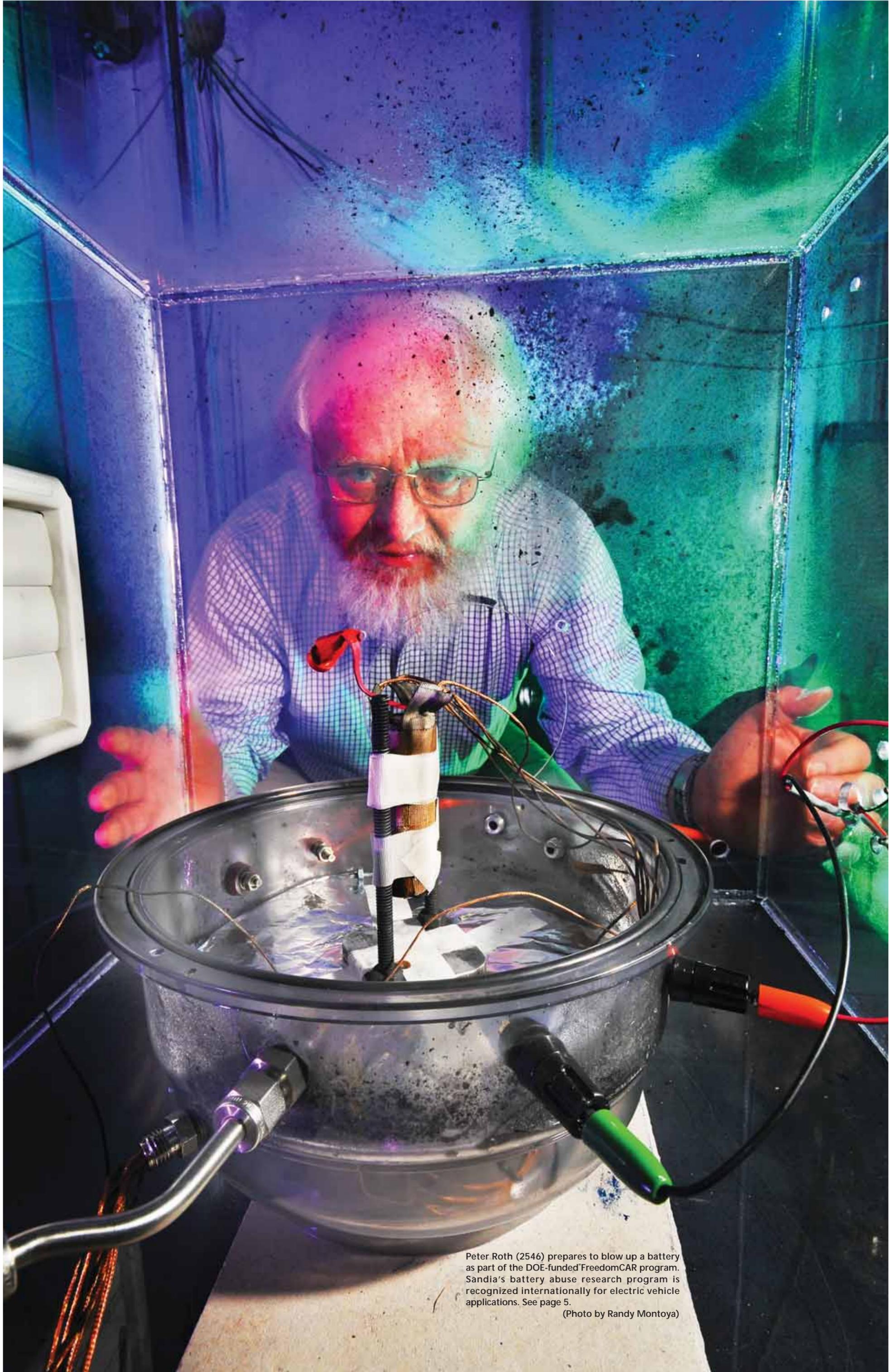
## Community involvement

In a year of great community need, Sandia employees chose to make a difference. For the first time since 1994, Sandia's Employee Caring Program (ECP) participation rate reached 76 percent. **Sandia's campaign raised more than \$3.7 million**. Retirees donated more than \$450,000. Employee donations increased by more than \$200,000 from the previous year. New-employee participation rose by 3.9 percent. Sandia is the largest contributor to the United Way of Central New Mexico.

More than **850 Sandians are active volunteers** who gave more than 114,000 volunteer hours to their communities in 2008.

Albuquerque school children receive shoes from Sandia volunteers. Sandia's 50-year-old Shoes for Kids program is one of Sandia's many community giving and outreach programs. (Photo by Randy Montoya)





Peter Roth (2546) prepares to blow up a battery as part of the DOE-funded FreedomCAR program. Sandia's battery abuse research program is recognized internationally for electric vehicle applications. See page 5.

(Photo by Randy Montoya)