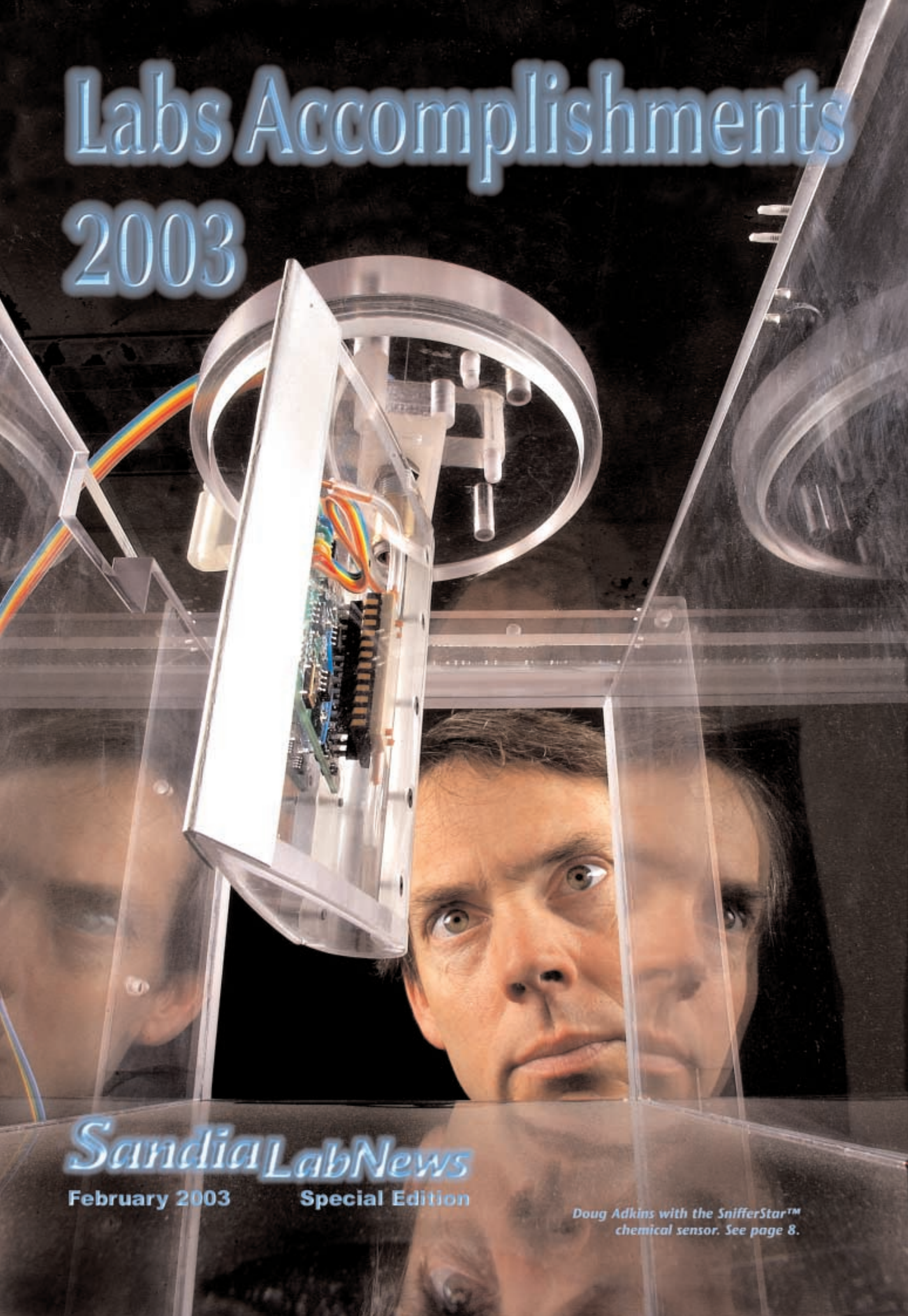


Labs Accomplishments 2003



Sandia LabNews

February 2003

Special Edition

*Doug Adkins with the SnifferStar™
chemical sensor. See page 8.*

To all Sandians:

The ever-increasing advance of technology is built on a foundation of small and large improvements in components — the basic building blocks of larger systems. This year's list of Sandia's accomplishments highlights many of these individual advances — from revolutionary methods of extracting data from deep within steel containment vessels (without penetrating the steel shell) to a breakthrough in high-temperature capacitors that allows them to store electrical energy at five times the previous energy density at the high operating temperatures within fuel cells. Such



C. PAUL ROBINSON

advances are fundamental to increasing the performance of military and civilian systems of the future. One of the most worrisome threats of today's world is the possibility that terrorist groups could acquire weapons of mass destruction (WMD) and detonate them within US cities. Over the past year Sandia has emphasized a multitiered approach to defending against such threats. We have greatly enhanced the security of nuclear plants both within our own country and in distant parts of the world (e.g. Uzbekistan.) We are developing new sensors to detect such threat weapons so they can be interdicted and destroyed. Recent progress includes new detectors for WMD sensors from fixed locations, unmanned airborne vehicles, and from satellites. One major advance is a novel way to concentrate biomolecules by a factor of 1,000 in order to improve our ability to detect and identify the threat substances. At the operational level we have now installed such advanced sensors in US seaports, airports, subways, and in other high-value facilities.

Sandia's historical expertise in how to achieve high reliability in mechanical and electrical systems expanded our contributions over the past year to include systems performance from nuclear reactor pressure vessels to storage and shipping tanks to satellite monitoring systems. Our record now exceeds more than 20 years of on-orbit performance without a mission-critical failure!

All of these advances are possible because of the unique nature of Sandia's operating philosophy of "pursuing science with the mission in mind." I invite you to read about the accomplishments of the past year. As you read them I'll bet you can glimpse just what an exciting future lies ahead for all of us.

C. Paul Robinson, Director

A Note to Readers

Shortly after the beginning of each calendar year the *Lab News* sums up Sandia National Laboratories' principal achievements during the previous fiscal year. Submissions are selected by the VPs' offices. In reading through the accomplishments, you'll notice some numbers in parentheses at the end of each entry. Those represent the Sandia center (or centers) in which most of the work on a particular accomplishment was done. Also, you'll note that many of the technical accomplishments include a key contact name and e-mail address. The work is presented here by category. We've found over time that this organizational approach is helpful, but it is important to recognize that such categorization, particularly in a multiprogram, multidisciplinary laboratory such as Sandia, is to some extent arbitrary. Much of the work listed in the category "Nuclear Weapons," for example, could very appropriately have been listed under "Computing," "Engineering Science," or any one of a number of other categories. And the converse is certainly true. Indeed, much of the work done across all the Labs' technical divisions supports Sandia's fundamental mission-related nuclear weapons work.



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.

Nuclear weapons



MESA TAKES SHAPE — A construction crew manages an 80-yard concrete pour for a Specialty Gas Room at the east end of the Microelectronics Development Laboratory. The vitally important MESA project has met several milestones over the past year.

The **Microsystems and Engineering Sciences Applications (MESA)** Project team attained a major milestone last November with the completion of final engineering design. This milestone represents the official request for DOE approval to begin major facility construction activities and signifies the conclusion of design effort that began in 1999 with the MESA Conceptual Design Report. Another recent accomplishment includes DOE Secretary Abraham's approval of the MESA \$518.5 million Performance Baseline on Oct. 8, 2002. (1700, 1900, 2300, 9100, 9200, 10200, 10500, 10800) Bill Jenkins, wljenki@sandia.gov

The **W76-1/Mk4A Life Extension Program** successfully completed its second year of development



MEMBERS of the W76-1 LEP staff responsible for assembling Flight Test Units include, left to right, Reyes Chavez, Jimmy Aldaz, and Shawn Kerr.

engineering, achieving several significant milestones:

- Numerous reviews, including the Customer Requirements Review, and the Arming, Fuzing, and Firing Subsystem and Joint Test Assembly Conceptual Design Reviews.
- Completion of two reentry body Model Validation Tests and our first Joint Ground Test in support of structural and thermal model validation and environmental specification.
- Delivery of our first flight test bodies in support of the Demonstration and Shakedown Operation Navy flight test in FY03. (2100, 1700, 1800, 2300, 2600, 2900, 9100, 9800, 12300) Mark Rosenthal, marosen@sandia.gov

As an outgrowth of efforts to protect US military assets from terrorist threats, we examined **alternative designs of radiological dispersal devices (RDDs)** using explosives, mechanical spray, and other novel approaches. A risk-based systems analysis laid out the RDD threat from end to end: from terrorist motivation, to acquisition of radioactive material, to design, fabrication, testing of the RDD,

to target selection and final weapon delivery and dispersal. The risk analysis identified immediate security requirements as well as several areas where better understanding is needed. (9800) Len Connell, lwconne@sandia.gov

Sandia, partnering with NASA Goddard, has developed a **radiation-hardened Field-Programmable Gate Array (FPGA)**. Because of their ability to implement digital circuits by programming, FPGAs have become one of the most popular implementation platforms for digital circuits. This rad-hard FPGA was designed for nuclear weapon applications in harsh radiation environments by Digital Microelectronics Dept. 1735 of the Microsystems Science & Technology Center

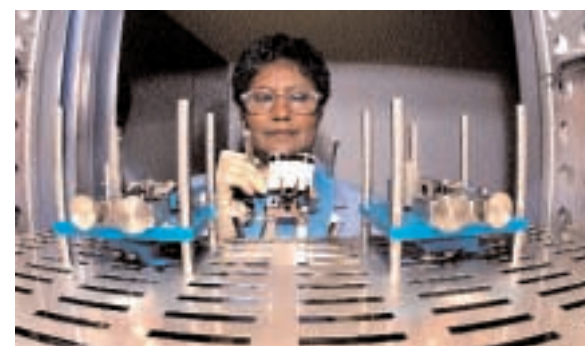
(1700 and fabricated in Sandia's Microelectronics Development Laboratory. The part has 30,000 usable gates, and is compatible with commercial Atmel 6010 non-radiation-hardened FPGAs. (1700) K.K. Ma, 1735, 844-6469, makk@sandia.gov

Stockpile surveillance and weapons systems personnel are verifying that design intent is satisfied for critical components by drawing upon many years of testing information and matching that data with original design documentation. Discoveries from this approach, which uses electronic databases for analyses that were previously not practical, are leading to **improvements in surveillance and design practices**. Continuing projects will further expand the utility of surveillance data systems by using corporate computing capabilities to integrate data operations within NWie, the Nuclear Weapons information environment. (2900, 2100, 9800) Glenn Kuswa, gwkuswa@sandia.gov

A unique course has been developed to provide training in good measurement practices for Sandia managers involved in research and development activities. The **course, which includes many examples of lessons learned across the NNSA complex**, emphasizes the application of critical thinking to measurements. It provides tools to assist the manager in determining the appropriate level of formality to use in the collection or analysis of data. The course has received excellent reviews, and several NNSA partners have expressed interest in using it. (2500, 2300, 3500) Larry Azevedo, ljazeve@sandia.gov

The **MC4380A Neutron Generator** was designed and qualified for the W76-0/Mk4 Trident warheads to provide additional margin in radiation environments. This intensive two-year project successfully supported the stockpile needs without the benefit of

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ANNIE NICKERSON places power supply fixtures for neutron generators into a drying oven at Sandia's neutron generator production facility. (Photo by Randy Montoya)

Homeland security

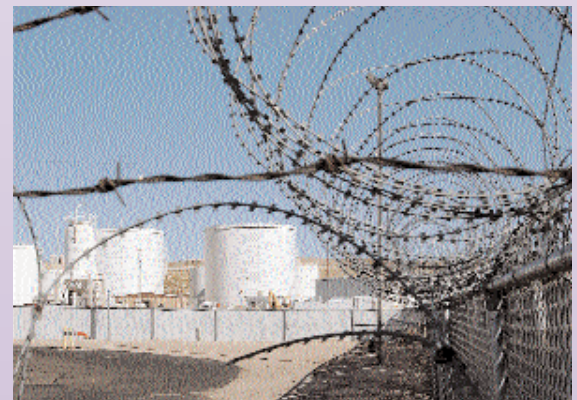
Sandia has established a **Homeland Security Office** to coordinate Homeland Security activities within the Labs. This office is managed by T. J. Allard. Sandia has played a critical role in the standup of the Department of Homeland Security through the support of their transition planning office. John Vitko, John Cummings, and Holly Dockery are lead on several transition teams planning office technology roadmaps.



SANDIA RESEARCHERS are developing detectors for biological weapons (above), demonstrating bomb-disablement and robotics technologies to Homeland Security Secretary Tom Ridge (photo at immediate right), and designing security procedures for the nation's critical infrastructure.



SANDIAN MARK TUCKER demonstrates chem-bio formulation technology to President George Bush, DOE Secretary Spencer Abraham, House Speaker Dennis Hastert, and others during a Homeland Security presentation at Argonne National Laboratory in Illinois.



Nuclear weapons

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underground tests. The effort began in August 2000 and was completed in April 2002, followed by completion of the first production unit in May and delivery of the first units to the Navy and the UK last summer. The MC4380A is the **first neutron generator developed and produced at Sandia and installed in the stockpile.** (2100, 1800, 2500, 2900, 6400, 9100, 9800, 12300, 14400, 14100, 15300)

The **Engineering Bill of Material (EBOM) software application began production use** in June 2002. It is the official Nuclear Weapons Complex (NWC) system for management of the way materials, parts, components, subassemblies, and assemblies fit together to form a product. It also records Engineering Authorizations for NWC products. EBOM is based on a commercial product data management application, and it replaced the outdated, internally developed Configuration Management System (CMS). During development, more than 1.3 million objects were migrated into EBOM from CMS. (2900, 9500) Tony Sill, aesill@sandia.gov

Engineer Authorization (EA) Web, built for the Sandia engineer but designed for the NWC community, has **reduced the number of document and processing errors, improved data integrity,** and reduced the overall release time of Engineering Authorizations (EA) from three weeks to two days. The EA Web application is an authoring tool used by weapon engineers to create, edit, and release EAs. This application has many features to improve the overall EA process. Today, EA Web supports more than 300 authors. (2900, 8200, 9300, 9500, 9800) Richard Graham, rdgraha@sandia.gov

Sandia's Lab Director recently conveyed to the Secretaries of Energy and Defense his seventh **annual assessment of and confidence in the continued safety and reliability of the US nuclear weapon stockpile.** The secretaries integrate assess-



ments from several sources into an annual stockpile certification statement to the President. Our technical staff supports these actions with thorough work throughout the year to maintain the stockpile and to assess its continued capability. (2100, 8200, 2900, 12300, 1) George Novotny, gcnovot@sandia.gov

In support of the NNSA Office of Transportation Safeguards, **Sandia conducted a full-scale test** of an armored tractor and safeguards transporter on the

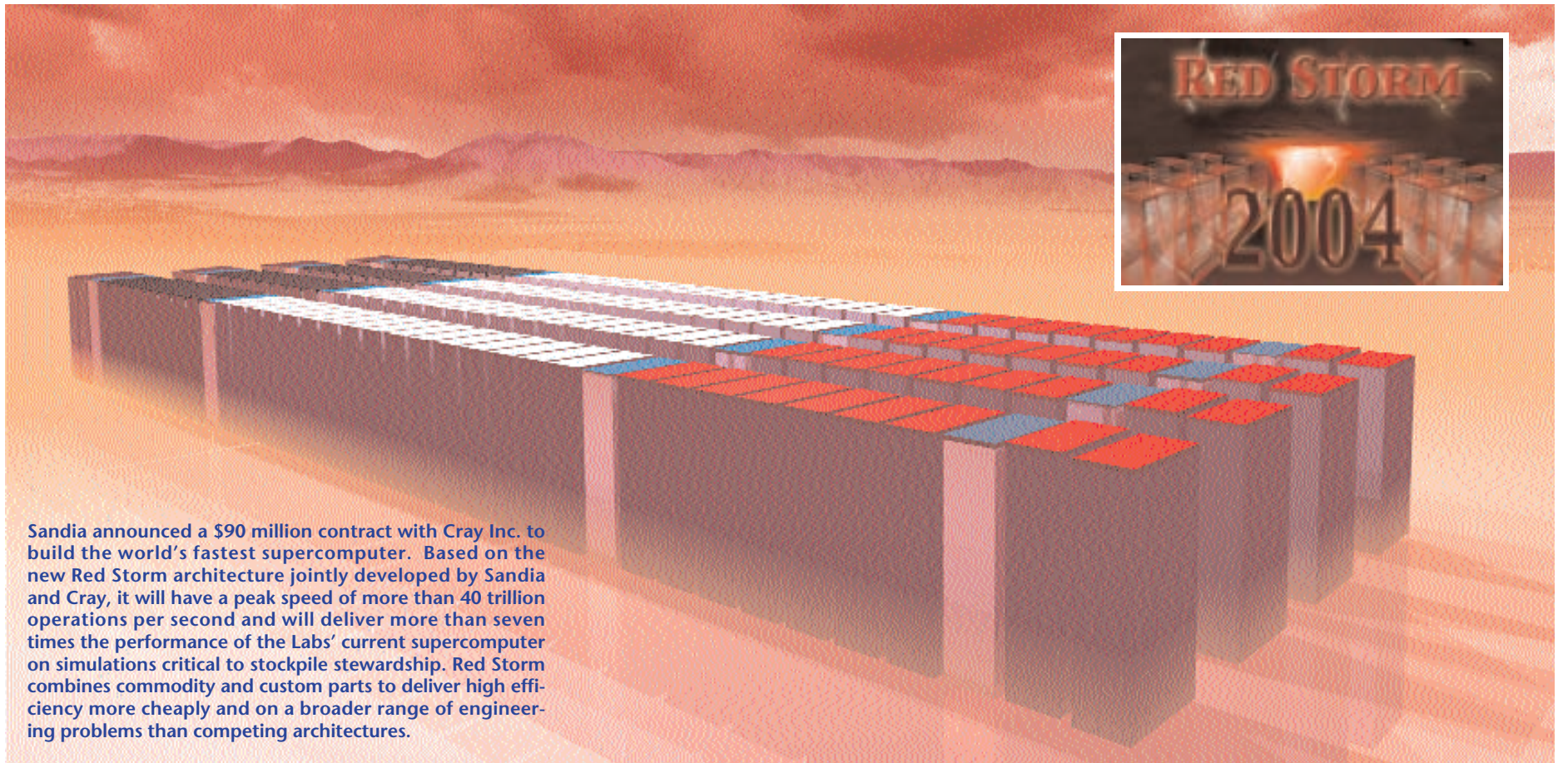
2,000 ft. rocket sled track in Tech Area 3. This test quantified transporter performance for a design basis accident condition. The transporter retained all surrogate cargo items. (5800, 2100, 2600, 2900, 6100, 9100, 9200, 10800, 12300, 12600) David Pace, dwpace@sandia.gov

The world can rest more assured of its safety because of several alterations (ALTs) completed on all B61-3/4/10 weapons located outside the continental United States. ALTs 335, 339, and 354 **enhance the safety, use control, and reliability of these retrofitted weapons.** Other significant accomplishments include retrofits to allow recoding capability using no-knowledge, end-to-end encryption with the Code Management System; characterizing the glass-to metal seal in the Lightning Arrestor Connectors; and qualifying a powder coat process to replace liquid paint. These projects are supported by hundreds of people across the complex. (1700, 1800, 2100, 2300, 2500, 2600, 2900, 6500, 9100, 12300, 14000, 14300) Beth Connors, ejconno@sandia.gov

The W76-1 Arming and Fuzing Subsystem (AFS) integrates radar, flight computer, and diagnostics in a single compact assembly. The design is **meeting aggressive cost goals through use of commercial off-the-shelf parts,** innovative packaging, and automated production processes. The AFS is part of the W76-1 Arming, Fuzing, and Firing system, and will be tested in the upcoming Navy FCET-30 flight test. The project team has delivered the first two AFS flight test units on schedule. (2300) Scott Holswade, scholsw@sandia.gov

A LIGA (German acronym for an X-ray lithography-based manufacturing process) spring enabled the development of an Environmental Sensing Device (ESD) that **can accurately sense low levels of acceleration.** The motion of the ESD spring and sense mass is fluid damped to assure smooth, long-term operation. This robust device is designed to play a key role in nuclear weapon safety architectures that use environmental sensing as part of their nuclear safety theme. Prototypes have been built and successfully tested. (2600, 8700, 1700, 1800) Carl Vanecek, cwvanecc@sandia.gov
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Nuclear weapons



Sandia announced a \$90 million contract with Cray Inc. to build the world's fastest supercomputer. Based on the new Red Storm architecture jointly developed by Sandia and Cray, it will have a peak speed of more than 40 trillion operations per second and will deliver more than seven times the performance of the Labs' current supercomputer on simulations critical to stockpile stewardship. Red Storm combines commodity and custom parts to deliver high efficiency more cheaply and on a broader range of engineering problems than competing architectures.

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A group of California Weapon Interns successfully **designed, built, and launched a highly instrumented W87 warhead** — Instrumentation Development Flight (IDF) 3 — last June. IDF-3, while also serving as a real-world weapon-training project for the interns, allowed Sandia to test some 10 different experimental technologies, including a broadband transmitter, a wireless system bus, a distributed transmitter, and two separate attitude and trajectory measurement systems. IDF-3 contained **the first LIGA micro-system to fly on a warhead** in a true test flight environment. Christian Scholz, cscholz@sandia.gov

A new high-G shock test method using the Sandia rocket sled track was invented, developed, and qualified by Sandia for assessing weapons component sub-assemblies for survivability in penetration environments. **The test capability will enable Sandia to respond quickly and less expensively to future weapon requirements.** Both W87 and B83 systems have been tested against the simulated hard target penetration shock delivered by this novel test method. A second method to test full systems impacting concrete targets under controlled impact conditions is currently under development. (8200, 9100) Scott Faas, sefaas@sandia.gov

The W80-3 Life Extension Program team developed a model-based qualification approach to qualify the W80 refurbished warhead. The W80 and the Accelerated Strategic Computing Initiative (ASCI) teams collaborated to **evaluate the W80 warhead in abnormal environments.** The analysts used Sierra-based ASCI codes to simulate the mechanical damage due to a dropped W80-1 warhead and the thermal response of the W80-1 warhead in a fire environment, as part of the FY02 ASCI Level 1 STS Abnormal milestone. (9100, 8700, 8200, 8900, 9900) Davina Kwon, dmkim@sandia.gov

During the last year, the NNSA created a new organization — the Program Integration Office (PIO) — to integrate the nuclear weapons program across NNSA organizational elements, and integrate programs and activities across the nuclear weapons complex. To augment this effort, **Sandia established the Integration Studies & Support Group**, which will provide critical sup-

port to PIO in all its functions. Rodney Wilson, rkwilso@sandia.gov

A full-scale B61 experiment in an Air Force transonic wind tunnel provided Laser Vapor Screen images of the vortices formed by the spin motor plume-freestream interaction and counter-moment data caused by the interaction of the vortices with the B61 fins. The counter-moment data was used with flight test data, Sandia vortex-fin interaction experimental research results, and ASCI fluid dynamic code predictions to construct a **credible simulation-based capability for predicting spin rates** and rolamite closure probabilities across the delivery envelopes for each B61 mod. (9100, 2100, drafting, machine shop) Carl Peterson, cwpeter@sandia.gov

Model Based Performance Analysis is using modeling and simulation of weapon electrical systems to **better understand baseline system variability** and how aging of materials and electrical devices can affect system performance and weapon lifetimes. Sandia's powerful circuit simulators ChileSPICE and XYCE coupled with the CPlant computation platform have been used to perform the hundreds of simulations necessary to thoroughly investigate the problem. Studies have been completed on the W80 warhead and are

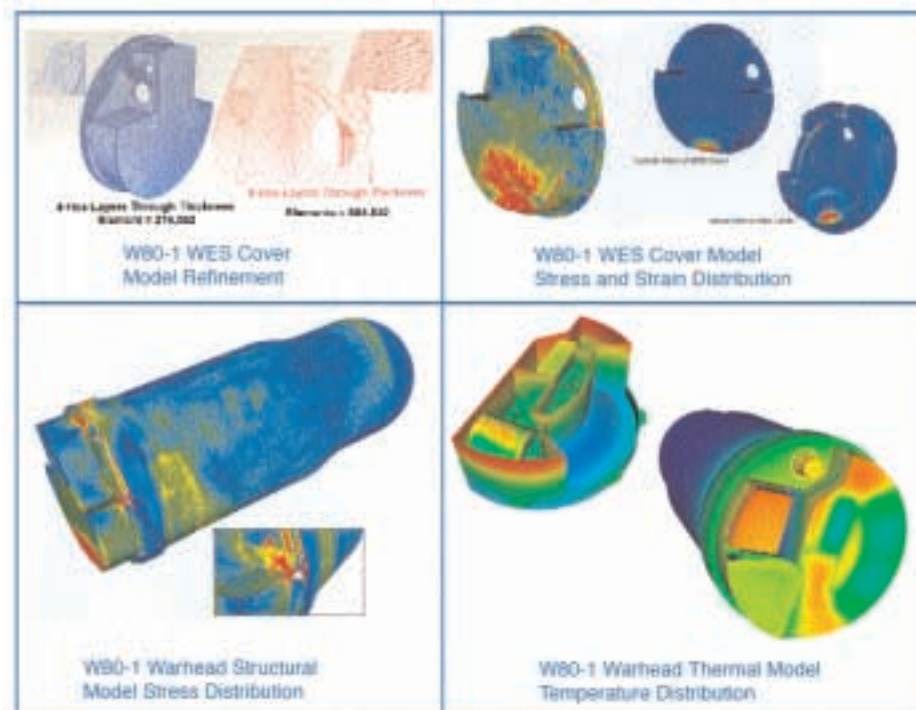
underway on the B61 and B83 bombs. (12300, 8200, 1700) Thomas Brown, tdbrown@sandia.gov

In FY02 the Nuclear Safety Information Center (NSIC) team successfully implemented the NSIC Archival Management System. The new system provides **inventory management and document search/retrieval** at the users' desktop. Information on more than 44,000 documents, videos, and photos is now available to more than 200 Sandia users with appropriate need-to-know. (12300) Debra Thomas, dlthom@sandia.gov

The nuclear weapon reliability departments at Sandia have developed a set of tools and processes to support the evolving stockpile stewardship mission. The **Reliability Assessment Model (RAM) software tools** allow analysts to efficiently manage complex reliability analysis information and assess age- or subpopulation-dependent reliability impacts on a weapon serial number basis. The RAM tool process allows for automated data updates to reflect ongoing stockpile activity and to quickly meet the information needs of the DoD, NNSA, and Sandia organizations. (12300, 8200) Kathleen Diegert, kvdiege@sandia.gov

The DOE Accident Response Group is responsible for providing worldwide, professional, accurate and timely technical support in resolving accidents and significant incidents involving US nuclear weapons. A new system, **Digital-Portable Integrated Video System (D-PIVS), was deployed last year.** The system provides accident site personnel with four channels of real-time secure video and audio of the accident site events. It can be linked via secure satellite communications to strategic command posts and national emergency response home team facilities. (12300, 5900, 14400, 15200) John Hoffman, jphoffm@sandia.gov

The Security Matrix Project, jointly sponsored by DOE and DoD, completed its fourth year of work. Reports of project findings for the Navy, Air Force, and DOE operations inside the US have been completed or are being written. Those findings are being used to focus attention on improvements to the stockpile during refurbishments and on improved security policies and postures where appropriate. Analysis of data collected at overseas locations will be conducted this year. (12300) Jeff Everett, jjevere@sandia.gov



Arms control technologies and nonproliferation programs

Sandia was selected by the City and Port of Los Angeles and the Port of Long Beach to serve as **security consultant and project manager for their Operation Safe Commerce (OSC)** efforts. OSC is a US government-sponsored effort to improve the security of maritime commerce without negatively impacting the necessary flow of goods through the supply chain. Sandia security and systems analyses of the ports and their supply chains will lead to the development and implementation of improved processes and technologies. Sandia will also provide security measures in the two ports as well as in the ports of major overseas trade partners. (5300, 5800) Bryon Cloer, bkcloer@sandia.gov

The GPS Nuclear Detonation Detection System (GPS/NDS) completed **another successful year of on-orbit operations** in support of DOE/NNSA's nuclear treaty verification mission. The payloads, which fly on each of the 24 Global Positioning Satellites, have performed their function without a mission-critical failure for more than 20 years. That works out to over 500 sensor-years on orbit without a mission failure. These payloads provide global monitoring for endoatmospheric nuclear events as well as the processing for space NUDET monitoring. (5700) Anthony Medina, ajmedin@sandia.gov

The Sandia-designed Multispectral Thermal Imaging satellite **completed its second year on orbit** last February, surpassing its system specification of 18 months. The system has collected more than 5,300 multispectral data cubes for a wide variety of government customers including NNSA, military, and civilian organizations. Having completed its NNSA goals,



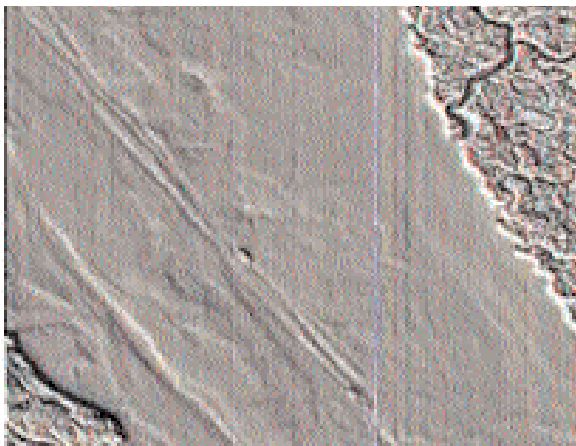
TWO VIEWS of one location: Sample MTI image processed with novel Sandia algorithms.



SAFE HARBORS — Sandia is working with the Port of Long Beach (above) and the City and Port of Los Angeles as security consultant and project manager for their Operation Safe Commerce program. The program aims to improve port security without unduly interfering with maritime commerce.

the system is now performing the majority of its collections for other government agencies. The system is operating nominally with few flight problems, and we expect it will meet its goal of three years of orbital operations. (5700) Anthony Medina, ajmedin@sandia.gov

The US Nuclear Detonation Detection System



(USNDS) Ground System includes L-Band antennas and receivers that process L1 navigation signals and L3 USNDS signals from the GPS constellation. Upgraded Ground System equipment has been installed and tested at Schriever AFB in Colorado Springs. **Certification testing for this equipment has been completed**, and the system is now fully operational. The upgrade enables improved satellite visibility, tracking capability and crosslink reception, and significantly enhances the nation's ability to perform space-based nuclear weapons treaty monitoring. (2600, 5700) Lorraine Baca, lsBaca@sandia.gov

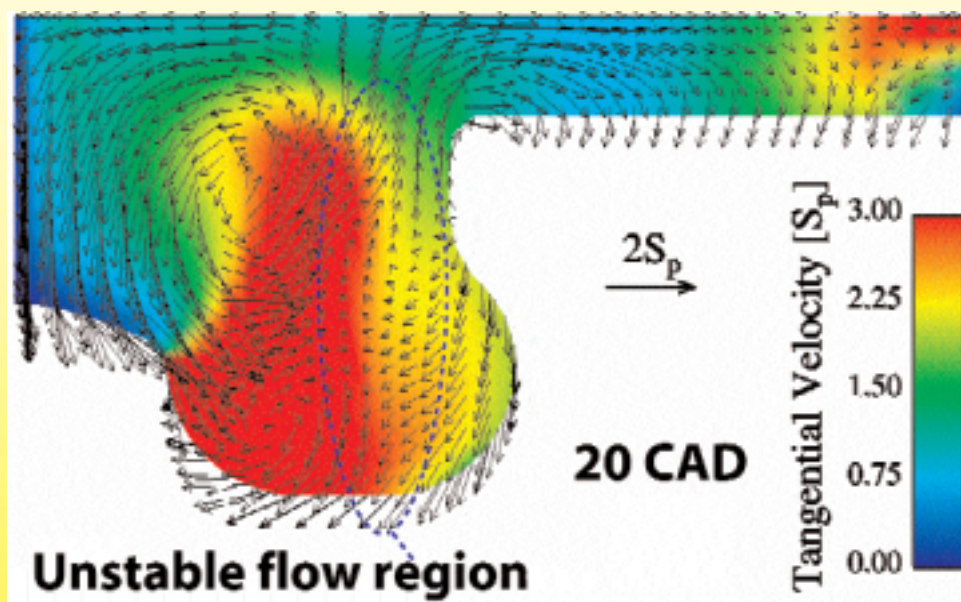
The US State Department approved and DOE sponsored the **establishment of a cooperative monitoring center in Amman, Jordan**, modeled after the CMC at Sandia in Albuquerque. It will provide a forum for regional training on nonproliferation technologies, development of new monitoring capabilities, monitoring demonstrations, and multidisciplinary interactions among scientists, engineers, and policy-makers. The CMC@Amman will be located at Jordan's National Laboratory, the Royal Scientific

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Engineering science

The closure of 177 high-level waste tanks at Hanford has become a top priority for DOE and an extremely aggressive schedule has been established for the contractor. Sandia developed and demonstrated in lab-scale experiments a sorbent material to **irreversibly immobilize Tc-99, which is one of the more mobile radionuclides** and presents one of the highest risk elements to site closure. Based on the proof of principle demonstration, Sandia is now working with Hanford to develop a sorbent grout for deployment in the very first tank closure, which will occur in FY04. Over the next 48 months, some 40 tanks will be closed and it is expected that the Sandia technology will be deployed in each of these closures. (6800) Joe Jones, jojones@sandia.gov

Direct-injection diesel engines offer significant fuel economy and greenhouse gas advantages but suffer from higher soot and NOX emissions than spark-ignition engines. Enhanced in-cylinder turbulence can reduce these emissions. Flow measurements in an optical diesel engine have provided **new insight into turbulence generation and control** via the interaction of the fuel sprays with the swirling flow. Current engine turbulence models do not accurately capture this phenomenon, and collaborative efforts with the University of Wisconsin and Wayne State University are now focused on developing a



THE FUEL SPRAYS redistribute the angular momentum of the in-cylinder flow, creating an unstable momentum distribution that breaks down into turbulence.

predictive capability. (8300) Paul Miles, pcmiles@sandia.gov

Breathing conditions in underground mines took a step toward clean air when the fuel-cell-powered locomotive outperformed its battery-powered predecessor. The project goal is to **replace diesel fuel with hydrogen in underground mining operations**. The 3-ton, 8.5KW (usable power) hydrogen-fuel-cell-powered locomotive, developed by Sandia and Vehicle Project partners (primarily funded by DOE), ran on rails hauling ore in Canada in October and demonstrated operation and refueling from a electrolysis reformer in November 2002. (8100, 8200, 8300, 8700) Bill Replogle, wcreplo@sandia.gov

Sandia's massively parallel structural dynamics simulation code, SALINAS, is the 2002 winner of the prestigious Gordon Bell Award for

innovative techniques to produce new levels of performance on a real application. The code development team demonstrated sustained aggregate performance of 1.16 teraflops on 3375 processors on the ASCI White platform, with unprecedented scalability for an implicit simulation code. SALINAS played a key role in the FY01 ASCI Level 1 Milestone and is being used for design and qualification activities for the W76 and W80 programs. (9100, 9200, 8900, University of Colorado at Boulder) Kenneth Alvin, kfalvin@sandia.gov

Arms control technologies and nonproliferation programs

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Society. (5300) Bryon Cloer, bkcloer@sandia.gov

In the aftermath of 9/11, Sandia initiated a **dialog between the directors of the US and Russian nuclear weapons laboratories on counterterrorism cooperation**. In April 2002, with the endorsement of their respective agency leadership, the lab



TWO PRESIDENTS — George Bush and Vladimir Putin during their May 2002 summit conference in Moscow.

directors agreed to begin work immediately on the development of advanced sensors for detection of fissile material and explosives. Working groups were formed for technical collaboration in the areas of Threat Definition, Materials Detection, and Incident Response/Recovery. Presidents Bush and Putin highlighted this initiative at their May 2002 summit in Moscow in their Joint Statement on Counterterrorism Cooperation. (5300, 5900, 5800) Bryon Cloer, bkcloer@sandia.gov

Past and current Cooperative Monitoring Center (CMC) Regional Security experience and systems engineering expertise have stimulated US interagency and foreign government requests for Sandia to serve as technical advisor on South Asia border security issues. In this role, Sandia contributed to Deputy Secretary of State Richard Armitage's **talking points for his visit to the region during the India-Pakistan nuclear crisis** (May-June 2002). This expertise also resulted in requests for briefings to ministerial level Indian and Pakistani officials, as well as to Sandia's participation in the Department of State-led Joint Working Group on Counterterrorism and the DoD-led Security Cooperation Group (SCG) with India. (5300) Bryon Cloer, bkcloer@sandia.gov

Following the events of 9/11, the US National Security Council directed that **security enhancements at the Uzbekistan Institute of Nuclear Physics nuclear reactor** be accelerated in response to an urgent request from the President of the Uzbekistan Academy of Sciences. DOE and NNSA selected Sandia to lead US assistance to enhance security for the highly enriched uranium-fueled facility. Enhancements were completed in Spring 2002. (5300) Bryon Cloer, bkcloer@sandia.gov

A multicenter team completed fabrication and flight qualification of an innovative satellite-based optical sensor. This sensor provides a **revolutionary level of processing** behind each pixel through a unique 3-dimensional microelectronics package. In 1.5 cubic inches, its event-driven architecture provides sensing and signal processing at the equivalent speed of more than a gigabit per second, a level of performance never before approached in a package near this volume. The package has been successfully integrated into the next level of assembly and should be delivered and launched in 2003. (1700, 5700, 14100) Anthony Medina, ajmedin@sandia.gov

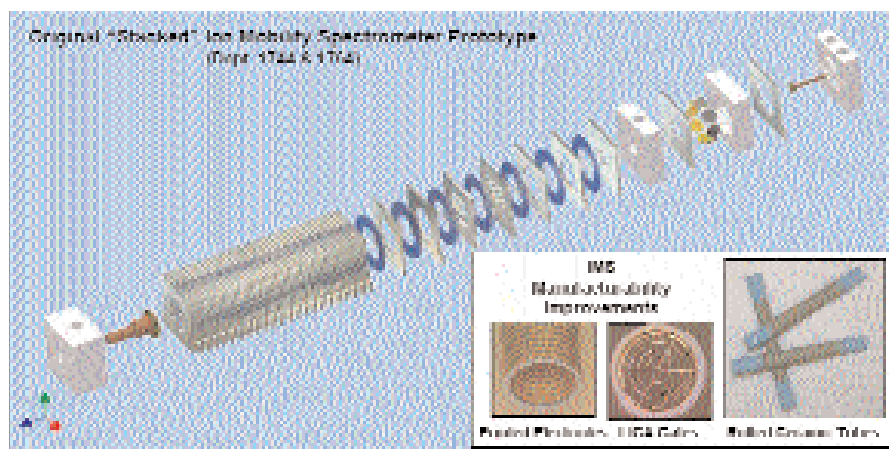


Demonstration of a 3-inch Ion Mobility Spectrometer (IMS) developed in Center 1700 proved



LAB DIRECTORS and officials from DOE and Russia's Atomic Energy Ministry met in Santa Fe last summer. Their work led to key agreements on cooperative efforts in nuclear energy research and counterterrorism technology.

basic functionality for detecting trace explosives. A **new construction method improves manufacturability** and reduces part count in the IMS using novel low-temperature co-fired ceramic processing techniques and a micromachining process called LIGA. The resultant assemblies are repeatable and manufacturable, requiring a fraction of the former man-hours. This accomplishment will facilitate the future deployment of MicroHound handheld explosives detection units and ease



transfer to a commercial producer. (5800, 1700, 14100) Steven Rohde, sbrohde@sandia.gov

A successful demonstration of the **Unconventional Nuclear Warfare Defense (UNWD) Test Bed** was held on Kirtland AFB. This was a combined effort of the Defense Threat Reduction Agency (DTRA), DTRA's contractor, the Washington Defense Team, Kirtland AFB, and a multi-lab collaboration of Sandia, Los Alamos, Lawrence Livermore, and the Remote Sensing laboratories. The UNWD Test Bed is a congressionally directed/funded program to showcase technology for protecting military installations against unconventionally delivered nuclear weapons, improvised nuclear weapons, and radiological dispersal devices. (5800, 6500, 5900, 2500) Ron Glaser, rfglase@sandia.gov

We led a substantial portion of the Site Security Enhancement Project to **significantly improve the security posture at a DOE site**. The enhancements were one of NNSA's highest-priority security upgrades and incorporated Safe Secure Trailers modified to accommodate stored materials. The effort successfully installed operational trailers in early 2002, four months after the original assignment. The success

was attained through an extraordinary team effort involving NNSA, the site representatives, and broad Sandia organization support. (5800, 10200, 12300, 3100, 6400, 14100) Steve Scott, shscott@sandia.gov

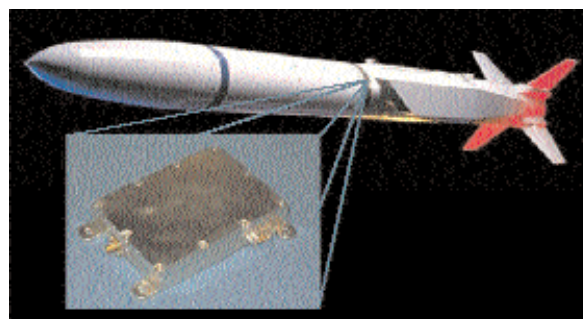
Operational test and evaluation of the Remote Response Platform, funded by the DOE Office of Security, was successfully completed. This technology allows for **extremely accurate and rapid response**, minimizes exposure for security response personnel, and effectively provides force multiplication. Force-on-force and combat simulation evaluations also have been completed with favorable results. Follow-on remote response platforms are being installed in real operational settings at both a DOE and USAF site. (5800, 3100, 6400) Mike Williams, mgwilli@sandia.gov

Development and fabrication of the Hound II, a chemical detection system that combines a commercial detector with Sandia's patented air sampling and preconcentration technology, was successfully completed. The Hound II **enhances the capabilities of hand-held commercial detectors** for detecting explosives and illicit drugs by increasing the sampling rate by two orders of magnitude. Field tests to demonstrate Hound II's capabilities were conducted at Pantex and US Customs' Thunder Mountain Center. Licensing and commercialization of the Hound II is currently being investigated. (5800) Karla Simoes, kjsimo@sandia.gov

Sandia has developed a toolbox of radio frequency communication elements that may play important roles in **identifying, tracking, and targeting terrorist activities**. We demonstrated the utility of our microtransmitter in a Navy Fleet Battle Exercise in August. In a recent test at China Lake, our new spread-spectrum tag was used to remotely verify that an Advanced Anti-Radiation Missile made a direct hit on a simulated surface-to-air missile site. Support to develop the elements of the toolbox has been provided by DARPA, US Navy, and Sandia

LDRD funds. (2300, 5900, 5700, 6500) Michael Murphy, mbmurph@sandia.gov

Sandia has successfully completed Phases 1 and 2 of the **Nuclear Explosion Monitoring Vision 2015 Study**. This project is examining the



ADVANCED ANTI-RADIATION missile; cutaway shows deployment of Sandia's spread-spectrum tag.

(Continued on next page)

Materials, physics, and chemistry

Removable materials, (thermoset resins that can be “uncrosslinked,” allowing rework of electronic parts) are being implemented as the base-line encapsulant materials (both foams and coatings) in the W76-1 AF&F refurbishment. These new materials are based upon a **thermally reversible chemistry** that has been explored over the past five years that allows for encapsulant removal at an elevated temperature — above the STS temperature but below any component degradation temperatures. The resin synthesis, material formulation, and processing is being done in conjunction with Honeywell FM&T KCP. (1800, 1700, 6200, 8700) Jim Aubert, jhauber@sandia.gov,

We have developed a hyperspectral imaging system for scanning DNA microarrays. **Acquisition of the entire emission spectrum at each array location** gives this instrument significant advantages over commercial scanners. Coupling the hyperspectral imager with multivariate data analysis provides an even greater advantage through **quantitative modeling of all emission sources at each pixel**. In collaboration with UNM researchers, we have demonstrated that this approach provides a more accurate estimation of the concentrations of fluorescent species and increases the reliability of gene expression data. (1800, 5700, 9200) Mike Sinclair, mbsinclair@sandia.gov

We have developed a **miniaturized protein concentrator** capable of 1000-fold concentration of proteins and other biomolecules. The concentrator is voltage-addressable and provides a simple means of concentrating proteins such as biotoxins to allow detection of previously undetectable amounts. It is based on a recent discovery of trapping of proteins in nanoporous beds under an applied electric field. The concentrator can easily be integrated into a miniaturized analysis system and is being developed as a component of μ ProLab module under the Molecular Integrated Microsystems project. (8100) Anup Singh, aksingh@sandia.gov

We have developed a microfluidic device with an **active self-assembled monolayer coating** that can absorb proteins from solution, hold them with negligible denaturation, and release them on command. The success grew from studies on the use of tethered organic coatings to reversibly switch the surface chemistry of components in microanalytical systems. This device can form the basis for microfluidic systems with proteomic analysis functions and for compact, rapid, highly selective, reusable biosensors capable of detecting multiple agents. (1100, 1700, 1800) Paul Dressendorfer, dressepv@sandia.gov

Aging of weapons components is governed by chemical reaction rates determined by activation energies. Because rates depend exponentially on activation energies, small errors in calculated energy barriers can give orders-of-magnitude errors in rates. Modern first-principles techniques and increases in computing power now permit **unprecedented accuracy in calculating these barriers**. A stunning example is carbon impurity diffusion through a grain boundary commonly found in nickel LIGA materials. This is the first simulation of such a complex system, taking two weeks on C-plant, equivalent to five years of CPU time. (8700) Bob Hwang, rqhwang@sandia.gov

A Sandia-developed **Gunshot Residue Test Kit** has been licensed to Law



PAM WALKER field-tests Sandia's Gunshot Residue Kit.
(Photo by Randy Montoya)

Enforcement Technologies and is now helping to solve real crimes throughout the country. Each kit includes a round fiber-glass swab that is rubbed on hands, arms, clothing, or vehicles belonging to someone suspected of firing a gun. The blue specks that appear on the swab seconds after adding a proprietary chemical provide important forensic information that helps law enforcement officials quickly solve the most difficult cases and jail the culprits. (2500, 1300) Pam Walker, pkwalke@sandia.gov

Friction and wear are major concerns in the performance and reliability of micromechanical (MEMS) devices. While many tribological coating materials are available, it is difficult to apply uniform coatings to the intricate three-dimensional structures typical of MEMS devices. **We have developed a novel coating process called atomic layer deposition (ALD)**, which uniformly coats shadowed surfaces such as gear hubs and teeth with wear-resistant or lubricating films. Many different types of hard or lubricating materials are possible by ALD, as well as alloys and nanolaminates with enhanced mechanical and tribological properties. (14100, 1800, 1100) Thomas Mayer, 844-0770, 14171, tmmayer@sandia.gov

Arms control programs

(Continued from preceding page)

technology the Air Force Technical Application Center (AFTAC) will need in the year 2015 to carry out its mission of global monitoring of nuclear testing. This system includes satellites, seismic stations, and other monitoring assets. Phase 1 included an evaluation of the monitoring and system requirements. Phase 2 was an evaluation of technology development necessary to build the new systems. AFTAC is looking to Sandia to complete Phase 3 (roadmap to 2105 and systems architecture) over the next several years. (5700)

Sandia is developing the Advanced Atmospheric Research Equipment (AARE) to provide the US Air Force with the ability to continue a 50-year-plus mission of monitoring foreign nuclear tests. AARE will provide a **unique capability to do treaty monitoring and sampling** against worldwide nuclear testing activities. The precursor to AARE, the Atmospheric Research Equipment (ARE), is the only Air Force airborne Nuclear Debris Collection and Analysis asset in service, and it is based on 30- to 40-year-old technology. AARE will replace this aging equipment with modularized systems that can be deployed on any of three designated Air Combat Command TC-135 training aircraft. This approach will save considerable operational costs for the Air Force compared to maintaining a dedicated aircraft for the mission. (2900, 5900, 6500, 9100, 14400) Eva Wallace, etwalla@sandia.gov

Mission Analysis and Simulation Dept. personnel developed **new algorithms to provide automated characterization** (nuclear or non-nuclear) and associated yield determination of sensor reports from the space-based Nuclear Detonation Detection System (USNDS). These algorithms, to be incorporated into the USNDS ground segment, provide a detailed discrimination analysis of individual optical signals and a rule-based characterization process of the collection of sensor reports from various sensors onboard multiple satellites. The algorithms were validated using 10 years of operational data, along with simulated nuclear detonation data. (6500, 5700) Bill Richard, bdricha@sandia.gov



SANDIA RESEARCHERS are developing sensors to provide early warning of chem-bio attacks in airports, subways, and other public spaces where people gather.

The PROTECT program, supported by DOE's Chemical and Biological National Security Program, is collaborating with a major international airport on **defense of such facilities from chemical and biological terrorist attacks**. A vulnerability assessment explored physical security and air handling issues that influence the likelihood and impact of such attacks. Tracer-gas release tests revealed new insights concerning intra- and inter-terminal transport. Finally, chemical and biological detection equipment was field-tested, including a gas-phase μ Chem-Lab prototype, and early warning sensors designed for real-time detection of biological threats. (8100, 1700, 6200) Susanna Gordon, spgordo@sandia.gov

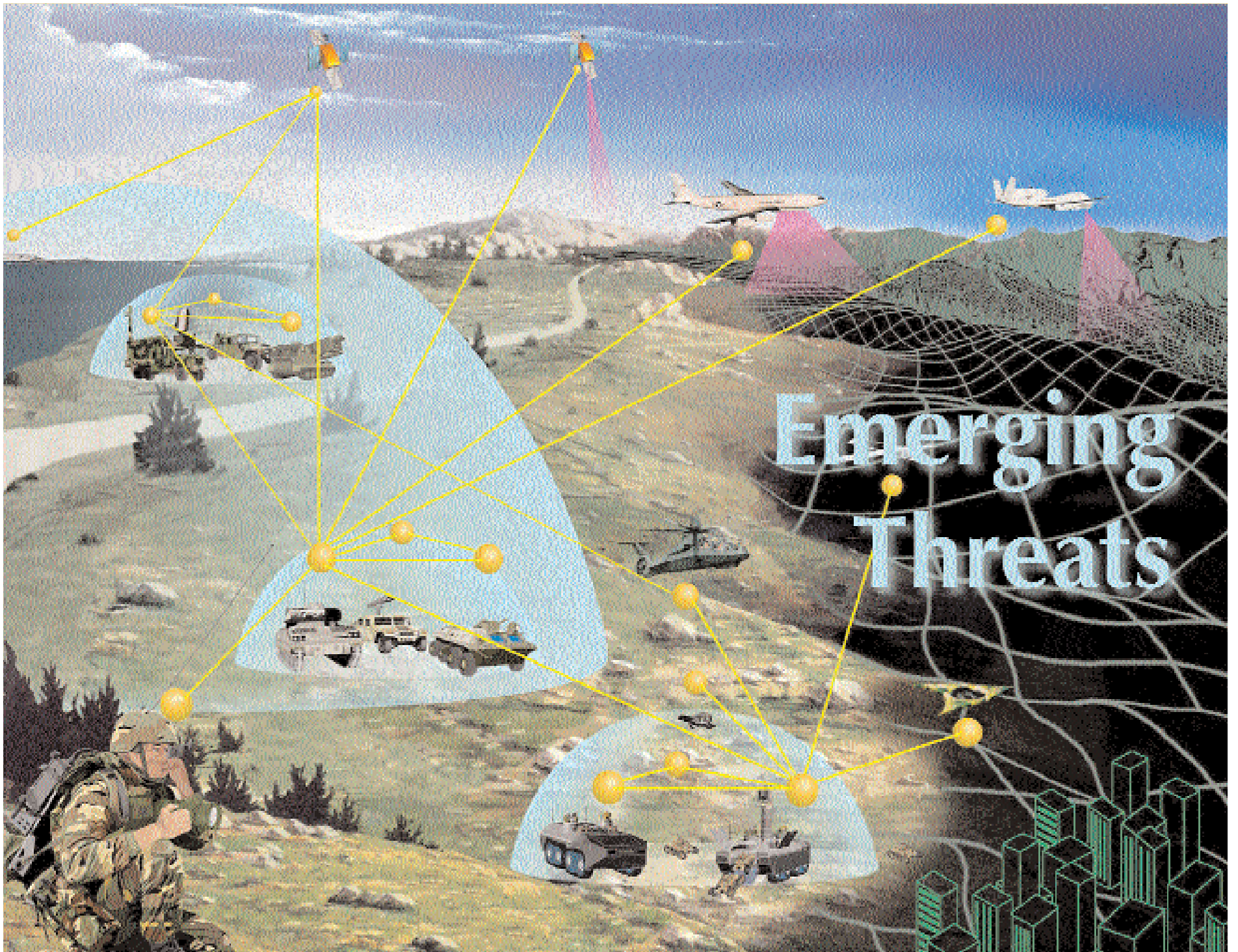
The AURA (Advanced UV Remote-Sensing Applications) ultraviolet laser-induced fluorescence lidar payload, designed for deployment on an unoccupied aerospace vehicle (UAV), successfully **detected a variety of known and blind releases** of biological warfare agent simulants in tests at Dugway Proving Ground, Utah. The AURA system discriminated between bio and non-bio releases. The AURA program also developed Ares, a new ground-based portable ultraviolet laser-

induced fluorescence lidar, for protecting high-value facilities or high-visibility events. Ares uses commercial off-the-shelf components as much as possible to reduce cost. (1100, 2300, 5700, 6100, 8100, 8300, 8400, 8900) W.R. Bolton, wrbolto@sandia.gov

μ ChemLab™/CBs are portable, hand-held chemical analysis systems incorporating “lab-on-a-chip” microfluid technologies for detecting chemical and biological attacks. The second-generation (Gen2), liquid-phase protein analyzer, using electrophoretic separations and optical detection, is being developed to **detect a broad range of biotoxin and viral agents**. Using a modular design, the Gen2 prototype contains two microseparation units that are easy to access and replace. Funded by DOE's Chemical and Biological National Security Program, the μ Chem-Lab™/CB Gen 2 prototype enables laboratory research and field testing. (8100, 8300, 8700) Art Pontau, aeponta@sandia.gov

The Embedded Reasoning Institute (ERI) is a multidisciplinary research program focused on distributed wireless intelligent sensing and monitoring technologies for weapon systems and emerging threat domains. This year ERI **demonstrated two complementary prototype wireless sensing systems** focused on hardware and/or software solutions to yield complete system development. The Hybrid Emergency Radiation Detector (HERD) project provided a rapidly deployable wireless sensing network in the hybrid microsystem arena. The Intelligent Monitoring and Analysis project provided decentralized software agent monitoring/control for weapon storage containers. (8100, 8200, 8900) Nina Berry, nmberry@sandia.gov

Advanced computer simulation and visualization were employed in a **powerful new interactive distributed simulation of urban terrorist attacks** using weapons of mass destruction. The capability embodied in the Weapons of Mass Destruction-Decision Analysis Center (WMD-DAC) integrates approaches to WMD defense by using simulations to: improve analyses of technology; create user-defined, realistic high-level exercises; allow better understanding of contextual insights; and improve planning and response. The WMD-DAC simulation is helping us design system architectures for wide-area nuclear threat detection and bio-attack detection and mitigation. (8100, 8900) Howard Hirano, hhhiran@sandia.gov



It is hard enough to watch where you step on a battlefield, but just try to watch what you breathe. This problem is addressed with the **SnifferStar™ chemical sensor** that mounts on a drone aircraft for remote surveillance of battlefield situations. Developed under a Shared Vision program with Lockheed Martin, the entire module weighs less than a golf ball and uses the motion of the craft to collect samples for analysis. SnifferStar is sensitive to both blister and nerve agents, but it ignores common interferents. (1700) Douglas Adkins, dradkin@sandia.gov

The Technology Demonstration 2 Flight Test, the objective of which was to **develop and demonstrate impact control technologies (position and attitude) important for hard-target penetration**, was successfully executed on July 27, 2002, when an F-16 carrying the flight test unit departed from Edwards AFB and released an inert bomb over Tonopah Test Range. The TD-2 unit flew a controlled flight profile using a GPS-aided inertial measurement unit to a pre-selected target point. It met

impact requirements. (15400) David Keese, dlkeese@sandia.gov

To mitigate risk in the development of the Army's Future Combat Systems (FCS) (see illustration above), a distributed network-centric system-of-systems, Sandia is leading an integrated team of DOE and DoD labs to **provide objective technical advice to the program office** at DARPA. This year, the team has used innovative analytical processes to address system-of-systems concepts and provide technical guidance on critical problems including assuring mobility in mined areas, assuring combat identification, and assessing vulnerabilities. We are teaming with Boeing, the lead systems integrator, on Block I implementation. (6100, 6400, 6500, 9200, 15200, 15300) Russ Skocypiec, rds kocy@sandia.gov

Sandia **fielded a next-generation inertial navigation system** for spinning vehicles in a National Missile Defense test. To meet program requirements, weight and volume were reduced to 7 pounds and 120 cubic inches, 50 percent lighter and smaller

than our previous roll-stabilized navigation system. This new system, known as the GLNMAC (Gimballed LN200 with Miniature Airborne Computer), was successfully flown on Instrumented Flight Test 9, launched from Vandenberg Air Force Base Oct. 14, 2002. (2300, 15400) Andrew Cox, abcox@sandia.gov

An Intelligent Mobile Land Mine (IMLM) system has been developed to address the needs of the Defense Advanced Research Projects Agency's Self-Healing Minefield Program.

The IMLM system **adds intelligence and mobility to anti-tank land-mines**

allowing them to detect and heal minefield breaches. The IMLM units feature a combustion-based hopping mobility system, radio communication and acoustic ranging. Collective behavior algorithms govern unit movement in response to minefield breaches. The ten-unit IMLM System successfully performed breach-healing missions at Fort Leonard Wood, Missouri in May 2002. (15200) Dan Schmitt, djschmi@sandia.gov



HARD-TARGET PENETRATION — On July 27, 2002, TD-2 was released from an F-16 aircraft flying over Tonopah Test Range; preliminary impact control results were very good.

Sandia's Rescue Recon team had a **record number of EMS and HAZMAT calls** in 2002. When the team was not helping Sandians, it assisted Kirtland and the FBI. Sandia's team also developed and taught chem-bio classes for UNMH. This year, new emergency equipment and training was acquired to better respond to terrorism. Sandia's responders attended radiation contamination classes and many more. In August, Rescue Recon flexed its muscles at

(Continued on next page)

Emerging threats

(Continued from preceding page)

the annual HAZMAT challenge in Los Alamos, placing third among 12 teams. Troy Hamby, thamby@sandia.gov

Sandia, Los Alamos, and Lawrence Livermore national labs teamed up to build a prototype for sustainable urban bio-surveillance and response systems. The prototype is the **Bio Defense Initiative Testbed** and is supported by the Defense Threat Reduction Agency and DOE's Chemical and Biological National Security Program. We developed the innovative airport surveillance architecture that used wireless intelligent modules, early warning detectors, and aerosol bio-detectors; led the task to unify the independent systems and local infrastructure; incorporated the Rapid Syndrome Validation Project; and conducted advanced architecture studies. (5300, 8100, 8300, 8700, 8900, 9100) Duane Lindner, dllindn@sandia.gov

We have developed materials and techniques for fabricating insulating microvalves that can control high-pressure fluid flow and high voltages in microchannels. These microvalves function by opening and closing the microchannels in response to electrical or pressure inputs. By generating a hybrid system composed of glass microchannels, porous polymeric elements, and high-dielectric-strength interstitial liquid, currents induced by high-voltage inputs may also be controlled. Together, these capabilities allow for modular integration of multiple electrokinetic and chromatographic analyses on a single glass chip. (8300, 8700) Art Pontau, aepona@sandia.gov



RESPONDING to threats to the mail.

In October 2001, a bio-warfare attack on the US homeland occurred, with the sudden appearance of anthrax-contaminated letters sent through federal mail, demanding an immediate counter. At the request of DOE, Sandia worked with the United States Postal Service, the Office of Science and Technology Policy, and other federal agencies to develop an immediate response with irradiation sanitization. Sandia's work included consultation to the federal agencies and industry, laboratory experiments and evaluations, radiation simulations, and continued system evaluations for the Postal Service. (15300, 8100, 2600, 1600, 1700, 3100, 5300) Bob Turman, bnturma@sandia.gov

Sandia delivered a space-qualified Radiation-Hardened Key Data Processor (RH-KDP) system design to the Air Force NAVSTAR Global Positioning System Joint Program Office. General Dynamics Decision Systems has integrated Sandia's design into a Selective Availability Anti-Spoofing Module (SAASM) for space vehicle applications. Sandia is the

Sandia human-centered control systems allow first responders to perform remote inspection and render-safe operations. Tests at the Army's Maneuver Support Center demonstrated that combat engineers and chemical technicians could successfully perform remote operations such as fuse removal, trip-wire cutting, and sample collection using commercially available equipment retrofitted with Sandia software. These tests were done without rehearsal, in the field, and with one hour of training with the equipment. Such operations typically require intensive training for one week or more. Phil Bennett, pcbenn@sandia.gov



REMOTE MINE locating and trip-wire cutting.



WITH TECHNICAL HELP from Sandia, the British Royal Engineers destroyed an Al Qaeda cave hideout in Afghanistan. The explosion was reportedly the largest the storied British unit has set off since World War II. (DoD photo)

sole supplier of NSA-endorsed terrestrial and space KDP designs, which implement the SAASM features mandated by the Joint Chiefs of Staff in order to enhance the security of all future military GPS receivers. (1700, 2300, 2600, 6500, 12300) Debby Kill, dljense@sandia.gov

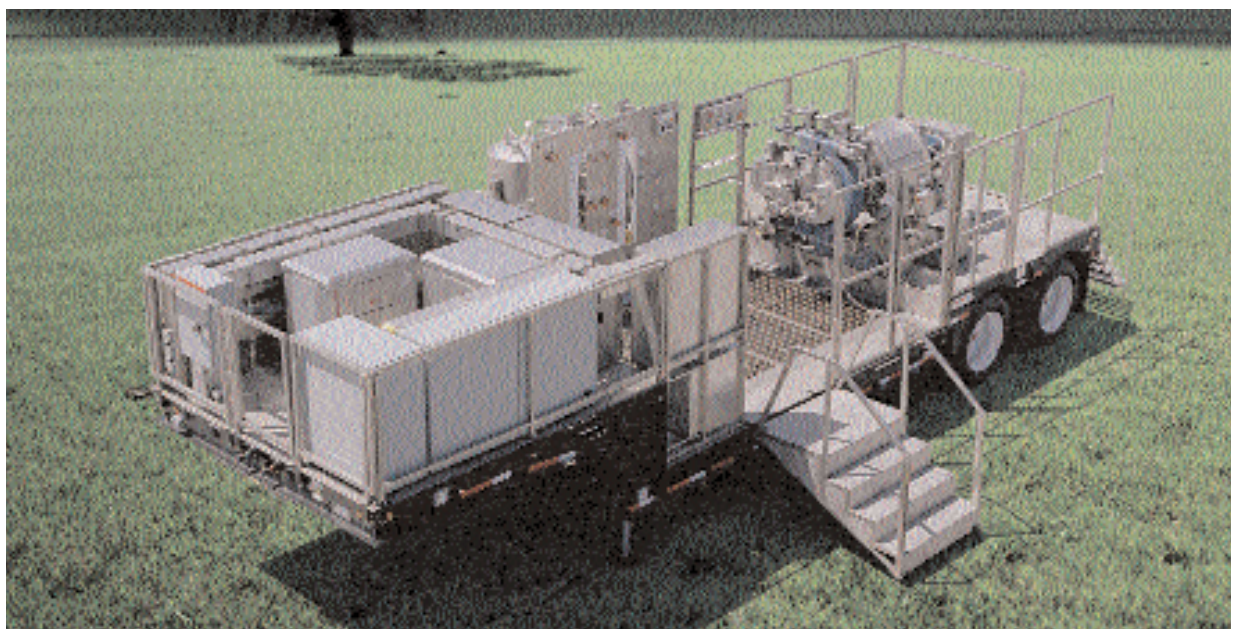
The Sandia targets team provided successful target objects for the Missile Defense Agency's flight test program. A Sandia target reentry vehicle was successfully intercepted over the Pacific Ocean in a March 15, 2002, flight test. In addition, Sandia fielded target systems for the West Coast Risk Reduction Flight and Glory Trip 180 (GT-180). GT-180 featured two new Sandia target designs that provided an opportunity for collection of exoatmospheric IR and RF signatures. (1000, 2000, 5000, 7000, 9000, 14000, 15000) Bruce Swanson, beswans@sandia.gov

Sandia's directed-energy group has successfully developed a highly compact high-voltage pulser capable of powering various directed-energy loads. The design uses Sandia's pulsed power experience and combines a battery-driven power supply and Marx generator in producing its output pulse. This development effort has resulted in a battery-driven pulser capable of delivering a 30 GW drive to a load. This extremely compact, lightweight, and rugged approach will enable many future directed-energy systems that require portable high-power drivers. (15300) Guillermo Loubriel, gmloubr@sandia.gov

Using technical assistance and advice provided by Sandia's Explosives Applications Dept. 15322 — including on-the-ground support from Dale Preece — the British Royal Engineers destroyed a cave complex on the border between the Paktika and Paktia provinces in Afghanistan on May 10, 2002. This Operation Enduring Freedom event was reportedly the largest explosion set off by the Royal Engineers since World War II. Rob Tachau, rdtha@sandia.gov

The US Army's Apache Recapitalization program is intended to reduce operating and support costs and improve readiness for the 700-plus units in use. Sandia has been requested to apply our reliability models and optimization tools to guide recapitalization investment decisions for a program that had a potential cost of \$600 million. Sandia's analyses has resulted in a recommendation that the program invest only \$150 million in specific subsystems, resulting in a \$183 million per year savings for the fleet, while increasing availability. Robert Cranwell, rmcranw@sandia.gov

We designed, fabricated, tested, and delivered to the US Army Nonstockpile Chemical Materiel program the second generation of Explosive Destruction Systems (EDS). The Army now possesses three operational systems ready to destroy legacy chemical warfare munitions wherever recovered in the United States that involve explosive quantities greater than one pound TNT equivalent. The fourth (and largest of the systems) can safely contain three-plus pounds of TNT equivalent and will now undergo Army tests at the Defence Science and Technology Laboratory in Porton-Down, England. (8100, 15300, 8700) Al McDonald, amcdona@sandia.gov



THE SECOND GENERATION of the Explosive Destruction Systems technology has been tested and delivered to the US Army.

Technology partnerships

The Extreme Ultraviolet Lithography Resource Development Center (EUVL RDC) is now fully "open for business" as a DOE Technology Deployment Center/User Facility. The Engineering Test Stand is the heart of the RDC; it is the world's only full-field scanning EUVL system, capable of printing 70-nm features over full 24x32 mm fields. Additional RDC capabilities include the Microstepper Laboratory, the Laser-Produced-Plasma Source Development Laboratory, and the Contamination Control Laboratory. Key customers of the RDC include semiconductor manufacturers, International SEMATECH, and semiconductor equipment manufacturers. (8700, 2300) John Goldsmith, jgold@sandia.gov

A new 5-year umbrella CRADA allows Sandia and a major industry partner to easily establish new collaborative projects to advance computer simulation tools and validation techniques for complex engineered systems. Based on a shared interest in computational mechanics, these projects are improving Sandia's code verification and model validation metrics that have direct application to nuclear weapons programs. The industry partner gains advanced technology tools for developing safer and better products faster and more efficiently. This CRADA is the seventh between Sandia and the



Sandia Science & Technology Park (SS&TP) attracted four new tenants in FY02. Applied Technology Associates moved into its new 15,000-square-foot facility in January, Sandia Laboratory Federal Credit Union and La Luz Early Childhood Center opened for business in their new 15,000-square-foot facility in August, and Sandians moved into the new 65,000-square-foot International Programs Building in August. Along the way, the SS&TP was recognized with a Piñon level Quality Award from Quality New Mexico for its processes and results in managing and developing the Park. (14000) Jackie Kerby Moore, jskerby@sandia.gov

partner since 1992. (9000,1300). John Kelly, jekelly@sandia.gov

The Shared Vision program formed by Sandia and Lockheed Martin Corporation in 1999 has continued to grow — doubling in size in CY02. This highly successful collaboration is applying technologies and systems developed by both organizations to the challenging defense and security threats of our changing world. Technologies with applications for both government and industry have included micro-electronics and photonics, sensors, robotics, situation and decision support modeling, cognition, and logistics. (1300, many others) John Kelly, jekelly@sandia.gov

The New Mexico Consortium for Bioresearch — recently formed by Sandia, the NM Department of Health, and UNM — unites New Mexico's unique multidisciplinary bioscience resources and talents to help create a healthier and safer world. In the wake of the 9/11 terrorist attacks, Sandia technologies helped decontaminate US mail and buildings; UNM's Disaster Medical Assistance Team spent a week treating victims on-site at the World Trade Center; and the NM Department of Health tested suspicious packages and provided public information during local anthrax scares. (1100, 1300) John Kelly, jekelly@sandia.gov

The MTR8500 is the **first commercial fiber optic transponder** to use 12-channel, 1.25 gigabit per second transceivers coupled to 12-channel fiber ribbon cable for short haul applications.



OPEN FOR BUSINESS — Sandia researchers work with the EUVL engineering test stand. The stand is the heart of the EUVL Resource Development Center.

This parallel channel approach, enabled by microsystems inventions in optical transceivers, flexible circuit boards, optical power control, opto-electronic housing and mounting, and optical coupling, has resulted in a transponder that can be manufactured for one-tenth the cost of other products. The project, an R&D 100 winner funded by EMCORE Corporation, also impacts Nonproliferation & Materials Control needs. (1700, 1800, 2300, 2500, 2600, 5700, 14100) David Peterson, petersdw@sandia.gov

The MESA Institute fosters relationships with US universities and professors that (1) leverage on-going Sandia microsystems work; (2) provide new opportunities to US students and professors; and (3) creates a pipeline of highly trained, potential new-hires for Sandia. Over two years the MESA Institute has sponsored 34 MESA Fellows from 22 universities, to work on-site at Sandia in 16 Sandia departments. Three of the four graduates have accepted job offers from Sandia. The MESA Institute is sponsored by the Microsystems Engineering Program and DOE's University Program. (1900) Regan Stinnett, rwstinn@sandia.gov

Manufacturing and production

Corporate Training and Development, in partnership with the Manufacturing Science and Technology Center, identified and benchmarked occupational and technical skill standards for the **Advanced Manufacturing Trades Training Program (AMTTP)**. The AMTTP ensures that Sandia's R&D organizations will remain viable and have world-class capacity to address mission success by providing an external pipeline of skilled workers. The AMTTP recruits and trains students in crucial trades disciplines of electronic fabrication, machining, and materials science. Phases consist of Mutual Education of Skills Training (MEST) and Specific Trades Training. (3500, 14100) Carla Forrest, cmforre@sandia.gov

A **Lean/Six Sigma kaizen [continuous improvement] event** focused on the MC4277 internal product acceptance process was held, with NNSA participation, by Neutron Generator Production Center 14400. The event resulted in reducing cycle time by 94 percent (29,310 to 1,766 minutes), touch time by 93 percent (5,305 to 385 minutes), pages of paper by 96 percent (578 to 26), and number of process steps by 70 percent (87 to 26). The estimated annual savings is \$203,000 per year. The process analyses and information from this event was also used to successfully request NNSA to discontinue their formal product acceptance process for the MC4277. (14400) Ruben Muniz, munizrb@sandia.gov

A one-year Production Staging Project was undertaken to **demonstrate the benefits of high-speed machining** in encapsulation mold fabrication. This technique maximizes metal removal rate and avoids tool chatter by taking advantage of the vibrational characteristics of standard machining tools. The molds were machined in 38 percent less time with 50

percent better surface finishes on average than called for without the use of hand polishing. Tolerances were within their design specifications. The decrease in machining time alone accounts for a 20 percent decrease in mold cost. (14100, 14400) Bernhard Jokiel, Jr., bjokie@sandia.gov

The Neutron Generator Production Center hosted the **first annual Neutron Generator Supplier Conference** last October. Conference objectives were to increase awareness of the nuclear weapons mission at Sandia, give suppliers a history of neutron generator production, and emphasize the importance of suppliers in this important national mission. The conference communicated performance expectations in the areas of quality and delivery. Nineteen commercial suppliers in the NG supply chain representing more than 80 percent of purchase dollars attended the conference, organized by the Purchase Material Team with the assistance of Supplier Relations. (14400, 10200) Lorraine Senaroudeau, lsenar@sandia.gov

Fundamental understanding of electrically induced strain development during the hot poling process has **solved a cracking problem in current stack production**. Results have led to a no-cost process change that improved hot poling yields from the low 60 percentile to greater than 95 percent, eliminated potential design changes to current stacks, and significantly reduced overall production costs. A high

level of sustained effort from the current stack team, combined with the above improvement, has helped reverse our inventory position, so that we are now significantly ahead of neutron generator production demand. (14100, 1800, 2500) Pin Yang, pyang@sandia.gov

Concurrent Design Manufacturing:

"Delivering Technically Challenging Hardware On Time & Within Budget Using Integrated Design and Manufacturing Capabilities."

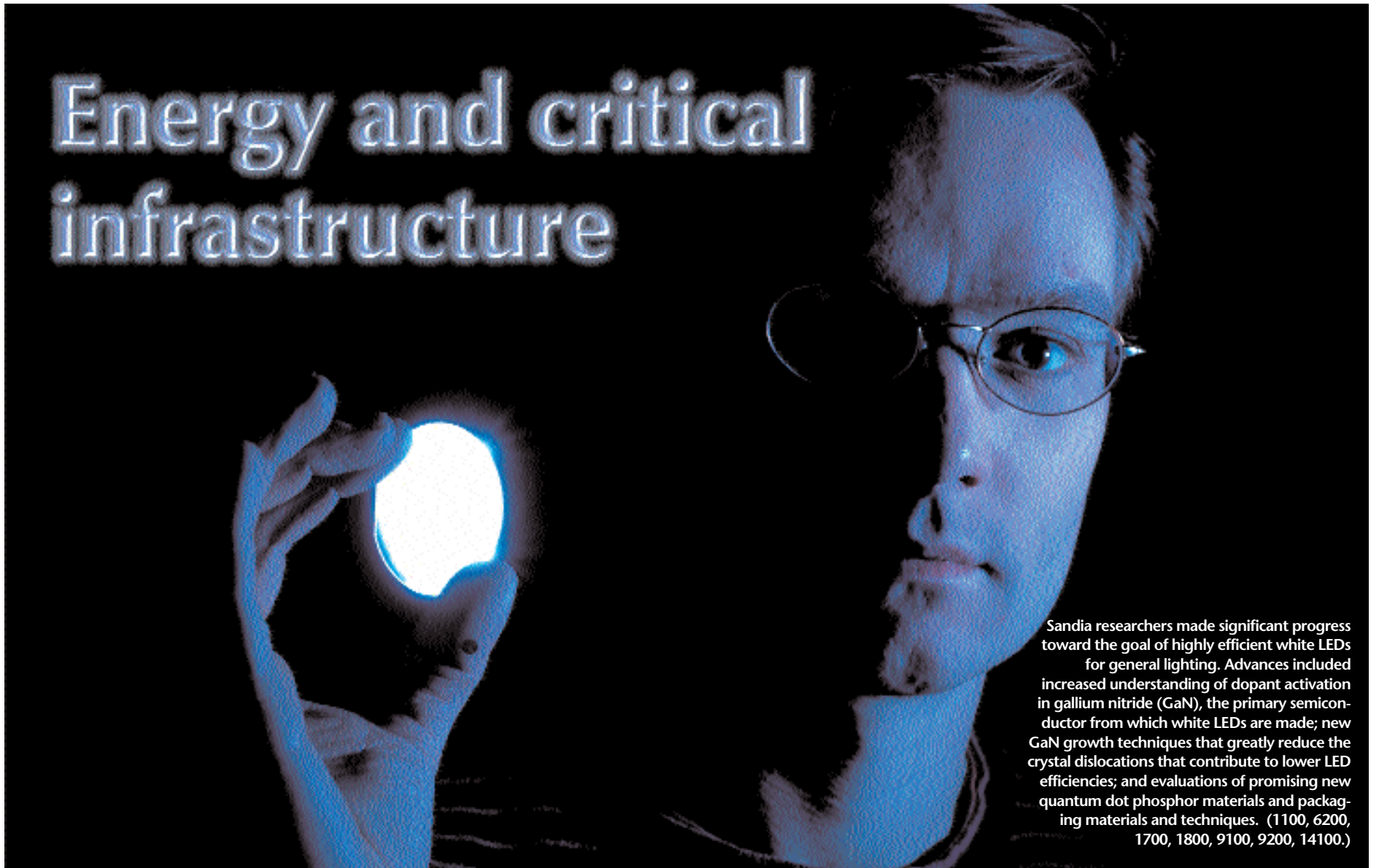
Our Accomplishments:

- Over 48,000 custom components delivered since 1991.
- Over 9,000 custom components fulfilled during the last 8 consecutive quarters.

CDM Technologies Include:

- Capacitors, Double-Layer Capacitors,
- Energetics, Frequency Devices, Magnetics,
- Microelectronics, & Power Sources.

Energy and critical infrastructure



Sandia researchers made significant progress toward the goal of highly efficient white LEDs for general lighting. Advances included increased understanding of dopant activation in gallium nitride (GaN), the primary semiconductor from which white LEDs are made; new GaN growth techniques that greatly reduce the crystal dislocations that contribute to lower LED efficiencies; and evaluations of promising new quantum dot phosphor materials and packaging materials and techniques. (1100, 6200, 1700, 1800, 9100, 9200, 14100.)

Sandia is working with industry, academia, and government to establish a national research initiative in solid-state lighting — the **Next-Generation Lighting Initiative (NGLI)**. Solid-state lighting refers to the use of light emitting diodes (LEDs) for illumination. LED lighting is as much as 10 times as efficient as incandescent and twice as efficient as fluorescent lamp technologies, while offering greater versatility and longer lifetime. Meeting the goals of the NGLI could reduce the nation's electricity consumption by 10 percent with significant environmental and economic benefits. James M. Gee, jmgee@sandia.gov

Community-based management of water resources is key to using every drop wisely. We have developed a **dynamic simulation model of the hydrology, demography, and economy** in the Middle Rio Grande Basin to help stakeholders understand the ramifications of trade-off decisions, from installing low-flow toilets to providing water for endangered species. Our cooperative modeling process bridges the technical demands and capabilities of a rigorous, quantitative model and the collaborative social processes required for community-based management. This process is already contributing to water sustainability in New Mexico and beyond. (6100, 6500, 5300) Erik Webb, ekwebb@sandia.gov



SANDIA RESEARCHERS are developing a variety of technical and systems approaches to helping communities deal with water issues. (Photo by Randy Montoya)

The Telemetry Technology Team demonstrated a wireless instrumentation system, which couples power and data, **allowing instrumentation of sealed containment vessels**. The power and data are coupled through the container walls via magnetic coupling between concentric coils inside and outside the canister. This technology supports the goal of ensuring safe transportation of nuclear materials and elimination of the costly individual container inspections. Bench testing has demonstrated the feasibility of transferring energy and data through multiple walls of stainless steel and lead. Future development will require high temperature electronics to measure hydrogen content, pressure and temperature, and add electronic identification to each containment vessel. (2600, 6100) Ron Franco, rjfranc@sandia.gov

Sandia scientists have **developed hydroxylated polystyrene film dielectrics** that have five times the energy density of commercial polymer film dielectrics at fuel cell vehicle operating temperatures. Sandia's breakthrough, funded by DOE's Office of Advanced Automotive Technologies, promises to substantially increase the fuel efficiency of fuel cell and electric hybrid vehicles. Enhanced fuel efficiency is a result of improved high-temperature performance and reduced size of DC Bus capacitors, the largest power inverter components. Capacitors have been fabricated in collaboration with TPL, Inc. and Brady Corporation. (1800, 1700) Bruce Tuttle, batuttl@sandia.gov

DOE's Office of Science has approved construction of a \$75 million **Nanoscale Science Research Center** jointly operated by Sandia and Los Alamos national laboratories. The project will construct a 90,000 sq. ft. core facility on Eubank Blvd. and a 30,000 sq. ft. gateway facility in Los Alamos. State-of-the-art tools and expertise for integrating the world of nanoscale materials and devices with micro and macro technologies will be available to university, industry, and government laboratory researchers. (1040) Terry Michalske, tamicha@sandia.gov

With less budget than most Sandia projects have for travel, a small but dedicated group led by Sandia

accomplished what at least three other large companies with tens of millions of dollars could not: **demonstrate a commercially viable dish/Stirling system**. This first-ever Sandia integrated solar thermal system is the first to ever demonstrate remote, unattended operation, high availability, low operation-and-maintenance cost, and high efficiency. A number of potential customers, including the



SOLAR THERMAL systems are becoming a viable power source in remote areas for water-pumping and village electrification.

Navajo Nation, are interested in the system for remote water pumping and village electrification. (6200) Richard Diver, rbdiver@sandia.gov

Russia's Kurchatov Institute President Evgeny Velikhov spent two days at Sandia, where he was briefed on a variety of nuclear-related technologies. As a result of the visit, scientists at Sandia and the Kurchatov Institute prepared a paper on the global future of nuclear energy. The paper served as a point of departure for policy makers in Russia and the US and resulted in a Summit press release during the Bush-Putin Summit Conference in Moscow in 2002. During the summit, Presidents Bush and Putin established a group to identify areas of potential collaboration on advanced nuclear fuel cycle research and development. The group presented its recommendations

(Continued on next page)

Energy and critical infrastructure

(Continued from preceding page)

within 60 days. Implementation of the recommendations will be in keeping with US nonproliferation goals. Thomas Sanders, tlsande@sandia.gov

To create the nation's first high-level waste and spent nuclear fuel geologic repository, the Nuclear Waste Policy Act requires a site recommendation from the Energy Secretary, with congressional concurrence and presidential approval. The Secretary's site recommendation of Yucca Mountain this past summer **could not have gone forward without Sandia's technical contribution** to the site characterization and performance assessment. Sandia directly contributed to a monumental body of work with defensible analyses of site performance, for a decision of national importance affecting America's national and energy security. (6800, 6100) Andrew Orrell, Sorrell@sandia.gov

Because of recent design changes to the repository for Yucca Mountain, a large portion of the underground storage area was moved into a rock unit that previously had not been explored and was found to contain numerous large voids (termed lithophysae). **Mechanical data for this rock unit were urgently needed** for the design to proceed, presenting a significant testing challenge. We developed a unique approach to the problem, including a field test that mechanically stressed a large tendon of rock between two slots cut in the wall of the tunnel. (6100, 6800) Laurence Costin, lscosti@sandia.gov

Two days after Sept. 11, 2001, a **classified assessment of nuclear power plant vulnerability to aircraft threats was conceived and initiated**. Less than four months later, a systems assessment of nuclear power plant vulnerabilities was completed. The multicenter, multilab team proactively engaged the Nuclear Regulatory Commission to carry out innovative analyses to better understand the conse-



GETTING THE DRIFT — An engineer at the Yucca Mountain project in Nevada checks out a tunnel at the proposed nuclear waste repository. Sandia researchers are helping understand the mechanics of rock structure in new areas of the project.

quences of specific terrorist threats on nuclear plants. Two ongoing, plant-specific vulnerability assessments are refining insights gained in the initial study. (6400, 9100, 9200, LANL) Robert D. Waters, rdwater@sandia.gov

The National Infrastructure Simulation and Analysis Center (NISAC) has become a key element in the national effort to protect critical infrastructures such as electrical power grids, natural gas and oil systems, telecommunications, etc. NISAC, a Sandia-Los Alamos partnership, was congressionally chartered in the USA Patriot Act of 2001 and is being incorporated into the Department of Homeland Security. NISAC is developing models and simulations of critical infrastructures, their interdependencies, and the downstream consequences of attacks in order to identify and resolve critical vulnerabilities. (6500) Steven Rinaldi, smrinal@sandia.gov

Sandia's College Cyber Defender Program has **successfully created a group of highly qualified cyber security professionals**. University students work on research projects and security technologies relevant to Sandia's mission. For example, participants recently improved a commercial security product through the application of a novel graphical security analysis tool developed in the program. Twenty-two students from 17 universities participated in this summer's program. This CCD is a Labs-wide program with support from 5000, 6000, and 9000. Robert Hutchinson, rlhutch@sandia.gov

The **Distributed Energy Technologies Laboratory (DETL)** was created to assist the development and implementation of distributed energy resources (DER). Energy security is among the benefits that DER offers to the nation's critical electric power infrastructure. DETL tests microturbine, engine-generator, photovoltaic, fuel cell, and energy-storage technologies both individually and in a collective microgrid. Collaborators include manufacturers, utilities, DOE, DOD, the California Energy Commission, universities, standards organizations, and other national and private laboratories. Sandia's Advanced Information and Control Systems Dept. 6517 employs DETL in its information security efforts. (6200, 6500, 2500, 10800) Jerry Ginn, jwginn@sandia.gov

In collaboration with Cornell University, the University of Massachusetts, and Lawrence Berkeley National Laboratory (LBNL), we have constructed and demonstrated a **new instrument for studying flame chemistry**. The ability to detect combustion species without modifying them during the detection is critical. The Advanced Light Source at LBNL provides tunable vacuum ultraviolet (VUV) light that permits us to gently ionize large molecules without fragmentation, enabling mass spectrometric detection. Tuning the VUV light enables unique identification of chemical species by ionization energy as well as mass. (8300) Andrew McLroy, amcrlr@sandia.gov

Following the terrorist attack on the World Trade Towers, Sandia was asked to assess the impact of such a threat on numerous NNSA, DoD and NRC facilities. The assessment team was responsible for developing the methodology to quantify the structural response and consequence of any fires that might ensue. This endeavor **brought to bear unique technical expertise**, state-of-the-art computational tools, and a unique experimental infrastructure to address a problem of national importance. This clearly exemplifies the uniqueness of the national labs in their ability to respond immediately to a technically challenging problem of national significance. (9100, 9200, 5800, 6400) Jaime Moya, jlmoya@sandia.gov

A 12-year program for the US Nuclear Regulatory Commission and the Nuclear Power Engineering Corporation of Japan was concluded by pressurizing a 1:4-scale model of a pre-stressed concrete

containment vessel for a nuclear power plant in Japan to over three times its design pressure before it burst. Sandia installed 1,500 sensors on the model to record the structural response, performed analyses, and conducted several pneumatic pressure tests prior to the final structural failure test. The insights provided will improve confidence in the analytical models used to predict the response of actual containments. (6400) Michael Hessheimer, mfhessh@sandia.gov



INTENTIONAL RUPTURE of a prestressed concrete containment model is helping development of computer models.

The Information Operations Red Team and Assessments™ (IORTA™) program performed numerous cyber system assessments, evaluations, and vulnerability experiments for a broad range of prototype through operational systems. Customers include civilian government agencies, the DoD, industry, and critical infrastructure assets including electricity, communications, water, oil and gas. IORTA's Red Team component, the Information Design Assurance Red Team (IDART™), a 2001 Sandia Gold President's Quality Award Winner, worked with an industry partner to help protect against industrial espionage and improve the security of manufacturing processes. See www.sandia.gov/iorta/

Purification of our saline water (more than 97 percent of this planet's water) could provide relief to a growing demand for fresh water that already outstrips supply in many parts of the world. Sandia, in cooperation with the Bureau of Reclamation, has taken a two-pronged approach: 1) A desalination R&D roadmap defining a path through the year 2020 that will support solving our water supply-related needs by advancing the state-of-the-art of water desalination; and 2) Design of a research facility in the Tularosa Basin to test and evaluate novel desalination technologies. (6100, 6200, 1000) Thomas Hinkebein, tehinke@sandia.gov

Pulsed power

The Z pulsed-power generator became a nationally recognized capability for dynamic materials research as the team received a 2002 DOE Excellence in Weapons Research award. Progress continued with the achievement of a 28 km/s flyer plate velocity, publication of new deuterium equation of state data, and several material dynamics experiments relevant to stockpile stewardship. Most notably, experiments were performed to investigate the effects of irradiation damage on material properties, and a containment system to enable testing of hazardous materials was demonstrated. (1600, Los Alamos, Lawrence Livermore) Christopher Deeney, cdeene@sandia.gov

Inertial confinement fusion (ICF) capsule implosions in z-pinch dynamic hohlraums on Z have produced the first clearly measured neutrons and X-ray images of imploded fuel symmetry. Spectra from argon dopants confirm that the deuterium fuel reached temperatures found at the center of the sun (~11 million °C). ICF capsules in the double z-pinch geometry on Z have been imploded to less than 1/2000 of their original volume, implying a radiation-drive symmetry that scales to within approximately a factor of two of high-yield requirements. (1600) Tom Mehlhorn, tamehlh@sandia.gov

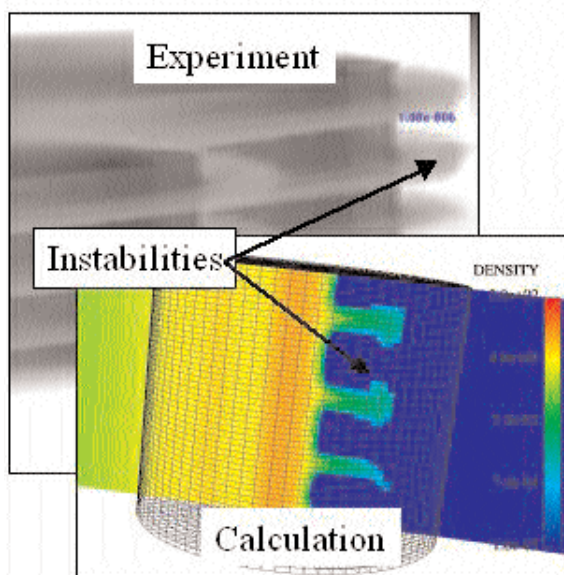
Computing and computational sciences

The DOE Office of Science's new Genomes to Life Program announced five projects in 2002, including the Sandia-led project, "Carbon Sequestration in *Synechococcus Sp.*: From Molecular Machines to Hierarchical Modeling." This effort is focused on developing new algorithms, simulation methods and software, and computing infrastructure for computational biology applications. The project also includes an experimental biology investigation to obtain necessary data as well as to prototype the computational biology capabilities on *Synechococcus*, a marine microorganism important in the global carbon cycle. Eleven institutions, including Sandia, are participating in this \$19.1 million effort over three years. Grant Heffelfinger, gsheffe@sandia.gov

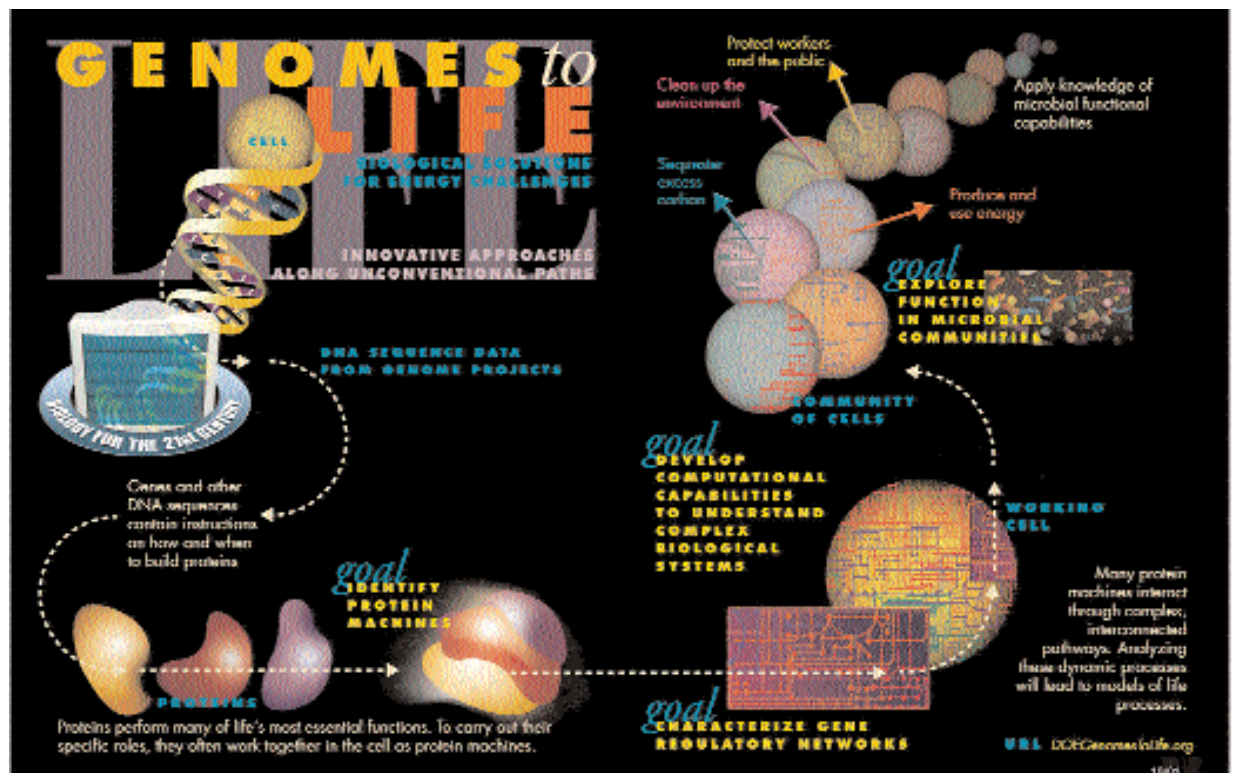
The next generation of secure videoconferencing was deployed on Sept. 23, 2002. Using new Internet Protocol-based videoconference appliances, the capability reaches all nuclear weapons complex sites over the Accelerated Strategic Computing Initiative's SecureNet computer network. Sandia developed and deployed this capability to provide a more reliable, scalable, and functional communications resource. This event met a significant Advanced Design and Production Technologies milestone by demonstrating the first secure multipoint videoconference among Sandia, Kansas City, Pantex, and Oak Ridge Y12. The next steps will be to include high-resolution data collaboration, large multipoint support, and more sites. (8200, 8900, 9900) Jim Berry, beri@sandia.gov

Classified information sharing with Nuclear Weapons Complex partners via electronic access is growing: 1) Need-to-Know groups and policies coupled with application architecture enhancements enable application deployment and information sharing across the complex; 2) Classified Drawing Viewer provides desktop access to product structure and product drawings; 3) Web FileShare enables the electronic sharing of classified project information, including video streaming; 4) Record of Assembly provides desktop access to weapon system and component assembly traces. This enables engineers to perform orderly analysis of current and historic weapon system configurations. (2900, 9300, 9500, 9600) Gary Rivord, gerivor@sandia.gov

A Three-Dimensional Resistive MagnetoHydroDynamics (3D-R-MHD) option has recently been implemented in the Sandia ALEGRA code and used to simulate z-pinch wire array implosions at a level of detail never before attempted. ALEGRA is being developed as part of the ASCI Applications program, and uses the Nevada finite element code framework. The new 3D-R-MHD modeling capability in ALEGRA is crucial for capturing the Rayleigh-Taylor instabilities that occur in z-pinch wire array implosions, which in turn are critical phenomena in determining the resulting radiation pulse generated in the Z machine. (9200) Paul Yarrington, pyarrin@sandia.gov



ALEGRA 3D resistive magneto-hydrodynamic simulations showing observed and calculated instabilities in z-pinch wire implosion event.



Sandia's Classified Network (SCN) underwent major enhancements this year: 1) the SCN internal and external connections were made more reliable by implementing network analysis and monitoring tools; 2) Cross-complex messaging, document management, and group authorization became a reality; 3) Eight new engineering and manufacturing applications were put into production; 4) New storage architectures, backup



RENDERING OF DISL BUILDING under construction at Sandia/California. View is from the SE looking across the center of the Tech Area.

processes, and systems monitoring procedures made these capabilities possible; 5) Customer interactions with the infrastructure were improved via enhanced jumpstart pages, training, searching, and look-and-feel as well as help desk support. (2900, 8900, 9300, 9500, 9600, 9700, 9800, 9900, 14400) William Swartz, wdswart@sandia.gov

Laser welding process models, developed through computational (9100) and experimental validation (1800) efforts, were applied in FY02 to improve processes used in nuclear weapons components. Research into the physics of laser welding processes, to ultimately predict the shape of the final weld, has been a multiyear effort that was introduced to the customer base at Sandia and the Kansas City Plant for the first time this year. The model has been incorporated in the KCP process simulator and is currently being used in AF&F design. (9100, 1800) Justine Johannes, jejoan@sandia.gov

Sandia's Restricted Network (SRN) got a facelift this year. Our need for improved reliability and bandwidth has culminated in a significant upgrade to the core of the SRN and to many high-end user desktops. The team designed and implemented a new scalable gigabit Ethernet core and distribution layer for the SRN and implemented gigabit Ethernet to the desks of many ASCI code developers and analysts. This work is part of a longer-term direction funded by the IES to improve reliability and the ASCI program to support high-band-

width needs. (9300, 9200, 9100) Michael Sjuln, mrsjuli@sandia.gov

Many of Sandia's important calculations concerning nuclear weapons stockpile issues run on the fastest computer available, the 10 TeraOps ASCI White supercomputer at Lawrence Livermore National Laboratory (LLNL). These calculations depend on the transmission of multi-gigabyte data files between LLNL and Sandia. Recent network engineering activities have doubled the routine file transfer performance to 100 MBytes/sec between the two sites by reducing or eliminating network bottlenecks. This accomplishment increases the productivity of Sandia engineers and scientists by reducing the time they have to wait for results. (9300, 8900) Larry Tolendino, lftolen@sandia.gov

Electronic and microelectronic components are critical to Sandia's nuclear weapons mission. Yet we have until now been hindered by the lack of powerful simulation tools in this area such as we have for mechanical systems. Existing industry codes lack the scalability to attack large problems and do not deal with radiation-hardened components. To fill this gap, a new massively parallel circuit modeling code, Xyce, has been developed and released. Xyce has been applied to the rad-hard Pentium adder and multiplier subcircuits and has been used to analyze a series of nuclear weapons circuits. A technical advance for parallel circuit simulation has been filed. (9200, 1700) Sudip Dosanjh, ssdosan@sandia.gov

Regarding Red Storm (see entry/illustration on page 4), in addition to working with Cray to build the new 40 TeraOps supercomputer, the Simulation Enabled Product Realization (SEPR) program initiated construction of three major facilities: the Distributed Information Systems Laboratory, the Joint Computational Engineering Laboratory, and the Supercomputing Annex. These key facilities and infrastructure are necessary to realize the SEPR vision of model-based product realization. (9900, 8500, 9100, 9200, 9300, 10800)

Sandia's Technical Library in December 2001 established the Cyberlibrary in the Bldg. 858 mezzanine; there, library staff are providing "high tech/high touch" information services, working with Sandians to best use digital resources such as electronic full-text journals, indexes, abstracts, standards, and the like available through the Library's Web site (<http://infoserve.sandia.gov>). The Cyberlibrary's advice is "... if you are searching more than 15 minutes on the Internet without success ... you are 'lost in (cyber) space.'" The Cyberlibrary provides computer workstations, comfortable chairs — but no paper! (9600, 1700) Julie Kesti, jakesti@sandia.gov

HR and finance

Sandia had **another banner hiring year** with more than 1,400 new regular and temporary employees joining the Labs. Approximately one-third of those were hired into the Student Internship Program (SIP). Sandia/NM had a 91.2 percent acceptance rate with 575 new hires. Sandia/CA had a 81.5 percent acceptance rate with 75 new hires, reflecting the tougher California market. As part of Sandia's goal to leverage the student internship program as a pathway for identifying future Labs talent, 84 of the new regular hires are former SIP interns. Susan Harty, slharty@sandia.gov

HR Information Systems made a number of **customer-focused enhancements** during FY02 that include changes to the Pension Calculation tool to reflect the provisions of the new plan, enhanced "Graphalyzer" functionality to support Lab Workforce Planning, a Mission Critical Designator system to facilitate base access during times of high security, and a major upgrade to PeopleSoft that is Web-enabled and supports the integrated view to "My Benefits/My Rewards," allowing employees access to their customized suite of "total rewards." (3500, 3300, 9500) Ed Saucier, saucier@sandia.gov

Three **highly successful negotiations with Sandia's labor organizations** (Security Police Association – SPA; Metal Trades Council – MTC; and the Office and Professional Employees International Union – OPEIU) were completed this past year. Highlights included: Revised work schedules with substantial cost savings — SPA; The resolution of major Trades Plan issues and introduction of a modified skills-based pay pilot for Neutron Generator Production — MTC; Establishment of a pilot program to reward classified document station custodians for handling high volumes of documents and the introduction of two new orientation/training programs for Tier employees — OPEIU. (3500) Julian Sanchez, jpsanchez@sandia.gov

The long-awaited **pension plan changes were announced** to employees upon approval from DOE and NNSA in a letter from Paul Robinson on Feb. 13, 2002. The change adjusted the pension formula for non-represented employees who retired after 12/18/2000. A 15 percent ad-hoc increase for employees who retired before 12/19/2000 was also approved. Comparable changes were made in the Pension Security Plan for retirees and represented employees. The approved package included changes to retiree and survivor health care plans that became effective Jan. 1, 2003. (10300, 3300) Rebecca Statler, beckymc@sandia.gov

Sandia's Occupational Health Program **formalized a disease management strategy** to reduce the morbidity and mortality associated with diabetes, heart disease, obesity, and depression. Multidisciplinary teams of health professionals provide comprehensive interventions that coordinate onsite and offsite health resources, making the best standard of patient care accessible at the workplace. As demonstrated by the success of Sandia's Diabetes Clinic pilot program, many complications of disease can be prevented with an integrative approach that combines health education, diet, exercise, and new pharmacological practices. Gigi McKenzie, gmcken@sandia.gov

Continuing changes in the travel industry and an increasing number of Sandia new hires highlighted the need for a **single location for travel information and guidance**. The Integrated Sandia Travel Page on Sandia's internal website has taken information from more than a dozen departments and consolidated it into one travel homepage for travelers. Information can be found for anything from airlines to rental cars to foreign travel requirements. There are two step-by-step walkthroughs, one for standard travel and one for foreign travel to guide new or infrequent travelers through the travel process. (10500, 5300, 10200, 3100) Bonnie Apodaca, blapoda@sandia.gov

Following a kaizen (continuous improvement) event, Sandia's internal Foreign Travel Request System **streamlined and improved our Foreign Travel process** by decreasing the number of required approvers from more than 10 to just two approvals per request. In addition, a new process was developed to collect Actual Cost Data (ACD) from a traveler's expense voucher. This improved Lab productivity and

Community outreach

Sandians donated more than 87,000 hours to a diverse range of volunteer efforts in the community during 2002, and collectively contributed through payroll deductions more than \$2 million — again — in California and New Mexico to local United Way and other charitable agencies.

Community Involvement implemented the very successful Family Science Night program. **More than 1,300 students and their families enjoyed an evening of hands-on science activities** at 22 local elementary schools. The goals of the program are to stimulate excitement and interest in science among children and their parents and to get parents involved in the educational process. English and Spanish instructions, along with all the materials, are provided. Sandia will host more than 40 Family Science Nights during the 2002-2003 school year. For more information, visit www.sandia.gov/ciim/ASK/html/elementary/familynight.htm (12600)

How do science teachers find an expert? How can students learn about an experiment? How can interested volunteers learn about outreach activities? Just ASK! **The Adventures in Science & Knowledge website** at:

<http://www.sandia.gov/ASK> answers all these questions and more. ASK provides a single location for students, teachers, volunteers and others

to access information about education outreach activities from a variety of Sandia organizations. "We believe this site will be invaluable to educators and students across New Mexico," says Michael DeWitte, deputy director for the Labs' Corporate Outreach group. (12600)

The National Atomic Museum relocated to Old Town Albuquerque in May 2002. The Summer Science

Camp, a partnership with the Albuquerque Hispano Chamber of Commerce, the Hispanic Cultural Center, and the National Atomic Museum, expanded once again this year to include four locations and more than 400 campers, including many who attended on scholarships. The Up'N'Atom outreach van presented more than 200 programs to schools and organizations in southern New Mexico. The museum hosted several cultural diversity programs, lectures, and special events for the community. (12600)



SANDIA AND LOCKHEED MARTIN were honored last year with the Presbyterian Healthcare Foundation Award of Excellence. During the award ceremony, Labs President C. Paul Robinson (at lectern) accepted the award on behalf of the Labs while then-NNSA Administrator Gen. John Gordon (at far left) and Lockheed Martin official John Freeh (center foreground) look on. More recently, Sandia and Lockheed Martin, along with Lockheed Martin's Technology Ventures Corp., were named the Corporate Partner of the Decade by the Albuquerque Hispano Chamber of Commerce.

decreased the hassle for travelers by eliminating unnecessary administrative requirements. Since travelers are already required to submit expense vouchers, they no longer have to submit ACD data separately. (3100, 9500) Samantha Flores, sflores@sandia.gov

The Security Oversight and Requirements Review Team has **achieved great success with its Security Topics website**. This series of timely security-related topics regularly includes cross-cutting issues (e.g., ES&H) and cites requirements, lessons learned, Porcelain Press articles, self-assessment questions, etc. Relevant information is presented in a variety of ways, including videos, puzzles, and other fun ways to learn about serious matters. The first topic, "Vouching," was viewed by more than 2,000 people. Feedback indicates that this is an effective method of communicating issues. Security Topics website: http://security/security_topics.htm (3100) Adele Montoya, amontoya@sandia.gov;

The **new Financial Reporting System (FRS)**, developed in partnership with our customers, deals with the issues of report fragmentation, speed of access, and data incompleteness. The new FRS has a user-friendly Web interface (titled Reportville). Financial reports for projects, programs, SBUs, and organizations are being automatically generated every weekend, and are available Monday morning. These reports include summary-level information down to detail-level information — everything a manager needs to manage financial aspects of their projects. Try out the new site by typing Reportville in your Web browser. (9500, 10500)

The Quality-Significant Procurement Program was **designed for all purchases determined critical** because of potential consequences if they fail (harm to people, property, or the environment). This Quality Assurance Procurement Program is based on a system of logical graded approaches in accordance with the risk faced when considering what is being purchased, and how and where it will be used. Online job aids and instructor-led training are available. We once benchmarked other DOE sites; we are now looked at as the DOE benchmark in this area. (10200) Lynne Adams, ladams@sandia.gov

Shopping for common use items has become easier for both Sandia and its Just-in-Time suppliers. Sandia has implemented iProcurement and the iSup-

plier portal. Oracle's iProcurement is self-service requisitioning software with an intuitive, Web shopping interface. It is a key component of the complete Internet-based procure-to-pay solution that helps your employees process requisitions, purchase orders, RFQs, quotations, and receipts quickly and efficiently. The iSupplier portal gives suppliers complete visibility into the procure-to-pay process. Suppliers can perform common business functions, including reviewing purchase agreements and verifying receipts. Both are saving time and money. Gary Concanon, concan@sandia.gov

A partnership of the Computer Support Units (CSUs), the Procurement organization, and DOE led to **successful implementation of a new contract** for staffing CSUs. The key to success was the proactive, value-adding approach taken by all the partners in planning, creating, and reviewing this complex, time-critical, innovative contract. The transition from the previous contract, involving addition of a new company and rearrangement of several CSUs, was accomplished with minimal if any perturbation of customer service. (9600, 10200, DOE) Charles Shirley, cshirle@sandia.gov

In partnership with our customers and stakeholders, **the ISO 9000 Program led an effort** to support them in the area of ISO 9001:2000 training and Business Management System (BMS) development/implementation. By using the ISO 9000 standards and process-based model our customers were able to integrate all of their customer requirements into one BMS. This helped our customers to better understand, use, and measure their business processes, objectives, measures, targets, and customer satisfaction to improve how they fulfill customer requirements, develop and deliver their products and services, and enhance supplier chain management. (12100) Phil Rivera, fariver@sandia.gov

We developed a Sandia assurance model to help beneficially change the governance relationship between Sandia and NNSA. At the core of assurance is self-assessment, augmented by independent assessment, Web-based insight into laboratory performance, oversight by Sandia management, and periodic reports to the Board of Directors. (12100)

Environmental remediation and environmental excellence

The Radioactive and Nuclear Materials Disposition Department at the Radioactive and Mixed Waste Management Facility in Tech Area 3 began evaluating a **promising technology to treat radioactive mixed wastes** that contain certain toxic metals. This treatment, called macroencapsulation, involves using molten polyethylene to seal the waste items into a monolithic block. Wastes treated in this manner can then be disposed of in a DOE or NRC-licensed landfill. The polyethylene, which completely surrounds the waste, prevents any toxic wastes from leaching from the landfill and possibly into groundwater. (3100) Jim Thompson, jthomp@sandia.gov

The **Pollution Prevention program supported five Sandia organizations** in implementing Environmental Management Systems using the State of New Mexico's demanding Green Zia Environmental Excellence Program criteria. The five organizations received recognition from Gov. Gary Johnson through the Green Zia program for Environmental Excellence: Sandia's Fleet Services, Manufacturing Science & Technology Center, Environmental Restoration program, and Custodial Services received Achievement awards; the Neutron Generator Production Facility received a Commitment award. (3100, 10200, 14400, 10800, 14100, 6100) Jack Mizner, jhmizne@sandia.gov

In earning its Green Zia award, whose criteria include efficiency, waste reduction, energy conservation, employee involvement, community interaction and environmental compliance (see above), **Fleet Services won praise** from judges for its avoidance of some \$31,200 per year in waste disposal costs and a reduction in total waste generated. (10200) Charles Kearns, cvkearn@sandia.gov

And speaking of Green Zia, Neutron Generator Production Facility and the Advanced Manufacturing Processing Laboratory team members were also

winners. The Green Zia program recognizes organizations that adopt systematic, business-based approaches to environmental excellence performance. The same activities that make an organization successful financially can also make it a great organization environmentally. **Centers across Div. 14000 have demonstrated significant reductions in pollution and waste**, providing a safer and healthier workplace for employees, and a better environment for the community. (14100, 14400) Max Saad, mpsaad@sandia.gov

Sandia's **Industrial Hygiene Analytical Chemistry (IHAC) Laboratory received accreditation** by the American Industrial Hygiene Association (AIHA) last June. This gives Sandia an on-site facility to analyze industrial hygiene, environmental, and customer-specific samples using validated methods, strict quality control, state-of-the-art equipment, and trained and qualified personnel. Accreditation involved developing and implementing laboratory capabilities and a laboratory quality assurance program that met the requirements of DOE, the AIHA and ISO/IEC 17025 (an International Organization for Standardization/International Electrotechnical Commission policy). (3100) Melecita Archuleta, melarch@sandia.gov

The Purchasing Green Team was recognized this year with a **White House "Closing the Circle" award from President Bush**, the DOE National Pollution Prevention Award, and the Sandia President's Quality Turquoise Award. These awards cited the Green Team's accomplishments in developing an environmentally preferable purchasing program, demonstrating Sandia's dedication to the preservation of our nation's limited natural resources. Before the implementation of the Green Team, Sandia's compliance with DOE's environmentally preferable purchases was below 40 percent. Since the inception of the Green Team, Sandia's compliance has risen to above 85 percent. (6100, 10200) Jimmy Romero, jromero@sandia.gov

Facilities, including maintenance and space management

The **Model Validation and System Certification Test Center (MVSTC)** project upgraded the communications infrastructure in Technical Area 3 and remodeled an 18,600-square-foot building housing office space, light laboratories, command/control centers, data management, computing, 3-D visualization, video editing, dark room, and video conferencing capabilities. The project, the first in a series of efforts to revitalize Sandia's full-scale environmental test operations, significantly expanded Sandia's programmatic testing capabilities. MVSTC was the first line item to use a design/build contracting methodology and was completed on time within budget. (9100, 9300, 10200, 10800, and 12300) Lynne Schluter, lhsclu@sandia.gov

Institutional General Plant Projects (IGPPs) have become an invaluable tool for providing critically needed office space. Sandia has used indirect funds to complete two new IGPP buildings in the last year. Thanks to a design/build contracting strategy, the first building was designed, built, and occupied in less than eight months and the second in six months. The teaming of Facilities, the contractor, and other Integrated Enabling Service (IES) providers such as procurement, security, and communications was critical in completing these projects in record time. (3100, 9300, 10200, and 10800) Lynne Schluter, lhsclu@sandia.gov

Sandia/California completed its first design/build

(for more on design/build, see entries immediately above) construction project on site, Bldg. 960. Design/build allows Facilities Management to **complete projects faster and for less money** than the traditional design-bid-build approach. A preliminary design based upon a pre-engineered building was provided to design/build contractors for bidding. The successful contractor clarified the requirements, provided a price, and began work before design was completed. The final product was an attractive, energy-efficient, competitively priced building that can stand as a model for other sites within DOE. Howard Royer, hjroyer@sandia.gov

Space and Real Estate Management Dept. 10854 is developing **innovative ways to meet Sandia's growing space needs**. Aside from traditional leasing options, the department considered having the General Services Administration (GSA), the US Postal Service, Community Reuse Organization, or a private developer construct a building for Sandia to lease. In August, Sandia occupied the first building, the International Programs Building, a 65,000-square-foot, build-to-suit lease, privately owned facility housing 160 people in Research Park. Sandia has committed to leasing this building for the next ten years. (10800) Whitney Wolf, wdwolf@sandia.gov

The Facilities Maintenance Program has **accelerated process improvements on several fronts** to reduce backlog, minimize response time, and increase preventive maintenance work, while still responding to the usual annual volume (20,000-plus) of service requests. Enhancements in the site-wide deployment of the Custodial team cleaning process and the elimination of the Fleet Services vehicle requests backlog have increased customer productivity. The recently launched Web-based "Facilities e-Services," which allows customers to initiate requests and track the status of ongoing work, exemplifies additional progress to improve customer satisfaction. (10800) Joe Martinez, jemarti@sandia.gov

The Decontamination and Demolition (D&D) Program spent \$6.1 million to remove most of the buildings in Sandia's old Technical Area 2, **freeing acres of valuable real estate for future development**. The D&D effort is removing unusable or substandard space at all Sandia sites. Sandia is "banking" over 90,000 square feet this year to offset the recent DOE requirement to remove one square foot of substandard space for each square foot of new space constructed. Without this effort, Sandia cannot build new facilities needed for mission-critical capabilities. (10800, 9700) Ed Tooley, estoole@sandia.gov

Legal, including patents and contracts

During FY02, Sandians submitted 344 Technical Advances disclosing inventions. **A total of 215 patents were filed** during FY02 for Sandia inventors, and a record 130 patents were issued. DOE approved 70 requests for permission to assert copyright in FY02, up from 49 in FY01. Of the 70 copyright assertions, all but six were for computer software. During FY02, Sandia registered five trademarks. (11500) Fred A. Lewis, falewis@sandia.gov

Sandia is **building a strong patent portfolio in the emerging technology of photonically engineered structures**. These materials have many potential applications, including in optical telecommunications, energy conversion, information displays, and lighting. To date, 15 patent applications have been filed related to photonic crystals, including five new patent applications filed and three new patents issued during the past year. (11500, line orgs.) Kevin Bieg, kwbieg@sandia.gov

Sandia has, for the first time, secured approval from DOE to **file a lawsuit in defense of Sandia patents**. The lawsuit, which concerns part of the suite of patents on Sandia's Explosive Detection Portal technology, marks a significant development in government recognition of the value of Labs-licensed intellectual property. DOE considers the Sandia example to be a valuable one for the agency and other labs to learn from and model in appropriate circumstances of intellectual property infringement. (11500) Russell Elliott, rusty@sandia.gov

The Legal organization **successfully supported Sandia's responses to DOE's request** for new/model contract concepts and ideas. This sub-

mission was widely recognized by DOE as the best in class of all those coming from M&O contractors. Lawrence Greher, lsgrehe@sandia.gov

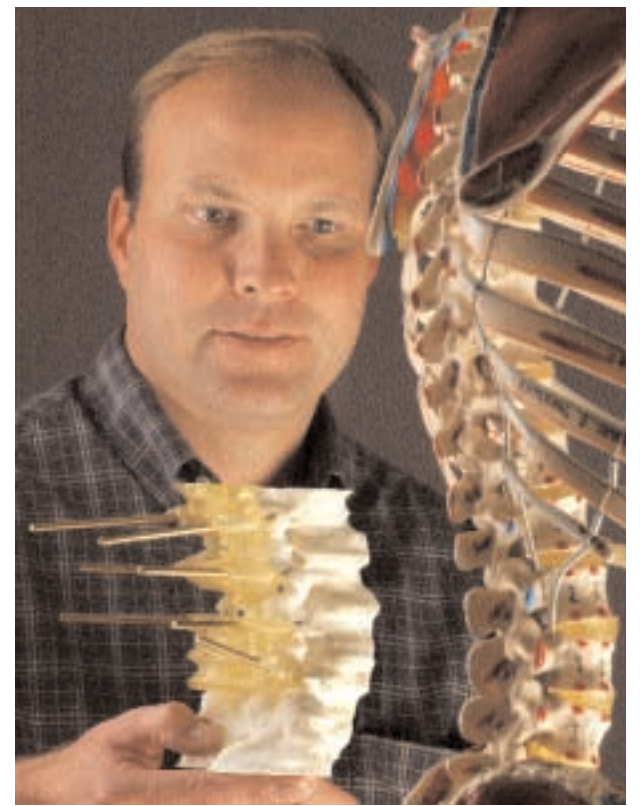
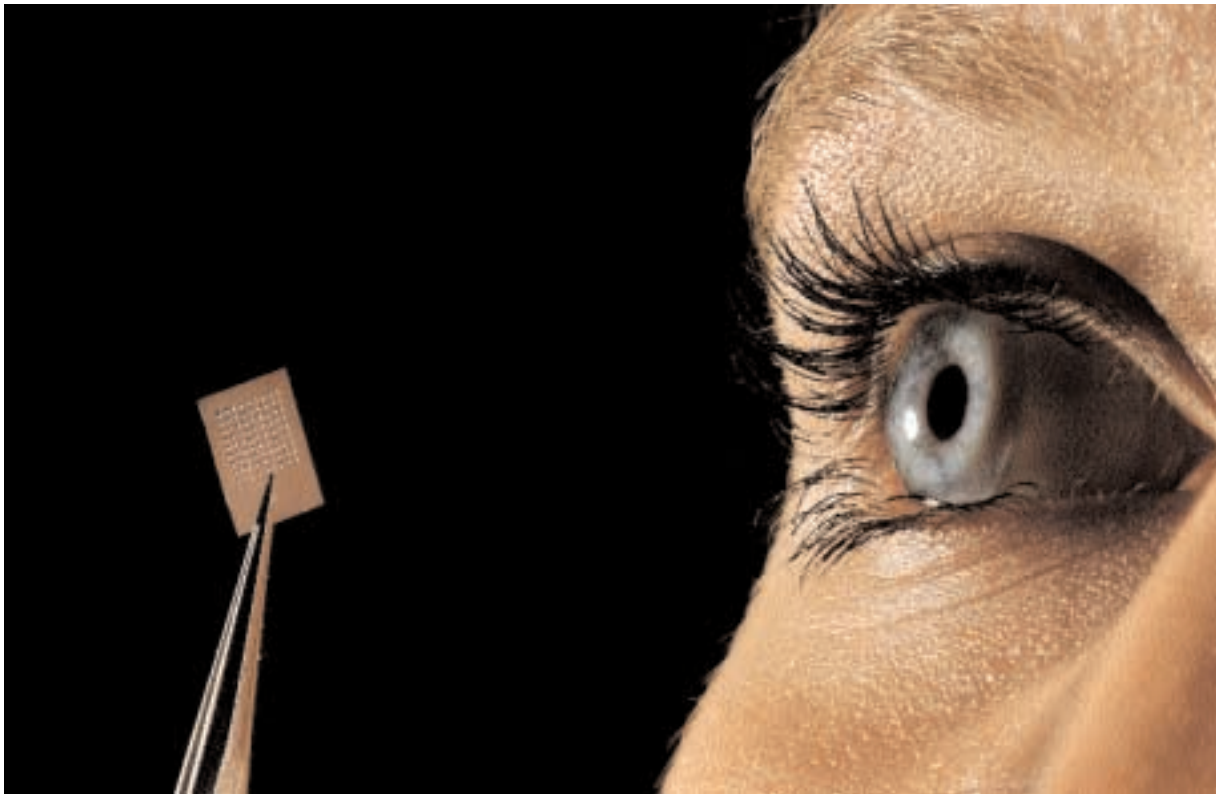
Sandia's Export Control Council, an informal group of Sandians with export control responsibilities, meets monthly to discuss and recommend solutions to export control issues and problems. Thanks to the efforts of the Council and the Sandia exporting population, Sandia had no export control incidents in FY02. (1300, 3100, 5300, 5900, 8500, 9300, 10200, 11500) George H. Libman 844-7644 Org. 11500 ghlibma@sandia.gov

State-of-the-art lab equipment is expensive. A mass spectrometer, for example, was recently quoted at nearly \$500,000. This was more than an emerging biotech program could absorb all at once, so **a lease was proposed to spread out payments**. The buyer's guidelines indicated, however, that sales taxes would require \$40,000 more; a lot of money for this program. After research, it was established the transaction would actually be tax-free in California. A revision to the guideline was prepared. (8500, 11200, 11600) Kurt Olsen, kcolsen@sandia.gov

Sandia **successfully defended a lawsuit** brought by two former employees of a contractor. Sandia had directed the removal of the people from the jobsite and terminated their access because of safety incidents. Sandia defended the suit in order to support several vital principles regarding safety, liability, and contract authority. Judgment was in Sandia's favor without trial. (10200, 10800, 11200) Charles Pechewlys, cpechew@sandia.gov



The year in pictures



Photos by Randy Montoya

