SANDIA NATIONAL LABORATORIES

PARTNERING FOR A STRONG AMERICA

ANNUAL

PARTNERSHIPS

REPORT

FY2005

Sandia National Laboratories

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Message From Al Romig, Senior Vice President, Deputy Laboratories Director for Integrated Technologies and Systems

At Sandia National Laboratories, partnerships are a vital component of our overall strategy for meeting the nation's needs in five key mission areas: nuclear weapons, nonproliferation and assessments, military technologies and their applications, energy and infrastructure assurance, and homeland security.

Through partnerships with industry, universities, and other government agencies, we are able to leverage our funding to develop new technologies and refine existing ones. Working through partnerships creates a synergy that promotes the generation of new ideas, often resulting in breakthrough technologies that neither partner could have achieved alone. Partnerships also offer new opportunities to advance our larger national security missions.

This edition of our annual report, *Partnering for a Strong America*, illustrates the many ways in which partnerships have contributed to meeting FY2005 goals. Our partnering activities include work with NASA on the Space Shuttle *Discovery's* return-to-flight mission, new developments in mission-critical projects supported by Lockheed Martin's Shared Vision program, technological advances in Sandia's miniSAR system, and the recent success of a small spin-off business, Advent Solar, which has the potential to stimulate the local economy while providing an important new product for the photovoltaic industry as our nation strives for more independence from petroleum-based energy sources.

I firmly believe that the value of partnerships at the national laboratories will continue to grow as pressure mounts on the Defense Complex to reduce costs and eliminate duplication. Partnerships allow us to diversify our end product while leveraging costs and services. Partnerships provide a path for the development of commercial sources that are critical for national security applications. Our strategic suppliers offer specialized skills in key areas. Our strategic partnerships generate useful products that benefit national security as well as U.S. industrial competitiveness. Industry partners can bridge the "Valley of Death," that so-called graveyard of inventions that never make their way from proof-of-principle to successful commercialization, investing the resources required to take an idea from prototype to production, and then proving the technology in the commercial marketplace.

Finally, I see partnerships as central to continued U.S. economic success. Our nation's economic engine is driven by innovation, and the national laboratories have a leading role to play in the development of new ideas. Partnerships with industry, universities, and other national laboratories encourage creative thinking and enhance creative solutions to our most pressing national problems. We gratefully acknowledge our many partners' contributions to our continued mission success.

Working through partnerships creates a synergy that promotes the generation of new ideas, often resulting in breakthrough technologies that neither partner could have achieved alone.

Partnerships projects offer dynamic, high-risk, fast-paced scientific challenges that keep our people energized and excited about their work.

Message From Rick Stulen, Vice President and Chief Technology Officer, Science, Technology, and Research Foundations

Sandia National Laboratories is committed to partnerships as a key component of our strategy to meet national security missions. Partners come to Sandia seeking innovative solutions to a vast range of engineering and design problems. They receive a huge return on their investment. Sandia offers its partners access to a wide spectrum of exceptional technical talent, world-class facilities, and high-quality, science-based engineering solutions to their scientific challenges.

At Sandia, we also receive a huge return on our investment in partnerships. Partnerships provide validation data and commercial sources for mission components. Sandia's long-term relationship with Goodyear, which culminated in the Sandia-Goodyear team winning an R&D 100 award during FY2005 for their work on novel computer simulation tools used in the design of Goodyear's new **Assurance™** tire, is an excellent example of successful partnering. For Goodyear, the partnership resulted in a new design tool that has allowed the company to simulate traction, wear, durability, and other characteristics to produce a commercial product from concept to market in less than a year. For Sandia, the enhanced solution algorithms developed through the partnership created a more robust family of codes for our national security applications.

Partnerships also help Sandia leverage important capabilities and acquire best engineering, business, and program management practices from industry. Partnerships move Sandia technologies from the laboratory to the market to increase U.S. competitiveness and economic strength. Partners provide the real-world application of our technologies, supplying the feedback that allows us to take the technology to its next level of development.

Perhaps most importantly, partnerships have a positive impact on our workforce. Sandia employs some of the best and brightest scientific minds in the world. Partnerships projects offer dynamic, high-risk, fast-paced scientific challenges that keep our people energized and excited about their work. Sandia researchers value collaborations with industry because they not only reinforce the relevancy of their work but produce tangible results as technical advancements turn into commercial products.

I am proud of our past year's accomplishments and look forward to continuing the spirit of innovation reflected in our collaborations with colleagues from industry, universities, other federal agencies, and within the national laboratory system.

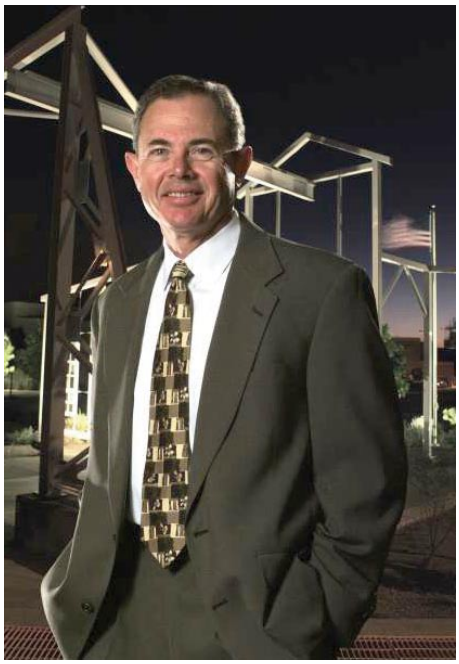
Message From Frank Figueroa, Vice President and Chief Financial Officer, Infrastructure Operations and Business Management

Sandia's Corporate Business Development and Partnerships Center provides an important service to Sandia National Laboratories. By delivering exceptional business development and partnerships resources to customers both inside Sandia and in the public and private sector outside the Laboratories, the Center contributes to Sandia's overall business success.

Our partnerships program is robust and has evolved to meet new challenges. Since the early 1990s, when Congress directed that Sandia and other national laboratories partner with industry, our partnerships program has matured in its support to Sandia's Strategic Management Units and Strategic Management Groups by teaming together to identify potential strategic partners, execute agreements, and perform research and development to pave the way for incorporating Sandia technologies into new products and services.

I believe our partnerships program will continue to evolve as new challenges arise. Our strategic partners and contractors are inherent to the core of Sandia's business strategy, and through these interconnected relationships, Sandia can absorb new ideas and discover solutions to its own business and technical problems. We must continue to develop strategic partnerships that leverage the Laboratories' intellectual capital, resulting in technological discoveries that could not be accomplished alone.

Sandia National Laboratories has a vision to help the nation secure a peaceful and free world through technology. The country looks to Sandia to develop solutions to the looming energy crisis, design new technologies that will protect our troops in combat, and develop novel approaches to defending our borders at home. We must recognize the power of partnerships to achieve these goals. Through collaborations with industry, universities, government agencies, and other national laboratories, we can work together to discover efficient and effective solutions to critical national needs.



Through collaborations with industry, universities, government agencies, and other national laboratories, we can work together to discover efficient and effective solutions to critical national needs.

Looking to the Future

How the New Energy Policy Will Affect Tech Transfer at the National Laboratories

Topping out at 1,724 pages, this sweeping new energy policy addresses a full array of energy issues and technology commercialization challenges relevant to the 21st Century.

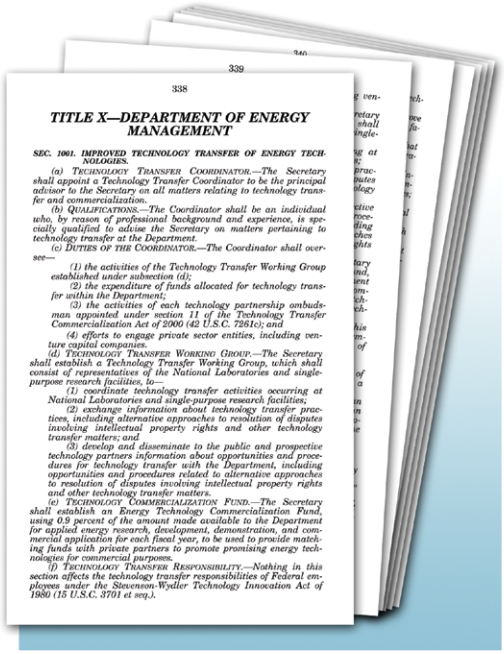
On August 8, 2005, President George W. Bush traveled to Sandia National Laboratories to sign a major new energy bill into law. Speaking at Sandia's Steve Schiff Auditorium, President Bush stated that the Energy Policy Act of 2005 will make America less reliant on foreign energy sources, encourage more environmentally friendly energy usage, promote nuclear, solar and other alternative energy sources, boost the nation's recovering economy, and keep the American homeland safer and more secure.

Topping out at 1,724 pages, this sweeping new energy policy addresses a full array of energy issues relevant to the 21st Century. It also places a welcome renewed emphasis on technology transfer activities at the Department of Energy (DOE).

Peppered throughout the giant document is language that upholds a firm commitment to ensuring the commercialization of technologies developed under DOE funding. Under each technology area identified in the new law, there is a provision for demonstration projects and programs that provide for the transfer of identified technologies to the private sector to accelerate wider application of those technologies in the global market.

The new law also establishes a budgeted position for a technology transfer coordinator who reports directly to the Secretary of Energy. That has people talking.

"We are pleased the act references the role of technology commercialization and seeks to raise visibility in the DOE for technology commercialization," says David Goldheim, Director of Sandia's Corporate Business Development and Partnerships Center.



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TITLE X—DEPARTMENT OF ENERGY MANAGEMENT

SEC. 1001. IMPROVED TECHNOLOGY TRANSFER OF ENERGY TECHNOLOGIES.

(a) TECHNOLOGY TRANSFER COORDINATOR.—The Secretary shall appoint a Technology Transfer Coordinator to be the principal advisor to the Secretary on all matters relating to technology transfer and commercialization.

(b) QUALIFICATIONS.—The Coordinator shall be an individual who, by reason of professional background and experience, is specially qualified to advise the Secretary on matters pertaining to technology transfer at the Department.

(c) DUTIES OF THE COORDINATOR.—The Coordinator shall oversee—

(1) the activities of the Technology Transfer Working Group established under subsection (d);

(2) the expenditure of funds allocated for technology transfer within the Department;

(3) the activities of each technology partnership ombudsman appointed under section 11 of the Technology Transfer Commercialization Act of 2000 (42 U.S.C. 7261c); and

(4) efforts to engage private sector entities, including venture capital companies.

(d) TECHNOLOGY TRANSFER WORKING GROUP.—The Secretary shall establish a Technology Transfer Working Group, which shall consist of representatives of the National Laboratories and single-purpose research facilities, to—

(1) coordinate technology transfer activities occurring at National Laboratories and single-purpose research facilities;

(2) exchange information about technology transfer practices, including alternative approaches to resolution of disputes involving intellectual property rights and other technology transfer matters; and

(3) develop and disseminate to the public and prospective technology partners information about opportunities and procedures for technology transfer with the Department, including opportunities and procedures related to alternative approaches to resolution of disputes involving intellectual property rights and other technology transfer matters.

(e) TECHNOLOGY COMMERCIALIZATION FUND.—The Secretary shall establish an Energy Technology Commercialization Fund, using 0.9 percent of the amount made available to the Department for applied energy research, development, demonstration, and commercial application for each fiscal year, to be used to provide matching funds with private partners to promote promising energy technologies for commercial purposes.

(f) TECHNOLOGY TRANSFER RESPONSIBILITY.—Nothing in this section affects the technology transfer responsibilities of Federal employees under the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3701 et seq.).

"Implementation via a recommended budget and an executive level position within the DOE, responsible for technology transfer, should be an effective means of reinvigorating a program that could provide great benefit to DOE's misions," continues Goldheim.

Additionally, the Energy Policy Act of 2005 calls for the establishment of Advanced Energy Technology Transfer Centers located around the country. The centers, which also come earmarked with a budget (authorized at $10 million per year for 2006-2010), would act as business incubators, working to commercialize technologies and create jobs by helping entrepreneurs build business cases and find investors.

Strategic Relationships Foster Mission Success and Provide Long-term Value

The long-term relationships among Sandia and its strategic partners result in many technologies and products that support our nation's security as well as the health and growth of the companies involved. Sandia values the opportunity to bring stimulating challenges into the Laboratories through its partnerships, and the nation benefits both through direct security applications and the economic strength of U.S. companies. Sandia is engaged in strategic relationships with Lockheed Martin Corporation, Goodyear Tire and Rubber Company, The Boeing Company, Intel Corporation, Northrop Grumman Corporation, NASA, and the Air Force Research Laboratory, among others.

HIGHLIGHT: Lockheed Martin Corporation

Sandia and Lockheed Martin have a long history of working collaboratively to achieve successful solutions to some of our nation's most important technical problems. In addition to a number of standalone Cooperative Research and Development Agreements (CRADAs) and Work for Others/Non-Federal Entity (WFO/NFE) agreements, Lockheed Martin and Sandia participate in the Shared Vision program, which supports activities of interest to both organizations in a variety of technologies, including Advanced Sensors, Advanced Power Systems, Synthetic Environments, Data Transmission and Communications, Information Assurance, Knowledge Management, Compact High-performance Electronics, and Photonics and Optical Computing.

During CY2005, the Shared Vision program supported 15 continuation projects and 8 new projects.

Electromagnetic Missile Launcher

Sandia and Lockheed Martin researchers have teamed to create an electromagnetic missile launcher (EMML) for naval applications based on pulsed power systems technology. The project was initiated in 2003 through the Shared Vision program and is continuing in 2006. Sandia's technical lead on the project is Matt Aubuchon, who works in the Magnetic Propulsion and Directed Energy Beam Applications department.

The EMML project brings together Lockheed Martin's expertise in systems designs and engineering for naval launcher platforms and Sandia's expertise with electromagnetic launchers. The Shared

John Jojola prepares the electromagnetic missile launcher for a test in mid-December. The missile's distorted shape is due to the camera's fish-eye lens. (Photo by Randy Montoya)

Vision team began the concept development course by building and testing a miniature model, and then designing intermediate and full-scale systems to identify potential difficulties.

Several types of mass launcher platforms are being researched and developed for future naval systems, including linear synchronous motors, linear induction motors, rail guns, and coilguns. The EMML is a mass launcher employing an induction coilgun platform that electronically imparts kinetic energy into the missile so that it will exit the launcher and maintain aero stability until the main rocket motors engage.

Successful development of the EMML will result in less deck heating on ships, reduce missile chemical propulsion requirements, and will be scalable to larger missiles creating a potential technology discriminator for Lockheed Martin.

The last two years of research resulted in Sandia and Lockheed Martin extending the sub-scale launcher concept to a full-scale design. The first electromagnetic missile launcher, with a full-scale mass and missile replica shape, was demonstrated to Navy, Lockheed Martin, and Sandia personnel on December 14, 2004.

The design met the requirements for a shipboard missile launch system and was praised by Navy and Lockheed program managers as a clear view of the future of electric-powered weaponry for the Department of Defense. Lockheed Martin personnel have stated that the success of the demonstration proved the feasibility of employing electromagnetic propulsion for missile boost and eject.

"This ongoing project has been quite successful for both Sandia and Lockheed Martin. I'm impressed with Lockheed Martin's level of commitment, which has resulted in the development of several launchers in a relatively short period of time. The combination of Sandia's expertise in electromagnetic launchers and Lockheed Martin's proficiency in systems integration has resulted in successful launcher designs for real-world applications," says Aubuchon.

In January 2005 the EMML team won a Sandia Employee Recognition Award by successfully demonstrating a unique solution to missile launch capability for the U.S. Navy using this electromagnetic launch technology.

The software tools developed through the SEM CRADA will help Lockheed Martin design and develop "autonomic" logistics systems for advanced weapon systems.

Support Enterprise Model is being used to help design a global sustainment system for the Joint Strike Fighter.
(Photo courtesy Lockheed Martin)

Support Enterprise Model

The Support Enterprise Model (SEM) CRADA, led by Sandia Principal Investigator Bruce Thompson, focused the expertise of Lockheed Martin and Sandia on developing a unique discrete event simulation tool to model the expected performance of enterprise-scale logistics support systems. The project was initiated through the Shared Vision program beginning in 2001. Use of SEM is expected to help in the design of logistics support systems that can meet specified performance metrics at the lowest feasible cost, a capability critical to successful execution of large-scale Performance-Based Logistics contracts.

In addition to enterprise-scale simulation capabilities, SEM includes a global optimization capability for support resources (e.g., spare parts inventory, personnel, and support equipment). This flexible capability works with the SEM simulation to identify, at each location in the global sustainment system, the optimal combination of support resources required to meet specified performance objectives at the lowest cost. Alterna-

tively, the optimization can determine how best to use a given support resource budget to maximize performance metrics.

The software tools developed through this CRADA will help Lockheed Martin design and develop "autonomic" logistics systems for advanced weapon systems. Lockheed Martin's initial SEM application is for the largest defense contract ever placed, the $200B Joint Strike Fighter (JSF) Program.

The SEM tool is now being used by Lockheed Martin Aero, the JSF Program Office, and the JSF International Partners (U.K., Canada, Netherlands, Norway, Italy, Australia, and Turkey) to help design and optimize a global JSF sustainment system worth billions of dollars in the coming decades. In fact, so critical is SEM to Lockheed Martin's plans, they expect to transition its use from a design tool to an operations tool as JSF aircraft are deployed. In addition, two other Lockheed Martin companies have started to use SEM to support multi-billion dollar Performance-Based Logistics programs and to help win additional programs.

SEM has also attracted the attention of the Lockheed Martin's new Net-Centric Integration Center and is the first Sandia-Lockheed Martin tool deployed in this showcase facility. Sandia is exploring the use of SEM for Department of Defense applications and for modeling and simulation of the nation's Nuclear Weapons Enterprise.

"The SEM CRADA has given Sandia the opportunity to use and build upon its expertise in simulation and optimization. We're now exploring ways that this unique capability can be applied to benefit both Sandia's logistics operations and the DOE/NNSA weapons sustainment enterprise," says Thompson.

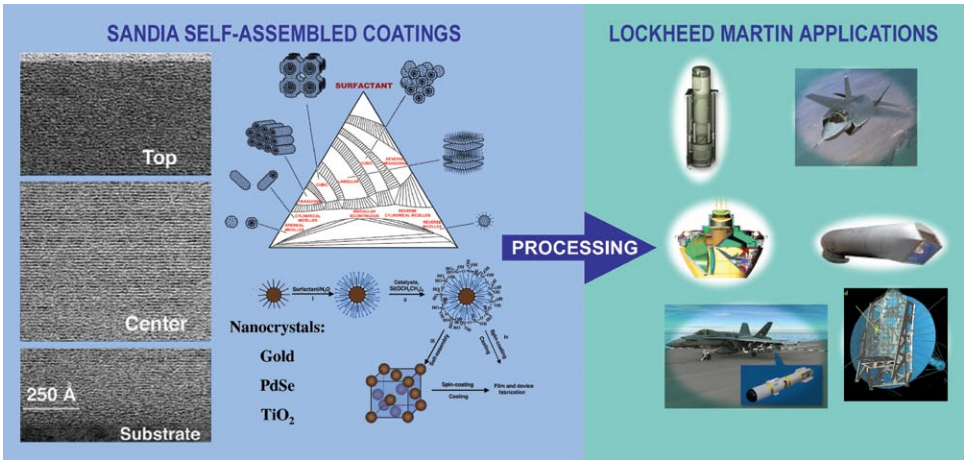
Self-Assembled Nanolaminate Coatings

Working under the Shared Vision program, Sandia and Lockheed Martin have teamed to develop simple and inexpensive processes and tools to produce multifunctional nanolaminate composite coatings with tailored properties (reflection, anti-reflection, and nanostructured porosity).

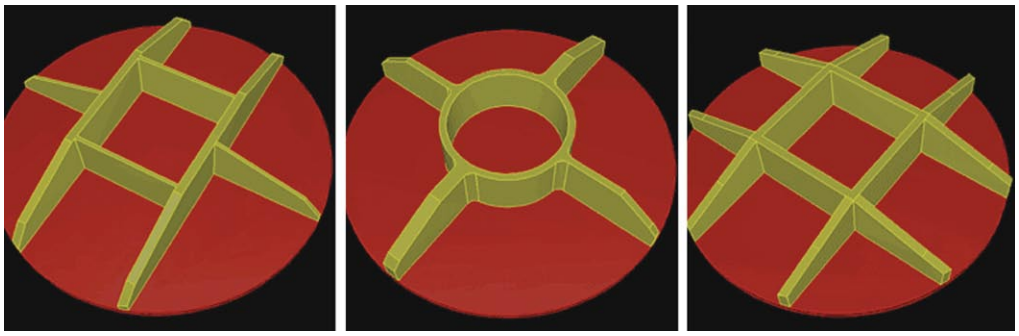
The project, led by Principal Investigator Hongyou Fan of Sandia's Ceramic Processing and Inorganic Materials department, leverages current Sandia Laboratory Directed Research and Development (LDRD) work and Basic Energy Sciences programs aimed at developing multifunctional nanomaterials for microelectronics and optics as well as structure/property investigations of self-assembled nanomaterials.

Various competitive advantages will be achieved through the partnership, including the unique ability to protect aircraft from natural elements, such as acid rain and corrosion, and the infrared reflective optical coatings will provide critical materials for military-based weapons and sensors. Further, the development of simple, inexpensive

Sandia is exploring the use of SEM for Department of Defense applications and for modeling and simulation of the nation's Nuclear Weapons Enterprise.



Sandia's Self-Assembled Nanolaminate Coatings can be applied to many key Lockheed Martin programs.



The illustration shows candidate reinforcement concepts for a radar load spreader. DAKOTA optimized each of these designs, allowing for rational comparison and informed selection.

Recently, Lockheed Martin and Sandia conducted a trade study for the F-35 JSF aircraft to design the external fuel tank for improved performance, store separation, and flutter.

methods and processes to produce these multifunctional nanocomposite coatings will significantly change how Lockheed Martin fabricates and applies coatings and final finish.

DAKOTA Optimization, Maturation, and Deployment

Sandia and Lockheed Martin researchers have teamed in a Shared Vision project to foster collaborative research and development of optimization and uncertainty quantification technology, deployed through the DAKOTA toolkit, and applied to modeling and simulation-based engineering design methodologies of common interest to Lockheed Martin and Sandia.

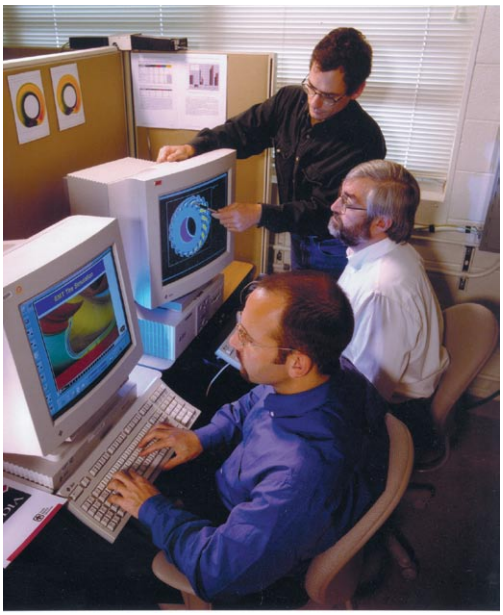
DAKOTA is a state-of-the-art software toolkit for performing "what if" engineering studies in uncertainty quantification, sensitivity analysis, calibration, and design optimization, among other topics. DAKOTA works on a variety of platforms from PCs to supercomputers and has been under development at Sandia since 1994.

Initially funded in 2001, efforts focused upon training and transition of DAKOTA to interested Lockheed Martin sites. Application success across multiple programs in 2003 motivated the pursuit for funding DAKOTA in both 2004 and 2005 Shared Vision programs. Lockheed Martin benefits from the DAKOTA toolkit through faster and more accurate trade-off analyses and derivation of system, subsystem, and mission options. Usability enhancements also reduce the learning curve and encourage early adoption of optimization techniques.

"This Lockheed Martin Shared Vision activity expands Sandia's application focus to include work in space systems and aerodynamics. By coupling algorithm and application domain experts, we can tailor Sandia technology to impact Lockheed Martin mission areas," says Sandia Principal Investigator Mike Eldred.

Recently, Lockheed Martin and Sandia conducted a trade study for the F-35 JSF aircraft to design the external fuel tank for improved performance, store separation, and flutter. CFD was used in conjunction with Sandia's DAKOTA optimization code to determine the optimal shape of the tank that minimizes drag for maximum range and minimizes yawing moment for separation of adjacent stores. Data obtained at several wind tunnel facilities verified the predicted performance of the new aeroshaped, compartmented tank for separation and flutter, as well as acceptable characteristics for loads, stability, and control.

F-35 JSF (Photo courtesy Lockheed Martin)



Goodyear Tire and Rubber Co. has teamed up with Sandia to apply ASCI modeling technology to automobile tire design.

HIGHLIGHT: Goodyear Tire and Rubber Company

The Sandia-Goodyear strategic partnership, which began in the early 1990s, is recognized as one of the best examples of successful technology transfer from the national laboratories to industry, producing useful technology for both the private sector and national security interests.

The Sandia-Goodyear research teams share knowledge in three main areas: advanced computational mechanics tools, structural dynamics, and advanced materials. Under a series of CRADAs, Goodyear has gained a better understanding of the structure and properties of various materials used in tire fabrication, as well as proprietary computer modeling software that has helped the company bring its tires to market faster and more efficiently.

Acceptance of these simulation tools by the design community at Goodyear has increased over time based on several successes, such as the design and introduction in the market of Goodyear's new **Assurance™** tire featuring TripleTred Technology™. The simulation tools were used extensively to bring this new product to market in less than a year. Goodyear and Sandia jointly won an R&D 100 Award in 2005 for the **Assurance™** tire and the computational approach used in its design.

Goodyear's leading tire designer stated that TripleTred Technology™ could have never been brought to market that quickly without the computational simulation capability and that he would never design another tire without it. Furthermore, Goodyear's Chief Technical Officer, Joe Gingo, recognized that his steady investment in the Sandia-Goodyear Advanced Mechanics CRADA over the previous decade was essential to having the simulation capability ready to go in 2005 when Goodyear found itself in urgent need of a new flagship line of tire products.

The Sandia-Goodyear software developments have also supported and enhanced Sandia's work under several national security objectives. The enhanced solution algorithms that led to the original breakthrough in the CRADA enabled many computational mechanics simulations for Sandia's nuclear weapons applications that were previously intractable or less accurate than desired.

"Solving Goodyear's hard problems has helped us get new and different perspectives on how to solve our own hard problems."

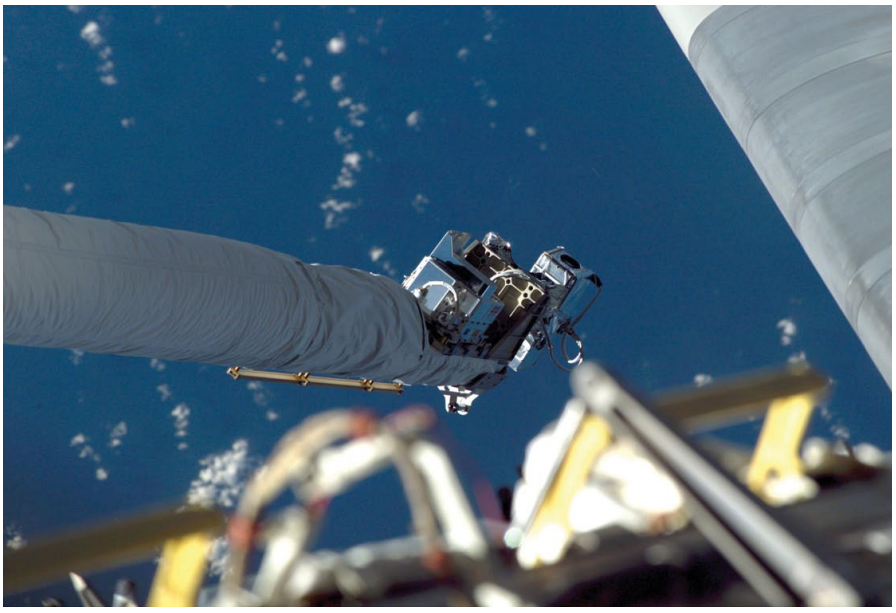
Hal Morgan, Senior Manager of Computational Simulation Sciences, Sandia National Laboratories

Hal Morgan, Sandia's senior manager of Computational Simulation Sciences, spoke about the partnership. "Solving Goodyear's hard problems has helped us get new and different perspectives on how to solve our own hard problems. In addition, experiencing how Goodyear has used modeling and simulation in their design and manufacturing processes has given us insights on how we can improve our own design and production processes."

The Sandia-Goodyear partnership has continued to evolve over time, with Sandia and Goodyear now actively collaborating in advanced mechanics, tire dynamics, chemical separation, pressure sensors, and engineered products. New collaborations were initiated during FY2005 in the following areas: manufacturing reliability with a focus on human factors in manufacturing processes, performance prediction focused on improved experimental diagnostics for measuring temperature, strain, and pressure, innovative use of microsystems as diagnostics, the manufacturability of innovative pressure sensors, and nanomaterials.

Sandia's sensor system detected loose gap fillers on Discovery that posed a danger for overheating on reentry.

Sandia's orbiter inspection sensor, attached to the space shuttle *Discovery's* robotic arm, characterized loose gap fillers. (NASA photograph)



HIGHLIGHT: National Aeronautics Space Administration

Sandia has collaborated with NASA over many years, developing some of the fundamental technologies used for Mars missions and other key NASA initiatives.

Sandia developed and delivered specialized radiation hardened computer chips, which exceeded their radiation design life by a factor of three, for the highly successful Galileo probe to Jupiter.

During the past several years, Sandia has supported the NASA Ames Research Center in a series of flight tests to demonstrate advanced thermal protection system materials. If these advanced materials perform as expected, they will facilitate a revolutionary class of space transportation vehicles with sharp leading edges and nose tips that minimize drag and increase performance. NASA is interested in this work for its possible applications in next-generation launch technology.

Several recent Sandia projects were also instrumental in helping NASA with its Space Shuttle Discovery's return-to-flight mission, which safely lifted off and landed between July 26 and August 9, 2005.

Orbiter inspection sensor

Sandia provided the primary Thermal Protection System inspection sensor to NASA for *Discovery's* return-to-flight mission.

Sandia engineers Bob Habbit and Bob Nellums led a collaborative effort of nearly 120 Sandia employees in creating the sensor, which inspects the orbiter for critical damage during the mission

and alerts astronauts if damage is severe enough to require repair.

The crew used the orbiter's robotic arm to scan the front edge of both wings for damage of as little as a 0.020-inch crack. The Sandia-patented 3-D technology uses a modulated laser illuminator coupled with a modulated receiver to image and spatially locate each point in the scene.

The sensor data was relayed back to Mission Control at Johnson Space Center — Houston, where a team of more than 20 Sandia employees working in the Mission Control Center during the mission processed and reviewed the data. The Mission Management Team used the Sandia data in combination with their own data to determine whether it was safe for the orbiter to re-enter.

In fact, Sandia's sensor system detected loose gap fillers on *Discovery* that posed a danger for overheating on reentry. The short strips of dangling material required an unprecedented repair by spacewalking astronauts.

Shuttle rollout

Moving the shuttle from the Vehicle Assembly Building at Kennedy Space Center in Florida to the launch site normally takes five to six hours at a pace of 0.9 mph. As the shuttle equipment ages, it is important to understand how this trip may fatigue the transport system and critical shuttle components.

NASA contacted Sandia to design the test and instrumentation to measure the dynamic vibration environment during rollout. Sandia also provided additional support to NASA by computing the input forces that the crawler applies to the mobile launch platform, which are being used by Boeing and NASA to determine the fatigue life for critical shuttle components.

Sandia engineer Tom Carne assisted with a series of tests beginning in November 2003 to develop the data necessary to understand the environment and the response of the space shuttle vehicle during rollout.

Sandia's analyses showed that modifying the speed of the crawler from 0.9 mph to 0.8 mph would reduce the fatigue stresses of the critical shuttle components and reduce the vibrations in the shuttle by shifting the engagement frequency of the crawler treads. The shuttle's vibration response can be much reduced when the driving frequencies are shifted away from its own resonant natural frequencies.

Sandia engineer Tom Carne assisted with a series of tests beginning in November 2003 to develop the data necessary to understand the environment and the response of the space shuttle vehicle during rollout.

The mobile launch platform and the crawler make its way to the launch pad. (Photo courtesy of NASA)

IN BRIEF

The five-year agreement will add to ongoing Sandia/ University of Texas System activities by undertaking joint technical research projects and collaborations that take advantage of Sandia and UT's complementary competencies.

Sandia, University of Texas System Sign Multi-faceted Memorandum of Understanding

In April 2005, Sandia and the University of Texas System signed a memorandum of understanding (MOU) calling for:

- UT System to develop and implement an independent peer review process for what Sandia calls its science, technology, and engineering foundation;
- Joint development and implementation of "strategic program areas that enhance" Sandia's broad missions in national security, which are in addition to ongoing activities; and
- Increased interactions and collaborations between individual staff, faculty, and students at Sandia and UT System academic and health institutions.

The five-year agreement states that the UT System will develop, perform, and be accountable for the peer review process of the Sandia Assurance System for Science, Technology, and Engineering. The reviews will cover the effectiveness of the unclassified research for Sandia's LDRD Program, the Research Foundations of the Nuclear Weapon Program, research sponsored by the DOE's Office of Science, as well as Sandia-based science, technology, and engineering research sponsored by other agencies.

The MOU also establishes a UT System position on the Sandia Board of Directors to organize and lead technical reviews of Sandia's Science and Technology Foundations, working through a newly formed Subcommittee of the Mission Committee of the Sandia Board. This subcommittee will be made up of at least two Sandia board members and at least two advisors from universities, two from industry, and two from government agencies or other federal or national laboratories. As part of this activity, the UT System has opened an office at the Sandia Science & Technology Park in Albuquerque, N.M.

Another key aspect of the MOU will add to ongoing Sandia/UT System activities by undertaking joint technical research projects and collaborations that take advantage of their complementary competencies in the areas of simulation engineering, high-energy density physics, sustainable energy security for the nation's transportation infrastructure, and in health security.

ITT Industries and Sandia Sign Umbrella CRADA

A new umbrella CRADA establishes a five-year collaborative relationship between Sandia and ITT Industries, Inc. This collaboration will advance the technical and engineering development of the following technologies:

- Ultra-short-pulse laser technologies for remote sensing applications;
- Instrumentation of ballistic missile defense flight targets, remote control vehicles, and the development and manufacture of next-generation air- and ground-delivered unattended sensors;
- Real-time embedded software and high-performance computing; and
- Miniature point sensing systems for a variety of applications.

Fostering Partnerships

A Message From David Goldheim, Director, Corporate Business Development and Partnerships

Supporting the dynamic business pursuits of Sandia's Strategic Management Groups, Strategic Management Units, and Divisions requires an innovative partnerships program tailored to individual Strategic Management Unit (SMU) needs. My organization, the Corporate Business Development and Partnerships Center, working in conjunction with our colleagues in California's Business Development Support department, seeks to provide in-depth subject matter expertise in all areas of business and partnerships development; facilitate partnerships to enhance mission success; develop novel approaches to partnerships creation; and balance proactivity with responsiveness in our business development support.

This year, as in past years, I believe our talented and dedicated business development and partnerships staff has more than achieved those objectives. You will read about many of our Center's success stories in this year's annual report. I would like to take this opportunity to draw attention to some additional highlights from FY2005.

In terms of our contributions to corporate strategies, our staff assisted in the development of a strategic vision and provided input in the strategic planning efforts for the Integrated Technologies and Systems Strategic Management Group (SMG), and continued to assist in various business strategies to assure that technologies developed by the Science, Technology, and Engineering SMU are integrated into the business pursuits of Sandia's business-booking SMUs.

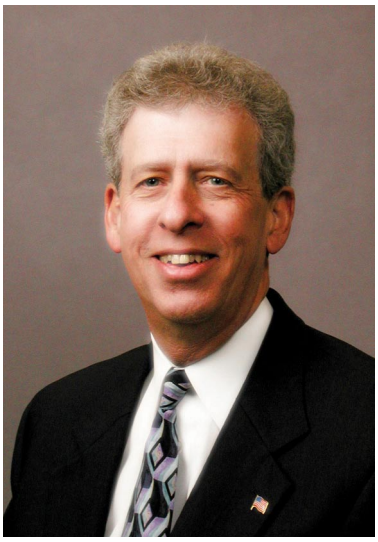
During its first year of activity, our Entrepreneur in Residence program developed imaginative product data sheets for some of our intellectual property portfolios stimulating increased interest from the investment community, from Sandians seeking licenses, and from Technology Ventures Corporation (TVC), our partner in the creation of startup companies.

Another unique contribution from this past year was the request, and subsequent funding, by the Department of Homeland Security (DHS) of a partnerships team from Sandia to assist the DHS in establishing its technology transfer program. A cross-agency benchmark study and three commercialization pilots conducted by the Sandia team — led by California's Business Development Support department — are helping the DHS identify ways to facilitate more rapid commercialization of key technologies.

Also noteworthy was the seamless assimilation of interagency agreements processing from the National Nuclear Security Administration (NNSA) into Sandia, which was acknowledged in Sandia's Annual Performance Evaluation Plans (PEP) as an "outstanding" example of NNSA/Sandia teamwork leading to improved site efficiency. I am very proud of the Center's FY2005 "Outstanding" PEP score for work for other federal agencies, which sums up our Center's performance and continues the legacy of past years.

Further evidence of programmatic excellence is indicated by the number of national awards received during FY2005, including four awards from the Federal Laboratory Consortium, four R&D 100 awards won in conjunction with industrial partners, and the Sandia Science & Technology Park's award for "Excellence in Technology-Led Economic Development" from the Department of Commerce.

In a somewhat different vein, but related to operational excellence, new software programs developed in conjunc-



Our strategic partnerships and collaborations with industry partners contribute significant technical advances and commercial practices to Sandia's programs and, likewise, our technologies provide valuable discriminators to our partners and the nation.

tion with Sandia's Information and Solutions Services Center enable electronic processing of proposals and agreements (e-WFO) and a searchable, comprehensive database for intellectual property, agreements, and licenses (PALS).

Among the significant organizational changes implemented throughout the year, our focus on contributing to SMU business creation led to our move into the Infrastructure Operations and Business Management Division. In addition, our Small Business Assistance organization was recently transferred into Sandia's Supply Chain Management Center, and we formally integrated the Sandia Science & Technology Park organization into our Center — a move that further solidified the relationship between two organizations that have always been close collaborators in Sandia's partnerships program.

Finally, I would like to stress that our strategic partnerships and collaborations with industry partners contribute significant technical advances and commercial practices to Sandia's programs and, likewise, our technologies provide valuable discriminators to our partners and the nation. Our team looks forward to continuing to support Sandia missions through high-impact industrial partnerships, licenses, and business development activities.

The benefits of this "rapid response" agreement are far-reaching, particularly for regional high-tech start-up companies and expanding small businesses.

HIGHLIGHT: Inter-Institutional Agreement Encourages Regional Economic Development

Public and private sector entities seeking to commercialize the diverse technologies developed at New Mexico's leading research institutions now have an easier road ahead.

On February 25, 2005, seven New Mexico research institutions (Sandia National Laboratories, Los Alamos National Laboratory, Science and Technology Corporation at the University of New Mexico, New Mexico State University, New Mexico Institute of Mining and Technology, The MIND Institute, and the National Center for Genome Resources) joined together to sign the Inter-Institutional Agreement (IIA), a contract that allows for the bundling of patents to boost economic development.

"The flexibility and capability of this agreement give it great power and the potential to create both economic benefits for the region and technological advances that will strengthen the U.S.," says Licensing Executive Paul Smith, who negotiated the agreement for Sandia. "Sandia supports economic development, and this agreement will help strengthen the Technology Research Collaborative now forming in New Mexico."

Prior to implementing this groundbreaking agreement, companies interested in licensing a portfolio of patents developed at various New Mexico research institutions would be forced to negotiate separate licenses with each institution. Because of the time and money involved in such negotiations, some companies, particularly small businesses, have chosen to limit the number of patents they license or terminate negotiations prior to successful completion. A hallmark of the IIA is that it pools the intellectual property

available in New Mexico to accelerate the commercialization of technological breakthroughs, thus alleviating the strain on companies of working with multiple organizations to gain intellectual property rights.

The IIA permits each institution to identify specific patents that are appropriate for the agreement and available for licensing while retaining the right to license their patents non-exclusively. The licensing will be led by one institution selected by all the institutions that have patents in the specific patent bundle. The IIA was designed to be flexible, allowing owning institutions to add or remove their own intellectual property and allowing other research organizations to become signatories.

The research institutions are now in the process of identifying the first bundles of synergistic patents from among the various participants. These decisions are being made in conjunction with industry experts, including participants from the New Mexico Optical Industry Association.

The benefits of this "rapid response" agreement are far-reaching, particularly for regional high-tech startup companies and expanding small businesses. A wide array of technologies developed throughout the state are now more available for commercialization, fueling regional growth, and promoting technological advances that will strengthen the United States.

IN BRIEF

Fledgling University Alliance Program Grows Up

Sandia's University Alliance program is a special licensing program that allows U.S. educational institutions to access Sandia's Microelectromechanical Systems (MEMS) teaching materials, SUMMiT™ design and visualization software, training for a school "superuser," and MEMS parts for test and evaluation. Since its creation in 2004, the University Alliance program has gained 12 members, with 3 licenses pending and has plans to grow participation by 50% over the next fiscal year.

The University Alliance program is part of Sandia's SAMPLES™ (Sandia Agile MEMS Prototyping Layout Tools, Education and Services) program, developed to facilitate MEMS education and access to Sandia's cutting-edge SUMMiT™ process technology. This MEMS batch fabrication process uses conventional integrated circuit processing tools to achieve high volume, low cost MEMS production. It enables the development and manufacture of complicated MEMS devices not otherwise achievable through surface micromachining processes for a variety of applications, including military hardware, optical switches, electronic imaging, telecommunications, and sensors.

The University Alliance program reaches out to Sandia's future workforce and academic partners by facilitating education in MEMS and fostering relationships with the academic community. It was honored as an industry "Best Practice" by MEMS community members attending the MEMS 2005 Educational Workshop sponsored by the National Science Foundation and the Institute of Electrical and Electronics Engineers.

The University Alliance program reaches out to Sandia's future workforce and academic partners by facilitating education in MEMS and fostering relationships with the academic community.

2005 University Alliance MEMS Design Competition

Students from Texas Tech University's Electrical and Computer Engineering department won the 2005 Sandia MEMS University Alliance Design Competition.

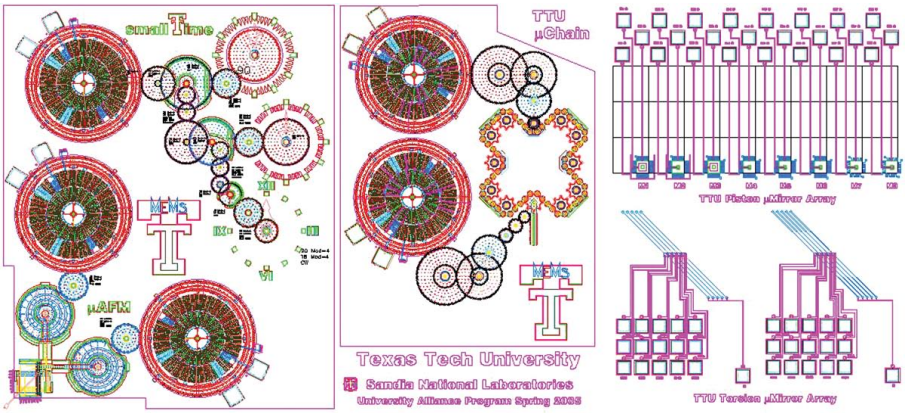
Sandia's University Alliance Design Competition provides exposure of Sandia's SUMMiT™ technology and tools and encourages growth in the MEMS industry.

The group of student MEMS designers was led by Dr. Tim Dallas and student lead Phillip Beverly.

Dr. Dallas described his school's response to the competition. "The [University Alliance] Design Competition added an exciting twist to our advanced MEMS courses this semester. Students really enjoyed designing complicated MEMS that are going to be expertly built, and they are looking forward to testing the devices. Grades became secondary as students concerned themselves with turning ideas into designs. This is a great way to harness the creativity of a number of students while expanding their knowledge of the micro and nano world."

Texas Tech's winning entry was a combination of four individual designs that included a micromechanical clock, a microchain, a torsion micromirror, and a micron-sized atomic force microscope. The design was chosen based on the use of Sandia's SUMMiT™'s specific strengths, usefulness of the design for educational demonstrations, and uniqueness of design.

Sandia's University Alliance Design Competition provides exposure of Sandia's SUMMiT™ technology and tools and encourages growth in the MEMS industry. The program is sponsored by Sandia's MEMS program and the MESA Institute. Institutions must be members of Sandia's MEMS University Alliance for their students to participate.



Students of the microworld — student-conceived MEMS devices from Texas Tech to be fabricated at Sandia facilities.

Sandia Supported Bi-National Sustainability Laboratory Designated a Nonprofit

FY2005 was a big year for the Bi-National Sustainability Laboratory (BNSL). In December 2004, the organization was officially established as a standalone nonprofit, the BNSL, Inc., and was granted initial funding to establish its management structure and operational site in Santa Teresa, New Mexico. Funding was provided by the U.S. Department of Commerce's Economic Development Administration (EDA), Mexico's Consejo Nacional de Ciencia y Tecnología (CONACyT), and the State of New Mexico.

Originally the brainchild of Gerry Yonas, Sandia Vice President and head of the Advanced Concepts Group, the BNSL's mission is to create opportunities for sustained economic development in the U.S.-Mexico border region through applied science- and technology-based solutions. Yonas conceived of the BNSL while seeking solutions to the myriad of problems that plague the U.S.-Mexico border region, which range from widespread poverty and the lack of basic resources, including public health and clean water supply, to the need for tech-based economic growth to sustain the region.

The idea for the BNSL was shaped by Yonas and the Advanced Concepts Group team over the past several years. Recently, Gary Jones, manager of the Corporate Business Development and Partnerships Center's International Partnerships Development office, assumed responsibility for Sandia's interactions with the BNSL.

Jones describes the BNSL's major function as that of helping build businesses and economic opportunity in the border region. This will be accomplished by establishing strategic partnerships with academic, private sector, and public sector elements and providing a variety of services, including applied research,

incubation and technology acceleration, seed funding for technology and product development, business mentoring and consultation, and financial networking.

Jones explains the premise behind the Laboratory's strategy. "If you really want to upgrade services and quality of life, you have to build up a community's tax base. You can do this by supporting companies in the region that have higher payrolls so that you build the community's wealth. However, as this is a systems problem, it requires a systems solution. Strong technologies are necessary, but are not sufficient by themselves to solve the problem. The Laboratory also will work to develop required human capital, help the business infrastructure adapt to a technology-based economy, and work with the community to ensure that associated cultural and lifestyle changes are not too disruptive."

The BNSL plans to advance technology and business opportunities in the border region in a number of areas, such as new product development, including advanced manufacturing, secure commerce, public health, infrastructure (energy and communications), and water issues. Specific near-term technology focus areas for the Laboratory are MEMS packaging concepts, refinery science, material corridor technologies, and energy and water.

Gerry Yonas addresses session announcing the opening of the Bi-National Sustainability Laboratory at Santa Teresa, N.M.

Jones cites a number of potential benefits coming from the BNSL. "We will see economic growth in the border region, with high value jobs on both sides of the border contributing to the community's wealth and providing the region a more stable infrastructure."

Jones is currently a member of the steering committee that is overseeing the EDA grant to fund the establishment of the BNSL's management and operational structure. The Laboratory's Executive Director/CEO is Dr. Paul Maxwell, former University of Texas Vice President for Research and Sponsored Projects.

Sandia Business Development Staff Assist DHS with Commercialization Plans, Technology Transition Processes

When the DHS realized upon its stand-up that it needed to establish a consistent and productive technology transfer mechanism, it requested the assistance of a partnerships team from Sandia in helping shape commercialization planning and technology transition. The aim is to get homeland security technologies deployed in products supplied by industry and available to end users who need them the most, while at the same time ensuring that transition strategies are developed at the outset when new technologies are initially conceived.

"Our ultimate goal has been to provide information analysis, ideas, and alternatives to DHS," says Denise Koker, Business Development manager at Sandia's California site and the commercialization lead for the lab's Homeland Security and Defense (HSD) SMU. "They can then use that information to create appropriate processes and mechanisms for achieving technology transfer."

Commercialization is an element of a broader effort in which Sandia is assisting DHS's Office of Research and Development (ORD) to establish

The aim is to get homeland security technologies deployed in products supplied by industry and available to end users who need them the most.

Left to right; Ellen Stechel, Denise Koker, and Lennie Klebanoff.

The Sandia team has been immersed in aiding DHS with exercising tech transfer processes and mechanisms by carrying out specific commercialization projects.

technology transition processes for the lifecycle of technology development, from basic research through deployment. Sandian Ellen Stechel is assigned to DHS/ORD working within the Office of Science and Technology to incorporate technology transition into program execution plans.

Added Stechel: "In the past, the labs and their funding partners may have been quick to develop a technology without having a technology lifecycle mentality, thereby considering whether there is a customer, or whether it might, down the road, run into issues of affordability, reliability, manufacturability, usability, or serviceability. That's where technology transition strategy and planning come in."

To this end, DHS has funded Sandia to aid them with several tasks. First, beginning in June 2005, Jill Micheau, a Licensing and Technology Transfer specialist with Sandia's Business Development Support department in California, went on temporary assignment to DHS. She and Koker conducted a benchmarking study comparing how other agencies conduct technology transfer and analyzing how alternative mechanisms and solutions might meet DHS needs. This is documented in a report to DHS. The DHS is now making decisions and implementing various technology transfer policies and processes.

The Sandia team has been immersed in aiding DHS with exercising tech transfer processes and mechanisms by carrying out specific commercialization projects. In November 2005, Koker and Micheau helped DHS to develop the broad strategy for the pilot program, which focuses on three key homeland security technologies important to the Department. Their contributions included a detailed process for selecting the most appropriate technologies, a step-by-step commercialization planning model to be used throughout the Pilot Project, and the identification of clear objectives and outcomes.

One of the three technologies selected by DHS for the Commercialization Pilot Program was Sandia's own BROOM (Building Restoration Operations Optimization Model), with Sandia's Jane Ann Lamph now leading the commercialization effort. Lennie Klebanoff had been the key BROOM figure until returning to his technical position in the Labs.

Micheau, meanwhile, is taking on the other two pilots: Idaho Explosive Detection System (IEDS), and a foot-and-mouth disease (FMD) vaccine from the U.S. Department of Agriculture which is being tested and further developed at DHS's Plum Island Animal Disease Center. The three technologies are diverse in nature and focus on different kinds of potential threats: BROOM addresses biological contamination and cleanup, IEDS is a device for detecting explosives in containers, and the FMD vaccine is intended to enhance agricultural security.

Commercialization plans for the three pilot technologies should be completed by May 2006. Development of the plans involves extensive interaction with stakeholder agencies, end users, and potential industry partners. Transition to DHS for continued implementation should be completed by June 2006.

HIGHLIGHT: Bio-Explosive Destruction System

Sandia researchers have developed a powerful new instrument in the fight against bioterrorism. Called the Bio-Explosive Destruction System, or BioEDS, this novel 8-ton apparatus neutralizes anthrax, sarin gas-infused weapons, and other biochemical agents.

The BioEDS extends the usefulness of the existing Explosive Destruction System, or EDS, developed by Sandia through a Work for Others/Other Federal Agency agreement in 1998 for the U.S. Army. Sandia designed the original EDS to neutralize chemical munitions, and the system has safely destroyed 228 potentially deadly munitions or chemical weapons nationwide since its creation.

Now, with $60,000 spent by Sandia for new research, the system has the capability to destroy deadly new biohazards, giving Homeland Security a new tool. During evaluation, Sandia performed tests with anthrax simulants, such as Bacillus thuringiensis and Bacillus stearothermophilus. The test system was operated in steam autoclave, gas fumigation, and liquid decontamination modes of operation. Each of the three treatment processes used during testing resulted in complete neutralization of the bacterial spores.

The units are particularly effective for disarming and neutralizing munitions near population centers. The old method was by open burn/open detonation, which could result in danger to the surrounding population. Use of the EDS results in a liquid effluent that can be disposed of at any commercial hazardous waste facility. The system's safety and portability—it can be easily transported on a flatbed trailer, rail car, or airplane to any site—make it the ideal candidate for a wide range of emergency response situations requiring the neutralization of bombs, suspect vials, canisters, or other munitions.

Such a system could provide DHS personnel a powerful tool for safely neutralizing a dormant terrorist device in a crowded location. It can also be used by the military to remove a land mine or canister shell without having to set off an open-air explosion. Project scientists estimate there are about 100 sites nationwide where World War I or II munitions could possibly be buried. The system has been modified and a prototype system developed by Sandia based on patents held by the U.S. Army.

"The EDS is a highly effective and successful system for destroying chemical munitions. Mobility has enabled EDS to be deployed in many different locations (Colorado, Alabama, Arkansas, Maryland, Delaware, Utah, and Washington, DC)," says Mary Clare Stoddard, Sandia's Chemical Demilitarization Program Manager. "The BioEDS concept was borne from the realization that if we could demonstrate efficacy with a biological agent, EDS would be a readily available and proven technology should the need arise."

Sandia's Bio-Explosive Destruction System won an award for "Notable Technology Development" as part of the *2005 Federal Laboratories Consortium Mid-Continent Region Annual Awards.*

Such a system could provide Department of Homeland Security personnel a powerful tool for safely neutralizing a dormant terrorist device in a crowded location.

The Explosive Destruction System can be transported to sites where materiel may not be safe to store or transport. Recent tests showed its efficacy in treating simulated bio agents in addition to the originally envisioned use for chemical agents.

IN BRIEF

Sandia researchers, front to back, George Sloan, Dale Dubbert, and Armin Doerry look at miniSAR assemblies meant to be used for reconnaissance on near-model-airplane-sized unmanned aerial vehicles, precision-guided weapons, and space applications. (Photo by Randy Montoya)

MiniSAR is less than one-fourth the weight and one-tenth the volume of SARs that currently fly on larger UAVs, such as the General Atomics' Predator.

First Successful MiniSAR Flight

Sandia researchers flew what is likely the world's smallest fine-resolution synthetic aperture radar (SAR) in May 2005, making real-time images from the six-kilometer range with a resolution of four inches. It was a first for the 25-pound instrument that may soon be used for reconnaissance on near-model-airplane-sized unmanned aerial vehicles (UAVs).

MiniSAR is less than one-fourth the weight and one-tenth the volume of SARs that currently fly on larger UAVs, such as the General Atomics' Predator. It has the same capability as the larger SARs of making fine-resolution images through weather, at night, and in dust storms.

Small and lightweight, miniSAR can be installed on airborne platforms that are one-tenth the cost of UAVs required for the larger SARs. It will also have a lower manufacturing cost than its larger cousins.

The near-term weight goal for the miniSAR is about 20 pounds. In the longer term, the Sandia team is working to exploit Sandia microsystems technologies to further shrink the miniSAR to as little as 5 to 10 pounds, which will be accomplished through data links with ground stations.

While miniSAR will initially be used for reconnaissance on small UAVs that can carry a payload of 50 pounds, it may also be used for precision-guided weapons. However, the cost and size of miniSAR will need to be reduced even more for weapon applications.

Various companies have expressed interest in developing and commercializing Sandia's miniSAR technologies. The SAR technology was originally created and matured through a combination of federal and commercial funding.

A critical aspect of hydride storage tank development is the act of recharging and discharging hydrogen. Here, Sandia National Laboratories engineer Mark Zimmerman integrates a hydride bed with temperature monitoring sensors. (Photo by Bud Pelletier)

General Motors and Sandia Announce Agreement to Advance Hydrogen Storage

General Motors Corporation (GM) and Sandia launched a partnership in 2005 to design and test an advanced method for storing hydrogen based on metal hydrides.

Metal hydrides — formed when metal alloys are combined with hydrogen — can absorb and store hydrogen

within their structures. When heated, the hydrides release their hydrogen. In a fuel cell system, the hydrogen can then be combined with oxygen to produce electricity.

GM and Sandia established the four-year, $10 million Work for Others program to develop and test tanks that store hydrogen in a complex hydride, sodium aluminum hydride (sodium alanate). The goal is to develop a pre-prototype solid-state hydrogen storage tank that would store more hydrogen onboard a fuel cell vehicle than current conventional hydrogen storage methods. Researchers also hope to create a tank design that could be adaptable to any type of solid-state hydrogen storage.

Sandia's work on the program is being conducted at its Livermore, CA, site, headed by Principal Investigator Chris Moen. Moen is the manager of Sandia's Thermal/Fluid Science and Engineering department.

The Sandia-GM program is one part of a concerted effort to find a way to store enough hydrogen onboard a fuel cell vehicle to equal the driving range obtained from a tank of gas, which will be key to customer acceptance of fuel cell vehicles.

This partnership supports President Bush's Hydrogen Fuel Initiative to accelerate hydrogen research and reduce our nation's reliance on foreign energy sources.

R&D Continues on Technology to Protect against "Dirty Bombs"

Researchers at Sandia have developed a new tool in the fight against terrorism. The Sensor for Measurement and Analysis of Radiation Transients — or SMART — system uses detectors and software to distinguish between normally occurring radioactive materials and those that are potential signatures of terrorist activities.

SMART car

SMART portal system at port test bed

Sandia's proprietary software is the key to the technology's success. The software helps operators to easily and accurately identify the isotopes associated with radiological emissions. The system operates in real time and indicates the level of confidence (low, fair, high) that the material has been correctly identified. A video imager captures an image of the person or vehicle carrying the radioactive material when the detector alarms.

Sandia licensed its FitToDB and PASSBY software technology to Thermo Eberline (TE) LLC in 2003 and its GADRAS-LT software to TE the following year. The company is incorporating the software technology into existing TE hardware platforms with the plan of delivering third-generation systems to the market in mid-2006. Under a CRADA signed in mid-2005, Sandia and TE also collaborated on refinement of the Sandia-developed software for large-scale commercial

The SMART system operates in real time and indicates the level of confidence (low, fair, high) that the material has been correctly identified.

deployments in TE's Advanced Spectroscopic Portal system.

Sandia's Principal Investigator for the project, Dean Mitchell, discusses the Sandia-TE partnership. "The FitToDB algorithm employs an advanced approach to spectral analysis that often exceeds the performance of experienced analysts. Although the algorithm provides exceptional capabilities, it is also quite demanding with respect to the quality of the measurement system because erroneous results can result if the input data is not repeatable and free of artifacts. Thermo Eberline worked closely with Sandia to understand these requirements, and they have developed spectroscopic measurements systems of exceptional quality. This partnership has been very successful in addressing the national security need to develop affordable radiation portals that can identify concealed nuclear devices while producing relatively few false alarms," says Mitchell.

The spectral analysis approach developed at Sandia is a key component in the protection of military assets and the homeland against the threat of dirty bombs and other nuclear devices. When fully commercialized and proven, systems that use the analysis software can be deployed in seaports, airports, border patrol stations, government buildings, military bases, and other environments that could be targets for terrorist radiological attacks.

New CRADA to Develop Electromagnetic Weapons, Systems

In June 2005, Sandia and United Defense, L.P. (UDLP) signed a CRADA to collaborate on the development of a range of mutually beneficial technologies that will enhance the understanding of and application to electromagnetic guns, power systems, and controls for land-based military vehicles. Each of these topics is critical to national security and will provide the U.S. military with new capabilities that will significantly increase war-fighting effectiveness. Leading the technical effort for Sandia is Principal Investigator Ronald Kaye, manager of Sandia's Magnetic Propulsion and Directed Energy Beam Applications department.

UDLP has since been purchased by British Aerospace Electronics Systems (BAES). The Sandia-BAES CRADA will develop pulsed power and electric power systems for electromagnetic guns for both non-line-of-sight and line-of-sight military applications.

Principal Investigator Mark Tucker examines two petri dishes: one with a simulant of anthrax growing in it, the other treated with the Sandia Decon Formulation, which completely killed the simulant.

R&D Agreement for Decon Formulation with MountainTop Technologies

Sandia and Mountain Top Technologies, Inc. of Johnstown, PA, are working collaboratively under a CRADA to determine the feasibility of deploying the Sandia DF-200 Decontamination Formulation by aerial spray or aerial drop for the purpose of cleaning large, open areas that have been contaminated with chemical or biological warfare (CBW) agents.

Mark Tucker of Sandia's Chemical and Biological Systems department is Principal Investigator for the CRADA effort. Tucker is a co-developer of the decontamination foam. Sandia's Decontamination Formulation is a nontoxic, noncorrosive, aqueous formulation

Sandia's Decontamination Formulation is a nontoxic, noncorrosive, aqueous formulation designed for the quick mitigation and decontamination of CBW agents.

designed for the quick mitigation and decontamination of CBW agents. It can be deployed as a foam, liquid spray, or fog. Advantages of the formulation are that it works quickly, is effective against both chemical and biological agents, and does not generate toxic by-products.

CRADA with PacSci Supports In-line Detonator Development

Sandia and Pacific Scientific, Energetic Materials Corporation (PacSci) are collaborating to merge Sandia's Monolithic Micro (M^2) Capacitive Discharge Unit (CDU) technology with the Smart Energetic Architecture (SEA™) developed by PacSci. These in-line detonators utilize Exploding Foil Initiators (EFIs), which provide safety, performance enhancements, and cost and size advantages over existing rocket motor igniters currently manufactured by PacSci. Darren Hoke, manager of Sandia's Advanced Fuzing Technologies department, is the Principal Investigator for the CRADA.

The developed system will ultimately provide a rocket and missile motor ignition capability that directly supports and/or enables emerging weapon systems for national security applications.

Bringing Sandia Technology to Market

"Our great track record in patents and licensing speaks to our ability to conceive of innovative technologies based upon scientific underpinnings, as well as to apply those technologies to solve real problems."

Wendy Cieslak, Deputy for the Vice President for Science and Engineering, Sandia National Laboratories

Innovation is at the heart of the work being conducted at Sandia National Laboratories and is fostered at the Labs by the continued funding of basic science and technology research and development, an emphasis on disruptive technologies, and a challenging, dynamic work environment that attracts a talented pool of workers.

Wendy Cieslak, Deputy for the Vice President for Science and Engineering, spoke about Sandia's success in developing breakthrough technologies: "Sandia is differentiated as an engineering laboratory whose success is enabled by the rigorous scientific foundations we bring to engineering problem-solving. Our great track record in patents and licensing speaks to our ability to conceive of innovative technologies based upon scientific underpinnings, as well as to apply those technologies to solve real problems," says Cieslak.

Many of these new technologies will eventually make their way into the commercial marketplace. Some recent Sandia discoveries could soon have a significant impact upon the medical community.

Sandia researcher Anup Singh led a team in the design and development of a portable device that can detect heart and gum disease instantly. The device is based on Sandia's lab-on-a-chip technologies originally created for detecting biotoxins and chemical agents. A new, lightning-fast technique, led by Sandia researcher Paul Gourley, has provided lab demonstrations of accurate, real-time identification of liver tumor cells at their earliest stages. And Sandia researcher Jeb Flemming recently led a team to develop two devices that offer quick and painless methods for checking patients' blood glucose levels and diagnosing heart attacks.

HIGHLIGHT: ElectroNeedles and µPosts — New Sandia Patents Promise Big Relief for Medical Patients

Two tiny devices recently developed at Sandia may soon have a big impact on patients who need their blood drawn for medical analysis.

ElectroNeedles and µPosts, developed under the direction of Sandia researcher Jeb Flemming, operate by painlessly penetrating the skin with an array of micron-sized needles to measure molecules inside the body, eliminating the need to withdraw blood from the patient and providing instantaneous test results.

ElectroNeedles contains micron-sized electrodes that measure molecules, such as glucose, that can donate or accept electrons. One key application of this device is for diabetes patients who must

Jeb Flemming, project lead for the ElectroNeedle platform, holds a test version of the device. The prickly parts are in the center of the package. A production version could be even smaller and simpler. (Photo by Randy Montoya)

withdraw blood to measure their glucose levels. Sandia project leader Flemming describes the device: "The tiny ElectroNeedles, expected to be constructed of cheap throw-away plastic, would not only make glucose testing simple and painless, but would significantly cut the diagnostics time involved in protein analysis. Because the analysis is done inside the body, the need to withdraw body fluid is eliminated, and because the needles are so small the measurements are painless." Test results are available within seconds.

µPosts are micron-sized posts that painlessly measure proteins and other macromolecules, including protein markers released during a heart attack. Test results are available in less than a half hour.

"Today if someone goes to an emergency room with chest pains, the doctor assesses the patient's condition based on their symptoms. In order to accurately diagnose a patient the doctor has to take a blood sample, which is typically sent to an off-site laboratory for analysis," Flemming says. "The person usually has to wait six hours to get confirmation on whether they have elevated Troponin I levels indicating they have had a heart attack."

Flemming and his team, including fellow researchers David Ingersoll and Carrie Schmidt, came up with the idea for the ElectroNeedles and µPosts while working on a Sandia-funded Bio-MicroFuel Cell research project where Flemming investigated harvesting sugars from living plants and animals. It wasn't until they hired Colin Buckley, a medical student from the University of New Mexico Medical School, that the team realized the significance of their invention. "Colin gave us a much-needed insight into the medical diagnostic field," says Flemming.

ElectroNeedles and µPosts now exist in prototype and are made of Foturan®, a glass-like material. The intent is to ultimately mass-produce them from an inexpensive plastic.

The technological advances at Sandia have led to several patents pending.

ElectroNeedles and µPosts, developed under the direction of Sandia researcher Jeb Flemming, operate by painlessly penetrating the skin with an array of micron-sized needles to measure molecules inside the body, eliminating the need to withdraw blood from the patient and providing instantaneous test results.

The Entrepreneur in Residence program strives to promote a "culture of entrepreneurship" within the Laboratories and help Sandia work more productively with the venture capital community.

HIGHLIGHT: Entrepreneur in Residence Initiative

During FY2005, the Corporate Business Development and Partnerships Center launched its Entrepreneur in Residence initiative, which seeks to stimulate spin-off companies to be built around Sandia technologies that are important to the Laboratories' national security mission.

The initiative allows proven startup entrepreneurs the opportunity to work directly with technical management and staff at Sandia to identify technologies that, when commercialized in startup companies, will contribute to Sandia's national security mission and support economic growth in New Mexico, California's Bay Area, and throughout the nation. The program also strives to promote a "culture of entrepreneurship" within the Laboratories and help Sandia work more productively with the venture capital community.

The primary responsibilities of the Entrepreneur in Residence position are to conduct technology assessments, develop market opportunities, formulate preliminary business cases, and propose business structures for startup enterprises. The first Entrepreneur in Residence will also be responsible for recommending policy and business practice modifications for the Entrepreneur in Residence pilot program to further refine approaches to creating companies based on Sandia intellectual property.

Entrepreneur in Residence, Tom Brennan

Kevin McMahon, former Sandia manager for licensing and intellectual property, named Tom Brennan as the first entrepreneur for the program in 2005. Brennan is chairman of Medical Lighting Solutions (MLS). MLS uses solid state lighting to treat disease.

"Tom is one of the most accomplished entrepreneurs in New Mexico," McMahon says. "He is uniquely qualified to become Sandia's first Entrepreneur in Residence due to his technical background, business acumen, knowledge and understanding of the Lab, and his extensive experience in high tech entrepreneurial endeavors associated with both Sandia and non-Sandia developed technologies."

During 2005, the Entrepreneur in Residence program reported:

- 36 Sandia technologies observed by potential investors;
- 16 preferred product data sheets created, indicating technologies with the promise of commercial viability;
- 4 companies actively pursuing investments in non-N.M. investors;
- 3 "brown bags," informal group lunches with discussion, for N.M. investors; and
- 2 entrepreneur leave-of-absence requests.

"The new and innovative Entrepreneur in Residence pilot program is a great way to see technologies internal to the laboratories — technologies that

otherwise might not see commercial application — identified and used in new applications to strengthen our national defense initiatives through commercial suppliers," Brennan stated at the program's launch in February 2005.

"I hope that our New Mexico economy will be additionally strengthened through job creation and an increased tax base."

IN BRIEF

TSA Installs Sandia Licensee's Explosives-sniffing Walkthrough Portal at Airports across the Nation

The Transportation Security Administration (TSA) purchased five Smiths Detection's IONSCAN® SENTINEL II Contraband Detection Portals in the fall of 2004 as part of the TSA's pilot screening program.

Sandia developed the original walkthrough personnel portal in the mid-1990s, which was subsequently licensed and developed for commercial use by Barringer Instruments, Inc. Smiths Detection acquired Barringer Instruments in 2002 and continued the commercialization efforts. The portal is based on Sandia's patented airflow design and preconcentration technologies. The Explosives Detection Personnel Portal rapidly screens people for trace amounts of explosives and has demonstrated 90 percent efficiency in collecting explosives particles.

The portal looks like a large airport metal detector with vents and nozzles on its inside walls and ceilings. As people walk through the portal, it gently puffs jets of air over them to remove particles and vapor from their hair, skin, clothes, and shoes. The particles are collected on a metal screen; heated to "boil off" the explosives into a gas phase; and delivered to the commercial detector, which identifies the chemical signatures of a variety of explosives.

In December 2004, The TSA placed one of the Smiths Detection portals in New York's John F. Kennedy International Airport for evaluation. This purchase represented the first time a Sandia-developed technology has been used for actual airline security.

The Explosives Detection Personnel Portal rapidly screens people for trace amounts of explosives and has demonstrated 90 percent efficiency in collecting explosives particles.

Following successful field trials in 2005, Smiths Detection deployed the SENTINEL II explosives detection portal at the San Juan International Airport, Pittsburg International Airport, Ronald Reagan Washington National Airport, Washington Dulles International Airport, and, most recently, the Sacramento International Airport. The portal can detect trace amounts of more than 40 substances and is capable of screening up to 420 people per hour.

Sandia's explosive detection portal technology was selected by the Federal Laboratory Consortium for a 2005 Excellence in Technology Transfer Award.

The Sandia patents represent an opportunity for the company to more efficiently manufacture solar wafers and cells through increased silicon utilization and increase the energy efficiency of its solar cells.

Sandia's explosive detection portal technology was selected by the Federal Laboratory Consortium for a *2005 Excellence in Technology Transfer Award.*

Solar Technologies Licensed

In January 2005, Sandia signed an exclusive license agreement for four promising solar technologies with Zia Power, Inc., a New York-based solar wafer, cell, and module manufacturer that plans to relocate to New Mexico and establish a manufacturing facility for state-of-the-art multicrystalline solar wafers and cells.

The Sandia patents represent an opportunity for the company to more efficiently manufacture solar wafers and cells through increased silicon utilization and increase the energy efficiency of its solar cells. As well, one of the patents holds promise in giving the company the ability to manufacture wafers and cells at a high-speed throughput capacity.

The company is seeking $1.5 million in Series A investments and is working with TVC of Albuquerque, N.M., to achieve their financial goals. Zia Power's interim Chief Executive Officer and President, Nathaniel Thompkins, stated that the company is planning to build a prototype cell plant in Albuquerque. Mr. Thompkins also praised the professionalism, expertise, and assistance of Sandia and TVC employees, saying that without their efforts the company would not have considered relocating to New Mexico.

HIGHLIGHT: NM Small Business Assistance Initiative Removes Barriers to Success

Sandia's New Mexico Small Business Technical Assistance (NMSBA) initiative addresses economic development issues in New Mexico by focusing on growing New Mexico's small businesses, encouraging quality development in rural areas, and building infrastructure for business expansion. The initiative represents a critical component of the state's business expansion strategy. The benefits for New Mexico include a measurable increase in the tax base and creation of business wealth through vibrant small businesses.

The NMSBA initiative, which was passed by the New Mexico Legislature in 2000, allows Sandia to utilize a portion of its gross receipts taxes to provide technical assistance to New Mexico small businesses. The NMSBA initiative:

- Enables New Mexico small businesses access to cutting-edge technology;
- Increases New Mexico small businesses' technical sophistication and capabilities; and
- Shares knowledge and resources between laboratory personnel and small businesses to address issues and develop real-world applications.

Since its inception five years ago, NMSBA has helped more than 1500 small New Mexico businesses. The small businesses surveyed anticipate creating more than 1800 new jobs in New Mexico over the next three years.

Darby Crow, owner of CuerVex, an Albuquerque-based photovoltaics small business that participated in the initiative, states: "The NMSBA program is one of the most innovative technical assistance programs existing today, and the New Mexico state government is to be praised for its leadership in establishing the program. The pro-business environment at Sandia and within the government will reap great benefits for the state's citizens."

The initiative continues to grow. During 2005, Sandia assisted 283 New Mexico small businesses, accounting for nearly $1.8M in tax credits. 69 percent of the projects were in rural New Mexico, and the rest were small businesses in urban New Mexico (Bernalillo County). The success of small business assistance projects demonstrates that with additional support from the State of New Mexico the NMSBA initiative could be an even greater economic development tool.

This year, Sandia scientists provided innovative solutions to a range of challenges, including reducing tire blowouts caused by low air pressure, creating a motorized fishing reel for the physically challenged user, and fixing a lighting problem within a local company's subtitle projection system to be used in performing arts settings.

Reducing Tire Blowouts — The Petty Project

Dale Petty, owner of Petty Farm & Ranch in Clovis, N.M., came to Sandia seeking a solution to a problem that had plagued him for years: tire blowouts on his ranch vehicles caused by low tire pressure. He wanted to develop a device that would automatically check tires for the recommended pressure and add or release air.

Through the NMSBA initiative, Petty was teamed with Sandia researcher John Browning. After a bit of work, Browning suggested three solutions to the problem of how to automatically maintain the

"The NMSBA program is one of the most innovative technical assistance programs existing today, and the New Mexico state government is to be praised for its leadership in establishing the program."

Darby Crow, owner of CuerVex, an Albuquerque-based photovoltaics small business

Dale Petty with prototype versions of the air compressor system and high pressure bottle.

A prototype system was built under the small business assistance project to address the safety and economic issues of under-inflated automobile tires frequently driven on America's roadways.

manufacturer's recommended tire pressure: an air compressor system, a high pressure bottle, and a gas generator.

Prototype versions of the air compressor system and high pressure bottle have been created and tested. Browning says the gas generator concept is potentially the lowest cost manufacturing solution, but because of the relatively high development cost was not pursued under the small business assistance project.

The air compressor concept was chosen in the preliminary design of an automatic tire pressure maintenance system. A prototype system was built under the small business assistance project to address the safety and economic issues of under-inflated automobile tires frequently driven on America's roadways.

The prototype has some features similar to the Dana Corporation's central tire inflation systems (CTIS), which have found utility in the trucking industry, particularly in off-road vehicles, and have been employed with both trailer axle vehicles and tractor drive axle vehicles. The CTIS is currently available on some models of the Hummer, but, says Petty, "Hopefully someday all vehicles will be equipped with a device that will help save lives."

With the assistance of Dale Petty's brother David, an automotive technician at Galles Chevrolet in Albuquerque, an automatic tire pressure maintenance system using wheel-mounted high-pressure nitrogen bottles was created as well. The system has been installed on all four wheels of a 1966 Ford Mustang and tested for tire balance and various road tests. The bottle road tests include rim and tire assemblies, shock and vibration from various highway speeds, and the structural integrity of the system. In addition, tests were conducted to detect leaks and simulation of proper functioning of the automatic tire pressure maintenance system.

"I am pleased with all the assistance Sandia provided," Petty says. "Sandia took the lead and helped out tremendously."

Other FY2005 NMSBA Projects

Cumbres & Toltec Scenic Railroad in Chama, N.M., is a 64-mile narrow gauge railroad system and is the most authentic steam era railroad in North America. It is jointly owned by the states of Colorado and New Mexico and runs between Antonito, CO, and Chama, N.M. The railroad requested Sandia's assistance in performing metallurgical testing required to guide difficult welding and repair approaches for very old locomotives. The NMSBA project was led by Sandians Ted Borek and Don Susan. The project's team provided the railroad with the materials analysis and characterization they needed so that they could move forward with repairs to locomotives.

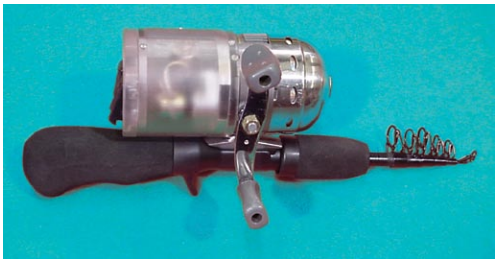
Cumbres & Toltec Scenic Railroad in Chama, N.M., is a 64-mile narrow gauge railroad system and is the most authentic steam era railroad in North America.

Drennan Mechanical Services in Hobbs, N.M., a small air conditioning and heating service company, discovered a need for a room thermostat to meet the needs of the visually and physically handicapped. The design idea includes voice-activated controls to change the comfort level settings and provide current setting information in a standalone wall unit. Although voice-activated models do currently exist, they must be networked to a home automation system for use. The company desired a simpler consumer model. Sandia Principal Investigator Lisa Marron helped develop a preliminary hardware design for a demonstration unit, utilizing a voice-activated speech evaluation board and commercial off-the-shelf parts.

Figaro Systems, Inc. in Santa Fe, N.M., is a design engineering company that specializes in electronic text delivery systems for the performing arts. Figaro Systems developed a patented system of electronic titles called SimulText®, which allows a musical performance's text to be displayed in any of eight languages on monitors as it is being performed. At the request of Figaro Systems, Sandia provided concept generation and design/analysis assistance to solve a stray light problem with a subtitle projection system for the National Hispanic Cultural Center's Roy E. Disney Center for the Performing Arts. Sandia Principal Investigator Richard Shagam designed a mirror/baffle system that intercepted the unwanted light and, incidentally, provided an enclosed path in the followspot projection booth that would prevent the followspot operators from obstructing the beam and suffering possible exposure to an eye hazard.

MesoSystems serves the security industry with innovative products for bio-threat surveillance and incident response. Sandia Principal Investigator Phil Hargis provided information on bio-aerosol properties and suggested design changes to improve the AirSentinel instrument that MesoSystems is currently developing. Hargis reviewed the technology and made recomendations regarding optical layout.

Olona Inc. in Albuquerque, N.M., develops motorized fishing reels for the physically challenged. For 18 years, company owner Gerald Olona has worked on a design that could be used with one arm by adults or children without the strength required to use traditional reels. Sandia Principal Investigator Herman Molina evaluated a variety of motor and gearing combinations. The project focused on improving the existing design. The reel needed to be smaller and lighter, with strong torque and longer battery life. The revised design weighed four ounces and had the required torque and battery life. This assistance allowed Olona Inc. to move forward with the development of the product, including identification of a manufacturer and potential distributors.



For 18 years, company owner Gerald Olona has worked on a design that could be used with one arm by adults or children without the strength required to use traditional reels.

Rather than turning over the technology to an unknown company, the program brings along the people with the most knowledge of the product, thereby increasing the likelihood of the startup's success.

HIGHLIGHT: ESTT Program Spins Out Successful High-Tech Startups

The Entrepreneurial Separation to Transfer Technology (ESTT) program offers Sandians the opportunity to participate in the startup of a new company. Begun in 1994 with the goal of moving more Sandia technologies from the Labs to the marketplace, the ESTT program is essentially a special termination of employment granted specifically to start a technology-based business or to help expand such a business.

The program encourages risk-taking…safely.

Rather than turning over the technology to an unknown company, the program brings along the people with the most knowledge of the product, thereby increasing the likelihood of the startup's success.

If the venture fails the Sandia entrepreneur is guaranteed the same or equivalent job at the Labs (good for up to two years, with an extension possible). In addition, Sandia may provide support for the entrepreneur via technical assistance, coaching, and business training.

In FY2005, five more Sandians left the Labs via the ESTT program. Since the program was implemented in 1994, 126 entrepreneurs have left Sandia and have been involved in starting 40 companies and expanding 44 more. Of the 126 that have used the ESTT program, only 36 have returned to the Labs.

"FY2005 was another productive year for Sandia's ESTT program. However, the more important perspective is the program's cumulative effect over its 12-year history. Since the program's inception at the Labs, Sandia entrepreneurs have contributed significantly to both New Mexico's and California's burgeoning tech-based business sectors," comments Dick Fairbanks, Sandia's New Ventures Program Leader.

ESTT Program Gives Rise to Successful Solar Startup, Advent Solar

Rising energy costs and instability in regions producing most of the world's fossil fuels have re-focused attention on the need for alternative, renewable energy sources. While the cost of solar cells has dropped over the past several decades, the technology is still not cost-effective for on-grid applications (homes, businesses). The solar industry needs further process improvements so that photovoltaic cells are more efficient and less expensive to manufacture.

James Gee, a former Senior Scientist at Sandia National Laboratories, spent much of his time at the Labs thinking of how to make that happen. He eventually figured it out.

During the 1990s, Gee and his team of researchers developed a breakthrough photovoltaic cell design and fabrication process that eliminates the current-collection grids from the front surface of the cell. The new process uses a laser to drill holes through the silicon substrate and form conductive channels from the front to the rear surface. This advance allows the electric power to flow to the back surface where the backside wiring carries the current away.

Unlike conventional cells with wiring on the front that inefficiently blocks sunlight, the laser-drilled holes make the cells more efficient by exposing more of the top surface of the solar cells to sunlight. These back-contact cells also reduce assembly cost by eliminating the front-to-back connection step, and they offer a more aesthetically-pleasing product for the consumer. Hundreds of cell prototypes were built at Sandia, and the work resulted in three fundamental patents.

The Advent 160 solar panel: 160 watt featuring emitter wrap-through technology

Recognizing the need in the market and the potential of Gee's new photovoltaic cell design, Russell Schmit — then president of Photowatt International, a photovoltatics manufacturer based in France — approached Gee to start a new company that would manufacture Sandia's novel back-contact solar cell design. Gee applied for and was granted entrepreneurial separation under the ESTT program, and formed Advent Solar with Schmit. The company was stood up in 2003 and has since licensed the back-contact photovoltaic cell technology from Sandia.

The partnership forged between James Gee and Russell Schmit is a great success story.

Working with TVC in Albuquerque, N.M., Advent Solar has obtained $40 million in venture capital funding. The funding came after Advent Solar, a TVC client since 2002, presented at TVC's 2004 New Mexico Equity Capital Symposium, where it was given the opportunity to deliver its business case to investors. Advent Solar is building its pilot production facility at the Manufacturing Training and Technology Center in the Science and Technology Park at the University of New Mexico and began construction of a commercial manufacturing facility in Albuquerque's Mesa del Sol development.

Sales of Advent Solar's product, the "emitter wrap-through" photovoltaic cell, began in December 2005. The company currently employs nearly 40 engineers, technicians, production operators, and administrative staff, and is projected to have 1000 employees within the next five years.

Gee has played a central role in the startup's success. As the original inventor, Gee brings to the company a fundamental knowledge of the technology, making it easier to troubleshoot problems during the product's development. Sandia provided Advent Solar with business and technical assistance in the commercial development of this technology, as well. Licensing Executives in Sandia's Corporate Business Development and Partnerships Center have worked with Advent Solar as needed to restructure the terms and conditions of the commercial license agreement to meet the needs of the company's investors, and Sandia's technical organizations have provided support in characterizing early prototypes from Advent Solar.

The transfer of Sandia's back-contact photovoltaic cell technology to the private sector has resulted in a commercial license, a new solar-based commercial product, and a startup company that is helping to fuel regional economic growth in the solar industry sector. Advent

The company currently employs nearly 40 engineers, technicians, production operators, and administrative staff, and is projected to have 1000 employees within the next five years.

Solar projects that this back-contact cell technology will have a manufacturing cost of less than half of conventional cell technology, which will help promote solar energy while building a strong U.S. photovoltaic company in a market experiencing global growth.

IN BRIEF

The Computer Science Research Institute (CSRI) broke ground on a 34,500 sq. ft. building in the Park.

Sandia Science & Technology Park Highlights

The Sandia Science & Technology Park (SS&TP) is a 200+ acre technology community located adjacent to Sandia National Laboratories. Tenants, which include EMCORE, Ktech, Applied Technology Associates, and Sunwest CAD, among others, have easy access to Sandia's world-class facilities, technologies, scientists, and engineers. The Park functions as a virtual extension of Sandia, providing an ideal location for companies that want to partner with the Laboratories on technology development or commercialization.

SS&TP welcomed three new companies and oversaw several major groundbreakings during the past year.

Poly-Flow Engineering, a California-based, high-tech company that produces cleaning equipment for the semiconductor industry, was purchased by Ktech Corporation—a long-time SS&TP tenant—in late 2004. Ktech is moving the company to Albuquerque and in July 2005 broke ground on a 37,000 sq. ft. facility at SS&TP that will house Poly-Flow.

The Computer Science Research Institute (CSRI) broke ground on a 34,500 sq. ft. building in the Park. The CSRI brings together researchers from universities and the national laboratories to solve problems in computer science, computational science, and mathematics and to provide new capabilities in modeling and simulation. Approximately 185 researchers and collaborators will occupy this space in the Park.

Team Specialty Products (TSP) is currently building a 22,000 sq. ft. addition to their 14,000 sq. ft. facility in the Park. The addition will provide much needed space for the growing company and allow it to expand its mission.

The Sandia Synergy Center, a 28,650 sq. ft. multi-tenant building, opened its doors for business in September 2005. CSA Engineering became the first tenant in the building occupying 8,300 sq. ft. of office and laboratory space.

MESA TOP II and Battelle Albuquerque Operations moved into the Park in March 2005. MESA TOP II moved into 9,500 sq. ft. of space on the second floor of the Ktech building. The facility enables a Sandia cross-functional team to collaborate to utilize MESA capabilities to reduce the size and cost of radar systems and provide a core enabling technology. Battelle Albuquerque Operations moved into 6,300 sq. ft. of space in the Sunwest CAD building. Battelle provides scientific and operational test support to the Air Force Operational Test and Evaluation Center at Kirtland Air Force Base.

In other Park news, the Optic Ring for Broadband Information Transport (ORBIT) Network, which provides high-bandwidth capacity in the Park, became operational during FY2005. The Orbit Network consists of an on-site fiber hub, a direct connection to service providers, and fiber optic links to customers throughout the Park. Sandia tenants in the Park that are connected through the ORBIT Network are the International Programs Building, MESA TOP I, MESA TOP II, the Sandia Controller and Pension Plan Management Center, the Research Park office complex, and two International Security Departments located in the Sandia Synergy Center.

By the end of FY2005, a total of 20 companies, employing nearly 1200 people, have made the SS&TP their home. The Park now has 490,925 sq. ft. of occupied space distributed over 15 buildings. Total investment in the Park exceeds $178.7 million, with $20.7 from public sources and the remaining $158 million from private sources.

Mentor Protégé Program

Sandia's Mentor Protégé program, which is currently in its fifth year of service, assists small businesses (protégés) in improving their business practices and processes to become more successful suppliers. The two-year program comprises first-year and second-year Mentor and Protégé teams, Alumni, and Business Service Advisors. Since its inception, the Mentor Protégé program has worked with 84 mentors and protégés.

The year's membership featured 15 first-year teams and 4 second-year teams, 19 alumni, and 12 Business Service Advisors. Throughout the year, the Mentor Protégé teams met monthly to work toward achieving their business goals.

Exhibit Solutions of New Mexico, owned by Gina Euell, participated in the Mentor Protégé program during 2005. As a first-year protégé, the company increased its sales by 31 percent and increased its net profit by 136 percent. Acquisition of new equipment and technology enabled the company to augment in-house graphics capabilities and reduce client turn-around times. Exhibit Solutions was recognized as the Outstanding Business of the Year by the Albuquerque Hispano Chamber of Commerce.

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IN BRIEF

Smiths Detection's commercial walk-through portal, known now as the SENTINEL, is noninvasive, does not require direct contact, nor does it require people to remove their shoes or outer garments.

Explosives Detection Portal Wins National FLC Excellence in Tech Transfer Award

The Federal Laboratory Consortium (FLC) announced its selection of Sandia's explosive detection portal for a 2005 Excellence in Technology Transfer Award. The walk-through explosives detection portal was originally developed by Sandia under an Other Federal Agency agreement for the Federal Aviation Administration. Barringer Instruments, Inc. was selected from at least 12 candidate companies for the licensing and commercialization of the technology. Smiths Detection acquired Barringer in 2002 and continued the commercialization effort.

This technology transfer effort was one of the first to utilize robust evaluation criteria for the many companies that were seeking to commercialize the technology. The evaluation criteria were specifically designed to accommodate the varying business interests and commercialization strategies of the interested companies, while meeting Sandia's and DOE/NNSA's needs and requirements. This technology transfer effort provided a path for commercialization that ultimately pushed the technology into commercial availability in only three years, an exceptionally short time for such a large and sophisticated technology.

Smiths Detection's commercial walk-through portal, known now as the SENTINEL, is noninvasive, does not require direct contact, nor does it require people to remove their shoes or outer garments. It can screen approximately 420 people per hour and is being used in facilities such as airports, office buildings, sports arenas, prisons, nuclear facilities, courtrooms, post offices, federal buildings, schools, and other high-traffic areas.

Sandia Awarded Three Regional FLC Awards

Three of Sandia's award nominations were selected as winners for the 2005 FLC Mid-Continent Region Annual Awards. Award recipients are the Inter-Institutional Agreement, Bio-Explosive Destruction System, and Aeroelastic Twist-Bend Coupling Design for Carbon/Glass Hybrid Wind Turbine Blades.

The Inter-Institutional Agreement was honored by the FLC with its "Regional Partnership Award," which recognizes outstanding efforts to promote technology transfer between federal government facilities and the private or public sector. Two Sandia-developed technologies, the Bio-Explosive Destruction System and Aeroelastic Twist-Bend Coupling Design for Carbon/Glass Hybrid Wind Turbine Blades, were presented with awards for "Notable Technology Development."

FLC Highlight: Scientists at Sandia's Wind Energy Technology Department have been working for the past three years to complete designs for a unique wind turbine blade that is now poised to push wind technology to a new level of efficiency and effectiveness. Manufacturers currently build blades with fiberglass spar caps. Sandia's novel wind turbine blade designs incorporate a hybrid of carbon graphite fibers and fiberglass to produce a stronger, lighter blade, combined with the concept of aeroelastic twist-bend coupling to reduce loads due to turbulence.

Sandia's groundbreaking work on wind turbine blades has garnered a great deal of attention at national symposiums and conferences. Upon hearing about Sandia's work in this arena, several blade manufacturers have submitted successful bids to further develop the Sandia blade

Sandia's ground-breaking work on wind turbine blades has garnered a great deal of attention at national symposiums and conferences.

designs through DOE's Low Wind Speed Technology Phase II solicitation. One contract, with Knight & Carver out of San Diego, CA, has been successfully negotiated. The San Diego company will work with Sandia to develop products for the wind turbine blade retrofit market.

Two additional contracts are in the negotiation process. Sandia will be working with these companies in partnerships cost-shared by industry and the DOE. Potential commercial markets include blade retrofits and blades for both large- and small-scale wind turbines for use by industry and individuals.

"Nobel Prizes of Technology" – Sandia Receives Four R&D 100 Awards

Sandia won four of the prestigious R&D 100 awards. The annual R&D 100 contest, sponsored by Chicago-based R&D Magazine, selects the year's best-applied new technologies.

One hundred winners are chosen from an international pool of contestants from universities, private corporations, and government labs. The sole criterion for winning, according to a description released by the magazine, is "demonstrable technological significance compared with competing products and technologies." Properties noted by judges include smaller size, faster speed, greater efficiency, and higher environmental consciousness. The awards are so prestigious they are sometimes referred to as the "Nobel prizes of technology."

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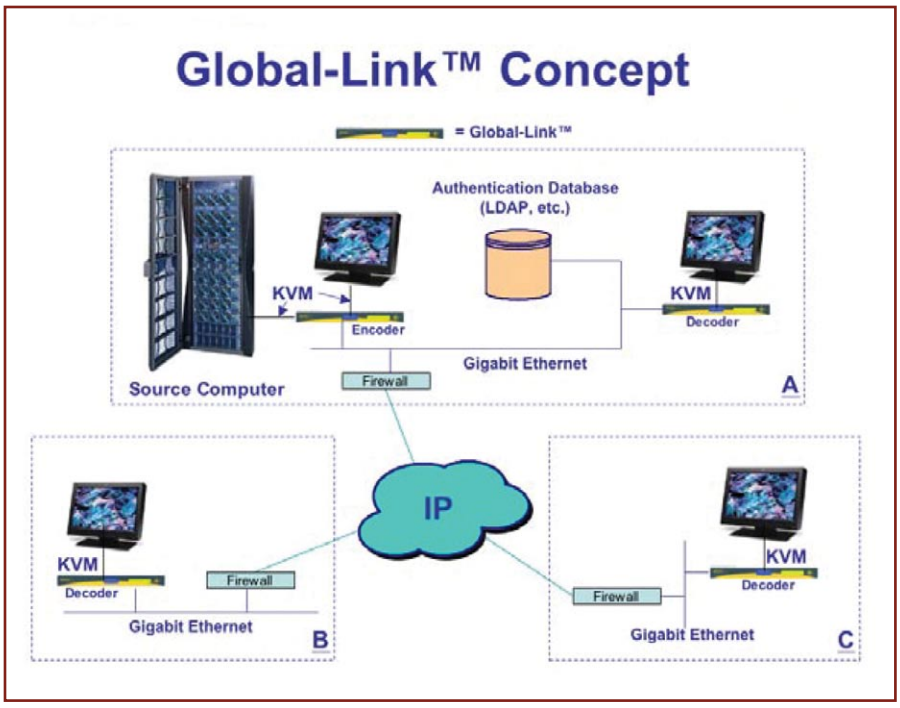
– Sandia and Goodyear Tire and Rubber Company were awarded one of 2005's R&D 100 awards for their joint work on the development of Goodyear's new **Assurance™** line of tires featuring TripleTred Technology™. The Sandia-Goodyear partnership is featured in the "Building Strategic Partnerships" section of this report.

– For another award, Sandia used innovative data compression techniques to help physicians consult in real time over MRI pictures, though the amount of data transferred is normally huge and the healers may be thousands of miles from each other. Global-Link™ allows such rapid transmission of complex data that a doctor in the U.S. can confer with a doctor halfway around the world,



Global-Link™ allows such rapid transmission of complex data that a doctor in the U.S. can confer with a doctor halfway around the world, viewing and manipulating 3-D MRI images in real time directly on each doctor's MRI computer.

viewing and manipulating 3-D MRI images in real time directly on each doctor's MRI computer. Extremely responsive interactions between an event and a remote, secure, high-resolution display are possible using Global-Link™ across the internet. Results were achieved in collaboration with Logical Solutions, Inc., which is marketing the product.

– Sandia earned a third R&D 100 award for the invention of a patented exploratory ion beam microscope system that does not require costly and complicated forming and focusing equipment. Joint winner Quantar Technologies is marketing this invention. The multi-dimensional, high-resolution analysis system is called the Ion-Photon Emission Microscope (IPEM). It allows scientists and engineers to microscopically study the effects of single ions in air on semiconductors, semiconductor devices, and biological cells without having to focus the beam. The technique determines the position at which an individual ion enters the surface of a sample; thus, focusing a beam is unnecessary.

– Sandia earned a forth award for the development of TEPIC, a rigid structural foam that was designed originally to meet certain high-temperature and high-strength requirements for Defense Programs applications. Because it is dimensionally and mechanically stable to temperatures in excess of 200º C, it meets processing requirements to be used as forms for molding advanced composite materials that cure at high temperatures. Formerly, only expensive metal tooling could meet this thermal challenge. Unlike many more conventional tooling materials, it can be processed in thick sections. Cost and weight savings should allow smaller businesses, with less capital investment, to process new composite structures, and in general enable incorporation of advanced structural composites in aerospace, military, automotive, and other consumer product industries. Scion Industries, one of two licensees of TEPIC, is also included on this award.

"These awards demonstrate that DOE scientists and researchers are hard at work developing the technologies of the future," said U.S. Secretary of Energy Samuel W. Bodman. "In the past, breakthroughs like these have played an important role in both our economic and national security."

Science & Technology Park Honored with National Economic Development Award

The Sandia Science & Technology Park won the award for "Excellence in Technology-Led Economic Development" as part of the Economic Development Administration's 2005 Excellence in Economic Development Awards program. The award recognized the Sandia Science & Technology Park's commitment to sound, research-based, market-driven development in helping grow the local economy.

The Economic Development Administration operates under the U.S. Department of Commerce. Its mission is to lead the federal economic development agenda by promoting innovation and competitiveness and preparing American regions for growth and success in the worldwide economy.

Mentor Protégé Award for Excellence

Sandia's Mentor Protégé program was selected for a C. Paul Robinson Award for Excellence for Innovation in Small Regional Business Procurement. This award recognizes the program's contributions in mentoring, coaching, and training assistance to small businesses in order to strengthen their capabilities and competencies and make them more competitive in the regional business community.

Over the last four years, the Mentor Protégé program has worked with 84 mentors and protégés.

Charting Partnerships

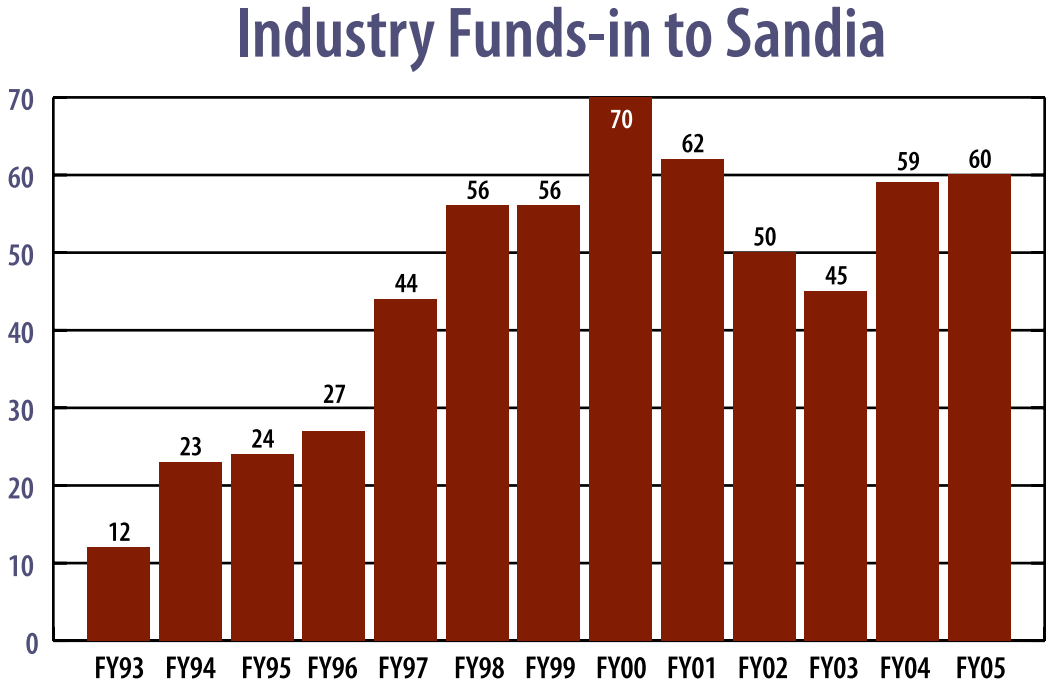
Like all organizations that have to respect the return on investment for their stakeholders and other constituents, Sandia National Laboratories measures its performance by collecting metrics that indicate progress against its objectives.

Sandia is involved in partnerships with industry and Other Federal Agency customers to support our national security and DOE/NNSA missions, transfer technologies to the commercial sector to improve the competitiveness of U.S. industry, and enhance job creation and small business development. Funds-in to the laboratory are a measure of the value of our intellectual property and capabilities and also provide funds to mature emerging technologies so they are closer to deployment and practical impact.

The charts that follow show the patterns of gains and losses over the course of more than a decade. For FY2005, the metrics show a mixed picture of increasing WFO/NFE activity, funds-in contributions and patent applications, and slight decreases in CRADA activity, patent disclosures, issued patents, and licensing volume.

Industry Funds-in

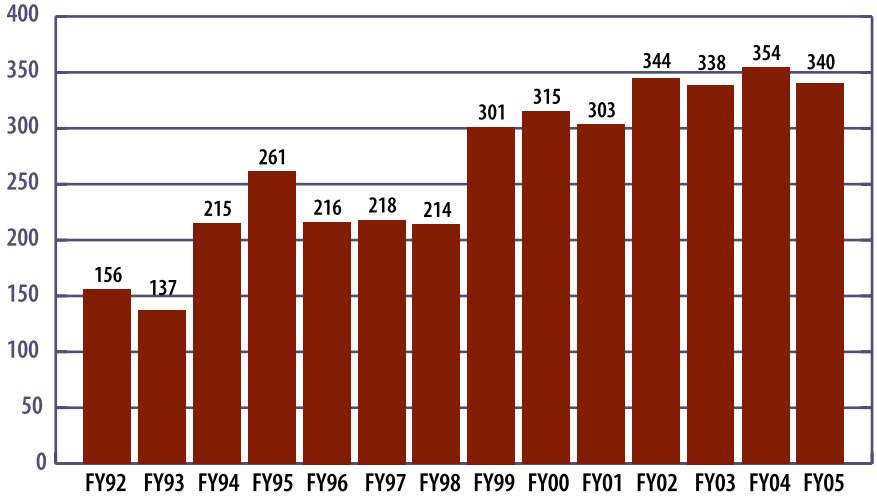
Funds-in from industry rose slightly in FY2005.



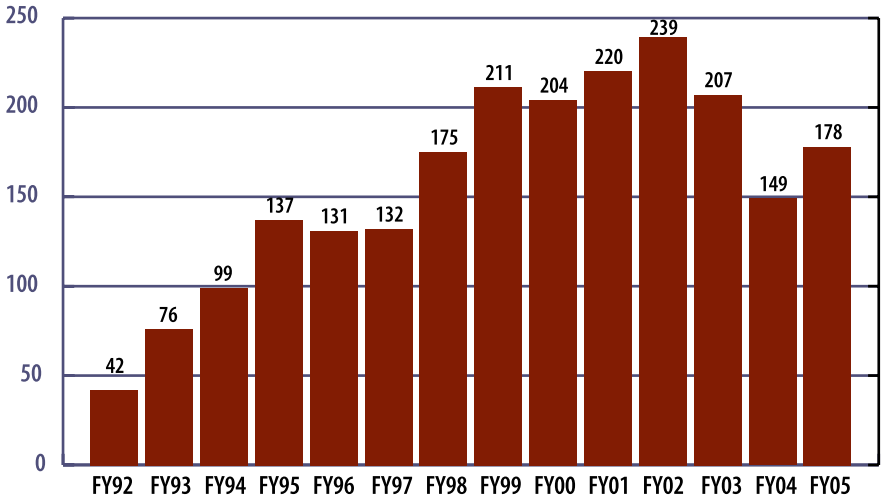
Patents and Disclosures

In FY2005, patent applications increased by nearly 20 percent, while patent disclosures and issued patents declined slightly.

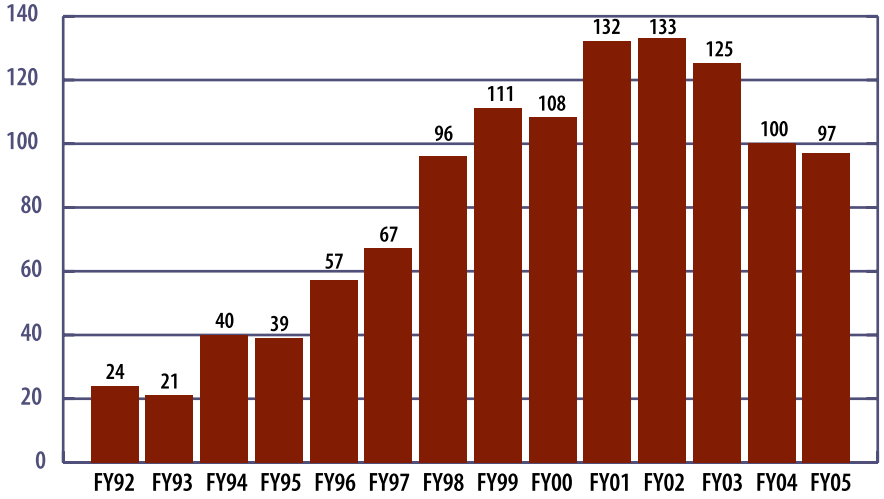
Patent Disclosures



Patent Applications



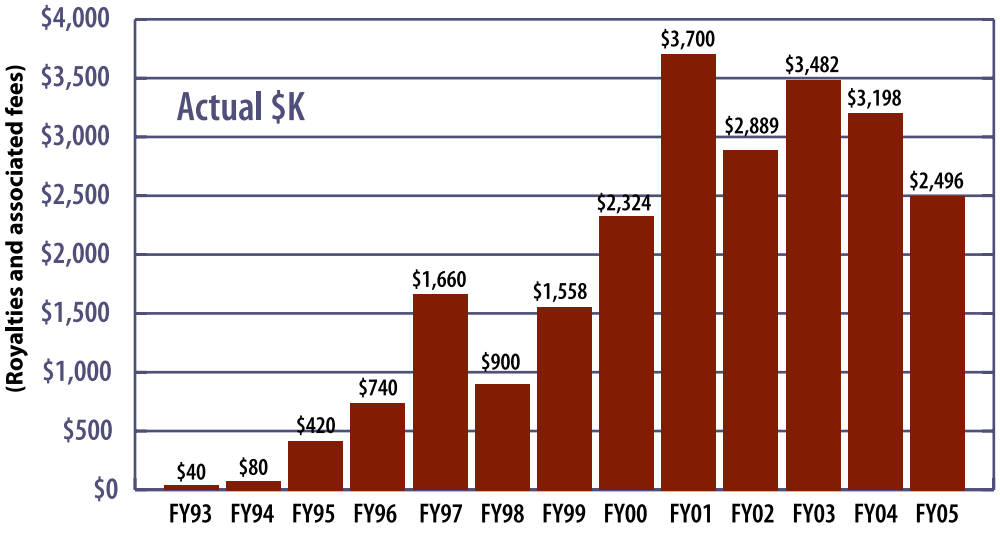
Patents Issued



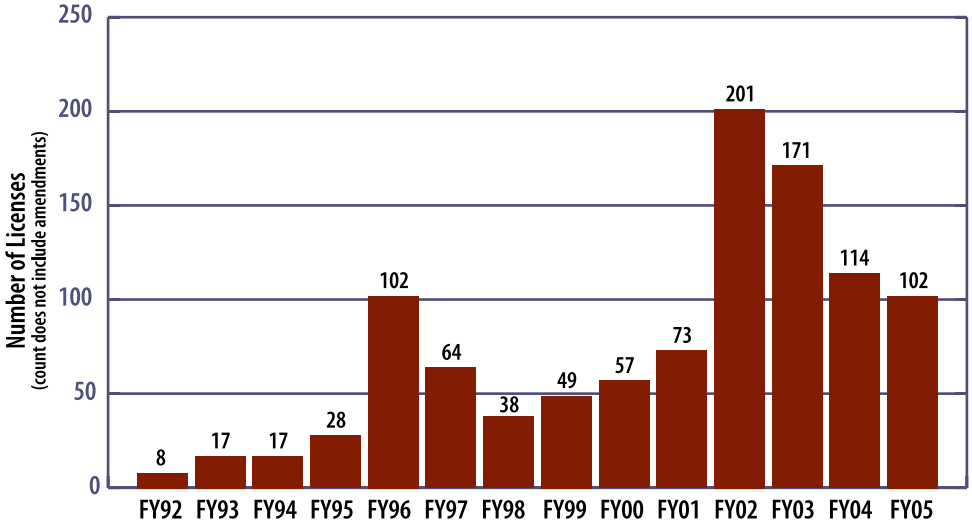
Licenses

The number of executed licenses and license income in FY2005 reflect primarily a decline in software licenses (particularly JESS™ and RAM™) as the technology has aged and the market has saturated. In addition, our focus on mission success results in intellectual property being used to attract larger CRADAs and other funds-in agreements, such that pursuit of licensing revenues has become a lower priority.

Licensing Income



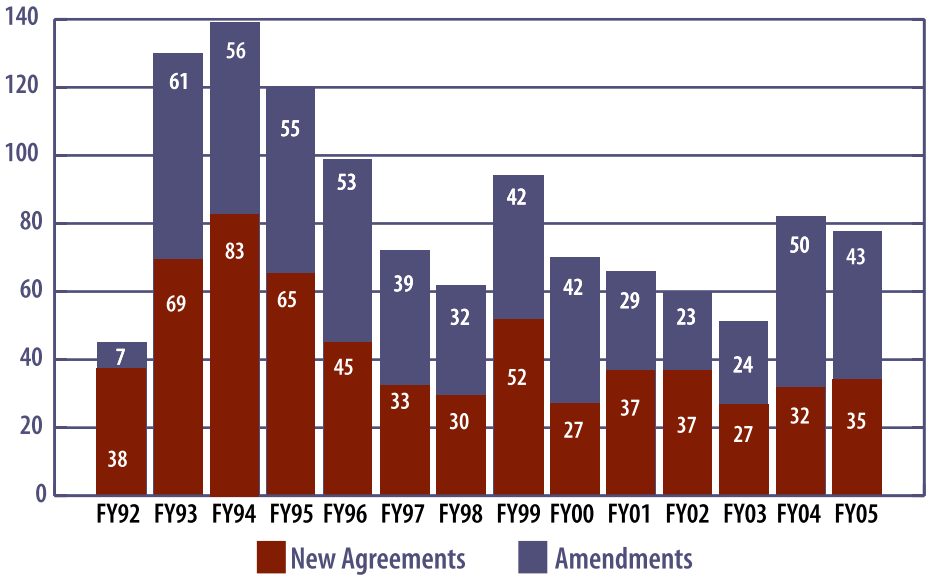
Commercial Licenses



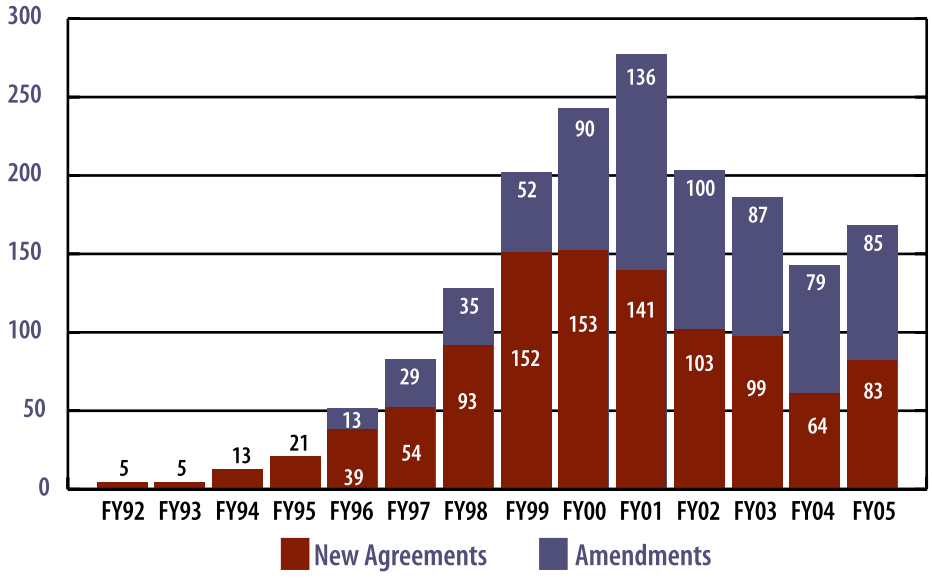
CRADAs and WFO/NFEs

Numbers of new WFO/NFE agreements jumped upward by nearly 23 percent, while WFO/NFE amendments increased by about 3 percent. Numbers of both new and amended CRADAs remained nearly steady during FY2005, with a small increase in the number of new CRADAs and slight decline in the number of amendments.

Sandia CRADA Program Activity



Sandia WFO-Industrial Partners Program Activity



Partnerships Annual Report Staff

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Our appreciation to the many individuals within Sandia, DOE/NNSA, and our partnerships community who contributed to this report and to the continuing success of Sandia's Partnerships program.