



Sandia
National
Laboratories

LABS ACCOMPLISHMENTS



Sandia Lab News
MARCH 2011



Gathered at the National Museum of Nuclear Science & History in Albuquerque, N.M., around two B28 gravity bombs recovered from the 1966 nuclear accident over Palomares, Spain, are Sandians (both active and retired), from left, Stan Spray, Leon Smith, Dan Summers, Ray Reynolds, Bill Stevens, and Bob Bradley. They are among 42 individuals — including key policymakers, scientists, and engineers — who appear on camera in *Always/Never: The quest for safety,*

control, and survivability, a feature-length documentary by Sandia filmmaker Dan Curry that brings the larger-than-life story of the US nuclear weapons program to a wide audience. The 143-minute film is the culmination of a nearly five-year-long effort to capture the story of this pivotal time in history from the perspectives of those who were shaping and experiencing it firsthand. (For more on *Always/Never*, see page 4.) (Photo by Randy Montoya)

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A member of the US Air Force demonstrates the placement of a water disruptor near its target in a simulated village used to train soldiers heading overseas.

This year's *Labs Accomplishments* publication recognizes some of Sandia's best work during 2010, as submitted by center offices and selected by division offices. Each citation is followed by the 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
- DS&A: Defense Systems & Assessments SMU
- IHNS: International, Homeland, & Nuclear Security SMU
- ECIS: Energy, Climate, & Infrastructure SMU
- IES: Integrated Enabling Services SMU
- WFO: Work for Others

Cover photograph by Randy Montoya



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Sandia National Laboratories

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

Nuclear weapons engineering

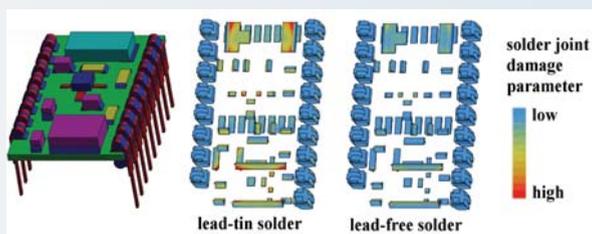
W76-0 and W88 Systems Engineering (2138) collaborated with Fire and Aerosol Sciences (1532) to successfully perform a test at the Cross Wind Test Facility to assess the W76-0 arming, fuzing, and firing subsystem in a simulated, fully-engulfing hydrocarbon fuel fire. Temperature and pressure data, video, and computed tomography were used to determine the state of critical components and integrity of the exclusion region to ensure confidence that nuclear safety would not be affected by the defined environment. (1500, 2100) NW



W76-0 arming, fuzing, and firing subsystem during an abnormal environment thermal test.

The prediction of the effect of short-pulsed neutron radiation has been extended to circuit-level. **The program to develop qualification alternatives to the Sandia Pulsed Reactor achieved a major milestone by creating a model that predicts the response of a weapon-representative silicon circuit to short-pulsed neutron radiation like that formerly produced by the retired Sandia Pulsed Reactor.** In comparing these predictions to validation data, the model was shown to capture major features of the circuit response, including the onset of non-linear threshold behavior as the neutron fluence increases, which have important implications for quantifying margins and uncertainties for silicon analog circuits. (1300, 1100, 1400, 1700) NW

On Aug. 20, 2010, Sandia and dignitaries from Congress and the NNSA celebrated the grand opening of the new Ion Beam Laboratory. This state-of-the-art facility houses a unique set of tools to perform basic and applied nuclear research and address an array of national security needs, including certifying nuclear weapons components. The construction project met its schedule and its success is due to the high degree of cooperation between the Radiation-Solid Integrations Department, Facilities, Purchasing, Security, ES&H, the Summit and Henderson construction teams, and the Sandia Site Office. (1100) NW



For the clock module (left), the lead-tin model (center) predicts much higher damage in the solder joints than the lead-free model (right), indicating a significantly longer lifetime for the lead-free component.

Because of concerns over environmental lead, legislated requirements and industry standards are replacing lead-tin solders with lead-free solders in future component designs and in replacements and retrofits. **To support this effort, the Materials Science Center and the Engineering Sciences Center collaborated to develop, validate, and exercise a solder lifetime model that captures the thermomechanical response of lead-free solder joints in stockpile components.** The model has been successfully used to support lead-free solder materials selection for stockpile component designs. (1800, 1500) NW

A new Power-free Gas Sampler (PGS) was developed and qualified for use on the B61 weapon. The PGS is being used at the Pantex Plant to collect surveillance gas samples during the B61 disassembly and inspection process, replacing the electrically powered Phoenix cart. The PGS operates off compressed air and does not require house power. This allows it to be used even when lightning warnings have been issued, resulting in a considerable improvement in the Pantex throughput. (1800, 2100, 00400) NW

Sandia researchers conducted a 90-day feasibility study for the Office of the Secretary of Defense of a common arming, fuzing, and firing (AF&F) system for the W78/Mk12A and W88/Mk5 warheads, with excursions of the AF&F for high-surety warheads and the W87/Mk21 system. **The study found that significant levels of AF&F commonality are possible with existing system architectures that**

support use in the Mk5, Mk12A, and Mk21 re-entry systems and enable modernization goals for the future stockpile. (500, 2100, 2500, 2600, 2900, 5300) NW

NNSA authorization to commence with dismantlement activities for the B53 bomb was approved in September 2010. **Sandia significantly contributed technical information and evaluation for the safe design of the B53 dismantlement process and special tooling.** This significant Level II milestone accomplishment involved several years of activity. Sandia is the design agency for the B53 non-nuclear components. The B53, a bomb weighing approximately 10,000 pounds, was introduced in the nuclear weapon stockpile during the 1960s and was retired during the 1990s. (2100, 400, 1800) NW

On Sept. 30, 2010, Sandia completed the Cycle 15 (FY10) Annual Assessment with the release of Laboratory Director Paul Hommert's letter to the secretaries of energy and defense and to the chair of the Nuclear Weapons Council. Issues addressed in the assessment this year included the need for the B61 Life Extension Program, neutron generator production workload, the need to transform our stockpile evaluation approach and the Kansas City Responsive Infrastructure and Sourcing activity. The work conducted for this year's assessment involved hundreds of Sandians across the Laboratories. (2200) NW



Paul Hommert signs his first Annual Assessment Letter. (Photo by Randy Montoya)

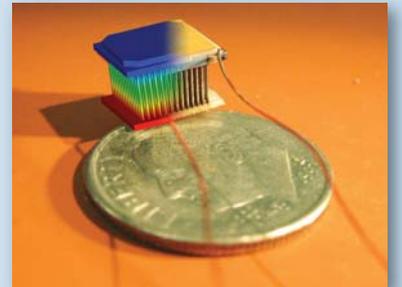
A new approach to manufacturing thermal batteries was developed and is being transferred to an external supplier to support production of new battery designs for future weapon systems. A new binder technology was developed to allow spray coating of thin-film battery materials to replace conventional pressed powder pellets. **Benefits of the new approach include significantly reduced weight and volume, lower manufacturing costs, and flexibility in form factor.** The binder is low-cost and also has potential utility in lithium-ion and other commercial battery applications. (2500) NW

The Weapon Intern Program graduated its 12th class in August 2010, for a total of 242 graduates (154 Sandians and 88 non-Sandians) since its inception in FY99. The 11-month, full-time program assists in the transfer of decades of nuclear weapon-related knowledge and experience. FY10 participants included staff from Sandia/New Mexico and California, the US Air Force, the Air Force Nuclear Weapons Center, Los Alamos National Laboratory, NNSA, Honeywell/Kansas City Plant, Pantex, and Y-12. (2900, 200, 1200) NW

On Sept. 21, 2010, a B52-H successfully released an air-launched cruise missile carrying the new W80-1 JTA8 design. This first JTA8, produced in September 2009, replaced the 27-year-old JTA1R design for the W80-1. **The instrumentation in the JTA8 has a higher sampling rate and fidelity than the JTA1R, which will allow more data to be collected and provide more surveillance**

information for both Sandia and Lawrence Livermore National Laboratory. It also addressed sunset technologies that had impacted the JTA1R, while decreasing production unit costs. (2900, 8200) NW

The Tritium Thermoelectric Generator (TTG) team demonstrated a functional prototype milliwatt generator. This milestone is the result of a significant engineering effort including end-to-end subcomponent simulation, prototyping, and testing. Project scientists characterized materials and manufacturing processes key to meeting TTG requirements. Component maturation is on an aggressive schedule and risks are reduced through a combination of engineering development, performance and environmental testing, materials characterization, and multiphysics simulations involving personnel from various centers across Sandia and other NNSA sites. (2500, 8200, 1500, 8100, 8300, 8600, 1800) NW



Sandia-fabricated TTG thermoelectric module with superimposed output from multiphysics simulation predicting the temperature distribution across the module during use.

The W80-1 JTA8 joint test assembly had its first successful flight on an Air Force Air-Launched Cruise Missile (ALCM) at the Utah Test and Training Range in September 2010. The JTA8 is a new instrumentation system designed to provide data to assess the performance and reliability of the W80-1 warhead. **All indications show that the JTA8 reached target as intended and all analysis indicates this to be a successful test for both the DoD and NNSA.** (8200, 8100, 2900, 0400) NW, IHNS

On July 23, 2010, the 500th Arming and Fuzing Subsystem (AFS) was accepted by NNSA through the Quality Assurance Inspection Procedure. Sandia's Radar Fuzing Department provides design and management support for this key component of the Navy's W76-1 Arming, Fuzing and Firing (AF&F) system manufactured by Honeywell's Kansas City Plant. The AFS is a highly integrated assembly that performs the missile interface, programmer, re-entry sensor, data multiplexer, and radar functions for the AF&F. (5300 1700, 400) NW



W76-1 AFS delivery milestone achieved.

Sandia's Stockpile Evaluation Program tested eight W76-1 laboratory samples at the Weapon Evaluation Test Laboratory (WETL), providing critical data for system assessment and for Pantex and Kansas City production. Also, data from the first four W76-1 surveillance flight tests were analyzed, providing verification that the system operates through space flight environments. In addition, the first W76-1 United Kingdom trials test was performed at WETL, providing qualification data critical to the UK implementation of the W76-1. (2900, 2100) NW



A typical launch of a D5 missile containing W76-1 re-entry bodies.

Always/Never: The Quest for Safety, Control & Survivability is a first-person documentary film about the use, control, detonation safety, and survivability of US nuclear weapons with an emphasis on the contributions of the DOE/NNSA nuclear weapon laboratories from 1945 to 1991. Exploring the historical interaction between technology, military operations, and national policy has never before been told in this detail. This video represents approximately five years of dedicated effort by Sandia's Video Services Department, led by producer Dan Curry, and sponsored by Div. 1000 VP Steve Rottler. (1000, 2000, 3600) NW

Filming the "Always/Never" documentary.



Bootstrap Uncertainty Analysis is a new tool that allows system-level reliability uncertainty to be quantified routinely. This is an enhancement to assessment that will be used internally as a decision tool. It can be used to optimize the allocation of surveillance resources. It will allow surveillance to understand the value and risk associated with performing additional or fewer tests. The tool has been deployed using MATLAB and allows the user to specify hypothetical sample sizes and failure rates to assess the impact on system-level uncertainty. (0400, 2900) NW

The **W62 dismantlement program** safely and securely retired the 1970s-era warheads, taking apart the last unit in August 2010, a full year ahead of schedule. Lawrence Livermore and Sandia designed the W62 warhead for the Air Force Minuteman III intercontinental ballistic missile. The dismantlement process includes four steps: retiring a weapon from service; returning it to NNSA's Pantex Plant; physically separating the high explosives from the special nuclear material; and processing the material and components. (8200, 2900) NW



The W62 re-entry vehicle.

The initial draft of the **B61 Life Extension Program (LEP) System-level Nuclear Safety Specification (NS) and Fault Tree for Option 2C** was completed Sept. 24, 2010. The initial NS includes the safety theme, conceptual

implementation, assertions, initial derived requirements, and rationale. The NS also captures derived interface requirements with Los Alamos National Laboratory. By having this early Phase 6.2 safety framework at the system level, the LEP is positioned to provide early requirement definition to subsystems and components, resulting in earlier design definition, hardware, and more time to improve designs. (0400) NW

Haptic Environment for Realization and Analysis (HERA) software enables 3-D stereoscopic visualization, dynamic sectioning, hide/show, fly-through capabilities, and virtual reality (VR) simulations of ProEngineer models. HERA is Sandia-subsidized and available for use by the Sandia design community via PC. It facilitates design error-proofing and training assembly/disassembly technicians. VR simulations using the B61-3,4,10, -7,-11, W76-1, W78, and W88 models were accomplished using integrated wireless gloves, head-tracking and head-mounted display. Future applications include the B61 Life Extension Program and Accident Response Group. (0400) NW



A staff member interacting with a Pro-Engineer model using a head mounted display and haptic glove.

Weapon security

Sandia developed the Physical Security Technology Management Plan (PSTMP) and process to revolutionize the way the Nuclear Security Enterprise (NSE) identifies, deploys, and sustains physical security technologies. The plan includes supporting rationale for physical security technology-related budget requests in annual future years nuclear security program submittals. **The PSTMP highlights the significant work NNSA has completed to implement physical security technologies at its sites, while improving security by consolidating special nuclear material at fewer locations.** This work was selected for a Defense Program Award for Excellence. (6600) ECIS

Nuclear weapon accident-incident exercise-11 was conducted Nov. 6-9, 2010, at the US Navy submarine base in Kings Bay, Ga., and naval air station in Jacksonville, Fla. The focus of this exercise was response to "loss-of-control" involving US nuclear weapons and subsequent recovery and render-safe operations. The exercise involved 1,800 participants from DOE/NNSA, DoD, DOJ, and a variety of local, state, and federal agencies. **Sandia deployed 18 responders to the field locations, 36 home-team personnel, and 10 exercise controllers.** (2900, 5400) NW



Nuclear weapon accident-incident exercise-11.

The Integrated Surety Solutions (ISS) project team completed a demonstration of a security upgrade concept for weapons in the SafeGuards Transporter (SGT) environment known as the Transportation Attachment Device (TAD). This demonstration capped the successful completion of one of NNSA's "Getting the Job Done" milestones. In addition to this milestone, **Sandia also partnered with Los Alamos National Laboratory on a more advanced concept for ISS, which was also demonstrated in FY10.** (8200, 6400, 2100) NW

Internal Audit performed a Nuclear Safety Culture Assessment of Sandia's Annular Core Research Reactor at the request of Nuclear Facilities and Applied Technology management. The assessment, an outgrowth of Internal Audit's Nuclear Operations and Maintenance Assessment Program, tackled the difficult problem of evaluating ACRR's safety culture, which in turn shapes behaviors. **Relying on safety culture principles developed by the Institute of Nuclear Power Operations, the assessment team provided recommendations to ACRR management, which can be extended beyond the ACRR to the entire Labs' safety culture.** (00800) NW, IES

Remote sensing

The Nuclear Detonation Detection System (NDS) Analysis Package (NAP) Ground System (NAPGS) **completed a major step in transitioning to operational status under Air Force Space Command.** NAPGS, located in Sandia Tech Area 4, was granted authority to connect to the existing Air Force operational NDS ground segment and began a period of rigorous Air Force testing. The NAPGS is a unique, autonomous earth station capable of tracking and capturing telemetry data from multiple NAP-equipped GPS satellites simultaneously. (2600, 5300, 5500, 5700) DS&A



Operational NAP ground station.

For more than 45 years, NNSA and the US Air Force have jointly provided satellite sensor systems designed to detect atmospheric and space nuclear detonations (NUDETs). On May 27, 2010, the first next-generation optical sensor was launched on a Global Positioning System satellite. **This Sandia-developed sensor is the result of a decade-long development effort funded by NNSA/NA-22.** Over the next 10 years, researchers will be



United Launch Alliance Delta IV night launch of the first GPS IIF space vehicle. (Photo by ULA/Pat Corkery)

launching 19 more next-gen sensors. This constellation will greatly enhance the nation's ability to monitor worldwide nuclear treaty compliance. (5700, 1500, 1700, 1800, 2600, 5300, 5500) DS&A

A Sandia/Lawrence Livermore team recently deployed a prototype, above-ground antineutrino detector at the San Onofre Nuclear Generating Station near San Diego, Calif. Earlier measurement systems had to be located underground; however, inspection regimes need devices that can be shipped to a reactor site and easily installed. This new system fits in a standard transportation container and uses innovative shielding and instrumentation to reduce the cosmic ray-induced background. **Ultimately, this device could make monitoring nuclear reactors easier, less intrusive, and more cost-effective.** (8100) IHNS



The deployed transportation container, which contains the Sandia/Lawrence Livermore antineutrino detector, sitting in the shadow of the San Onofre Nuclear Generating Station's Unit-3 Nuclear Reactor.

Partnerships & alliances

Seven thousand units of a life-saving water disruptor used to safely disable improvised explosive devices, were deployed to warfighters in Afghanistan just seven months after Team Technologies, a Sandia Science & Technology Park tenant, acquired a license for the technology from Sandia. Additionally, Entrepreneurial Spirit Week was initiated to emphasize the importance of innovation and entrepreneurial spirit in Sandia's culture. It featured two major events: the Innovation and Intellectual Property Celebration; and the Entrepreneurial Spirit Awards Luncheon. (1900) DS&A

Emmilio Segovia, a student at Central New Mexico Community College and an employee with TEAM Technologies Inc., packages Sandia-developed water disruptor devices for shipment to Afghanistan. (Photo by Randy Montoya)



Product realization

During FY10, Sandia shipped more than twice as many neutron generator assemblies (NGAs) to its NNSA and military customers than in any previous year. This totaled 850 NGAs and 340 packaging requirement kits. Record completion rates were achieved in four different production areas within the neutron generator supply chain, in concert with a shift to a common neutron generator subassembly that improved production efficiency. Sandia established a balanced supply chain capacity approach to help meet future NG directive schedule challenges with a diverse neutron generator product mix supporting numerous weapon systems. (2700, 2500, 1500, 400) NW



A neutron generator assembly.

A methodology has been put in place to help the nuclear weapons enterprise better secure itself against modern nation-state threats. The methodology is now being applied and has already yielded some significant results. **These results are enabling the nuclear enterprise to make strides toward a more robust security posture against modern supply chain and cyber threats.** (2300, 400, 2100, 5600, 6300) NW

The Primary Standards Lab has completed the development and testing of the Bismuth Germinate Oxygen (BGO) neutron detector system, achieving excellent agreement in data between the laboratory and production systems. **The BGO detector will provide an increased sensitivity factor of five compared to the current system in low-level applications. The detector is now ready to begin qualification for shelf life testing applications.** (2500) NW

Supply chain

The Fleet Services team received national recognition as one of the "100 Best Fleets in North America," meeting the program's standards of excellence for 2010. The 100 Best Fleets award program recognizes and rewards peak performing public sector fleet operations in North America. The program also identifies and encourages ever-increasing levels of performance improvement within the fleet industry. (10200) IES

The Fleet Services and the Energy Management (facilities) team received White House recognition as one of eight recipients of the 2010 GreenGov Presidential Award. The team earned the "Green Innovation Award" for developing and implementing photovoltaic-powered carts. The goal of the project was to reduce grid-tied energy use, increase renewable energy use, and implement solutions for reducing greenhouse gas emissions. The awards recognize extraordinary achievements in pursuit of President Obama's Executive Order 13514 on Federal Leadership in Environmental, Energy, and Economic Performance. (10200) IES



Israel Martinez, left, Erika Barraza, and Matthew Brito were key members of a Sandia team that developed a photovoltaic-powered cart that won a 2010 Presidential GreenGov award. The cart is based on a modified GEM cart, familiar around Sandia's Tech Area 1. Members of the PV cart team were honored at a White House ceremony on Oct. 7, 2010. (Photo by Randy Montoya)

Neutron tube yields were significantly increased by eliminating delay-time failures at acceptance testing. Delay time failures are caused by source instability during source start up. The problem had caused an approximate 5 percent loss for the last decade, but the failure rate had recently risen. A multidisciplinary team from across manufacturing, design, test, and science attacked this issue as a priority problem, and focused resources on it in a timely manner. The problem was solved by matching the source-drive conditions at acceptance testing with those in the next-assembly neutron generator. This yield improvement will better enable the Center to support future NG directive schedules for the W76 and W78. (2700, 400, 2500) NW

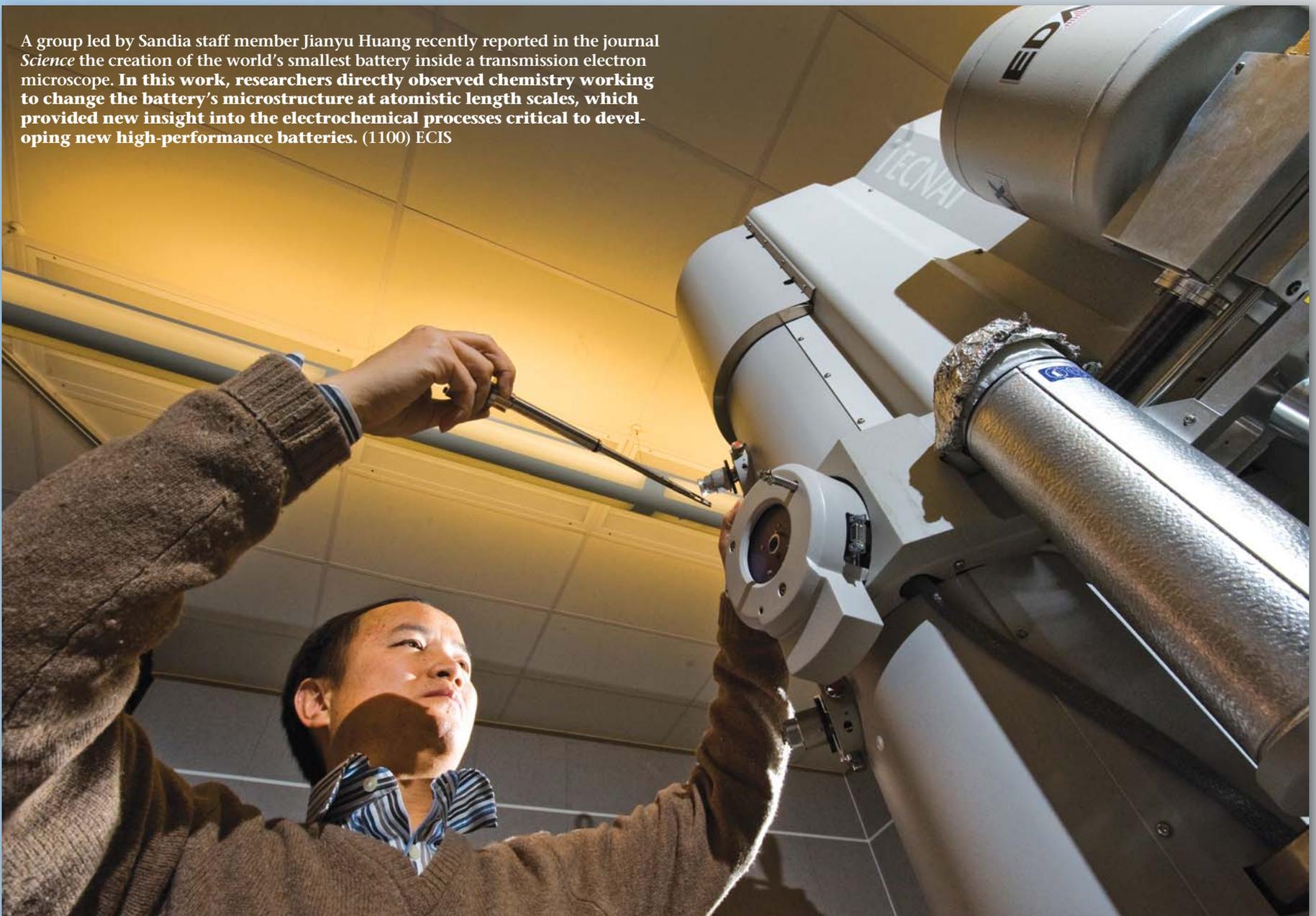
The lean tester value stream released a tester that provided savings to active ceramics production. The SE3382 hot liquid poler processes voltage bar and current stack components used in ferroelectric power supplies for neutron generators. **This "smart hot poler" was designed**

such that it replaces three existing processes and cuts down testing time by 60 hours, engineering time by eight hours, and queue time by five days per lot. Two SE3382 testers have been built to replace five existing testers, reducing floor space requirements by a factor of three. (2700) NW

In FY10 the Nuclear Weapons Quality Training Program provided in-depth training to 267 engineers (from 26 centers) involved in the development of nuclear weapons, satellites, and other custom products. Classes covered best practices known to be effective in preventing defects or for detecting and removing defects at each stage of product realization. The result of the program is significant cost and schedule savings due to rework avoidance. The classes covered product acceptance, qualification, HALT/HASS, demonstrating reliability rapidly, mistake-proofing and preventing supplier quality problems. (400, 2900, 10200) NW, DS&A

Materials

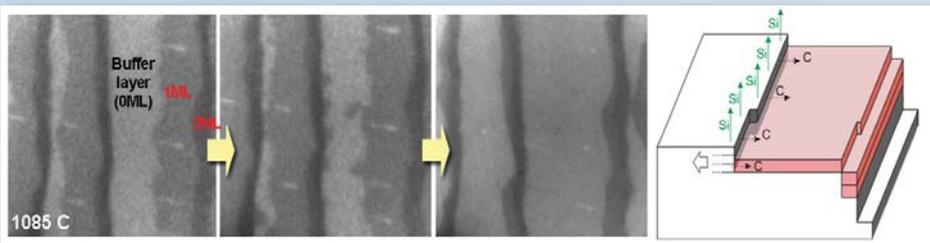
A group led by Sandia staff member Jianyu Huang recently reported in the journal *Science* the creation of the world's smallest battery inside a transmission electron microscope. In this work, researchers directly observed chemistry working to change the battery's microstructure at atomistic length scales, which provided new insight into the electrochemical processes critical to developing new high-performance batteries. (1100) ECIS



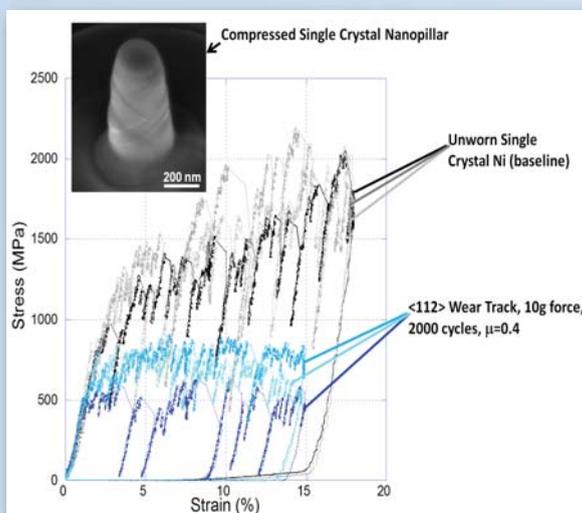
Jianyu Huang demonstrates insertion of a sample holder into a transmission electron microscope at the Center for Integrated Nanotechnologies.

(Photo by Randy Montoya)

Graphene is a promising advanced electronics device material. The development of large-area high-mobility graphene on suitable substrates is a key challenge. Taisuke Ohta (1114) and Norm Bartelt (8656) used coordinated low energy electron microscopy measurements and computational modeling to further the scientific understanding of graphene on silicon carbide growth. Their understanding of the role of atomic steps on silicon carbide led to an engineered step-flow growth route for producing large-area graphene films with improved domain size and mobility characteristics. (1100, 8600) DS&A



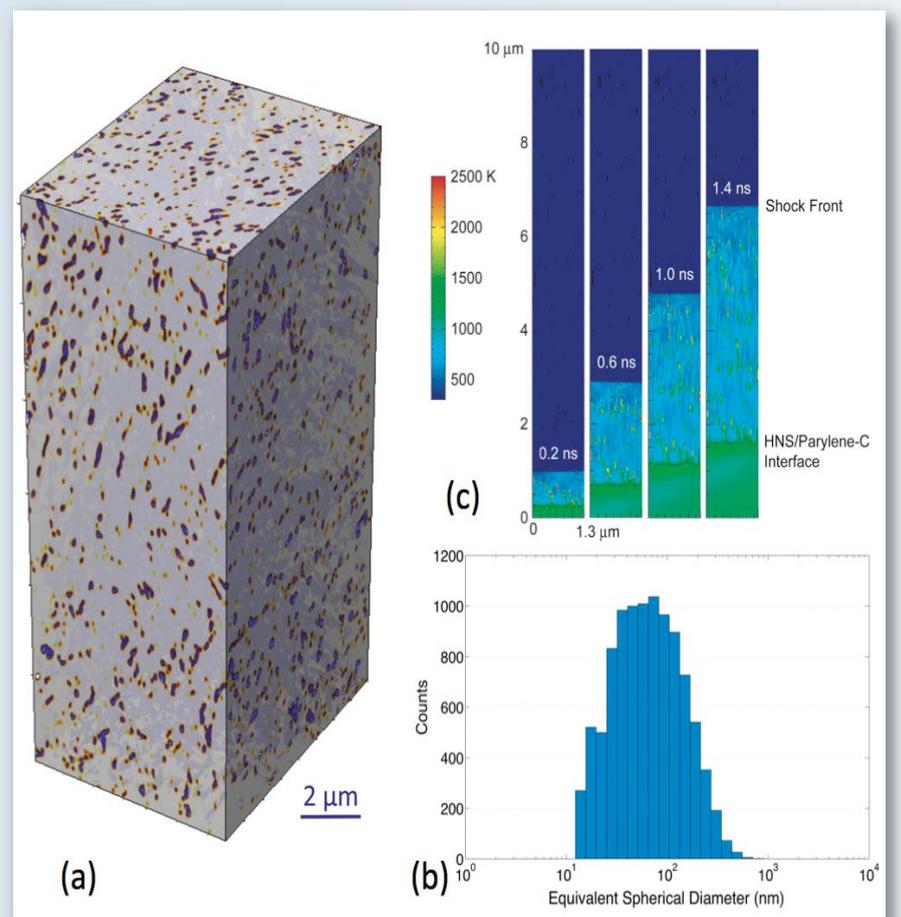
Step-flow growth of graphene. Left images are the growth observed in LEEM ($3.5 \times 3.5 \mu\text{m}^2$). As indicated, the dark gray regions consist of two layers of graphene, the medium gray regions are single layer, and the light gray regions are buffer layer. The right schematic illustrates the topography of a step-flow growth based on LEEM and scanning tunneling microscopy studies. Triple bilayers of SiC are transformed into a single graphene layer.



This graph and image depict soft nickel surface-layer wear test results.

Metallic friction is an important engineering concern for Sandia applications. Nanocrystalline nickel and some crystallographic orientations of single-crystal nickel exhibit unusually low sliding friction (approximately 0.3 microns) at low contact stresses and sliding velocities. Researchers have employed nanopillar compression experiments on the thin layer of wear material formed underneath the sliding contact and discovered that this tribologically induced layer is notably softer than the parent material. This surprising result helps explain the mysterious frictional behavior and is hypothesized to be related to a dislocation "de-starvation" process. (1800) ECIS

Researchers in the Energetics Characterization Department used ion-beam nanotomography to cross-section explosive pellets, giving the first-ever high-resolution images of the internal microstructure of explosives. Resulting data has provided high fidelity three-dimensional representations of explosive microstructure, which can be directly used in hydrocode simulations. This work is a key component of a larger effort to build a science-based understanding of explosives initiation necessary for the design and evaluation of new devices. (2500, 1500) NW



Nanoscale porosity in hexanitrostilbene (a) and the corresponding pore-size distribution (b). These data were used as input for a CTH simulation of shock initiation (c), demonstrating the effect of porosity on the thermal field of shocked material.

IT, networks, & facilities

Construction of the Sandia/New Mexico Ion Beam Laboratory (IBL) was completed last fall after two years of work. The project had zero recordable and lost-time injuries. The IBL also achieved Leadership in Environmental and Energy Design Gold certification for New Construction from the US Green Building Council. **Completion of IBL ahead of schedule and under budget upholds Sandia's record for completing congressional line-item construction projects on time and under budget 100 percent since 1988, when Sandia took over execution of such projects from DOE.** (4800) NW

The IBL will contain six accelerator systems capable of generating ions of every element in nature, from one electron volt (eV) to 400 million electron volts (MeV), and at intensities ranging from just single ions to trillions of ions per second. One eV is enough to ionize a single atom or energize a single photon; 400 MeV will accelerate the heaviest ions to 7 percent the speed of light.
(Photo by Darrick Hurst)



Custodial Services in the Facilities Management and Operations Center received **numerous awards in a competition that included the cleaning teams of several major institutions and commercial businesses.** Among the awards were Best Cleaning Industry safety and health program, Outstanding Cleaning Worker, and the Green Cleaning Program of Excellence. Participation by Custodial Services was also essential in achieving Leadership in Energy and Environmental Design (LEED) Silver certification for Bldg. 750 in the Existing Buildings: Operations & Maintenance rating system of the US Green Building Council. (4800) IES



Chris Romero instructs two Sandia custodians in the OS1 cleaning process.

The Sandia Energy Management program implemented \$1.5 million in energy projects in FY10. Examples of these projects included upgrading building lighting using more energy-efficient lamps, installing occupancy sensors, installing photovoltaic street lamps, installing a free-cooling exchanger in Bldg. 962, installing variable frequency drives in Bldg. 986, using automatic standby features for computers when not in use, and retro-commissioning eight buildings. **These projects will save \$1.03 million in energy costs and reduce energy use by 30 billion British thermal units (BTUs).** (4800) IES

Working with SMUs, the Facilities Management and Operations Center has prepared the *Site Development Plan Supporting National Security Missions* at Sandia/New Mexico to guide campus planning and prioritize investments for nuclear, cyber, energy, intelligence, and other mission work for DOE, NNSA, and WFO. **The plan promotes efficiency and effectiveness in facilities and infrastructure, while also identifying safety, security, and employee amenity needs for attracting and retaining a highly qualified workforce.** The plan emphasizes Tech Area I improvements to create a more robust Sandia national security complex. (4800) IES

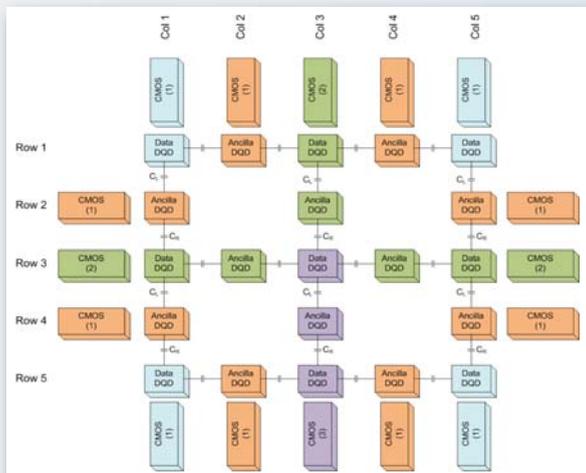
The Red Sky and Red Mesa computing platforms service the simulation and modeling needs of all Sandia SMUs and support growing demand at the National Renewable Energy Laboratory under a cooperative agreement between the labs. Computer users are allocated time on the systems in proportion to their budget subscriptions. **The combined systems, jointly developed by Sun/Oracle and Sandia, ranked 10th in the TOP500 listing of major computers worldwide in June 2010.** (9300, 1400, 6100) All SMUs



Red Sky and Red Mesa reside in the Bldg. 880 Computing Annex. (Photo by Randy Montoya)

Computer & information sciences

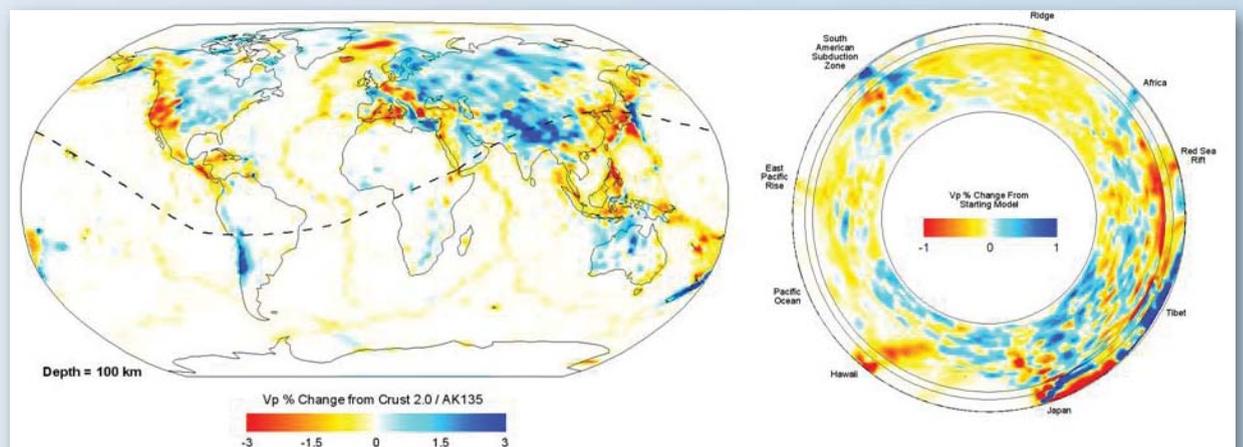
The Quantum Information Science & Technology Grand Challenge LDRD architecture team achieved its goals of designing an error-corrected "logical" qubit. This task used advanced mathematical and computing



Schematic of a logical-qubit layout comprised of double-quantum-dot qubits and CMOS controllers.

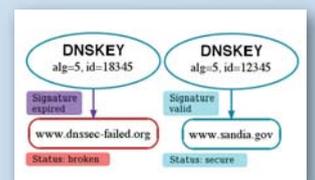
techniques to evaluate Si qubit systems from the atomic-scale modeling of the problems of quantum dots all the way to predictive simulations of error correction, which is considered one of the project's most impressive technical achievements. Sandia's published logical qubit design leveraged in-house expertise in optimization, scheduling, quantum information, and electronics. (1100, 1400, 1700, 8900, 9300) DS&A, IHNS, NW

Partnering with Los Alamos National Laboratory, Sandia's Ground-Based Nuclear Detonation Detection team has developed a 400-processor distributed computing system capable of processing more than 14 million seismic event signals. From this, researchers are able to realize a three-dimensional seismic-pressure-wave-velocity model of the entire Earth. **Sandia can then deliver to its customers a capability to more accurately compute the locations of new seismic events, especially those that might be due to clandestine underground nuclear test detonations.** (5500, 5700) DS&A



These maps illustrate the differences between Sandia's 3-D model (right) and the standard 1-D model normally used to locate seismic events.

The translation of domain names (e.g., www.sandia.gov) to Internet addresses using the Domain Name System (DNS) is fundamental to Internet usability. DNS security (DNSSEC) helps protect this essential service from compromise. However, DNSSEC is complex, and misconfiguration is prevalent, inhibiting DNS functionality. DNSviz is a web-based tool developed for DNSSEC visualization to aid administrators in understanding and troubleshooting DNSSEC deployments. **It has been used by federal agencies complying with the US government's DNSSEC mandate, as well as a broader DNS community.** (8900) IES



DNSviz provides visual representation of DNSSEC deployments for analysis. This image illustrates the secure status of www.sandia.gov contrasted with the broken status of www.dnssec-failed.org, the result of an expired DNSSEC signature.

Military programs



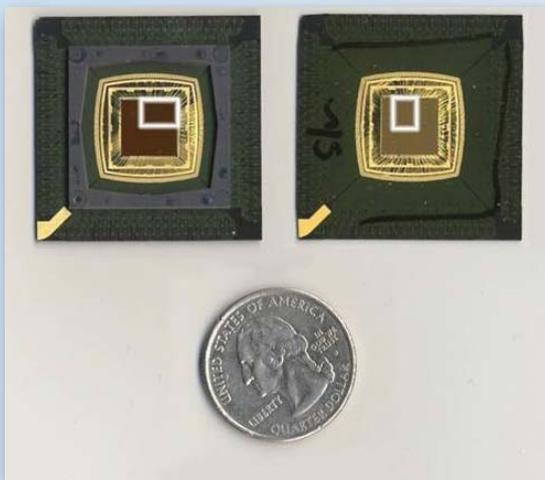
Matthew Heine (5916), left, lead explosives operator for Sandia's Dynamic Explosive Test Site, explains to US Air Force Tech. Sgt. Mark Brady of Luton, England, center, and Airman 1st Class Patrick Connolly of Dayton, Ohio, how a water disruptor invented by Sandia researchers can deactivate improvised explosive devices, or IEDs. (Photo by Randy Montoya)

TIME Magazine selected a device developed by Sandia researchers, which disables improvised explosive devices, as one of its "50 Best Inventions of 2010." As a measure to defeat roadside bombs and other IEDs, the disruptor shoots a thin blade of water capable of penetrating steel. The high-speed, precise blade penetrates the IED and is followed by a water slug that performs the general threat disruption. Sandia licensed the technology to TEAM Technologies, Inc., and so far, about 7,000 units have been shipped to warfighters in Afghanistan. (5400) DS&A

The Precision Tracking Space System (PTSS) presents an opportunity for Sandia to apply more than 25 years of established space technologies and expertise to constellation-level challenges for detecting and tracking dim targets. Sandia is part of a national team developing an alternative approach to the challenging requirements levied on the Missile Defense Agency's space layer. Engaging the missile defense mission is part of the space strategy to increase Sandia's impact on national security and broaden the support base for Sandia's unique space competencies. (5400, 5500, 5700) DS&A

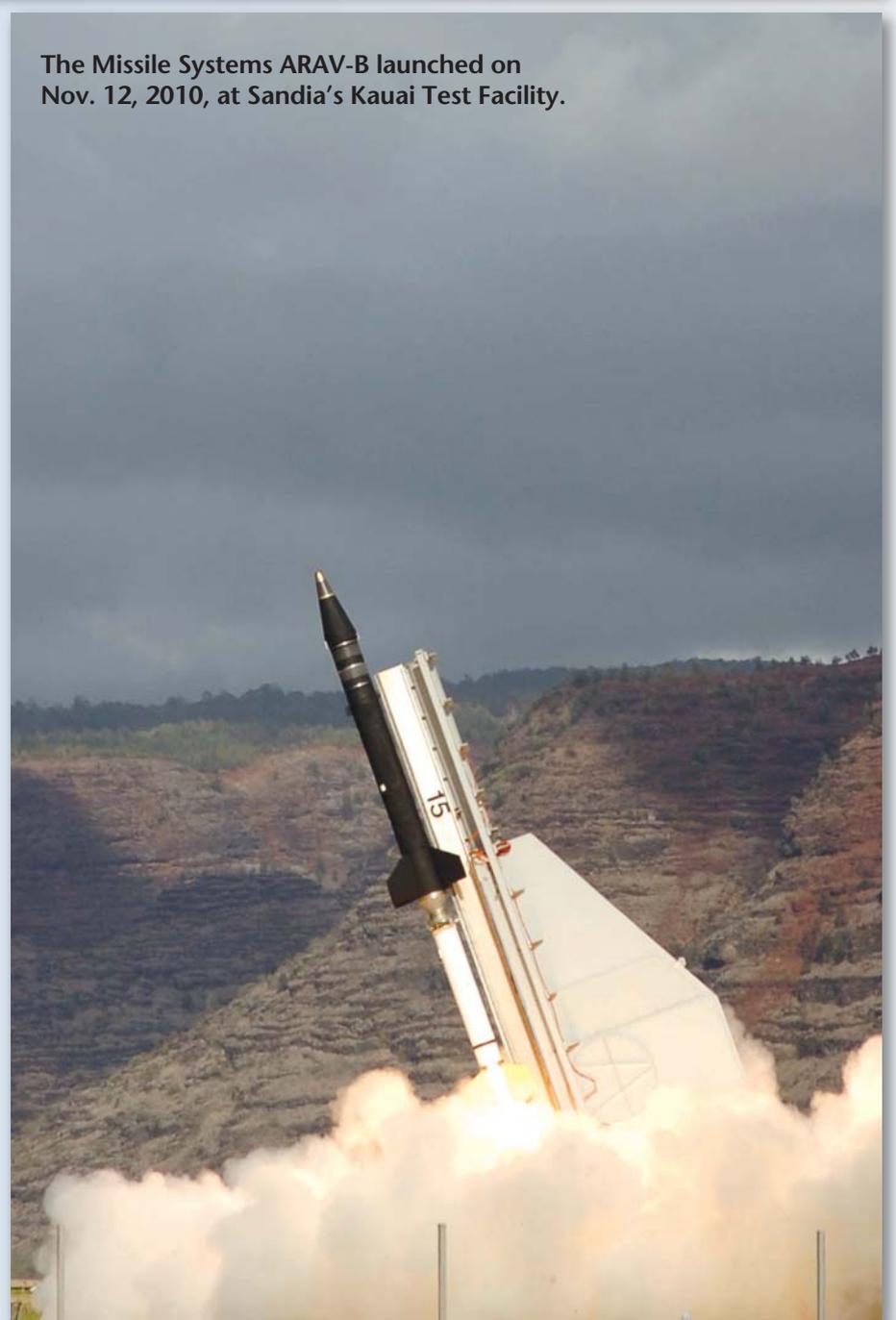
The Aegis Readiness Assessment Vehicle (ARAV) team was presented with the 2010 David Packard Excellence in Acquisition Award by Hon. Ashton Carter, undersecretary of defense for acquisition, technology, and logistics, in recognition of its innovative acquisition practices in building, integrating, and launching, eight ballistic missile targets, including a new vehicle that allows the US to test against complex, realistic countermeasures. The ARAV team sought to build and launch a cost-effective family of high fidelity ballistic missile targets. The resultant ARAV-As and -Bs are more than 85 percent less costly than the targets they replaced. (5400) DS&A

The KDP-III and KDP-IV completed NSA-witnessed cryptographic verification testing in summer 2010. The KDP is the Sandia-designed cryptographic engine at the heart of each Selective Availability Anti-Spoofing Module GPS receiver. The module decrypts GPS satellite transmissions and grants access to military signals and data for increased precision and signal authentication. **Completion of this cryptographic verification testing, and the approval letter from the NSA, allow the SAASM developers to load and execute classified Sandia-written and NSA-certified operational SW into the GPS receivers.** (2600) DS&A



The KDP-111 and KDP-IV shown with a quarter for size comparison.

The Missile Systems ARAV-B launched on Nov. 12, 2010, at Sandia's Kauai Test Facility.



Homeland security

The Gemini-Scout mine rescue robot.



In any mining disaster, rescuers face unknown and hazardous conditions underground. To overcome these challenges and help rescue efforts move faster, Sandia robotics engineers have designed the Gemini-Scout Mine Rescue Robot. The robot is able to go into dangerous situations ahead of rescuers to evaluate hazardous environments to determine how operations should proceed and even provide some relief to trapped miners. The Gemini-Scout was developed at Sandia through a National Institute for Occupational Safety and Health-sponsored program. (6500) ECIS, IHNS

At the Secretary of Energy's request, representatives from Sandia, Lawrence Livermore National Laboratory, and Los Alamos National Laboratory reported to BP's crisis center on May 1, 2010, to support the Houston-based Incident Management Team. The focus of the laboratories' effort was to support BP in stopping the flow of oil from the Macondo Well following the accident on April 20, which destroyed the *Deepwater Horizon* rig. In addition to providing technical support, Sandia acted as facilitator and integrator for this team's interactions with BP and the government. (6100, 6200, 6600, 6900, 8100, 8600) ECIS



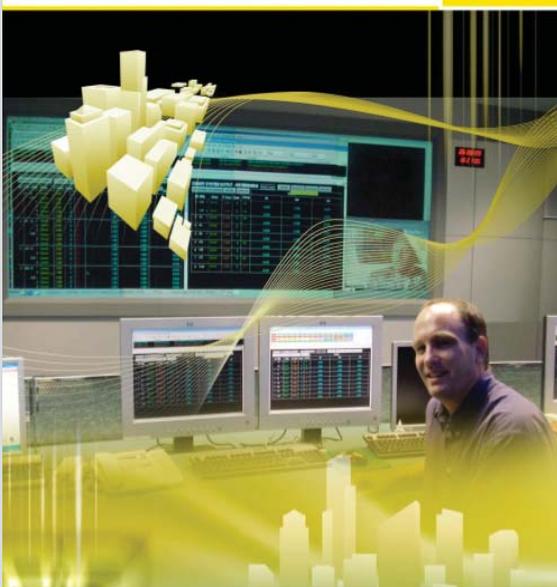
At the time Energy Secretary Steven Chu took on the *Deepwater Horizon* crisis response role, he said, "Putting our best scientific minds together with BP's deepwater drilling engineers will enable these dedicated professionals to examine every feasible means and practical solution to this environmental crisis in the Gulf of Mexico." To accomplish the DOE mission, Chu summoned a number of technical experts to work closely with him. Among them was former Sandia Labs Director Tom Hunter, who spent substantial periods of time in Houston following the crisis. In this May 25, 2010, photo from DOE's Houston base, Tom, right, works closely with Chu on the oil spill response. (DOE photo)

Sandia was a major contributor to the Interagency Biological Restoration Demonstration, a four-year, DOD- and DHS-sponsored, urban bio-aerosol threat case study in the Seattle, Wash., area and the first comprehensive examination of the wide-area biological restoration problem in the country. Sandia led the development of a series of software-based decision support tools to better guide planning and response to biological attacks. These tools were exercised by the emergency response community in a number of simulation exercises and are currently being transitioned into more widespread use. (6600) IHNS



Workers perform decontamination procedures as part of the Interagency Biological Restoration Demonstration. These procedures were developed to meet environmental safety health standards for decon personnel.

CANARY: Event Detection Software 2010

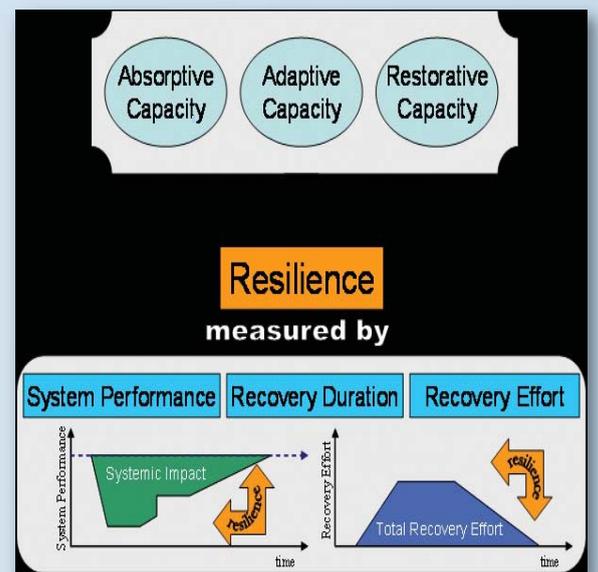


Sandia developed the CANARY software in partnership with the US EPA's National Homeland Security Research Center. CANARY continuously analyzes data from water quality sensors to achieve online detection of abnormal water quality in real time in municipal drinking water distribution networks. CANARY is designed to leverage existing utility investments in sensor and Supervisory Control and Data Acquisition system hardware. Currently, CANARY is operating in several large US utilities and in Singapore. CANARY was selected as one of the 100 most significant technologies of 2010 by *R&D Magazine*. (6900) ECIS

A critical challenge to national security is detecting illicit or smuggled special nuclear material (SNM). SNM emits energetic neutrons by spontaneous or induced fission. A new technology, dubbed LIGHTHOUSE, has been demonstrated to show high-efficiency energetic neutron imaging using time-encoding modulation. This innovative imaging method promises to be capable of locating SNM at greater distances and shorter dwell times with greatly reduced system complexity and cost compared to other imaging systems. (8100) IHNS



Illustration of the time-encoded neutron detector system (dubbed LIGHTHOUSE). The direction of a radiation source is uniquely determined by the signal detected by the single scintillator cell modulated by the rotating mask.

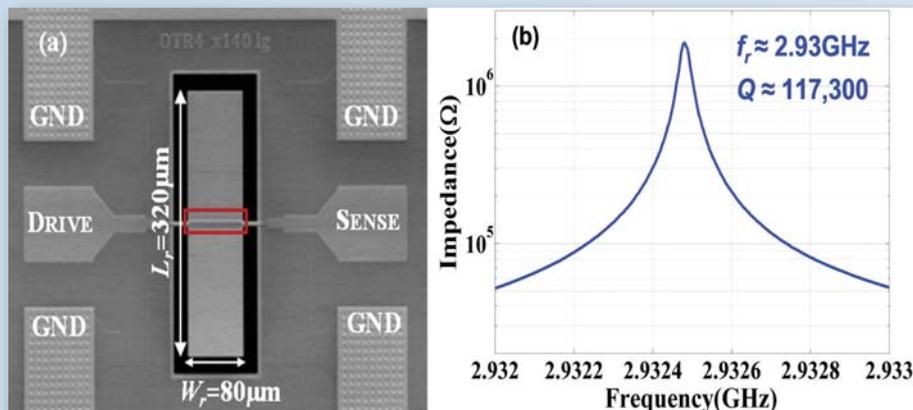


A conceptual illustration of the resilience assessment framework.

Infrastructure resilience is a top priority for DHS, interdependent agencies, and Sandia's Consequence Effects Department developed an innovative assessment approach to address that goal. The approach leverages the mathematics of optimal control to create a unique resilience assessment framework to identify optimal restoration sequences that minimize disruption costs. The homeland security community has recognized the new tool's significance by inviting Sandia to support a resilience-policy advisory summit and co-author a guidebook on creating infrastructure resilience. (6900) ECIS, IHNS

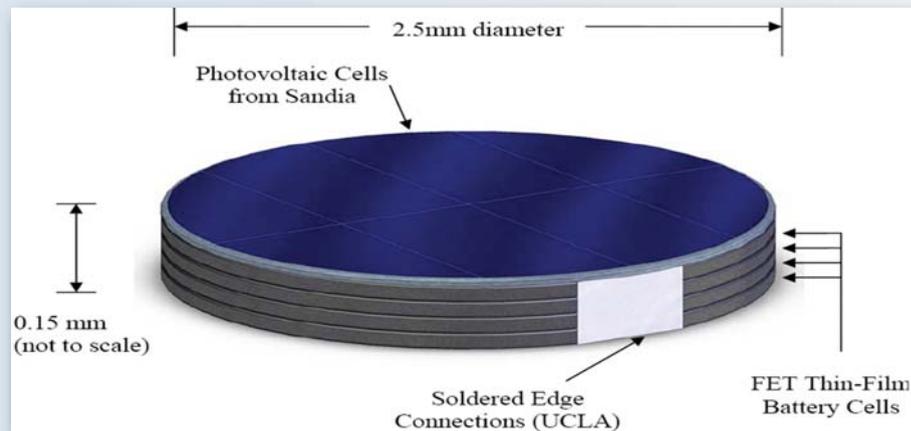
Microelectronics & microsystems

MESA researchers demonstrated the world's lowest-loss radio-frequency (RF) MEMS acoustic resonator. The resonant structure comprises a 1µm-thick film of silicon carbide (SiC) acoustically isolated above a silicon substrate. The measured quality factor, Q, is 117,300 at 2.93 GHz, yielding a record frequency times Q product (fQ) of 3.4x10¹⁴. This performance is a factor of 3.4 better than any previously reported. The high fQ, small size, and frequency diversity of SiC microresonators will improve the frequency selectivity of RF filters and oscillators for radios and radars. (1700) DS&A



(a) Image of the suspended SiC acoustic microresonator. (b) Measured response near resonance demonstrating the record high frequency quality factor product.

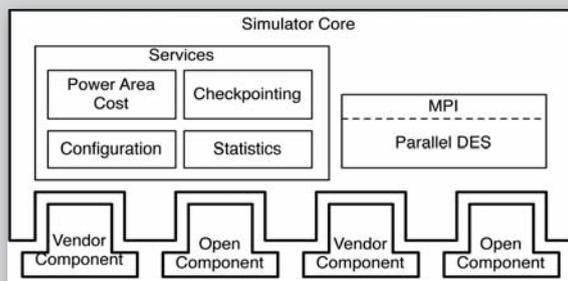
The R&D 100 Award-winning Micro Power Source is a rechargeable, ultra-small power source for smart cards, environmental sensors, tags for material tracking, continuous medical monitors, and power for microsattellites. Sandia and partners integrated a lithium-ion-based solid electrolyte battery with an ultra-thin photovoltaic collector as an energy harvester. With a system volume of 1 liter, it has an energy density greater than 300 Wh/L and can handle 3,500 charge/discharge cycles. The device is based on existing manufacturing technologies that are amenable to volume manufacturing scale-up. (1700) DS&A



The rechargeable, ultra-small Micro Power Source.

Engineering sciences

To design and optimize the next generation of the world's fastest computers, Sandia has developed and released the Structural Simulation Toolkit (SST). This computer simulator models the complex interactions between processors, network, and memory for future supercomputers, and will enable the efficient design of machines roughly 1,000 times more powerful than those today. A parallel simulator itself, the SST enables Sandia to use the supercomputers of today to design the supercomputers of tomorrow. (1400) NW, ECIS

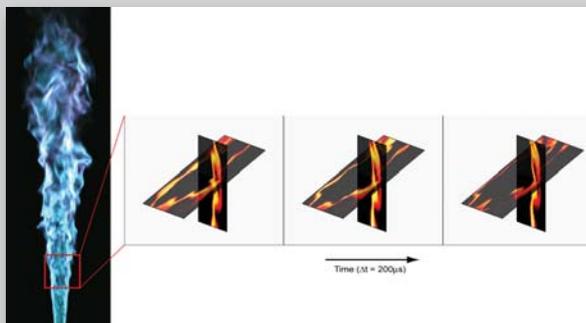


The SST supplies a modular interface allowing open and proprietary simulation modules to interact and share common services.

An integrated team of analysts, verification and validation experts, and code developers performed a comprehensive Quantification of Margins and Uncertainties assessment of thermal safety for the B61 stockpile system. This study considered multiple failure modes, including the weak link-strong link safety theme and thermal-mechanical failure due to internal pressurization, with fully engulfing and directed heating scenarios. The multiple failure modes were integrated within a

probabilistic framework to provide a system-level assessment of probability of loss of assured safety in abnormal thermal scenarios. (1500) NW

Cinematic imaging using high-repetition-rate lasers and high-frame-rate cameras provides new insights into complex interactions between turbulent flows and flames. Improved understanding of these interactions is required for developing advanced combustion technologies. Jonathan Frank (Combustion Research Facility), in collaboration with colleagues at Deutsches Zentrum für Luft und Raumfahrt (DLR) in Stuttgart, Germany, used crossed-plane laser-induced fluorescence and particle imaging velocimetry to capture the dynamics of turbulent jet flames. Results will aid the development of models for predictive simulations of turbulent combustion. (8300) ECIS



Cinematic imaging of the hydroxyl radical (OH) reveals the dynamics of turbulent flames. Left image: flame luminosity from a turbulent non-premixed jet flame with a fuel stream mixture of hydrogen, methane, and nitrogen. Right images: three frames from a movie of crossed-plane OH laser-induced fluorescence measurements acquired at 5 kHz. Simultaneous velocity measurements (not shown) provided insights into the dynamics of localized extinction and re-ignition.

Explosive and energetic operations were resumed at Sandia's Rocket Sled Test Facility. The RSTF staff worked with teams from across Sandia to successfully conduct several series of energetic test operations at the rocket sled track and its explosive firing site. These test operations were conducted to investigate the performance of components from critical national security systems. High-speed radiography techniques have been used to capture new details associated with the complex interactions during an explosion. (1500, 4100) NW



A real-time sequence from a test performed at Sandia's Rocket Sled Test Facility.

HR & finance

The Health, Benefits, and Employee Services Center implemented one new healthcare plan, Sandia Total Health, for nonrepresented employees and premedicare retirees. Sandia Total Health is a consumer-driven healthcare plan that includes an employer-funded health reimbursement account that promotes consumerism and a greater focus on prevention. Sandia also partnered with Extend Health® to provide retiree health benefit administrative services. These changes will significantly reduce future healthcare costs and liability for Sandia. Onsite, through lab-wide organizational health assessments, Health Services helps divisions design their own workgroup prevention programs. (3300) IES

The FY10 hiring target goal of 699 new Laboratory employees represented a five-year high. FY10 hires totaled 709. This aggressive hiring goal was obtained through hard work and teaming by the line managers and support teams, and Human Resources. In the midst of this hiring activity, a new PeopleSoft system was implemented on time and with minimal impact to the ultimate Labs' hiring target. (3500) IES

The Controller's Center was instrumental in developing solutions that will reduce future pension costs and help preserve the solvency of Sandia's retirement plans. The decisions included revising the Retirement Income Plan benefit formula, making early contributions to the

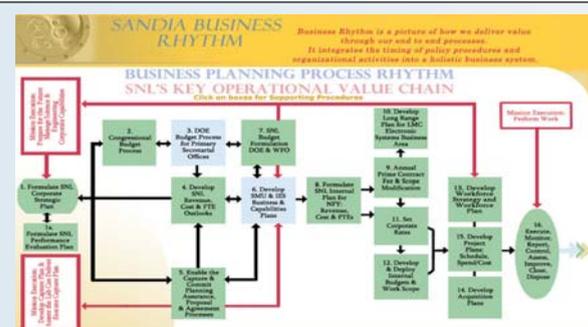
plan, updating actuarial assumptions, taking advantage of recently enacted legislative relief, and implementing overhead reductions to generate cost savings that can be used to support future pension contributions. The Pension Fund/Savings Plan Management and Indirect Financial Management Departments provided analysis of the alternatives considered, including the impact on Sandia's fringe rate. (10500) IES

As good stewards, Sandia continues to review its business practices to enable the Labs to better meet its mission objectives. One of the benefits of this effort is the ability of the Labs to position itself to address future pension obligations. By assessing and improving how Sandia imple-

ments certain business practices, the Labs has been able to make early contributions to the pension fund in order to mitigate future costs. \$50 million and \$75 million were contributed in FY09 and FY10, respectively, that resulted from cost savings across many areas of the Labs, including approximately \$4 million for equipment disposal cost avoidance, \$1 million in savings due to changing the process for two-way radio maintenance, and \$800,000 in savings through removing the vault-type room logging requirement. In addition, some of these savings were reported to SSO as part of the annual Performance Evaluation Plan, which requires a minimum of \$15 million of cost savings or avoidance resulting from efficiency gains. (10600) IES

The Business Rhythm project, one of seven elements in the Business Reengineering corporate strategic thrust, is aimed at efficient planning processes in support of mission execution. Business Rhythm is a picture of how the Labs delivers value through its end-to-end business planning value chain, integrating the timing of policy procedures and organizational activities into a holistic, transparent business system for all members of the workforce. The model's universal appeal and informative usefulness is acknowledged by its process owners and users alike. (10500, 10600, 10010, 10200, 3500, 1900, 200, 0040, 4200, 4800, 5200) IES

The interactive Business Planning Rhythm Value Chain model can be found through the Corporate Governance Policy Area on ILMs or at <http://tiny.sandia.gov/8eyif>.



Global security



The Compact Uncooled Thermal Longwave Advanced Staring Spectrometer (CUTLASS).

Sandia is developing advanced R&D sensor technologies to address challenges faced by the nation in the area of nuclear material counter proliferation. Sandia's research in this area, termed **Nonproliferation R&D**, has yielded a next-generation sensor system — the Compact Uncooled Thermal Longwave Advanced

Staring Spectrometer (CUTLASS). Recently, this multispectral sensor system was successfully deployed at the Nevada Test Site in support of a NNSA NA-22 Test Campaign where it performed data collections in a realistic remote sensing operations scenario. (700, 5700) DS&A

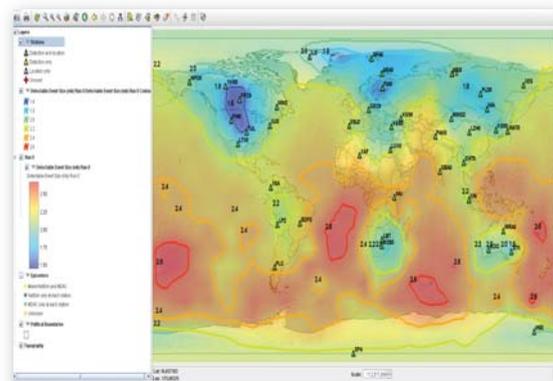
Bioscience

Sandia's Acoustic Wave Biosensor, originally developed for environmental sensing applications, is being actively commercialized for medical diagnostic applications through collaboration among Sandia, the University of New Mexico Health Sciences Center, and Adaptive Methods, Inc., the technology licensee. Adaptive Methods was recently awarded a grant from the US Department of Health and Human Services through the 2010 Affordable Care Act, which supports small biotechnology companies develop cost-saving medical therapies. The Acoustic Wave Biosensor is the recipient of a 2010 R&D 100 Award. (1700) ST&E, DS&A, IHNS



A prototype Acoustic Wave Biosensor used to detect viruses, DNA, bacteria, and proteins.

Designed and tested in close collaboration with the US National Data Center, Sandia's **Network Capability Assessment Program (NetCAP)** is a simulator that assesses the capability of the US ground-based nuclear explosion monitoring system to detect, locate, and identify nuclear explosions anywhere in the world. NetCAP, the first new simulator for ground-based monitoring developed since the 1990s, improves both the fidelity and extent of the simulations, incorporating important R&D concepts that have emerged from US monitoring researchers in recent years. (5500) DS&A



The NetCAP tool can assess the detection capabilities of any real or hypothetical monitoring network; the colors and contours represent the magnitude of the event detectable by a hypothetical network.



Paula Austin teaching a biosafety and biosecurity course in Baghdad, Iraq.

Collections of dangerous pathogens in Iraq and Afghanistan are vulnerable to theft and misuse by terrorists. For this reason, the US Department of State has sought the assistance of Sandia's International Biological Threat Reduction (IBTR) program to engage Iraqi and Afghan officials and scientists on managing biological risks in those countries. Members of Sandia's IBTR team have assessed laboratory biorisks, implemented safety and security upgrades, and conducted training events in both countries. **IBTR's work has successfully advanced biorisk management and reduced biothreats in Iraq and Afghanistan.** (6800) IHNS

Sandia developed the concept and framework for implementing the Gulf Nuclear Energy Infrastructure Institute (GNEII) to introduce an integrated energy safety, security, safeguards and nonproliferation program in the Middle East. Organizations from the United Arab Emirates and the US formally agreed to establish the GNEII in Abu Dhabi. Sandia developed the academic program and curriculum, the management and financial structure, and the implementation plan for the GNEII. A GNEII pilot course has been developed and will be deployed in spring 2011. The GNEII was named by the White House as a "Top 5" initiative to meet in President Obama's Cairo speech objectives. (6800) IHNS



GNEII Letter of Intent signing ceremony, March 16, 2010, in Dubai, United Arab Emirates. Front row (signees, L to R): Mohammed Al Hammadi (Emirates Nuclear Energy Corporation), Amir Mohagheghi (Sandia); Arif Al Hammadi (Khalifa University of Science, Technology, and Research); William Travers (Federal Authority for Nuclear Regulation); and David Boyle (Nuclear Security Science and Policy Institute/Texas A&M University).

Energy



A new solar collector alignment system improves the efficiency of solar plants. The truck-mounted system consists of a boom with multiple cameras that photograph the collector troughs. The boom is attached to a multi-axis platform that aligns the boom to each trough as the truck drives down a row. The collected images are analyzed to determine shimming parameters for trough alignment. The Satellite Mechanical Design Department, in collaboration with the Geothermal Research Department, led the mechanical design of the alignment system for Sandia's solar programs. (2600, 6900) ECIS

The truck-mounted solar collector alignment system.

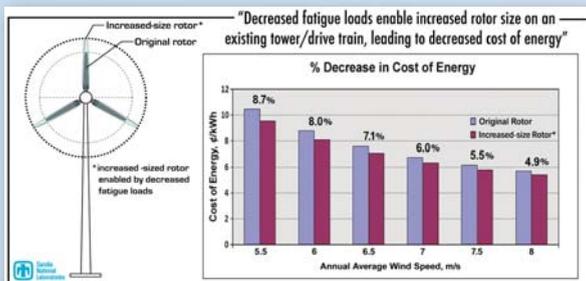
Sandia computational scientists played pivotal roles in developing the successful proposal for DOE's five-year, \$122 million Energy Innovation Hub for Nuclear Energy Modeling and Simulation, Consortium for Advanced Simulation of Light Water Reactors (CASL).

Sandia researchers are now leading CASL efforts in multiphysics coupling, verification

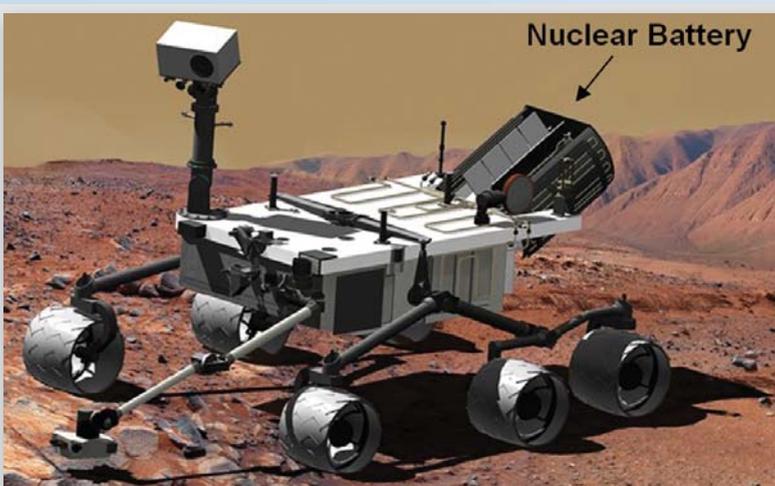


and validation, and uncertainty quantification to create a state-of-the-art "virtual reactor" incorporating many Sandia-developed computational technologies. This virtual reactor will run on the world's most powerful computers to enable significant leaps forward in nuclear reactor design, engineering, and operation. (1400, 1500, 1800, 6700) ECIS

Sandia has demonstrated the potential for small active aerodynamics load control (AALC) devices to lower the cost of energy for wind systems and enable future industry growth. Leveraging Sandia's diverse capabilities in blade technology, controls, sensors, and modeling, three 9-meter test blades were built with AALC devices and extensive sensor arrays. R&D test results show improved system efficiency and reduced fatigue loading on blades and gearbox components. AALC devices are projected to reduce the cost of wind-generated energy by at least 5 percent. (6100) ECIS



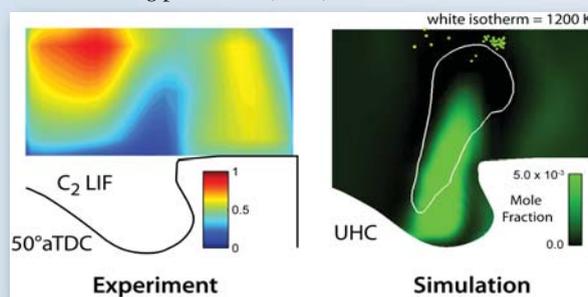
AALC devices are projected to reduce the cost of wind-generated energy.



The launch of radioactive material into space requires launch approval from the president or his designee. Sandia is responsible for developing and writing the safety analysis report for that launch approval. In FY10, Sandia completed the report for the upcoming Mars Science Laboratory mission, which uses a 110-watt nuclear battery to power a Mars rover five times heavier than previous rovers. The report is being forwarded to DOE, NASA, and Office of Science Technology Policy for final launch approval. (6200) ECIS

Nuclear-powered Mars rover; launch approval safety analysis provided by Sandia.

Engine combustion researchers from the Combustion Research Facility have employed a two-photon laser-induced fluorescence (LIF) technique to image the spatial distributions of unburned hydrocarbons (UHC) and carbon monoxide (CO) in the cylinder of an operating diesel engine. These species represent the products of incomplete combustion, and prevent low-temperature diesel combustion systems from realizing their full CO₂ emission reduction potential. The measurements have resulted in improved reduced kinetic mechanisms employed to simulate engine combustion. Additional work is needed to accurately model fuel-air mixing processes. (8300) ECIS



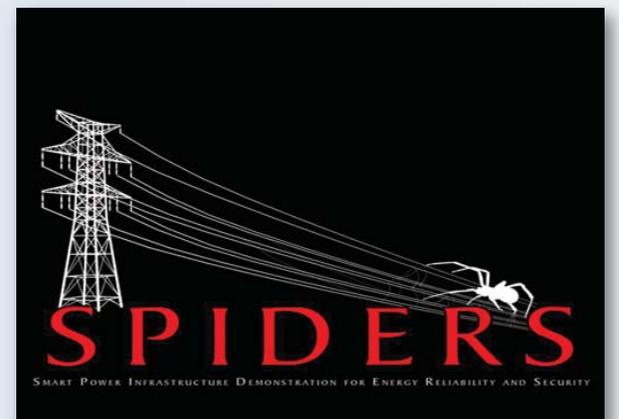
Current computer simulations predict UHC and CO emissions to be dominated by a plume of rich mixture leaving the piston bowl. In contrast, the images show that the dominant sources are lean bulk gas mixtures in the central regions of the cylinder and in the cylinder periphery, above the piston top.

Ionic liquids (ILs) are of interest as a new solvent for the pretreatment of biomass. The realization of an economically viable pretreatment technology employing ionic liquids requires the nearly complete conversion of biomass into its component sugars and recycling of the ionic liquid solvent. HCl catalysis of switchgrass dissolved in the ionic liquid (C2mim) Cl and recovered more than 90 percent of the total sugars available. This patent-pending IL treatment process may eliminate the need for enzymes altogether, and could potentially provide a scalable and economical route to the production of biofuels. (8600) ECIS

A new 8400-square-foot Combustion Research Computational and Visualization facility was built to accelerate the realization of predictive modeling and simulation for combustion processes. Funded jointly by the DOE Offices of Science (SC) and Energy Efficiency and Renewable Energy (EERE), it provides interactive data visualization and modern collaborative workspaces, as well as dedicated computer hardware space. It includes many sustainable and energy efficient features, and was submitted to the National Green Building Council for LEED certification. Construction activities were completed ahead of schedule. (8500, 8300) ECIS



New Combustion Research Computation and Visualization building. (Photo by Randy Wong)

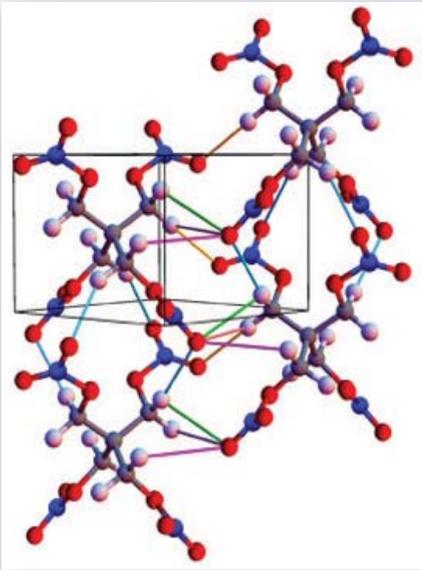


SPIDERS is based on Sandia's Energy Surety Microgrid design concepts.

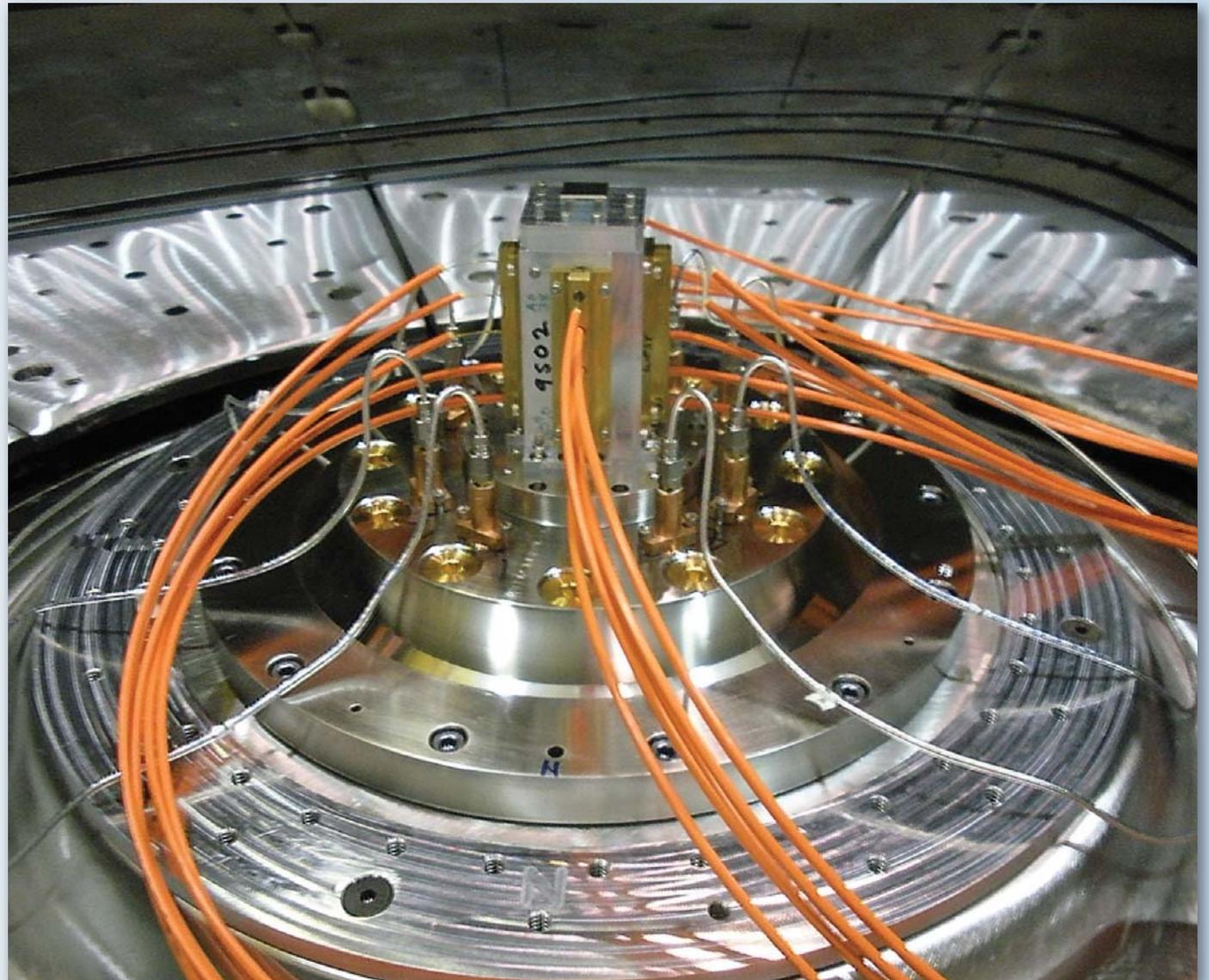
Sandia was selected as the assistant technical manager and lead systems engineer in a three-year, \$42 million, DoD Joint Capabilities Technology Demonstration titled Smart Power Infrastructure Demonstration for Energy Reliability and Security (SPIDERS). SPIDERS will demonstrate secure microgrid implementations, based on Sandia's Energy Surety Microgrid concepts, at three military installations. These microgrids will provide electric power to mission-critical assets in the event of an electric utility disruption. SPIDERS is the first collaborative project under a recently signed DoD-DOE memorandum of understanding in energy security. (6100) ECIS

Pulsed power

Complex molecular dynamics calculations based on first-principles density functional theory are increasingly being used to understand the properties of materials at high pressures and temperatures. The marriage between these efforts and high-quality data obtained on experimental facilities such as Sandia's Z is allowing researchers to provide accurate equation-of-state tables for materials of interest to our NNSA customers. These materials include krypton, xenon, beryllium, quartz, high explosives, foam, and water. Some of the results are also of interest to planetary and astrophysical researchers. (1600, 1400, 2500) NW, ST&E



Four molecules of PETN, each of which has 28 atoms. The unreacted shock properties of this high explosive were determined from molecular dynamics calculations.

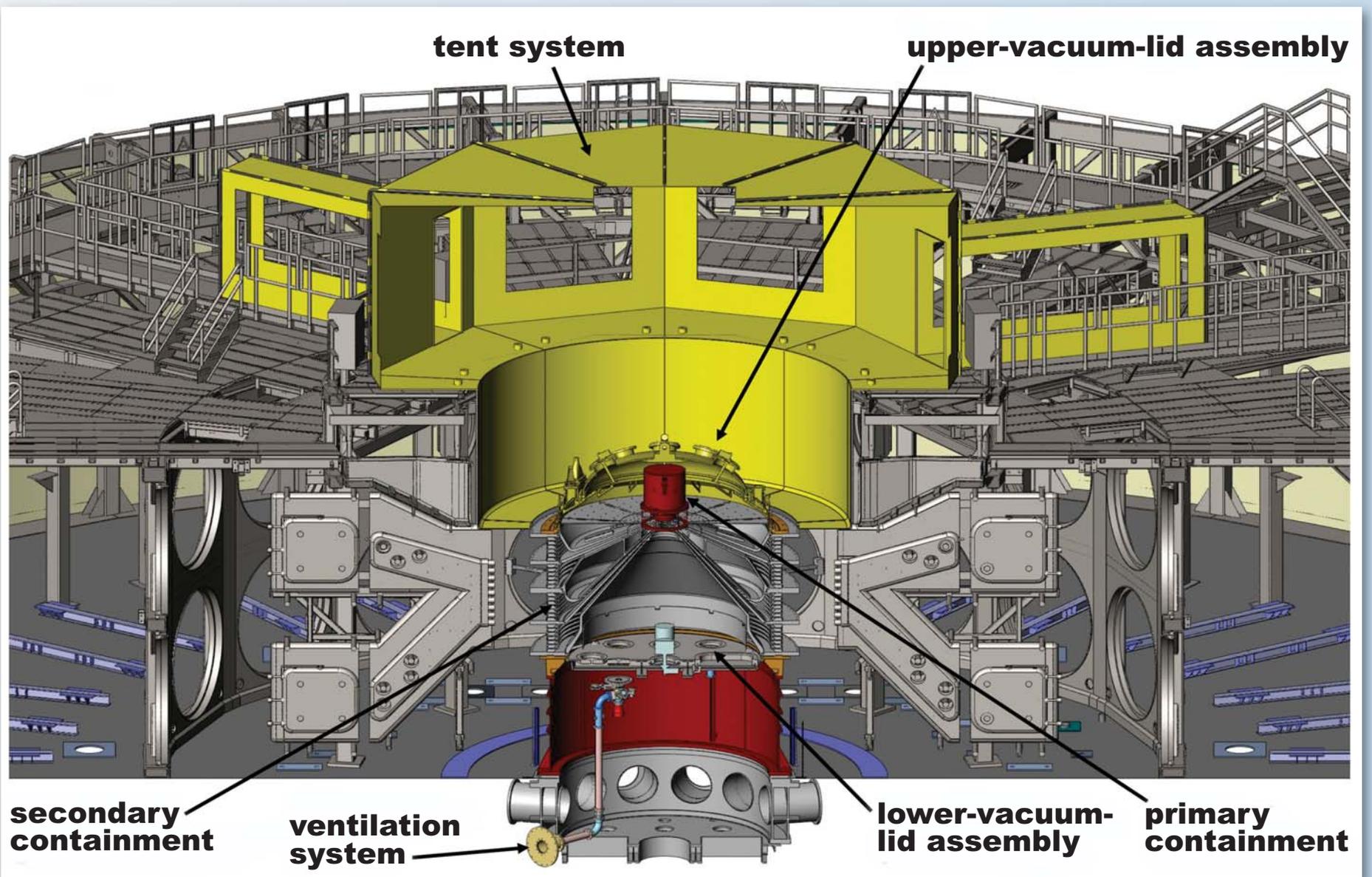


Hardware used to obtain Z data for TATB-based explosives.

Z was prepared for high-priority plutonium experiments to ensure minimal risk of contaminating workers and the high-bay. Hardware to reduce the exposed volume of the central vacuum section and a novel negative-pressure tent system were designed, procured, and tested. The operations crew was trained

in re-entry, disassembly, radiation-survey, and hardware-disposal procedures. Shots were conducted to assess the mechanical and vacuum integrity of the primary plutonium-containment chamber and to determine the required current pulse shape. The first Pu shot was conducted Nov. 18, 2010. (1600) NW, ST&E

Conceptual drawing of new center section hardware and sealed tent system within the Z accelerator for use on plutonium shots.



ES&H & security

Sandia was one of eight winners out of 137 participating federal government agency sites in the FY09 Electronics Reuse and Recycling Campaign, spearheaded by the Office of the Federal Environmental Executive. **The lab contributed 400,119 pounds of electronics toward a total 15.8 million pounds of electronics reused or recycled government-wide in the reuse and recycling challenge.** This was the second year in a row that Sandia picked up the award in the category of large civilian facilities with more than 2,500 employees. (4100) All SMUs

Bernadette Bazen (10267) maneuvers a loader with electronics products destined for reuse and recycling at Reapplication Services as Jeff Adams (10267) and Doug Vetter (4131) review the full list of e-scrap. (Photo by Randy Montoya)



The Safeguards & Security Center **developed and delivered 30 classification subject matter briefings to educate the workforce in the identification and protection of classified and sensitive information.** The center released the briefings to create a high-end awareness of classified elements in the mission work and reduce the potential for the inadvertent release of classified information. These online briefings are available to personnel in the Training Education & Development System (TEDS). Upon completion of a briefing, personnel are granted access to the associated classification guides. (4200) NW

The Safeguards & Security Center took a leadership role in the NNSA effort to reform security requirements. The effort aims to produce a concise, streamlined, cost-effective set of security requirements, while maintaining the appropriate protection strategy and practices commensurate with risks. In September 2010, the Physical Protection and Information Security NNSA Policy Letters (NAPs) were placed on Sandia's contract. **The new NAPs will allow Sandia to reduce complexity in compliance activities and allow management to refocus resources on mission work.** (4200) NW

In 2010, Sandia developed source documents for a new Site Wide Environmental Impact Statement (SWEIS) by collecting data from about 100 facilities throughout Sandia/New Mexico regarding capabilities, activities, material inventories and use, radioactive air emissions, and possible future physical or operational changes. The SWIES is the foundation of Sandia/New Mexico environmental coverage under the National Environmental Policy Act (NEPA). The current SWEIS is more than 10 years old; **the update of this document will help reduce the time and effort for routine NEPA reviews and provide flexibility and maintainability for future Sandia/New Mexico operations.** This massive data collection effort took a year and was delivered to DOE on time and on budget. (4100) IES

Work Planning and Control successfully completed the Verification and Validation (V&V) of the actions for the 2008 HS-64 Audit Finding. While significant progress has been made within Work Planning and Control, and the V&V showed that the corrective actions were partially effective, **assessments that occurred as a result of the corrective action plan showed that many line organizations were effectively implementing work planning**

and control. However, there is still room for improvement in organizational work planning and control processes, hazard identification and implementation of controls, and implementation of corporate technical work document requirements along with assurance processes. (4100) IES

Scientists at Sandia/California's Combustion Research Facility collaborate extensively with the international community, but the process to allow access for foreign scientists and visitors was time-consuming. Thus, **a more public-like General Access Area (GAA) security area was established that greatly reduces the requirements for advanced notice and visit approval.** In addition, a separate east side site entrance was created that maintains appropriate security for the balance of the Sandia/California site and the adjacent Lawrence Livermore National Laboratory site. (8500, 8300) ECIS

The US EPA's Office of Resource Conservation and Recovery selected Sandia/New Mexico as **recipient of the 2010 WasteWise Gold Achievement Award for Industrial Materials Reduction.** (4100) IES

Built-in Network Security (BINS) is a Cyber Security-led, multi-organization project to instrument the Sandia unclassified network. This first-of-a-kind implementation is composed of next-generation customized network hardware, advanced analytical software, distributed log aggregation system, and a searching/visualization capability. BINS enables cyber situational awareness/analysis. Using BINS, cyber analysis can replay events, acquire packet capture, and search logs. This flexible system is adaptable to include evolving hardware/software tools. Partner organizations can leverage BINS to evaluate technologies and conduct analytics on a production network. (9300) NW



Cyber analysts will be able to conduct log searches, packet captures, and replay events on the Sandia unclassified network using BINS. (Photo by Randy Wong)

Community involvement, customer relations, institutional development



Helping kids discover that science is fun. (Photo by Ray Ng [3655])

Eight Sandians took part in the USA Science and Engineering Festival on the National Mall in Washington, D.C., Oct. 23-24, 2010. Thousands of youth (ages ranging from toddlers to teenagers) assembled on the mall to interact with scientists and engineers from across the country. The festival's mission was to reinvigorate the interest of our nation's youth in science, technology, engineering, and math. The visitors got to see and touch some of the Sandia technologies that are helping keep their world peaceful and free, and the Sandians got a first-hand reminder of why the Labs' work is important. (3600, 5200, 5700, 5900, 10600, 1700, 6500, 6600, 5400) All SMUs

As part of a strategy to integrate social media into Sandia's communications practices, the Media Relations and Communications group successfully leveraged such resources for crisis communications in support of the emergency response to the events that occurred at the EMCORE complex Monday, July 12, 2010. During the emergency, the corporate Twitter, Flickr, and YouTube social media channels were demonstrated to be effective in reaching a vast audience of members of the public and news media with timely information concerning the breaking events, safety of the workforce, rumor control efforts, and post-emergency outreach. For many members of the workforce, these channels served as a primary source of emergency information during the event. (3600) All SMUs

Governance, leadership, & management

Throughout FY10, Sandia worked consistently to respond to the NNSA administrator's direction to mature the government/contractor relationship into one founded on the principles of transparency, accountability, and a mission focus. To realize the administrator's vision, Sandia partnered with the Sandia Site Office to reduce regulatory redundancy in the Sandia contract and revise the Laboratory Performance Evaluation Plan to embody the administrator's governance principles. The impacts of these efforts are far-reaching as Sandia continues to work across the Nuclear Security Enterprise to establish enduring processes and train other sites on this new approach, which is now recognized Enterprise-wide. (Labs-wide) All SMUs

Paul Hommert, Al Romig, and Jerry McDowell, along with Sandia Site Office Manager Patty Wagner and Deputy Manager Kim Davis signing the FY11 Laboratory Performance Evaluation Plan, which embodies the NNSA Administrator's Reform Principles of transparency, accountability, and a mission focus.

(Photo by Randy Montoya)



Livermore Mayor Marshall Kamena congratulates Tom Hunter, left, and Rick Stulen, center, on Sandia's 60 years of service in the national interest. (Photo by Randy Wong)

Building on the success of Sandia's 60th Anniversary events in Washington D.C., and New Mexico, the California site held a commemorative event in December 2009 attended by eight Congressional offices, the Governor's office, multiple state and local elected officials, and regional community and business leaders. The commemoration helped communicate with members of Congress and community leaders concerning the values that drive our institution and the many ways that Sandia supports national security needs. (0060) All SMUs

Contract Audit developed and piloted a program for expediting closeouts of contracts where the Defense Contract Audit Agency (DCAA) is the responsible auditing agency. By reducing the need for DCAA assist audits, the program will save DOE/NNSA money and help eliminate an approximately \$195 million audit backlog. The program employs a risk-based review process and complies with generally accepted government auditing standards. Contract Audit conducts audits of approximately one-third of about 500 of Sandia's contracts annually to ensure they are negotiated and settled for a reasonable cost. (0800) IES

Ethics & business conduct

Sandia has intentionally focused on advancing a diverse and inclusive work environment. Positive progress is reflected through the Laboratories, exceeding its Diversity Maturity Model Assessment target; establishing a diversity and inclusion organization with direct reporting responsibility to the Deputy Laboratories Director, the development and implementation of a Sandia Diversity Action Plan, and implementation of an annual on-site diversity conference week, which provides an opportunity for all members of the workforce to increase their awareness and competency on a variety of diversity and inclusion topics. (0040) All SMUs

Adapting to **DIVERSE** challenges, through **INCLUSION** of all people.

diversity.sandia.gov

Who Represents You?

- Diversity and Inclusion Organization (DIO)
- Corporate Diversity Team (CDT)
- Executive Diversity Council (EDC)
- Division Diversity/Employee Councils (DDC/WEC)

Visit diversity.sandia.gov to identify your representative

Tools/Resources

- Training modules and assistance
- Diversity/fixes and DiversityPicks
- The Heart of Diversity Award
- Diversity Cinema
- On-line Diversity Dialogues

Highlights / Accomplishments

- Diversity Action Plan
- VP champions
- Director Sub-Teams
- Exceeded 2009 DMM target
- LLT Diversity Focus Sessions
- First annual Sandia Diversity Conference

Upcoming Events

- Annual D & I onsite conferences
- Veterans Recognition

VISION: We build and sustain a diverse workforce where all individuals know that they are an important part of Sandia because they are valued, included, treated with respect and dignity, and are fully productive contributors to mission success.

DIVERSITY & INCLUSION GOALS:
Diverse People - Inclusive Culture - Aligned Systems

For further information, visit our website or contact
Esther Hernandez at 505-844-3704, or Marie Brown at 284-3171

Sandia National Laboratories

**Mary Bao Tran-Gyamfi (8634) examines a plate of endophytic fungus *Hypoxylon* sp, which produces potential compounds used for fuel. Experiments with fungi are helping researchers to understand the fundamental autoignition chemistry of potential new biofuels.
(Photo by Dino Vournas)**

