

2001 Labs Accomplishments

To all Sandians:

In Donald Stokes' book *Pasteur's Quadrant*, it was suggested that the best model for advancing science and technology



may well be to seek new "understandings" while also seeking new "uses" for science and technology. It is a model we at Sandia greatly respect.

This year, the challenge of marrying use with understanding appears to have been well met. This report chronicles

many accomplishments, large and small, by technical teams, support staff, and individual researchers. I believe you will agree with me that Sandians have made many important advancements.

Great significance, new possibilities

Some of the achievements are already of great significance, like the innovations that have kept America's nuclear weapons safe and reliable. Others opened up new possibilities to create new strengths for the future, including advances in short-pulse lasers; in ultra-high magnetic pressures; in nanotechnology; in miniaturized sensors and circuitry; in missile defense targets and advanced satellites; in new energy conversion technology; and in supercomputing, information systems, and cybersecurity.

The greatest privilege

The opportunity the nation affords us to participate in the creation of new knowledge, as we also help to solve important national problems, makes working in the Laboratories perhaps one of the greatest privileges any citizen can have.

C. Paul Robinson

Labs Director and President



LIGHTING THE WAY — Keven Krenz (8420) briefly doffs his face mask for a photo at the chamber of the extreme ultraviolet lithography device where workers align light used to pattern circuits in this potential next-generation approach

to microchip manufacturing. Sandia is making the EUVL tool as part of the largest-ever funds-in DOE CRADA (\$250M over 5 yrs). See the EUVL entry below.

(Photo by Randy Montoya)

Sandia LabNews

Special Section

January 26, 2001



Partnerships

Extreme Ultraviolet Lithography (EUVL) extends current lithography capability to the sub-100 nanometer feature size, allowing fabrication of microprocessors with 100 times the speed and 1,000 times the memory of today's integrated circuits. Sandia activities in EUVL include precision engineering, modeling and simulation, and process development activities. Once complete, the EUVL tool will be capable of printing features as small as 70 nm. This program is the largest-ever funds-in DOE CRADA (\$250M over 5 yrs). (8400, 8700, 2300, 2200) *Bill Replogle, wcreplo@sandia.gov*

The Southwest as a Region of Innovation Conference 2000 brought together representatives from Arizona, Colorado, New Mexico, and Utah to work toward creation of a southwestern Microsystems Industry Cluster. The Albuquerque conference attracted 338 attendees who discussed how to form this cluster and focused on using the microsystems expertise, facilities, and resources present in the Southwest. A regional Leadership Team was formed and is working toward this cluster creation. The new Microsystems and Engineering Sciences Applications facility is

envisioned as the cluster cornerstone facility. (14000, 1000, 1300, 1700, 1900, 12100, 12600) *Jackie Kerby Moore, jskerby@sandia.gov*

Sandia and ten industry partners have signed the **Cold Spray Consortium** cooperative research and development agreement, under which the Labs will develop and commercialize Cold Spray technology over three years. In this process, metal or composite powders, accelerated to high velocities in a compressed gas jet, bond to a target surface by a process similar to explosive welding, but on a micro-scale. Depositing metals/composites in the solid state opens exciting new design and manufacturing possibilities. (1800, 9100, 1300) *Mark Smith, msmith@sandia.gov*

Sandia researchers, in partnership with the UNM Cancer Center, were instrumental in obtaining a \$1 million grant for UNM Health Sciences from the Keck Foundation to support development of **new tools for research in functional genomics**. By combining optical imaging devices developed as part of our satellite program, chemometrics data analysis routines developed for materials characterization, and data mining/visualization software (VxInsight™),

(Continued on next page)

A note to readers

Toward the beginning of each calendar year the *Lab News* sums up Sandia National Laboratories' principal achievements during the previous fiscal year. This issue of Labs Accomplishments continues that tradition.

All Sandia divisions were invited to submit achievements; submissions selected by the VPs' offices are presented on the following pages. The work was accomplished mostly during the fiscal year that ended Sept. 30, 2000. Key Sandia organizations contributing to each accomplishment are in parentheses at the end of each entry. Also — new this year — a key contact name and e-mail address for each submission are included.

You'll note that the work is presented here by category. We find this organizational approach to be 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 under the category "Nuclear weapons," for example, could very appropriately have been listed under "Microelectronics" or "Computing."



Partnerships

they proposed, and were funded to develop, a next-generation gene chip micro-array scanner. (1800, 9200, 5700) *David Haaland, dmhaala@sandia.gov*

The New Mexico Legislature passed legislation that allows Sandia to earn a tax credit of up to \$1.8 million in return for assisting small businesses in the state. Through its New Mexico Small Business Assistance Program, Sandia is using Labs expertise and capabilities to **help small businesses resolve technological problems or business issues**. The program is geared to help retain current small businesses, generate additional employment opportunities, and expand the base of suppliers for Sandia and other large entities in New Mexico. (1300, 12000, 14000) *Olen D. Thompson, odthomp@sandia.gov*

Recent licenses with startups MEMX Inc. and Novint Inc., grant Sandia an equity position in each company in exchange for rights to develop business around Sandia intellectual property. These **first-of-a-kind (for Sandia) equity licenses** offer an opportunity to share in the companies' technical developments and financial successes while enabling Sandia to better meet its national security missions by developing a regional supplier base through the licensing of important technologies. Novint is launching products based on haptics, a technology that adds the sense of



MEMX SPINS OFF — Four Sandia researchers have agreed to join a private spin-off company, MEMX, Inc., to commercialize Labs-developed microsystems technology. They are, from left, Paul McWhorter, Sam Miller, Jeff Sniegowski, and Steve Rogers. (Photo by Randy Montoya)

touch to 3-D computer interfaces, while MEMX, a spin-off company from Sandia's microelectromechanical systems (MEMS) development activity, will commercialize a MEMS-based optical switch for the telecommunications industry. (1300, 1700, 9200) *Olen Thompson, odthomp@sandia.gov*

Sandia and industry partners have launched the **Radio Frequency CRADA** to explore the possibility of commercial manufacture of complex electronic assemblies for weapon applications. In FY00 this CRADA delivered prototype assemblies produced on state-of-the-art automated manufacturing lines, using commercial off-the-shelf components, at a fraction of the cost traditionally incurred for similar products. Continued success

of this CRADA may significantly reduce the cost of RF assemblies for weapon needs in the future. (2300, 1700, 1800, 14100, FM&T) *Ron Diegle, rbdiegl@sandia.gov*

Sandia and other organizations in DOE's nuclear weapons complex (NWC) renegotiated a **volume purchasing agreement** with Parametric Technology Corporation for use of its Pro/E software, the standard 3D solid modeling tool used by the weapons programs. The deal saves Sandia \$1/2 million. The three-year agreement covers 226 Sandia users of Pro/E, and includes the flexibility to adjust that number to accommodate changing program needs. This effort represents the establishment of a significant partnership between members of the NWC and a key software provider for the complex. (2900, 10200) *Charles Fleetwood, cdfleet@sandia.gov*

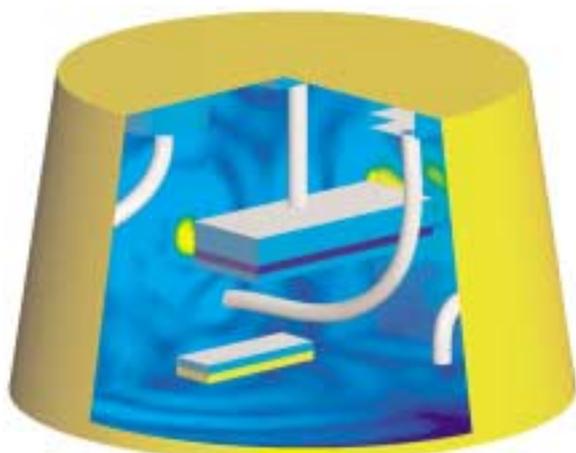
Sandia licensed its technology in a unique, emerging microelectromechanical systems technology known as LIGA to photonic subsystem provider AXSUN Technologies. LIGA, an acronym from the German words for lithography, electroplating, and molding, is a **technique that allows precise microstructures to be fabricated** from metals, plastics, and ceramics. After a successful prototyping effort at Sandia, AXSUN committed to establishing a Livermore-based LIGA production facility. The facility will manufacture alignment structures for use in AXSUN's optical products. The licensed Sandia know-how enables AXSUN to more quickly establish production capabilities. (8700, 11600) *Jill Hruby, jmhruby@sandia.gov*

(Continued on page 5)

Engineering Sciences

Sandia has **successfully simulated a section of the RHP (radiation-hardened Pentium) microprocessor** using the Sandia-developed ChileSPICE™ circuit simulator. Production runs using ChileSPICE have reduced simulation time from 3-10 times when compared to commercial simulators. The increased performance and enhanced convergence technologies will lead to improved circuit designs on a much larger scale than can be achieved today. Initial performance evaluations of Xyce™, the next generation massively parallel circuit code, show a dramatic improvement in circuit simulation performance. (1700, 9200, 8400, 2300, 9300) *Steven Wix, sdwix@sandia.gov*

We have made **significant advances in the parallel performance and physical fidelity** of our suite of electromagnetics and plasma physics computational tools, collectively named EMPHASIS. EMPHASIS is used to qualify systems to intense electromagnetic and X-ray environments,



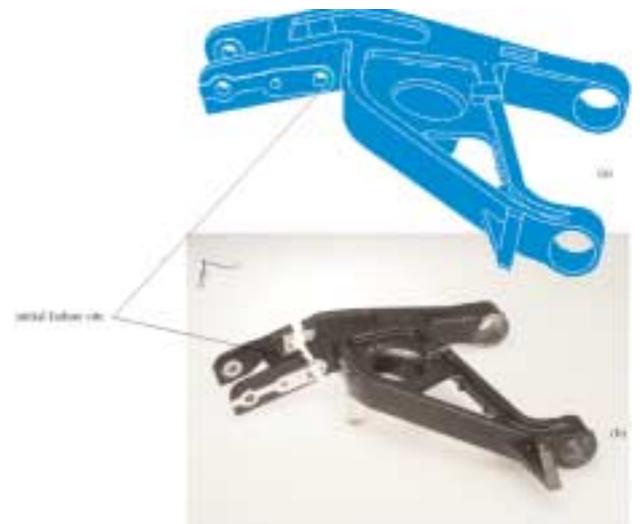
EMPHASIS calculated magnetic fields in a cavity containing cable-connected circuit-board modules in response to an external electromagnetic environment.

design high-frequency electronics, and model pulsed power components. We are using it to assess shielding effectiveness of a Lockheed Martin system. One EMPHASIS tool has demonstrated performance of 1 trillion operations per second on Sandia's teraflops computer. Another has novel algorithms to dynamically balance the computational load. (1600, 9200) *Mark Kiefer, mlkief@sandia.gov*

A **microstructure-property material model** that can predict the accurate stress and failure response for component designs and/or manufacturing processes received an R&D100 award. Three examples exemplify the model. The size/weight of automotive components was lowered resulting in reduced emissions and conservation of fuel. The multiphase aspect of the material model was used in a commercialized heat treatment simulation tool for process design involving carburizing and quenching phase transforming alloy steels. Third, the model was used to optimize die design in a weapons component forging process. (8700) *Mark Horstemeyer, mhorst@sandia.gov*

Predictive modeling of the dynamics of structures with bolted interfaces is of broad engineering interest. The damping generated in bolted joints is particularly difficult to model. A combined experimental and analytical program initiated at Sandia focused on the damping mechanisms in bolted interfaces and led to the **discovery of an underlying power law relationship** between the applied force and the energy dissipation per cycle. Promising reduced-order analytical models developed will be important to successful modeling of weapon system structural performance. (9100) *Dan Gregory, dlgrego@sandia.gov*

The **GOMA software team** has used its broad customer base in defense programs and industry to guide successful research, code development, and analysis projects. In an effort to bring a science-based understanding to manufacturing processes, the GOMA team has worked with manufacturing personnel and material scientists in the areas of welding, brazing, cermet processing, and encapsulation. Driving projects from model



RESULTS of a simulation for the USCAR CRADA show that Sandia's microstructure material property model predicts the exact location of the initial failure site. The model prediction was performed ahead of the test to ensure its predictive capability. Note that the predicted initial failure site was identical to the experiment.

development to code implementation and finally performing high-fidelity engineering analysis has required a team effort with a respect for the talent each member brings to the team. (9100, 9200, 1800, 8700) *Justine Johannes, jejohn@sandia.gov*

The SALINAS massively parallel 3D structural dynamics code was used to **complete critical simulations of W76 system response** to hostile radiation environments, running for 24 hours on 2000 ASCI Red processors. Sensitivity and optimization analyses were performed on the arming, fuzing, and firing (AF&F) model using Sandia's DAKOTA software package. A high-fidelity model for timing and scaling studies was generated with CUBIT advanced meshing software. The Sandia team greatly exceeded the milestone success criteria, demonstrating capability beyond anything commercially available. (9100, 9200, 9300) *James Peery, jspeery@sandia.gov*

Nuclear weapons

Sandia made significant contributions to the Nation's missile defense effort during the previous year in the areas of targets for system testing, lethality, threat and countermeasures, and navigation, guidance, and control. We **provided target objects for three National Missile Defense Integrated Flight Tests** and two National Missile Defense Risk Reduction Flights. Sandia also provided high-fidelity, scaled targets for lethality impact testing, and supported the analyses of the data from these tests with over 100 high-resolution hydrocode calculations. In addition, Sandia is providing the navigation, guidance and control system for the first two National Missile Defense interceptor prototype booster systems. *Jerry Langheim, jrlangh@sandia.gov*

The Advanced Firing & Detonation Systems and Microsystems Advanced & Exploratory (A&E) projects demonstrated **a wide range of new technologies for future firing system applications** in nuclear weapon refurbishment and DoD fuzing options. These included Surface Micromachine (SMM) and LIGA stronglinks, Direct Optical Initiation (DOI) firing sets and micro-DOI concepts, optical charging and triggering of Capacitive Discharge Units (CDUs), and several technologies necessary for microfiring sets. Several demonstration units were fabricated in partnership with the Kansas City plant. (2000, 2100, 2500, 1700, 1100, 1800, 8400) *Larry Hostetler, ldhoste@sandia.gov*

The most detailed structural dynamic model validation experiments ever performed on a nuclear weapon system were completed this year on the W76/Mk4 Reentry Body (RB). These experiments successfully **identified modes of vibration as high as 1,000 Hz** for the RB and each major subassembly. The test series discovered significant unit to unit variability for frequencies above 1,000 Hz. Data gathered from multilevel shock and vibration inputs will be critical to the validation of high-fidelity models that mimic the nonlinear behavior of real weapon structures. (9100, 2100) *Randy Mayes, rlmayes@sandia.gov*

New Weapon Evaluation Test Laboratory (WETL) authorized:

After operating in a more than 30-year-old pre-fab building for years, the construction concept for a new state-of-the-art facility for Sandia surveillance programs passed its final hurdle, the DOE External Review. Design for this \$24 million facility will be done this year, with construction the following two years. Blending the best of the reshaped core surveillance and enhanced surveillance program, this modern facility that will begin to move the DOE toward a predictive capability. (2900, 7800, 9500) *W. L. Norris, wlnorri@sandia.gov*



ARTIST'S CONCEPT of new Weapon Evaluation Test Laboratory.

Working with our counterparts at the Kansas City plant we **designed and built two versions** of prototype firing sets for the W76 Arming, Fuzing, and Firing life extension program. Through the use of simulation and rapid prototyping tools and techniques, we were able to go from paper designs to hardware, demonstrating form, fit, and function in less than a year. In addition, these tools allowed us to evaluate and solve a variety of design and manufacturing issues before the prototypes were fabricated. (2600) *Jim Hole, jwhole@sandia.gov*



MINUTEMAN 2 BOOSTER launched from Vandenberg Air Force Base, Calif., as part of the National Missile Defense initiative, in which Sandia provided target objects and other vital support.

Sandia's **Military Liaison Department**, in partnership with the DoD and the military, implemented an upgraded Unsatisfactory Reporting system for nuclear weapons, ancillary equipment, and publications. The system, known as the "Workflow Enabled UR System," has yielded dramatic improvement in tracking steps in the process and sped up the answer to the operational unit. DOE recognized this effort through the DOE/AL Performance Excellence Award for the Weapons Surety Division's Weapons Logistics Quality Program (Silver Medal). (2900, 9500) *J. Mike Rhoads, jmrhoad@sandia.gov*

On Sept. 22, 2000, the W76-0/Mk4 became the first enduring stockpile weapon to **complete the DOE Seamless Safety Process** for Disassembly & Inspection operations at the Pantex plant in Amarillo. The project included development of new tooling, new procedures, a Weapon Safety Specification, a Hazards Analysis, and hazards controls. DOE authorization for W76 operations makes it possible to conduct weapon surveillance assessments at Pantex, which provide essential information about weapon reliability and state-of-health. (2100, 1600, 8400, 12300) *J. Paul Atencio, jpatenc@sandia.gov*

The Nuclear Weapons Council has authorized initiation of the **W76 Life Extension Project**. Authorization was the culmination of a multiyear effort to assess the warhead state-of-health, develop refurbishment options, and generate management processes and plans to meet aggressive requirements. The conceptual design incor-

porates new performance options and challenges Sandia to implement technical innovation and employ new modeling and simulation tools. Key to winning authorization was our systematic scrutiny of requirements and design options, our plan to reuse selected components, incorporate high-grade commercial electronic parts, streamline production and qualification processes, and rigorously manage risk. (2100, 1700, 2300, 2500, 2600, 8400, 9100, 9800, 12300, 15300, and KCP) *Patrick Sena, pasena@sandia.gov*

Using modern predictive analyses coupled with limited field testing, the **B61-11 ALT 349 weapon design was certified** for stockpile use by Sandia and Los Alamos national labs. The final Design Review And Acceptance Group (DRAAG) meeting for the B61-11 ALT 349 was held in September at Sandia. The DRAAG wields the authority to accept/reject a weapon for use in the stockpile. The design was recommended for acceptance as a standard stockpile item by the DRAAG to the Nuclear Weapons Council Standing and Safety Committee in December 2000. (NW) *Kevin Eklund, kreklun@sandia.gov*

The **In situ-Impregnated Gel Capacitor** is being developed as the energy storage device in firing sets for several Stockpile Life Extension Programs (SLEPs). The gel/Mylar dielectric system results in a volume reduction greater than two when compared to the air/Mylar dielectric used in the majority of firing sets for the enduring stockpile. Further, a cost savings of almost an order of magnitude is realized when compared to older dielectric systems used in other stockpile weapons. The process has been successfully scaled up from 10 to 80 capacitors per run. (1700) *L. Roger Edwards, lredwar@sandia.gov*

The **In-Ground Storage Vault (IGSV)** was designed and constructed to provide high-security, temporary (two-year) storage for the Sandia Pulsed Reactor (SPR) fuel materials. This state-of-the-art facility yields annual security cost savings of approximately \$6 million and is the first step in a comprehensive plan to insure that the SPR is available at a reasonable cost to meet essential nuclear weapons testing requirements. That plan will culminate in construction of a new high-security Sandia Underground Reactor Facility (SURF) to house future SPR operations. (6400, 5800, 7100, 7800) *Kenneth Reil, koreil@sandia.gov*

The DOE National Nuclear Security Administration Office of Transportation Safeguards (OTS) must meet the highest security standards because its mission is critical to the continued effective operations of the nuclear weapons complex. Sandia was directly responsible for four of six mandatory milestones required to obtain acceptable OTS security ratings from DOE HQ, and ensure **uninterrupted operation of the transportation fleet**. All milestones were met, and the OTS security rating was upgraded. (NW) *M. Brad Parks, mbparks@sandia.gov*

Reliability and data credibility probability analyses have been completed for the B61-7/11 and Redesigned W76 Type 2F telemetry systems. Both studies used a new methodology for estimating the reliability of commercial parts, as well as a software
(Continued on next page)



IN THE CAB of an armored Safeguards tractor.



Nuclear weapons

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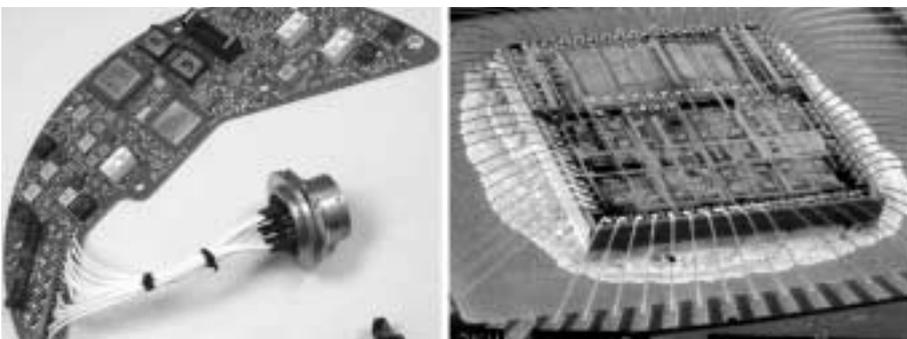
tool that allowed for examination of key contributors to unreliability. A report has been published documenting the results of these studies. In addition, a complete description of the general methodology for analyzing instrumentation systems (both reliability and data credibility) has been included in the study report. (8400, 12300) *Rene Bierbaum, rlbierb@sandia.gov*

A Sandia team in collaboration with Lawrence Livermore National Laboratory and Lockheed Martin designed and flight tested a warhead concept under the Submarine-launched Warhead Protection Program (SWPP). Warheads currently deployed by the US Navy were designed and certified prior to cessation of underground nuclear testing and the closure of major DOE weapon component facilities. The SWPP Pit Reuse Project investigated potential future replacement options. While no stockpile hardware is intended, the flight test exercised DOE/DoD interfaces and exposed new staff to this important national security mission. (2200, 2600, 8400) *Bill Wilson, wgwilso@sandia.gov*

Sandia contributed to the successful completion of the Phase 6.2/6.2A study for the W80 life extension program (LEP). The Nuclear Weapons Council accepted the recommendations provided by the study team and approved entry into Phase 6.3, with a first production unit date of February 2006. The W80 Phase 6.3 represents a significant effort for Sandia, requiring new designs for the entire warhead electrical system, neutron generators, gas transfer system, and several new mechanical structural components. (2100, 2200, 2300, 2600, 8400, 10100, 12300) *Doug Gehmlich, dlgehml@sandia.gov*

The W76 Joint Test Assembly telemetry system redesign was employed in a re-entry body, which was launched from a submarine in February 2000 as a "Follow-on CINC Evaluation Test." The flight resulted in a **successfully scored weapon system test**. Advancements in space radiation tolerance were proven, as was the efficacy of the Modular Telemetry Design Methodology as a design tool. An important first for this design was the digitization and transmission of neutron and firing system waveforms. This instrumentation system is significantly more complex, having ten times the data rate of the original, yet the production costs are significantly less. (8400, 2100) *Art Hull, alhull@sandia.gov*

Tech transfer comes full circle: Organic hydrogen getters, invented by Sandia to scavenge



ANALOG ASIC — As the stockpile ages and electronic components show the first signs of degradation, Manufacturing Development Engineering (MDE) steps in to design and validate new War Reserve quality components that use technologies often many generations ahead of the old ones. These new technologies, once validated, are far more reliable and many times lighter and smaller. MDE developed an analog ASIC used in an encryption translator. The chip-sized ASIC replaces a much larger printed-wiring board (PWB) that held individual electronic components. Note that the Application Specific Integrated Circuit at right is many times smaller than the printed wiring board circuit it replaces. (1700) *Donald Evans, dcevans@sandia.gov*



MESA MOVES FORWARD — The conceptual design for Sandia's Microsystems and Engineering Sciences Applications (MESA) complex has been completed. This major piece of work was a substantial effort for many organizations across Sandia. The final Conceptual Design Report (CDR) was printed and distributed in May 2000. The effort led to the authorization of funds to start the next phase (Title I/II Design) of the project. Completion of the CDR is enabling Sandia and DOE to make investments which will create technological capabilities to meet near-term and future mission needs for nuclear weapons. (1000, 2000, 6000, 7000, 9000, 10000) *Don Cook, dlcook@sandia.gov*

unwanted hydrogen in various systems, have been reinvented, patented, and commercialized through a 100-percent funds-in cooperative research and development agreement with Vacuum Energy Inc. Sandia's **hydrogen reduction technologies** are now found in numerous con-



MAIN ELECTRONIC subassembly of the New W76 Telemetry System .

sumer and industrial products. Millions of units have been purchased for products such as flashlights, refrigerators, and heat exchangers. The advanced getters created for consumer markets are now being certified for the shipment of radioactive materials within the Nuclear Weapons Complex. (8700, 6100) *Tim Sheppard, tjshepo@sandia.gov*

The Nuclear Weapons Strategic Business

Unit (NW SBU) developed and deployed its Quality Management System and Policy for organizations that perform work for the SBU. The management system provides taxonomy for the SBU and its requirements, processes, and products, and is based on ISO 9000, the nationally recognized set of Quality guidelines. The policy provides high-level direction for the SBU and internal

requirements to support its advancement. Policies and Processes can be found from the Sandia home page and the NW SBU button. (9000, 1000, 2000, 8000, 12300, 14000) *Mark Dickinson, mddicki@sandia.gov*

We have completed an assessment of **Sandia's current and long-term equipment recapitalization needs** for capital-intensive facilities that support the Defense Programs (DP) mission. A methodology was developed to assess needs based on different levels of potential future capability for each facility and to estimate the associated labor and expense costs for each level. Capital equipment investment at Sandia has declined dramatically since the 1980s. The study is intended to provide a starting basis for developing capital equipment strategies and priorities for future DP needs. (9800) *Keith Almquist, kjalmqu@sandia.gov*

The **multidisciplinary MAVEN Fire Team** demonstrated that laboratory-quality diagnostics, particle image velocimetry, and planar laser-induced fluorescence could be brought into a field-test-scale facility and used to obtain velocity, temperature, and species concentration validation data. We completed a test series involving

42 experiments for a one-meter-diameter flow for helium plumes and methane and hydrogen fires. Limited data analysis has been completed and compared with Large Eddy Simulation computations. These data will be applied to validate transport models in the FUEGO fire code. (9100, 6400) *Gene Hertel, esherte@sandia.gov*

The Security Matrix Project, jointly chartered by DoD's Office of the Assistant to the Secretary of Defense (Nuclear-Chemical-Biological)/Nuclear Matters and DOE's Defense Programs-20, provided an **integrated assessment of weapon security and use control**. Team members visited all US sites where weapons are held and conducted in-depth analyses of locations, weapon configurations, site infrastructure, and physical and operational security. The study played a significant role in the W80 Lifetime Extension Program and led to changes in Air Force security posture, Navy/Marine Corps security capabilities, and overall DoD security requirements. (12300) *Timothy Petersen, tppeter@sandia.gov*

The W76 SLEP down-select for Phase 6.3 for the Navy Mk4A weapon systems occurred in July. A 12300 independent Weapon Assessment Team reviewed the warhead candidates for quality, reliability, nuclear safety, stockpile surveillance, and security/use control attributes and effectiveness. **The Weapon Assessment Team confirmed the Preferred Option candidate**, recommended by Div. 2000, as a viable design that enhanced reliability over the extended lifetime and afforded nuclear safety and significant use control enhancements to the present baseline W76 design. The selection of the Baseline Option was made with idea of a block upgrade approach, where the surety advantages of the Preferred option could be incorporated at a later date. (12300) *Frederick Trussell, fgtruss@sandia.gov*

In FY99, a **new approach to evaluating weapon safety** in thermal accidents was developed. This approach (the FINDV code) uses the ALASKA distributed computing platform to evaluate probabilistic weapon safety for a wide range of scenarios. Thermal responses are obtained using the COYOTE code. In FY00, this process was used to evaluate candidate design options for the W80 Lifetime Extension Program (LEP). A wide variety of engulfing, planar, and directed fire scenarios were evaluated and compared against similar results for the design currently in the stockpile. These comparisons showed that the downselected Option 3a conceptual design has significantly improved safety performance in the range of fire
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Partnerships

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Sandia has significantly improved the accuracy while also expanding the frequency range of structural dynamics models for the noise, vibration, and harshness response of passenger vehicle tires. These improved models have been experimentally validated and have directly led to improvements in Goodyear's relationship with vehicle manufacturers. Goodyear has stated that this effort has reached **technical achievements "previously thought unattainable by industry experts."** The experimental and analytical tools and techniques developed during this partnership are directly applicable to model validation for DOE defense programs. (9100, 9200, 2100) *Curt Nelson, cnelson@sandia.gov*

By integrating Sandia-developed sensing, cutting, and contour generating technologies, a cross-organizational team led by the Labs' Robotics Center successfully **demonstrated an automated meat cutting system** for industry sponsor IBP, Inc. Last September, the prototype device was shipped to IBP for further testing and development. The shipment marks Sandia's successful completion of all technical tasks spelled out in the Sandia/IBP cooperative research and development agreement a year-and-a-half ahead of schedule and under budget. Sandia and IBP have filed a number of technical disclosures and patent applications as a result of this work. (15200) *Jerry Langheim, grlangh@sandia.gov*

The **Sandia Science & Technology Park** program office spearheaded the creation of a landmark Memorandum of Understanding (MOU) that binds public and private parties to develop the 219-acre park just outside the Kirtland AFB Eubank gate. The park aims to attract technology-based companies. Signato-



SANDIA SCIENCE & TECHNOLOGY PARK

ries to the MOU include Albuquerque Public Schools; New Mexico State Land Office; Shaw, Mitchell, & Mallory Limited Partnership; City of Albuquerque; Sandia; and the Science & Technology Park Development Corporation. The MOU was two years in the making and a necessary step for the creation of a Master Development Plan. (14000) *Jackie Kerby Moore, jskerby@sandia.gov*



SAR SCIENCE — Sandia researcher Bill Hensley checks the Lynx synthetic-aperture radar (SAR) installed on an unmanned aerial vehicle. During the past year, the Sandia-developed General Atomics Lynx system attained several significant achievements, resulting in a fielded demonstration system for the US Army. (Photo by Randy Montoya)

General Atomics Lynx Synthetic Aperture Radar: The **Lynx Synthetic Aperture Radar (SAR)** system developed by Sandia for General Atomics had several significant accomplishments which have resulted in a fielded demonstration system for the Army as well as providing key support for DARPA-funded Ground Moving Target Indicator (GMTI) efforts. The system was installed on the Predator unmanned aerial vehicle (UAV) including a satellite down-link capability for remote operations. It was also installed on Army U-21 and C-12 aircraft. The U-21 system was then used in DARPA-funded data collections demonstrating its advanced GMTI collection capabilities. (2300) *Jerry Langheim, grlangh@sandia.gov*

A **newly patented pressure indicator** designed specifically for a medical application was licensed to the cooperative research and development agreement partner Numotech, Inc. The device monitors the pressure within the topical hyperbaric oxygen therapy enclosure used to treat hard-to-heal wounds including burns, diabetic ulcers, and pressure sores. The device uses no electricity, is inexpensive, disposable, has no enclosure penetration, requires no calibration, and is readable from several meters. FDA has approved use of the device. Keith Miller and Mark Vaughn (both 15252) are co-inventors. *Jerry Langheim, grlangh@sandia.gov*

Nuclear weapons

(Continued from preceding page)

scenarios examined (12300) *Michael Bohn, mpbohn@sandia.gov*

A recent survey of the **laboratory balance calibration process** revealed that some calibrations being performed were technically inad-

quate, leading to questionable calibrations. The survey also showed that many balance users lacked proper training in the use of balances. The process was improved to assure technically adequate calibrations and a user training program was established assuring proper balance use. Customers are delighted with the process and now have confidence in the quality of the balance measurements they make using balances calibrated by the Primary Calibration Laboratory. (2500) *Jim Simons, jmsimon@sandia.gov*

The Purchased Material Team (PMT) was chartered by Neutron Generator (NG) Production Management to **develop and implement an overall procurement process** to ensure supplier quality for purchased neutron generator components. The team partnered with Honeywell's FM&T division, a proven leader in meeting and maintaining DOE requirements for supplier quality. FY00 metrics showed that the team's efforts led to significant improvements: PPA (percent parts accepted) from 80 percent to 96 percent and PATF (percent accepted trouble-free) from 62 percent to 86 percent. (14400, 10200) *Lorraine Senar-Rondeau, lsenar@sandia.gov*

The **Manufacturing Development Engineering (MDE)** program is a model for manufacturing low-volume, high-reliability parts for the NWC. Since its inception in 1992, we have achieved mission assignment requirements of delivering more than 40,000 components needed for the enduring stockpile. More than 6,400 MDE parts were manufactured during FY00 by 12 private sector companies that have partnered with Sandia's design community in this critical nuclear

weapons program. Products manufactured include: actuators, thermal batteries, igniters, gas generators, capacitors, magnetics, frequency devices, and electronic components. (1700, 2500, 14000, 10250) *Eva Wilcox, ewwilco@sandia.gov*

The Manufacturing Development Engineering (MDE) department **designed and tested a replacement digital ASIC** (application-specific integrated circuit) microcontroller used in a specific B61 configuration. During testing, a problem was discovered with the memory working at cold temperature. A failure analysis team worked for two months to pinpoint the problem. In order to best use materials, the wafer lots in process were stopped at the silicide stage (before metal contacts were made) to accommodate a change in metal routing. The fix was made and new masks were ordered to process the lots on hold. In November 2000 the design fix was proved. (1700) *Tim Mirabal, mirabatj@sandia.gov*

A **high-voltage power transformer** was developed for use in firing sets for several weapon systems in the enduring stockpile. The original transformers had relatively low yields due to cracked encapsulation around and in the core and/or separation between the contact assembly and encapsulation. The MDE program developed design improvements such as use of a stress barrier between the core and the epoxy encapsulant and elimination of the contact assembly. Transformers produced via this design are much more robust with respect to mechanical environments. More than 250 war reserve (WR) transformers with these design improvements have been successfully produced. (1700) *Wendel Archer, wearche@sandia.gov*



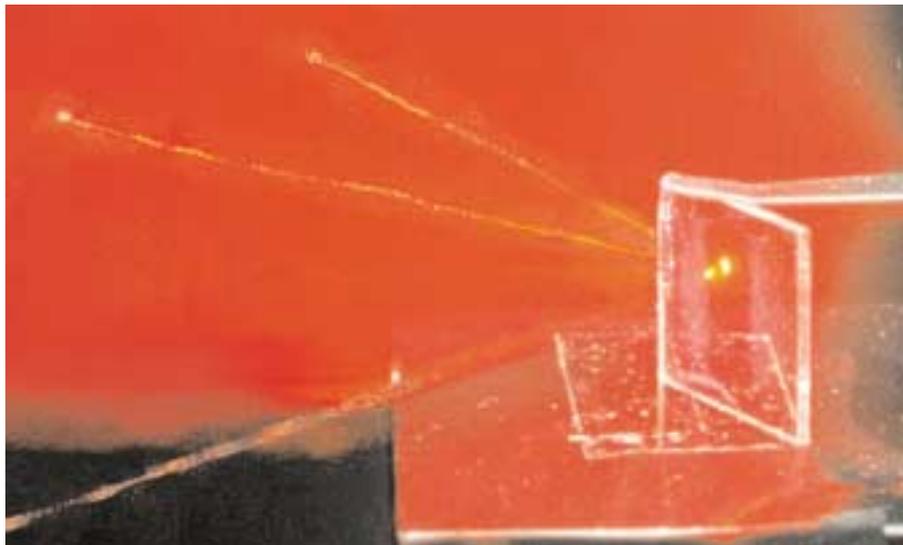
GETTING BALANCED — Jay Bennett (2544) calibrates a laboratory balance. These balances, used in labs throughout Sandia, are used to weigh chemicals, explosives, and other research materials.



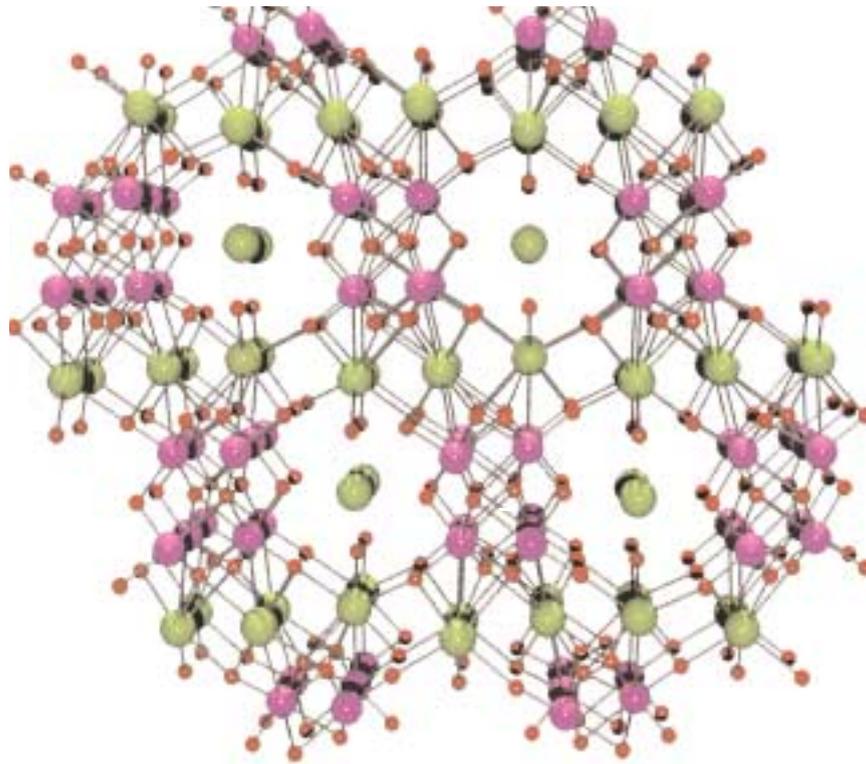
Materials

Collapsing tunnels are disastrous in mining and transportation. In an atomic world, however, they can be extremely useful when they trap hazardous materials. Under the Environmental Management Science Program, Sandia scientists discovered a family of tunnel-collapsing materials named **Sandia Octahedral Molecular Sieves (SOMS)**. When SOMS are submerged in waste solutions, specific metals like radioactive strontium stick inside its tiny tunnels. Heating the SOMS collapses the tunnels and traps the hazardous contents so they can be safely disposed. Immobilizing the waste is vital to DOE cleanup efforts. (6200) *Tina Nenoff, tmnenof@sandia.gov*

A new ion beam analysis facility enables researchers to measure — non-destructively and in depth — the constituents (including tritium) of neutron tube targets and sources. Further improvements of the process



OPTICALLY DEFINED multifunctional patterning of nanocomposites was the subject of a *Science* article submitted by Sandia researchers working with an international team of scientists.



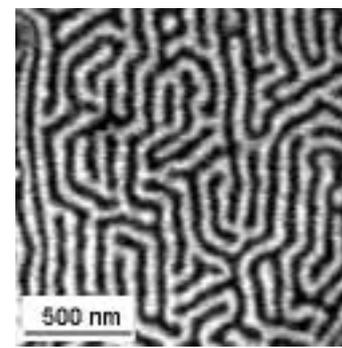
MODEL of SOMS, showing its framework and tunnels.

will enable War Reserve certification of our beam-line. This system serves the neutron tube science program, which is closely coordinated with the Labs' neutron tube design and production processes. (1100, 2500, 14400) *Wil Gauster, wbgaust@sandia.gov*

Sandia researchers, working with an international team of scientists, developed a **photochemical technique for producing unique nanostructures** (hexagonally-packed tubes or 3-D tetragonal configurations). In the process, silica gels containing photo-activated acids are locally exposed to ultraviolet light,

thereby engineering particular nanostructures. This photo-induced densification process has been shown sufficient to modulate the refractive index of the resultant material enough to make a diffraction grating or other optical device. This work was featured in a *Science* magazine article. (1800, 1100) *M.J. Cieslak, mjciesl@sandia.gov*

The **Low Energy Electron Microscope (LEEM)** offers Sandia researchers an invaluable tool for learning how certain combinations of atoms spontaneously self-order into stunning structures consisting of nanometer-sized dots, stripes, or polygons. Such nanostructured materials frequently exhibit unique mechanical, optical, or electronic properties. Recent experiments provided the elusive proof of a simple theory that explains how inter-atomic forces compete to pro-



Spontaneously formed pattern of alternating lead and lead/copper alloy stripes imaged by LEEM.

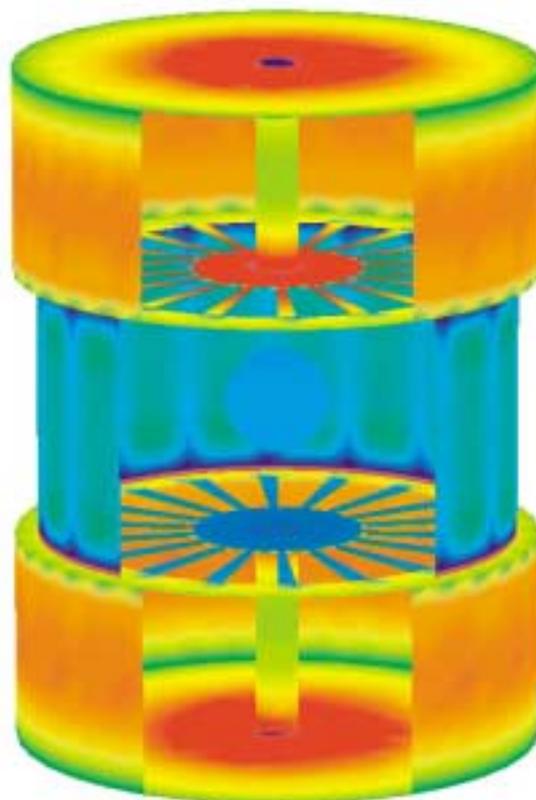
duce these structures. Once understood, self-assembly can be exploited to synthesize new classes of materials with tailored properties for multi-functional, miniaturized actuating or sensing systems. (1100, 8700) *Neal Shinn, ndshinn@sandia.gov*

Dynamics of Alloying at Surfaces: What are the atomic mechanisms when metals mix to make alloys? Using a unique microscope, Sandians Schmid, Bartelt, and Hwang (8700) discovered the surprising way bronze alloy forms when tin is evaporated onto copper. Microscopic tin crystals slowly shrink while "grazing" the copper surface in an entertaining, almost life-like dance. To explain this peculiar motion, the team proposes that a repulsion between tin atoms within the crystals and tin atoms left in their wake pushes the crystals forward, away from the bronze in their tracks. (8700) *Andreas Schmid, akschmi@sandia.gov*

Pulsed power

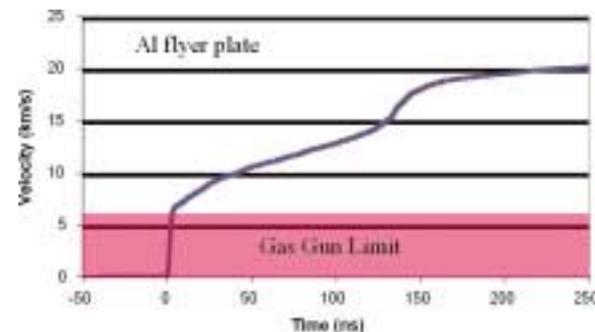
Novel Methods to Study Radiation Symmetry in ICF Hohlräume: What does an architect have in common with an inertial confinement fusion (ICF) target designer seeking 1 percent radiation uniformity at a fusion capsule? The Lightscape™ commercial lighting simulation package from the architecture world has been adapted to accurately **model radiation transport in complex 3-dimensional z-pinch hohlraums**. Complementary research uses Sandia-developed viewfactor codes and constrained optimization algorithms to automatically find hohlraum geometries with optimal symmetry. These are two examples of the novel methods we recently developed to study radiation symmetry in ICF hohlraums. (1600) *Roger Vesey, ravesey@sandia.gov*

The Annular Core Research Reactor was modified to provide **hostile environment testing for weapon components**. The reactor was reconfigured for pulse operation with experiments located in the center of the reactor. Exceptional efforts by many people enabled completion of high-level programmatic goals for both ACORN and neutron generator programs. NNSA Defense Programs official Gen. Thomas Gioconda praised the reactor reconfiguration effort, which earned a DOE Nuclear Weapons Program Award of Excellence



LIGHTSCAPE™ simulated radiation flux contours in z-pinch ICF hohlraum.

and a Sandia President's Gold Quality Award. *John Guth, jrguth@sandia.gov*



MAGNETICALLY accelerated flyer plate velocity as a function of time. The large magnetic fields produced in the insulating gaps of the Z accelerator have been used to "gently" accelerate relatively large aluminum, copper, or titanium flyer plates (9-12 mm in diameter by 200-300 mm thickness) to velocities in excess of 20 km/s.

A Revolutionary New Method for Launching Flyer Plates with the Z Accelerator: Recently a new, revolutionary capability has been developed at Sandia to **magnetically launch macroscopic, hyper-velocity flyer plates**. The large magnetic fields produced in the insulating gaps of the Z accelerator have been used to "gently" accelerate relatively large aluminum, copper, or titanium flyer plates (9-12 mm in diameter by 200-300 mm thickness) to velocities in excess of 20 km/s. This technique is being used to perform equation-of-state experiments with unprecedented accuracy in ultrahigh-pressure studies. (1600) *Marcus Knudson, mdknuds@sandia.gov*

Arms control and nonproliferation



PAYLOAD PAYOFF — Sandia engineers Chuck Looney (left) and Dennis Gutierrez make last-minute checks of the solar arrays on the Multispectral Thermal Imager (MTI) satellite at the Payload Processing Facility at Vandenberg Air Force Base, Calif., prior to encapsulating the satellite in preparation for launch that took place on March 12, 2000. Half of the satellite's protective fairing (rocket nose cone) is visible in the background with its internal (black) thermal-acoustic blankets. (Photo by Randy Montoya)

On March 12, 2000, the USAF launched the **Multispectral Thermal Imager (MTI)** satellite into polar orbit aboard an Orbital Sciences Taurus rocket. MTI is a Sandia-led, multilaboratory R&D project sponsored by DOE's Office of Nonproliferation and National Security. Its objective is to develop, demonstrate, and evaluate multispectral and thermal imaging and related technologies for a broad range of national security civilian applications. **Brian Brock**, bcbrock@sandia.gov

Mayak Production Association is a major Russian nuclear enterprise involving numerous plants that process and store large quantities (estimated to be more than 100 metric tons) of plutonium and uranium for both weapon and civilian uses. Under the sponsorship of the DOE Material Protection, Control, and Accounting (MPC&A) Program, the Mayak Project has provided an initial design for large **steel-clad, steel-reinforced concrete blocks to cover canisters of plutonium dioxide** in order to increase the time required for a thief to gain access to the canisters. An agreement was recently signed that establishes the foundation for initiation of security upgrades at another of Mayak's



STEEL-CLAD reinforced concrete blocks are being placed on top of canisters of plutonium dioxide in storage to make it harder for a thief to access the materials.



MTI SATELLITE image showing the San Rafael Bridge north of Oakland and San Francisco, Calif. Vegetation shows up as bright red.

plants in which extremely large quantities of weapons grade plutonium and uranium are processed and stored. (5300, 5800) **Jim Chapek**, jfchape@sandia.gov

We have designed, fabricated, and demonstrated prototypes of two **portable chemical analysis systems** tailored to the rapid detection and analysis of toxic agents that might be released during a terrorist attack. Extensive testing of these prototypes with targeted agents (one for chemical warfare agents and one for biotoxins) has demonstrated that our devices can detect specific agents with extremely high sensitivity in very short times. Furthermore, our tests have shown that these systems are not affected by common chemicals that could potentially serve as interferences. (1700, 8100, 8300)

Duane Lindner, dllindn@sandia.gov

The Advanced Modular Tag (AMT) is a miniature, LPI/LPD (Low Probability of Intercept/Low Probability of Detection) **communicator and tracking device** intended for use by special operations and other DoD forces. This work is funded by the Air Force Space Warfare Center; and, Centers 5700 and 2300 have teamed with Lockheed Martin in this development. Recently, the AMT successfully passed a

critical series of laboratory and field tests required for full certification and use with US assets. (2300, 5700) **Michael Murphy**, mbmurph@sandia.gov

Sandia's best friend may be the newly developed Hound™ — that is, if you need contra-band detection capabilities. The Hound™ is a **portable sampling/preconcentration system** fitted to a commercial portable detector to

improve sensitive and sampling efficiency. This portable sampling/preconcentrator system is a direct outgrowth technology from the explosives detection portal (EDP) developed by Sandia for the Federal Aviation Administration. The EDP and the Hound™ are capable of detecting vanishingly (parts per trillion) faint odors of explosives and other chemicals. (5800) **Kevin Linker**, kllinke@sandia.gov



SAMPLING on the Chirchik River in Uzbekistan are, from left, Viktor Poznyak, Kazakhstan; Alexandra Inoyatov, Uzbekistan; Bajgabyl Tolongutov, Kyrgyzstan; Raisa Radyuk, Uzbekistan; Sandian Dave Barber; Valentina Alekhina, Kyrgyzstan; and Djamshed Kamalov, Tajikistan.

The Cooperative Monitoring Center is collaborating with nuclear physics institutes in Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan in a **waterborne radionuclide monitoring experiment** on the major rivers in Central Asia. Since the breakup of the Soviet Union, these countries have been pursuing independent courses, and cooperation on any issue has been extremely difficult. These republics contributed greatly to the Soviet nuclear weapons program, from uranium mining and processing to nuclear weapons testing. (5300) **Dave Barber**, dsbarbe@sandia.gov

DOE's AURA (Advanced UV Remote-Sensing Applications) program completed a **successful engineering flight test** deployment to Dugway Proving Ground, Utah, last October. The AURA payload, an advanced ultraviolet laser induced fluorescence lidar, was installed in the Altus UAV (Unmanned Aerospace Vehicle) and completed six successful flights. All science goals were met or exceeded. A second flight test deployment is set

(Continued on page 10)



Microelectronics

First Solid State Ultraviolet Vertical Cavity Surface Emitting Laser (UV-VCSEL): Sandians and researchers at Brown University have used the results of *in situ* stress studies to design an AlGaIn/GaN distributed Bragg reflector. This reflector enabled the first **demonstration of an InGaIn UV-VCSEL**. These lasers will be part of a revolution in white lighting where current lighting will be replaced with solid state lighting as envisioned in the National Solid State Lighting Initiative. The improved efficiency of solid state lighting will result in a huge energy savings and pollution reduction. (1100) *Robert Biefeld, rmbiefe@sandia.gov*

Sandia researchers, with industry partners Cielo, Inc., have developed the first **1.3-micron electrically pumped vertical cavity surface emitting laser (VCSEL)** grown on gallium arsenide. The 1.3-micron wavelength, which is optimal for ultra-high bandwidth data communication over glass fiber optics, is also transparent to silicon, allowing considerable flexibility in incorporating such a photonic device with silicon microsystem structures. (1700, 1100) *Peter Esherick, esheric@sandia.gov*



SANDIA SCIENTIST Jung Han adjusts laser pumping on a prototype ultraviolet VCSEL surface. (Photo by Randy Montoya)

Arms control

(Continued from page 7)

for September 2001. The September test will represent the first demonstration of an operational lidar for the detection of WMD proliferation effluents. (Sandia centers that support the AURA program include 1100, 2300, 5700, 6100, 8100, 8300, 8400, 8900, and 15400.) *Al Lang, alang@sandia.gov*

US/Russian Arms reduction treaties require verification that nuclear materials from dismantled weapons are not returned to weapons use. The Trilateral Initiative of the United States, Russian Federation, and International Atomic Energy Agency (IAEA) is developing a **model verification agreement** and exploring verification technologies. Sandia provides a senior technical advisor and leads a group of technical experts for the US delegation to develop inventory monitoring systems and approaches for verification that are acceptable to all parties. (5300, 5800, 6500) *Dennis Mangan, dlmanga@sandia.gov*

Mission Analysis and Simulation Dept. personnel, using the Sandia Data Analysis and Display System, performed detailed mathematical and statistical analyses of the more than 20,000 sensor events collected during the **Nuclear Detonation Detection System Characterization Test** sponsored by the Air Force Space and Missile Systems Center. Radio frequency illumination of the electromagnetic pulse sensors onboard Global Positioning System satellites was accomplished using the Stanford Research Institute pulser located at Algonquinn Radio Observatory in Ontario, Canada. A comprehensive report was completed in August 2000. (6500) *Bill Richard, bdricha@sandia.gov*

Sandia delivered **Release 4.0 of the Nuclear Explosion Monitoring Knowledge Base** to the US National Data Center (US NDC). This Knowledge Base improves the ability of the US NDC to detect, locate, and identify clandestine nuclear tests. It does this by providing detailed knowledge of the earth's structure and signal propagation characteristics developed at DOE's national labs.

Sandia-developed information management systems, applications interfaces, and user interfaces integrate the Knowledge Base with the 24-hour-a-day operations at the NDC. (6500, 6100, 5700) *Ralph Keyser, rgkeyse@sandia.gov*

India and Pakistan have come together at the Cooperative Monitoring Center (CMC) to collaborate on issues of common regional concern. A CMC-sponsored water quality project shared data among India, Pakistan, Nepal, Bangladesh, and Sri Lanka. Workshops at CMC and overseas were conducted with the Department of State, Stanford University, and the Regional Center for Strategic Studies on cooperative monitoring to enhance regional security. Visiting scholars from India, Pakistan, and the US published papers on South Asian nuclear doctrines and agreements, potential for regional naval cooperation, and border security. (5300) *Kent Biringner, klbirin@sandia.gov*



CHRIS CHERRY, left, Sandia's world-recognized bomb-disablement expert, demonstrates render-safe technology during last year's Operation: America training workshop for bomb squads from across the US. The 2000 program was held in San Diego and was sponsored by the National Institute of Justice.

The first in a series of **Operation: America training workshops for bomb squads** was held in San Diego, Calif., Sept. 18-22. The program focuses on advanced disablement technologies to render-safe complex terrorist type devices. Several more five-day workshops are planned, each hosted by a different US city and involving bomb techs from

Environmental remediation

Under contract to DOE Nevada, we completed a Performance Assessment (PA) for **disposal of transuranic wastes** in a Greater Confinement Disposal (GCD) configuration at the Nevada Test Site (NTS). The assessment documents almost 10 years of site studies and system characterization; development and evaluation of conceptual and mathematical models and ranges of defensible input parameters; and final demonstration of compliance with Environmental Protection Agency standards. The PA easily demonstrated protection of humans and the environment, and that GCD is an ideal system for isolating radioactive wastes in arid settings such as the NTS (6100, 6800). *Doug Brosseau, dabross@sandia.gov*

Sandia's Solid Waste Transfer Facility teamed with Kirtland AFB to implement a **base-wide residential recycling center** which achieved DoD recycling goals and national recognition by winning the Air Force Materiel Command "Ronald Yates Award for Team Excellence." Materials collected at the recycling center include plastic, aluminum, new paper, cardboard, tin, and glass. Further teaming efforts now include pick-up of Kirtland's commercial cardboard, roll-off truck services, and joint use of equipment. (7100) *Gabe King, ggking@sandia.gov*

the neighboring region. The San Diego workshop was hosted by the San Diego County Sheriffs Office and the US Navy and taught primarily by Sandians. The Operation: America series is sponsored by the National Institute of Justice. (5900) *Chris Cherry, crcherr@sandia.gov*

Mission Analysis and Simulation Dept. personnel developed an **improved method for evaluating the performance** of an inter-satellite communications system used by the constellation of Global Positioning System (GPS) satellites. The method, while collecting large amounts of data without significantly impacting either space or ground operations, provided new insights into possible error sources. This in turn led to the development of new error reduction techniques, and subsequently influenced the design of future GPS satellites. (2600, 5700, 6500) *Bill Richard, bdricha@sandia.gov*

Sandia has completed two projects demonstrating technologies vital to **protection of major US facilities** against chemical and biological agent attacks. One project has deployed chemical agent detectors and supporting information systems into a testbed in the Washington, D.C., subway system to provide operational data that addresses the long-term reliability and false alarm characteristics of detection systems. A second project has focused on the release of tracers in the San Francisco International Airport to characterize attacks and to evaluate the potential of air handler responses to mitigate effects. Both projects are sponsored by the DOE Chemical and Biological National Security Program. (8100, 2200, 8900, 6400, 6200) *Larry Brandt, lbrandt@sandia.gov*

A Chemical Defense Assessment Team was formed at the direction of Gen. Eugene Habiger to **study defenses against the possible use of lethal chemical agents** to attack the people guarding SNM (Special Nuclear Material) at DOE sites. This Sandia-led team assessed three of the most critical sites this past year and wrote, with the aid of experts from Sandia and DoD's Edgewood Chemical Biological Command, A Guide to Defending SNM Facilities Against Chemical Attacks. (8100, 5800, 9100) *John Vitko, jvitko@sandia.gov*

Emerging threats



HOPPER co-developer Barry Spletzer shows how high the new hoppers can go. This one leaps 10-20 feet high on each jump. (Photo by Randy Montoya)

Reliable, autonomous mobility in difficult environments has previously eluded robotics engineers. Intelligent System Sensors & Controls Dept. 15211's DARPA-funded work developed a hopping machine that **may soon give robots unprecedented mobility** for exploring other planets, gathering war-fighting intelligence, and assisting police during standoff or surveillance operations. Most mobile robots are designed to steer directly to a spot and require expensive and complicated control systems. Over long distances you don't need as much precision, so semi-random mobility is sufficient for many applications. *Jerry Langheim, grlangh@sandia.gov*

Sandia-developed Rapid Terrain Visualization (RTV) Interferometric Synthetic Aperture Radar (IFSAR) is a **revolutionary terrain-mapping radar** capable of producing terrain elevation maps with height accuracies of 0.5 m. The system provides the Army a two-hours-to-data mapping capability for regions of conflict and enables battlefield visualization. The system solves three key problems in interferometric mapping: 1) timeliness of data through real-time processing, 2) high-accuracy digital-elevation maps through innovative multipath reduction techniques, and 3) the elimination of phase unwrapping through multiple antenna baselines. RTV is the first program to demonstrate these capabilities. (2300, 5900). *Gene Kallenbach, gakalle@sandia.gov*

Gathering and transmitting measurements during explosive events is a difficult task requiring a broad radio frequency bandwidth. We successfully flight-tested a 33 megabits per second (Mbps), 16-symbol Quadrature Amplitude Modulation (QAM) High Explosive Radio Telemetry (HERT) that is designed to **collect and transmit data during a high explosive detonation**. The primary benefit of QAM is bandwidth reduction: To transmit a 33 Mbps rate, this system requires 10 MHz bandwidth compared to over 35 MHz using conventional telemetry. (2600, 8400) *John Moser, jcmoser@sandia.gov*

The first **Explosives Destruction System (EDS)** unit designed, fabricated, and quality-tested by Sandia for the US Army Non-Stockpile Chemical Materiel program closed out a campaign of engineering development tests carried out at the Defence Evaluation and Research Agency (DERA) facility in Porton Down, England. World War I vintage mortar shells and artillery projectiles (7 filled with phosgene and 12 with mustard) were destroyed, as was a container filled with more than a pound of Sarin nerve agent. The chemical agents were consistently destroyed below detectable limits. (8100, 15300, 8700) *Al McDonald, amcdona@sandia.gov*

An advanced diagnostic tool, the **line-imaging optically recording velocity interferometer system (Line-ORVIS)**, has been developed and demonstrated, under LDRD funding, to quantify material dynamic response at unprecedented temporal and spatial resolution. This diagnostic provides 1-D spatially- and temporally-resolved material response and/or provides single-time 2-D response data. Line-Orvis has been applied in collaborative computational "discovery" studies of energetic material mechanical response at the meso-scale, has provided data critical to stockpile materials, including PZT, ALOX, and HMX, and is a primary diagnostic for Z-pinch physics studies. (9100, 2500, 1600) *Arthur Ratzel, acratze@sandia.gov*

Following two years of planning and coordination, a series of chem/bio simulant release tests were



ONLY A TEST — Chem/Bio Simulant Release Test in SFO Boarding Area G. The simulated chem/bio agents were released to experimentally characterize the response of the facility to a terrorist attack with these weapons of mass destruction. The tests were designed to demonstrate that DOE technologies can be successfully used to address the emerging chem/bio threat to critical national infrastructure.

Warbirds



SYSTEMS RELIABILITY DEPT. 6411's primary efforts during FY00 focused on the broad area of sustainment and readiness of weapon systems. Major programs were established with: Lockheed Martin in Support Enterprise Modeling and health monitoring for the Joint Strike Fighter and the F-16; Raytheon in Service Life Extension for the Advanced Cruise Missile and predictive reliability/maintenance for the Future Combat System; DARPA/Army in predictive reliability/maintenance and health monitoring for the Joint Virtual Battlespace; the Air Force in supply chain management and spares optimization for the F-22; and the Army in predictive reliability and retrofit optimization for the Apache helicopter. (6400) *Jerry Langheim, grlangh@sandia.gov*

performed at the San Francisco International Airport. The **simulated chem/bio agents** were released to experimentally characterize the response of the facility to a terrorist attack with these weapons of mass destruction. The experiments were a major milestone under the PROTECT Domestic Demonstration and Application Program funded by DOE, which is intended to demonstrate that DOE technologies can be successfully used to address the emerging chem/bio threat to critical national infrastructure. (9100, 8100, 6400, 6200) *Richard Griffith, rogri@sandia.gov*



ROBOTIC VEHICLE WITH FUEL CELL

We integrated and tested a **fuel cell power system on a robotic vehicle**, an industry first. The fuel cell combines hydrogen and oxygen at low temperature without combustion to produce electricity at high efficiency, potentially offering much greater operational range than batteries presently used. In collaboration with the Fuel Cell Propulsion Institute, Sandia combined an H-Power Corporation stack with a hydride bed hydrogen storage unit developed at Sandia/California. (15200, 6200) *Jerry Langheim, grlangh@sandia.gov*

In July 2000, Sandia completed work on two royalty-bearing license agreements to **commercialize Sandia's decontamination formulation** for chemical and biological weapons agents. The formulation can be deployed in various ways: as a foam, fog, spray, mist, or liquid. It is non-toxic to humans. The two separate licensee companies obtained non-exclusive rights under the agreements that allow them to supply emergency responders with technology that can mitigate the effects of a chemical or biological attack. Part of the royalty and fee revenues will support future Labs R&D endeavors. (11500) *Russell Elliott, rusty@sandia.gov*

The **Laser Dynamic Range Imager (LDRI)** sensor was developed for NASA/Johnson Spaceflight Center (JSC), which provided the funding for this project. The LDRI sensor, capable of capturing 3-D images at a rate of 7.5 Hz, was delivered to Kennedy (Continued on next page)



Computing

Cplant™, short for Computational Plant, is now the **largest Linux cluster in the world** with nearly 2,000 Compaq Alpha nodes. The Cplant team has developed a flexible architecture to accommodate further additions, and a testing strategy to ensure a production quality environment for the users. In FY01, Cplant is to be a tri-Lab computing resource, extending its access to sister labs and to the open community. Cplant clusters have already reached usage levels up to 90 percent. (9200, 9300) *Neil Pundit, ndpundi@sandia.gov*

SecureNet Videoconferencing in Production: A new, more reliable classified videoconferencing capability has gone into production at Sandia/California and Sandia/New Mexico. The system enables customers to use classified videoconferencing whenever they wish, without the need to schedule through DOE/HQ. This videoconferencing capability uses the SecureNet network infrastructure to transport video and audio between sites. Interest in this new classified videoconferencing system is spreading quickly throughout DOE. (8900, 9300, 2100) *Brian Chamberlain, bgchamb@sandia.gov*

As users on the Sandia Restricted Network (SRN) have been keenly aware, network outages over the past year or so have interrupted business at very inopportune times. A year ago, network reliability dropped below 99 percent, which was unacceptable. A Network Reliability Task Force was assembled to analyze and address the problem. In the first quarter of FY00, reliability was

99.3 percent, 99.5 percent the 2nd quarter, 99.8 percent the 3rd quarter, and **99.9 percent the 4th quarter**. The team continues to work toward improved reliability and availability, while supporting the dynamics of advanced systems that support supercomputing users and MESA. *Pat Manke, plmanke@sandia.gov*

The corporate need for information management, retention, and collaboration tools on both the restricted and classified networks was accomplished with the implementation of Web Fileshare (WFS). More than 16,000 files have been contributed by users at the Labs and 2,800 searches are run each month. This content management system provides a **common set of tools to effectively manage information** through its life cycle — from creation to archiving. It can be integrated with project Web sites to assist in accessing collections of information. (9300, 9500, 9600) *Beth Moser, ecmoser@sandia.gov*
(Continued on next page)



CHECKING OUT CPLANT™ — Carl Leishman (14111) examines one of many racks of computers that, when clustered together, form the basis of Sandia's CPlant system, the largest Linux cluster in the world, with nearly 2,000 Compaq Alpha nodes.
(Photo by Randy Montoya)

Emerging threats

(Continued from preceding page)

Spaceflight Center in September and installed on the Endeavor space shuttle. A critical demonstration of the sensor was completed successfully during a November Shuttle mission. (2300, 5700, 9100, 14000, 15000) *Jerry Langheim, grlangh@sandia.gov*

The Short-Pulse Laser (SPL) Program made hallmark scientific discoveries in FY00. World's-first laser techniques for creation, sustainment, and control of 50 femtosecond "optical bullets" were developed, world record propagation distances were achieved, and new phenomenologies were demonstrated in the lab and in field trials. These successes secured a combined DoD/DOE FY01 funding increase of roughly 50 percent over FY00. The SPL team includes nationally recognized experts from Center 15300. Sandians from other divisions contribute to the program's success on an as-needed basis. (15300) *Jerry Langheim, grlangh@sandia.gov*

The Information Design Assurance Red Team (IDART) has continued to analyze advanced information systems for DARPA with the intent to help designers rethink traditional system design approaches. Major accomplishments in FY00

include the **definition and characterization of adversary models** that range in sophistication from novice to foreign intelligence and the development of a training curriculum in the IDART methodology. The team trained new "Red Teamers" at Sandia and DARPA to analyze systems from an adversarial point of view to demonstrate how a cyber terrorist, for instance, might exploit vulnerabilities. (6500, 2600, 5800, 9300) *Jerry Langheim, grlangh@sandia.gov*



COMIN' AT YOU — Sandia's Information Design Assurance Red Team, good guys playing bad guys, seeks out weaknesses in computer systems. Red Team members shown are, at keyboard, David Duggan (6236), from left in the background, Michael Eckley (2662), Ruth Duggan, Ray Parks, Julie Bouchard (all 6237), and Dave Farrell (5932).
(Photo by Randy Montoya)

Manufacturing & production

The **qualification of the MC4380 Neutron Generator** was completed for the W76-0 and a major corporate milestone was met. This project showed for the first time that we can design and qualify a component to survive strategic radiation environments without underground testing. We also established a new Neutron Generator Production Facility and showed we can reliably produce neutron generators for the stockpile. This project was accomplished through the teamwork of organizations throughout Sandia. (2100, 1800, 2500, 2900, 3500, 4600, 6200, 6400, 7100, 8400, 8500, 8900, 9100, 9200, 9500, 9800, 10200, 12300, 14000, 15300) *Pat Sena, pasena@sandia.gov*

The W76 Recertification Program was put on hold for six months to assist in the October 1999 deadline for the MC4380 Generator production. After coming back on line with full production of the recertification program and with reinstated ship requirements, the program picked up where it left off. We are now at **63 consecutive successful Quality Assurance Inspection Process (QAIP)** submittals to the DOE. The program continues to meet 100 percent of ship requirements to the Navy. (9100, 2500, 141001, 14400, 10200) *Norman Schwentor, njschwe@sandia.gov*

A process has been researched and developed whereby **micron-scale tools can be fabricated using a Focused Ion Beam**. These tools may then be used on precision machining equipment to make micron-scale features. Previously, miniature machining techniques could only get down to the 50-100 microns scale. It is now possible to directly fabricate micron-scale components out of traditional design materials such as stainless steel, alloys, and ceramics. We expect this technology to have application in microactuation, microanalysis, medicine, and component fabrication. (14100) *David Adams, dpadams@sandia.gov*

The Manufacturing Enterprise (ME) (14181/14186) was awarded a **Certificate of Registration to ISO 9002 Quality Systems** on April 28, 2000. The ME is the first organization to achieve this recognition at Sandia National Laboratories and a first for the DOE weapons labs. It was a process that began three years ago with a vision to position the ME for the future. Accomplishing this task required major changes in our business processes, involved all aspects of our business and all of our people. (14100, 12300) *Paul McKey, pcmkey@sandia.gov*

Energy and critical infrastructure

After 10 years of planning, design, and construction, Sandia overpressurized a 1:4-scale model of a Japanese nuclear reactor pre-stressed concrete containment vessel to failure. The model, tested for the US Nuclear Regulatory Commission and Japan's Nuclear Power Electric Company, initially leaked at 2.5 times the design pressure (Pd) before reaching a maximum pressure of 3.3 Pd. The data from almost 1,500 sensors will be used by an international team of experts as a benchmark for structural analysis codes and will aid the development of new state-of-the-art accident response models. (6400) *Mike Hessheimer, mhessh@sandia.gov*

The safety of high-power lithium-ion batteries, which will be used in hybrid electric vehicles and the NASA Space Shuttle, is of key importance. Thermal runaway in lithium-ion cells, if not controlled, can have serious safety implications. Our calorimetric studies have identified the mechanism of thermal runaway under abuse conditions. This improved understanding of the reaction sequence will enable researchers to investigate the chemical mechanisms responsible for thermal abuse intolerance, mitigate these effects, and substantially improve the operational safety of batteries for these applications. (2500, 1800.) *Dan Doughty, dhdough@sandia.gov*

Risk Informed Regulation: Many existing regulations governing design and operation of nuclear power plants in the US do not contribute to safety and reliability, which has resulted in unnecessary burden to plant operators and regulators. The Nuclear Regulatory Commission is using risk-information to identify alternatives to



QUARTER-SCALE prestressed concrete containment vessel, overpressurized to failure as part of a test conducted by Sandia for the US Nuclear Regulatory Commission and Japanese nuclear power industry. (Photo by Randy Montoya)

existing regulations. The first step established a risk-informed framework for generating alternative regulations. The framework ensures that new regulations protect public health and safety by providing defense-in-depth measures that address the prevention and mitigation of risk-significant accidents. (6400) *Jeff LaChance, jllacha@sandia.gov*

a robust cyber security architecture that has withstood the test of numerous audits and reviews. Viruses, various Internet attacks, attempted intrusions, and unauthorized access are subject to rigorous scrutiny and rapidly adjudicated when detected. On-line procedures, rapid response teams, and a sophisticated cyber architecture have created a state-of-art system designed to provide Sandia an effective cyber security posture. (9300, 9600) *R. Michael Cahoon, rmc@sandia.gov*

The Scalable Rendering Team developed a high-performance computer graphics rendering system. The large ASCI (Accelerated Strategic Computing Initiative) supercomputers generate datasets exceeding the capability of the largest computer graphics systems. The team used \$350 PC graphics cards to build a scalable rendering system. Recent results, using a 64-node graphics cluster, demonstrated rendering 225 million polygons/sec. This is 100 times faster than the best graphics pipe available on the production ASCI visualization servers. This technology is a key capability for the ASCI program. (9200). *Phil Heermann, pdheerm@sandia.gov*

The Virtual Node Operating System (VNOS) Team extended the Cougar OS to enable user applications to transparently access compute coprocessors on Sandia's ASCI Red teraflops supercomputer. This work was driven by the needs of the Tflops user community for more computational throughput and by severe schedule constraints imposed by Sandia's support contract with Intel. The team developed and delivered the VNOS capability in six months, while meeting all of Intel's stringent testing and evaluation requirements for the OS. The Virtual Node OS provides the ASCI Red user community with the equivalent of many thousands of hours of additional Tflops computer time, worth tens of millions of dollars, over the four years of the machine's expected remaining life cycle. This is a high payoff for a project that cost less than \$500,000. (9200) *Robert Benner, rebenne@cs.sandia.gov*

Computing

(Continued from preceding page)

The Sandia Classified Network (SCN) re-emerged as an enhanced capability providing Sandia engineers and scientists the requested functionality and tailored security to accomplish their critical mission work. The solution creatively featured the flexibility of Web technologies interwoven with unique need-to-know security structures. This achievement marks a major step in the alignment of IIS activities with major Sandia program focus. (IIS, 8900, 2900, 9800, 9300) *William Swartz, wdswart@sandia.gov*

To increase user access and efficiency, more than 1,000 journals are now provided electronically to your desktop through the Technical Library's full text, electronic delivery of information. The Engineering Index, SciSearch, Social SciSearch, and INSPEC are examples of our subject-specific indexes, and electronic indexes are linked directly to full-text articles. From the Library's web page you can also access electronic reference tools, like the CRC Handbook of Chemistry and Physics. (9600) *Lynn Kaczor, lmkazco@sandia.gov*

The cost of desktop computing support at Sandia reached a new low of \$2,200 annually per customer in FY00 while adding several new services and achieving increased customer satisfaction (a new high of 8.8 on a scale of 10). This is a 31 percent reduction from 1994's cost of \$3,200 when the CSUs were first formed. The reduction is the result of process and technology improvements implemented by Computer Support Units, Technology Development, and the Corporate Computing Help Desk. *Charles Shirley, cshirle@sandia.gov*

Agile intrusion detection processes, new firewall management procedures, network scanning, switched high-speed networks, and the Sandia Common Operating Environment have produced

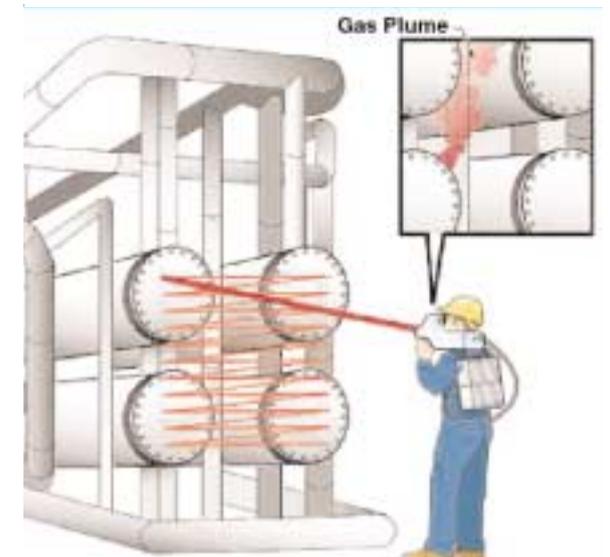
Severe Accident Analysis: Department 6415 recently released version 1.8.5 of the MELCOR code, a software product developed for the NRC embodying more than 20 years of research into severe accident behavior. MELCOR models the progression of a severe accident in a nuclear power plant and potential release of fission products from the site. A significant advance over previous MELCOR releases, version 1.8.5 was distributed to more than 40 foreign and domestic users for application to plant safety and licensing studies around the world. (6400) *Randy Gauntt, rgaunt@sandia.gov*

Sandia fire safety research contributes to safer nuclear power plants and continues to receive industry and customer praise. Notable accomplishments this year under Nuclear Regulatory Commission-sponsored programs include: assessing the impact of fire-induced cable faults on power, control, and instrument circuits; review of worldwide nuclear plant fire events; and plant fire safety inspections. These efforts are supporting development of risk-informed regulatory standards and policy designed to maintain high levels of safety while eliminating requirements marginal to risk. (6400). *Steve Nowlen, spnowle@sandia.gov*

Over the past two years, we have conducted an extremely aggressive Sandia-led project to develop, integrate, and test a state-of-the-art dish/Stirling solar power generation system. We pulled together the "best-of-the-best" advanced technologies, and in November 1999, demonstrated unattended operation of the prototype system. The system has met all of its performance objectives and demonstrated to DOE that Sandia is second to none in the integration of solar thermal systems. We will field a second-generation system on an Indian reservation in the Southwest next year. (6200) *Richard B. Diver, rbdiver@sandia.gov*

The 2001 American Physical Society Herbert P. Broida Prize has been awarded to David W. Chandler, Sandia National Laboratories, and Paul L. Houston, Cornell University, "for their critical contributions to the investigation of vibrationally and rotationally resolved molecular photodissociation and reaction dynamics, in particular for the invention and development of the photofragment ion imaging method." Ion imaging enables studies of the dynamics of photodissociation processes with a degree of detail unmatched by any other method. This technique has been adopted by laboratories worldwide since the first demonstration in Dave's lab in 1986. (8300) *John Goldsmith, jgold@sandia.gov*

Each year US industries spend enormous sums (\$1 million/yr at a typical oil refinery) combatting gas leaks. To simplify leak detection, Sandia has developed a portable instrument that makes video movies of gas plumes. An infrared laser illuminates the scene and the gas becomes (Continued on next page)



USING THIS Sandia-developed portable instrument, an infrared laser illuminates the scene and the gas leak becomes "visible" by absorbing the laser light.

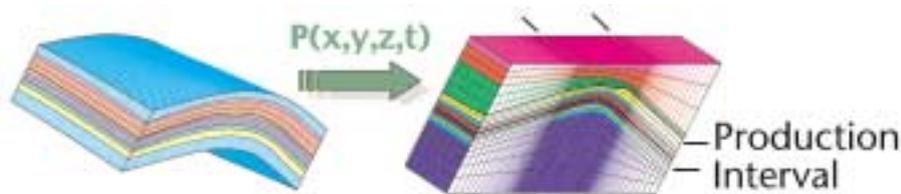


Energy/ critical infrastructure

(Continued from
preceding page)

“visible” by absorbing the laser light. The small size was enabled using newly developed laser materials and a high power fiber amplifier. The technology will be tested at a refinery in April and is being evaluated by the EPA. (8300)
Tom Kulp, tjulp@sandia.gov

New Technique Reduces Well Failure Rate at California Diatomite Oil Fields: Rock compaction resulting from oil production can cause severe bore-hole damage, sometimes resulting in expensive well abandonment and replacement drilling. Sandia scientists, with funding from DOE, Chevron, and Aera Energy, developed a **methodology for understanding the failure potential** of wells in diatomite reservoirs. The approach used 3D coupled reservoir flow - geomechanical simulations to predict the impact of different well drilling patterns and water flooding



IN THE COUPLED MODEL, reservoir fluid pressures (P) as a function of space and time are passed from the reservoir fluid flow simulation (left) to the geomechanical simulation (right). The oil reservoir sits within the central area (marked) of the finite element mesh built for the JAS3D geomechanical simulations that consist of several hundred thousand elements.

on well integrity in weak rock formations. The industry partners have incorporated the Sandia technique into their reservoir management practices. (6100, 9100) *Joanne Fredrich, fredrich@sandia.gov*

Many Sandians have made significant contributions toward the completion of the **Yucca Mountain Site Recommendation Consideration Report**. This report cumulates technical advancements in site characterization, performance assessment, and engineering design of Yucca Mountain. It will be given to the DOE Secretary for consideration in recommending Yucca Mountain as a geologic disposal site for high-level radioactive waste. If the Secretary decides to recommend Yucca Mountain as a suitable site, a Site Recommendation will be sent to the President in 2001. (6800, 6100) *Hong-Nian Jow, hjow@sandia.gov*

A new way to safely, simply, and effectively **connect electricity-producing photovoltaic (PV) solar systems** to utility company power grids has been developed. Several manufacturers have adapted it into their systems. This Underwriters Laboratories-certified control method automatically diverts or turns off electricity flow from grid-connected PV systems when an electric distribution line shuts down. *Joe Tillerson, jrtille@sandia.gov*

The Advanced Information System Lab (AISL) developed a radical and innovative new approach



DISHING IT UP — Rich Diver (6216) checks out the first prototype of the 10kW Solar Dish/Stirling Remote Power System, which incorporates the best of advanced solar technology developed at the Labs in recent years. A version of the solar collector will be placed on Indian lands in the Southwest where it will pump water for agricultural purposes. (Photo by Randy Montoya)

to computer security. It uses **intelligent agents to implement a dynamic defense**. It will have significant impact on Sandia's national security mission and commercial value to the multi-billion-dollar cybersecurity industry. The research team recognized the need for a paradigm shift in information security practices to meet the next generation Internet security threats and developed Standard Agent Architecture II (SAAII)/Agent-in-a-box, which incorporates several advances in state-of-the-art agent and information security domains. This research was funded by LDRD and DP funds. *Reynold Tamashiro, rstamas.sandia.gov*

Sandia recently completed a seminal report (NUREG/CR-6672) that provided **much more accurate risk estimates of transporting spent nuclear fuel**. The Sandia work is already being used to revise the Yucca Mountain Draft Environmental Impact Statement and will become a common reference for regulators, users, and the public. By matching accident statistics and accident conditions, and modeling cask and fuel response to those accident conditions, transportation accident dose risks were shown in NUREG/CR-6672 to be three to four orders of magnitude smaller than those in NRC's current EIS for radioactive material transportation (NUREG-0170), which demonstrates that shipping spent

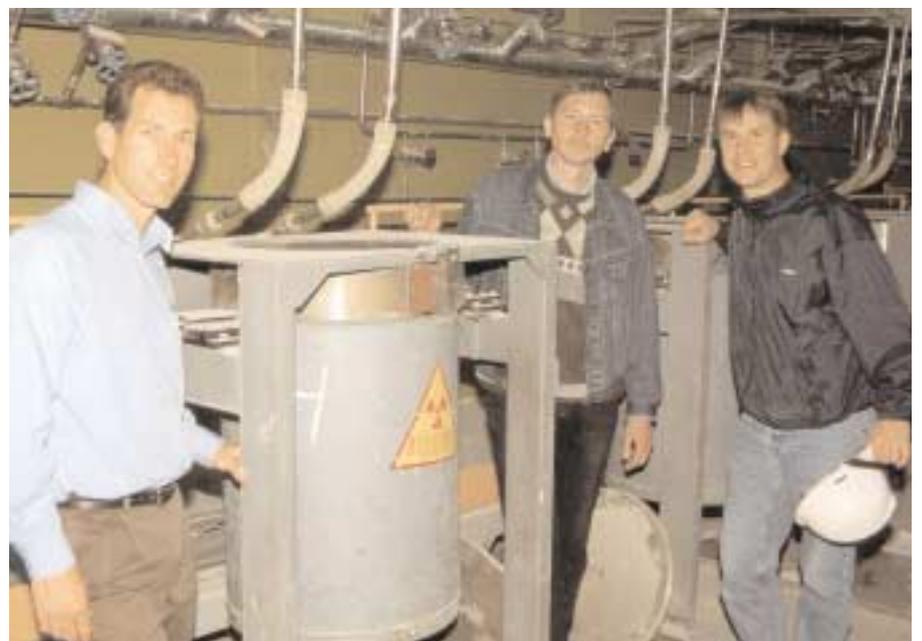
nuclear fuel is very safe. (6100) *Ken B. Sorenson, kbsoren@sandia.gov*

Emissions of sulfur dioxide (SO_2) from fossil-fuel combustion dominate the atmospheric sulfur budget. *In-situ* SO_2 measurements are required to address long-standing uncertainties about the influence of these emissions on local, regional, and global scales. Sandia researchers have recently developed a **laser-induced fluorescence detection scheme for SO_2** that has the requisite sensitivity (parts-per-trillion) for measurements throughout the atmosphere. They have constructed a prototype sensor, which has been used for ambient SO_2 measurements, and are developing a compact ultraviolet laser system for use in field studies. (8300) *Dahv Kliner, dakline@sandia.gov*

Significant improvements have been made in our **understanding of soot formation in diesel engines**, the most efficient

engine option available for transportation. Research has demonstrated that the amount of fuel-air premixing upstream of the initial flame location on a diesel spray plays a pivotal role in the amount of soot formed. The research is providing insight on how parameters such as injection pressure, orifice diameter, turbocharging, intercooling, etc., impact the soot formation in diesel engines and suggesting directions for reducing soot formation. (8300) *Dennis Siebers, siebers@sandia.gov*

In October 2000, Sandia completed a two-year project with Lockheed Martin with the commissioning of a radioactive waste processing facility at the Zvezdochka Shipyard in Severodvinsk, Russia. A similar facility will be commissioned in June 2001 at the Zvezda Shipyard in Bolshoi Kamen, Russia. These facilities support **Russian submarine dismantlement activities** funded by the US Defense Threat Reduction Agency (DTRA). Sandia technical staff led the design, construction, and licensing activities. Lockheed Martin Energy Technologies, the prime contractor for this DTRA project, contacted Sandia in 1998 seeking its international radioactive waste management experience to accomplish this first-of-a-kind facility. (6800, 6400) *Joe Jones, jojones@sandia.gov*



SUB WORK — Sandians Joe Jones (6849, left) and Joe Saloio (5327, right) with Oleg Pazhukin of the Russian design institute VNIPIET near sorbent columns installed at the “Zvezdochka” Submarine Yard in Severodvinsk, Russia.

Labs Support

A Passport for the Journey: What do you want to be when you grow up? Kids hear that question a lot, but have few chances to explore different careers. In response, Community Involvement joined with businesses, local government, and school districts to provide the first annual "School to World" event. School to World provided 1,200 middle school students a chance to discuss more than a hundred careers with people who are actually doing them. In addition to funding and event coordination, Sandia provided 65 volunteers. (12600 coordinated) *Amy Tapia, astapia@sandia.gov*

Sandia launched its first **Information Technology/Computer Science (IT/CS) Retraining Program** in June. Executive VP Joan Woodard and the Laboratory Leadership Team championed this Labs-wide, fast-track program that is led by Corporate Training and Development with partnerships across the Labs. The program grew out of increased demands for critical IT/CS skills, hiring limitations, a competitive external market, and Sandia's commitment to career development. (3500, 6500, 8500, 9300)

Building Bridges, Sandia's Participation in DOE's EEO/Diversity Standdown, engaged more than **8,000 participants in a forum for learning and dialogue** on building inclusion, trust, and respect in our work environments. Nearly 200 individuals working in more than 20 sub-teams in New Mexico and California contributed to this Labs-wide effort. As a result of the program, suggestions were produced for positive action to ensure goals that take full advantage of the diversity of people at Sandia. (3000, 8000)

Sandia/New Mexico Health Services Center's Clinical Health and Occupational Medicine organizations were recognized for quality programming and services with five President's Quality Awards, including three Golds. The Health Services Center was also awarded the **highest level of accreditation by the Accreditation Association for Ambulatory Health Care, Inc. (AAAHC)**. (3300)

The Benefits Department oversaw the **renovation of the Bldg. 861 cafeteria**. This cross-organizational project included both internal and external organizations for the design and completion. Construction was done in half the normal time



Sandians and students at the first-ever "School to World" event.

required for a project of this magnitude. The upgrade ensures compliance with safety and code requirements; reduces maintenance costs; creates a more efficient flow of traffic as requested by customers; improves the ambiance in the dining area, and increases the quality of time spent there. (3300, 7800, 7100)

Sandia hosted its **Fifth Annual Summer Technical Student Symposium and Career Fair** on August 10 with 504 attendees, 150 presenters, and 26 exhibitors. The symposium culminated a 12-week program for 250 technical interns at Sandia. The program provided technical and professional development and required interns to prepare papers and presentations on assigned projects. The Symposium offered an opportunity for Sandia and Lockheed Martin, cosponsors of the event, to consider candidates for employment. (3500)

More than 100 women managers attended a one-day conference May 11 with the theme **"Creating a Woman-Friendly Culture at Sandia."** Executive VP Joan Woodard and HR were conference champions. The conference provided a forum to share experiences and make workplace recommendations. More than 100 summer and year-round interns attended Sandia's first "Technical Women of the Future" luncheon June 12. Speakers at the luncheon encouraged female interns to continue their pursuit of higher education in science, math, engineering, and technology and provided an overview of Sandia's philosophy and practices. (3000)

tractors, along with 4,000 visitors, were rebadged between April and June (mandated by DOE and conducted every five years). All received the newly designed DOE/Sandia standard badge. In connection with rebadging, all Limited Area entrances at Sandia/New Mexico were changed to require use of both badge and Personal Identification Number. These changes were accomplished with minimal disruption to the Lab. Personnel Security also issued the newly designed ES&H Quick Reference Card to more than 10,000 employees and contractors. (7100, 7800) *Bob Baca, rgbaca2@sandia.gov*

A diverse multi-department team **packaged and shipped enriched uranium to the Y-12 Plant**, reducing security risk and future costs. This multifaceted project presented a broad range of new challenges, each requiring resolution before work could begin. Concerted efforts of 40 individuals in 13 departments across three centers were necessary to plan, execute, and finalize the shipment. The synergy that evolved within the team was paramount to success. The corporate knowledge gained here will facilitate continued initiatives to deal appropriately with Sandia's legacy nuclear material in coming years. (7100, 10200, 6400) *Warren Strong, wrstron@sandia.gov*

The Facilities Custodial Services Department rolled out a new cleaning management process in FY2000. This process has **dramatically increased building tenant satisfaction** by improving cleanliness and efficiency while expanding the scope of services provided. The system is built around teams of specialists using more effective equipment and standard chemicals, and includes techniques for work loading and scheduling. The teams should be fully deployed during spring 2001. (7800) *James Kadlec, jckadle@sandia.gov*

During FY00, the Facilities Management and Operations Center (with Nuclear Weapons Strategic Business Unit funding) **demolished five buildings at the New Mexico site**. These demolitions eliminated more than 67,000 square feet of substandard space. The demolition program reduces operations and maintenance costs and allows building sites to be re-used for new mission requirements. During this same period, vacant space was reduced by some 7,000 square feet. This increased efficiency in the use of available space also reduces operating costs for the entire Labs. (7000) *L. Patrick Murphy, lpmurph@sandia.gov*

The **Processing and Environmental Technology Laboratory (PETL)** received the Program and Project Management 2000 award from DOE's Office of Engineering and Construction Management. This achievement was made possible by the dedicated efforts of many individuals who effectively teamed to construct this highly successful facility on schedule and within budget. The building, now completely occupied, is a state-of-the-art 21st-century materials science chemistry laboratory that provides a safe, efficient (energy savings of \$100,000 per year), and attractive work environment for its occupants. (1800, 7800) *Bill Hendrick, wehendr@sandia.gov*

In FY00, Sandia made **significant strides in resource conservation:**

- Earned two State Environment Department Green Zia awards for efforts to reduce energy and water use at the central steam plant and incorporate sustainable design into new building designs.
- Saved 22 million gallons of groundwater by

(Continued on next page)

Security and force protection

Sandia's Security Police Facility Command Center (FCC) became operational last April in a newly constructed, modernized area in Bldg. 956. It has state-of-the-art phone and radio systems, caller ID, and 911 tie-in. The new strategic location saves officers' time and transportation costs. Our old Headquarters Command Center in Bldg. 802 (unstaffed, but fully functional) is now the backup command center. No communications between Bldgs. 802 and 956 existed before installation of a fiber-optic pathway. (7100, 7800, 9300, 9500) *Janet Ahrens, jsahren@sandia.gov*

All Security audits and surveys received satisfactory ratings (DOE's highest ranking). Results noted **Sandia has made significant progress over the past year** in improving and strengthening the overall performance of the Safeguards and Security Program. In addition Sandia made notable progress in implementing the Energy Secretary's new security enhancements. Enhanced security procedures for vaults and vault-type-rooms were implemented. Unapproved space-savers were replaced with GSA-approved safes. Nonstandard storage locations are either manned or alarmed. (7100) *Terri Lovato, talovat@sandia.gov*

More than 10,000 employees and con-

The **College Cyber Defenders Program (CCD)** provides students with hands-on experience in the areas of information protection, computer security, networking, and distributed systems. The mentors and staff of the CCD program have developed a unique environment that challenges students with cutting edge research projects, while supplying multiple levels of new skills for students with varied computer backgrounds. The program has grown rapidly since its inception and has graduated two students to full time jobs at Sandia. CCD students assisted in the December 1999 security audits. *Nina Berry, nmberry@sandia.gov*

The US Air Force installation in Izmir, Turkey, is distributed throughout the city in various facilities, sometimes sharing the structures with non-US businesses (hotels, etc). The terrorist threat, at times, is real and imminent. For this nontraditional security application, Sandia **has provided and installed for the Air Force an intrusion detection and surveillance capability** to deter and detect intrusions and other activities that could preface a terrorist incident. Part of this system is now used as a model for a European-wide upgrade to the Joint Services Interior Intrusion Detection system. (5800) *Bob Graham, bgraham@sandia.gov*



Labs support

(Continued from preceding page)

reusing microelectronics wastewater for other operations at Bldg. 858.

- Made the case for Sandia to purchase "green electricity" beginning FY01. (5300, 6200, 7100, 7800) *Ralph Wrons, rjwrons@sandia.gov*

Facilities Management & Operations Center implemented a major change last year by establishing a **swing shift of five mechanical tradesmen** to perform preventive maintenance. This breakthrough action accomplished key objectives: minimizing disruptions to building residents; taking a proactive approach to reduce maintenance costs by significantly increasing preventive maintenance activities, thus reducing equipment failures; and, reducing overtime costs some \$50,000 per year. (7800) *James L. Rush, jlrush@sandia.gov*

Facilities Management and other exemplary operations at the California site completed the **demolition of the 85,000 sq. ft. Bldg 913** to provide a building site for the new Distributed Information Systems Laboratory. This was the largest deconstruction project in the history of Sandia. Following a difficult relocation plan, approximately 20 functions were relocated into 10 other existing facilities. With known building contamination the project team had to perform extensive and creative characterization and cleanup prior to demolition. The project recycled 6,500 tons of concrete and approximately two million pounds of metals (steel, copper, aluminum, brass). (8500) *Gary Shamber, gwshamb@sandia.gov*

A project that involved everyone at Sandia? Yes, Sandians and contractors working at the individual, team, Labs-wide, community, and national levels **assured that the Y2K transition was a non-event**. Thousands of hours were spent identifying and evaluating potential vulnerabilities of software, hardware, facilities, operations, & safety and security systems. The success of this project is a tribute to all who demonstrated true teamwork, thoroughness of execution, and dedication. Participants represent every organization in the company, their DOE & LMC counterparts, and staff at the KAFB. (7000) *Nancy Freshour, nlfresh@sandia.gov*

Sandia received several awards in recognition of its outstanding achievement in providing **contracting opportunities to small business and its exemplary outreach activities**. These awards include: DOE's Management and Operating Contractor of the Year Award, the U.S. Small Business Administration's Dwight Eisenhower Award for Excellence, the Southwest Region Business Advocate of the Year Award, and the District II Corporate Hispanic Advocate of the Year Award. (10200) *Cynthia Schneeberger, ccschne@sandia.gov*

Oracle ERP implemented and stabilized: Sandia's Oracle ERP system was stabilized after coming fully on line in October 1999. Included in the implementation and stabilization were improved response times, development of substantial additional reports for line customers, ongoing training programs, and accomplishing the first year-end closing using the Oracle system. (9500, 10200, 10300, 10500, 14000) *Cynthia Schneeberger, ccschne@sandia.gov*

Pension plan benefits were approved that increased income for retirees and surviving spouses effective Oct. 1, 2000. The benefit changes included increases in pension benefits from 3 percent to 18 percent for eligible participants and the introduction of minimum pensions. (3500, 10300) *Cynthia Schneeberger, ccschne@sandia.gov*

Sandia's Legal, Procurement, and HR organiza-



Sandia employees made a difference in their community once again. More than 300 Sandia employees, contractors, family members, and friends, partnered with retiree Irv Hall and Judy and Ronald Ewing to build a Habitat for Humanity house. Irv Hall (above) donated the \$30,000, the Ewings donated the land, and Sandia volunteers pounded nails, hung wallboard, textured, painted, had fun, and completed the house in seven working weeks. Others donated lunches and snacks or contributed to the Carpenter's Fund. The Zozaya family calls Hall House home. (Photo by Randy Montoya)

tions worked with Sandia Staff Augmentation suppliers to **develop and implement an alternative to the three-year rule** which had previously limited contract associates' service to a maximum of three years. The alternative manages co-employment risks in an innovative manner, enabling Sandia to retain the services of more than 425 trained and valued individuals. These people would have had to be replaced, increasing overall costs and reducing productivity. Instead, they can remain at Sandia. (3500, 8500, 10200, 11200) *Skip Reeder, chreede@sandia.gov*

Logistics developed a **cost-effective way to meet DOE regulatory requirements** for on-site transportation of hazards. It consolidated operations teams involved in hazardous material storage and transportation in one location and commenced cross training. It excelled in numerous audits, most notably an audit of Shipping and the Federal Motor Carrier Program by the Department of Transportation. It reduced the amount of time required for hazmat training certification and formed the Packaging and Transportation Management Committee to leverage corporate resources. (10200) *Bob Eldredge, rvseldr@sandia.gov*

A team led by the Export Control Office obtained funding from DOE/DP and completed design, development, and roll out of an **on-line training program called EC100**. This modular system automatically tailors the depth and breadth of the training to be taken based on the student's responses to an initial set of eight questions. EC100 has been completed by more than 250 people at Sandia, and has been requested by DOE and DoD as a model for next-generation training tools. (2900, 3500, 9500, 10000, 10300) *Chad Twitchell, catwitc@sandia.gov*

Sandia received **DOE approval to make several significant computer codes available** under open source licensing. Open source licensing, used for common software packages such as Linux, allows a broad community of researchers to use, improve, and share improvements to software. Open source licensing will help transfer important technology from Sandia, and will allow Sandia to leverage the efforts of others in improving technology important to our mission. The codes currently approved for open source licensing include Cplant, Zoltan, Chaco, and Verde. (9200, 11500, 1300) *V. Gerald Grafe, vggrafe@sandia.gov*

Sandia's Legal Division supported the Contracts Organization in another successful effort to execute a "fee and scope" amendment to our prime contract. The amendment **enables a stable flow of fee to Sandia**, which is used to compensate our corporate parent for its contributions to the Sandia mission, and to pay for expenses and

costs of Sandia, which are either "unallowable" under our prime contract or would be viewed by DOE as either excessive or unnecessary. (11200, 10000) *L. S. Greher, lsgrehe@sandia.gov*

For 2000, the National Atomic Museum increased children coming to acclaimed **Science is Everywhere Summer Camp** from 80 in 1999 to 160 children in 2000. For 2001, the camps will increase again and offer second site services at the Hispanic Cultural Center. In addition, the museum served 18,569 school children with six educational programs for ages K-12. The museum presented three programs called "Young Women Take Flight" to accompany a Smithsonian exhibition, Women in Flight, which was at the museum January to May 2000. *James Walther, jkwalth@sandia.gov*

In strategic planning, the Laboratory Leadership Team **refined the vision for the Laboratories** developed 10 years ago, including revised values, revised purpose, and a new "highest goal." To study the long-term external environment, LLT also developed scenarios for the future, following the approach developed by Global Business Network. The four scenarios show plausible futures that the Labs could find itself dealing with in 15 years. Planning activities this year will challenge program managers to develop robust strategies for success in each of the scenarios. (12100) *Lori Parrott, lkparro@sandia.gov*

The Congressional Testimonies Team prepared seven congressional testimonies in FY00 — nearly triple that of any previous year. The **testimonies have created or enhanced relationships** with key staffers and lawmakers in Congress. The integrity, candor, and responsiveness of the testimonies and written statements have improved congressional perceptions of the Labs. (12100)

The Government Relations team, working through the SBUs/SMUs, **developed a Congressional Issues Document** that contains a set of well-defined, prioritized issues whose resolution are critical to Sandia's success. The document contributes significantly to conveying a uniform, consistent Laboratory message that has already been demonstrated to be effective. In concert, they developed a Washington strategy that will ensure that Sandia is properly positioned to help shape the resolution of issues of importance to national security. (12100)

The Ombuds team has intervened on contractor dispute issues, diversity issues across the complex, and nearly 600 cases involving individuals within the Labs. The **Ombuds team interacts with all Sandians** to ensure common understanding of differences and to provide a basis for dispute resolution. It is recognized across the DOE complex as a model program for excellence and is repeatedly called on by DOE at all levels to assist in developing approaches for dispute resolution. (00011 and 00012)

The President's Quality Award team serves a corporate strategy to target project teams for self-assessment and review of processes and customer relationships. This year, the number of **applications increased 40 percent** over last year and a record of nine gold awards was obtained. The PQA program received two international awards for its promotional videos. This year, the ceremony was aired live and sent electronically to a total of 700 participants. (12100)

The **Trades Training Program (TTP)** is operated by Sandia in cooperation with the Metal Trades Council, Albuquerque TVI, and Albuquerque Public Schools (APS). Attrition in Sandia's skilled Trades strategic workforce is affecting product realization capabilities. The TTP aims to maximize use of community resources, existing Sandia programs, and a new approach to training that produces fully qualified trades people at greatly reduced cost. (14100, 3500, MTC) *Phillip Gallegos, plgallego@sandia.gov*