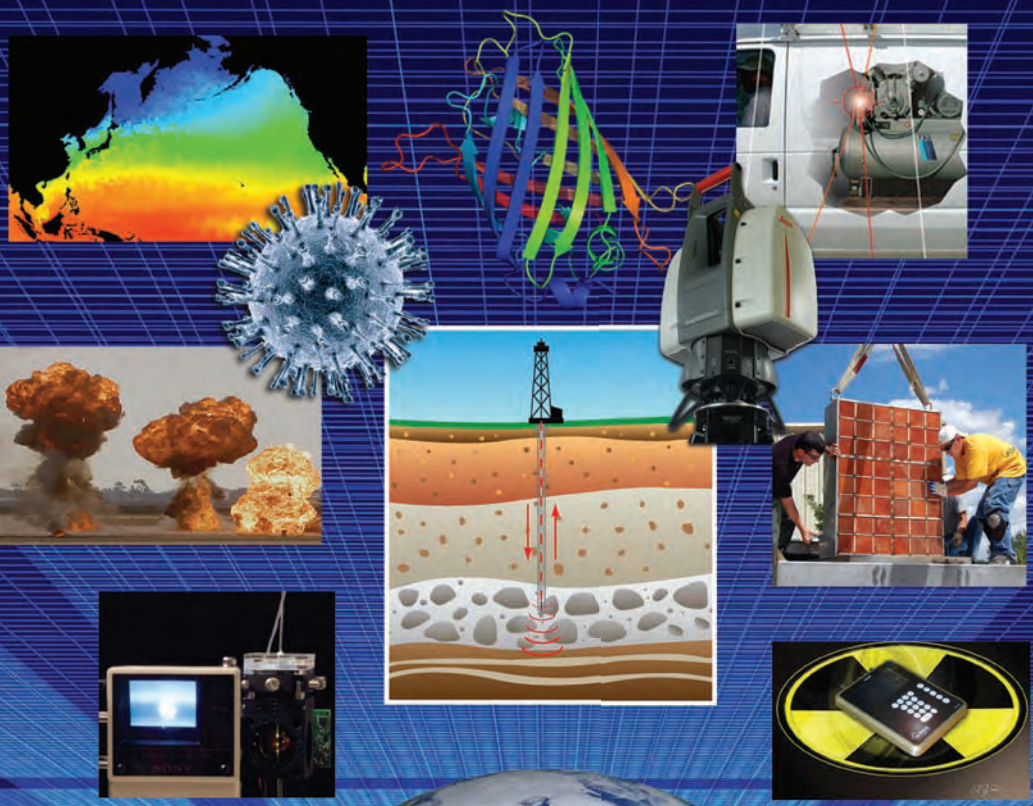
2007–2008 Progress Report

Technology Transfer

Sustaining Our Legacy of Addressing National Challenges



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21st Century Innovations Evolve from Manhattan Project Roots

Our national security depends on science and technology, and the United States relies on Los Alamos National Laboratory for the best of both. No other laboratory in the world pursues a broader array of world-class scientific endeavors, and no one else collaborates on national security science in as many technical disciplines.

From work in weapons design and plutonium research to climate modeling and nuclear detection and forensics, Los Alamos scientists discover, develop, and perfect the means to protect our nation against nuclear attack, bioterrorism, and energy shortages. They strive to understand and minimize the devastating effects of pandemics, from AIDS to avian flu. They create technologies for exploration and security in space while they further our understanding of seismic forces and environmental issues on our own planet.

Many existing and emerging technologies and industries trace their genesis to research performed at Los Alamos. Fuel cells, human genome sequencing, genomics, flow cytometry, and superconductivity are just a few technologies with strong roots in the basic research programs at Los Alamos National Laboratory.

The Laboratory's Technology Transfer Division helps move technologies from the Lab to the marketplace. As the Laboratory's liaison with industry, Technology Transfer also manages Lab-industry research partnerships and serves as the Laboratory's resource on industry relations.

Such corporations as Procter & Gamble have been collaborating with Los Alamos on technical problems of mutual interest since 1995, and the Laboratory and Chevron Energy Technology Company have been partners in the Advanced Energy Solutions Alliance since 2004. Both companies enthusiastically sponsor Industrial Fellows who act as technical liaisons between the company and the Laboratory.

As the search continues for new solutions to the nation's security challenges through science and technology at Los Alamos, it also fuels startup companies, creates job opportunities, and attracts business and capital to Northern New Mexico. And that benefits the region, the national economy, and all of society.

Leading Technology Transfer Toward New Challenges

"CRADAs are the sweet spot for accomplishing open innovation with industry."

The Technology Transfer Division is well known for its efforts to partner with industry to ensure that Laboratory-developed technology benefits industrial competitiveness and economic security for the United States. In this progress report, we provide a glimpse into the variety of interactions in which the Laboratory engages with industrial and other institutional partners to address national security challenges in energy, electronics technology, and health, among others, as well as in support of regional economic development.

The Technology Transfer staff recognize that our mission is much broader than commercializing technology. Two other aspects of our mission that are less well known but equally worthy of emphasis include our efforts to develop industrial collaborations that support mission- and program-critical capabilities; and our management of intellectual property to give the Laboratory a competitive advantage in the competition for new federal program dollars. As federal sponsors increasingly require us to partner with the private sector to ensure delivery and deployment of technical solutions, these nontraditional technology transfer missions are growing in importance.

Cooperative Research and Development Agreements (CRADAs) remain an effective mechanism to bring exciting new problems into the Lab and promote recognition for the breadth and significance of our technical capabilities and innovative capacity to industry. Technology Transfer has been helping the Laboratory achieve significant growth in CRADAs and non-federal Work for Others. During fiscal years 2007 through 2008, both activities brought industry research dollars totaling nearly $75 million into the Lab—double the figure for the previous two-year period. To increase engagement with Laboratory programs and personnel, Technology Transfer is launching an aggressive in-reach program in fiscal year 2009, emphasizing open innovation (i.e., the deliberate use of collaborative research and development to achieve new intellectual property) and leveraging intellectual property to support critical capabilities and capture new programs. Our staff is working with Laboratory managers and technical staff to identify industry partners whose capabilities enhance and complement the Laboratory's, and then to court and cement relationships with these partners.

Technology Transfer supports Laboratory missions in another often-unrecognized program. Through community outreach and our technology commercialization efforts, we help create a more diversified, high-tech, regional economy. The lack of employment opportunity outside the Laboratory increasingly challenges our ability to recruit and retain the high-caliber technical staff required to accomplish Laboratory missions. With the selection in late fiscal year 2008 of a new Laboratory partner under the Los Alamos Venture Acceleration Initiative, the Verge Fund and ARCH Venture Partners team, we look forward to participating in a vigorous effort to spin out new technology-based companies from the Laboratory in Northern New Mexico.

In summary, the Technology Transfer Division comprises a group of very talented people who are passionate about their success—namely, being trusted catalysts for developing partnerships that are good for the Laboratory, the nation, and the region. We will continue to use our business development and intellectual property acumen to help the Laboratory meet its national security and other emerging missions as we actively seek to engage with every program and line organization to ensure Los Alamos remains the nation's premier national security laboratory.

—Steven Girrens
Technology Transfer Division Leader

Technology Transfer Overview

Leveraging a Rich Tradition of Premier Science and Technology

The fact that the Laboratory's world-class scientific and technical staff routinely achieve breakthrough solutions to many of the nation's and the world's most crucial challenges is inherent in our work to preserve national security. From fundamental research in biology and global climate to problems related to nuclear nonproliferation, energy and infrastructure, and countermeasures to nuclear and biological threats, outstanding science underpins our past, present, and future.

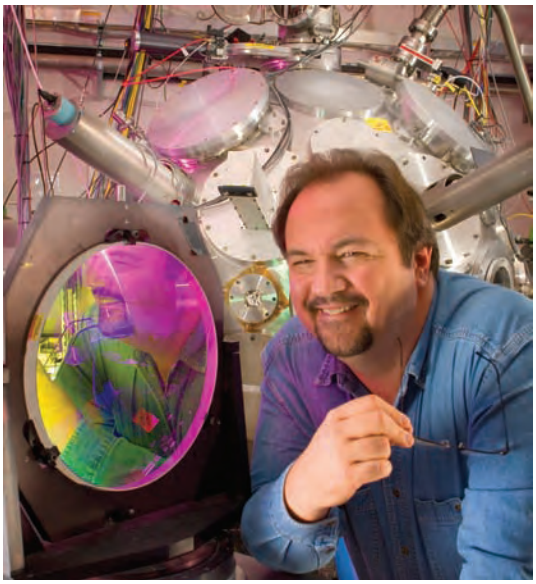
Forging Strategic Partnerships with Industry

In order to share our innovations with the private sector, the Laboratory's Technology Transfer Division strives to forge strategic relationships with industry. Through these partnerships, we bring industrial innovation and best practices to our national security work while providing our industry partners with access to our cutting-edge research and talent. We offer a variety of ways for industry to partner with us:

- license agreements
- cooperative research and development agreements (CRADAs)
- industry funds-in (Work-for-Others, non-federal) contracts
- personnel exchanges
- technical consulting and assistance
- access to unique research staff and user facilities.

Protecting and Licensing the Laboratory's Intellectual Property

For the Laboratory to effectively work with industry, we must protect our intellectual property. Technology Transfer works with the Laboratory Counsel to ensure protection of the Laboratory's intellectual property through patents and copyrights. Intellectual property protection enables us to negotiate, execute, and administer commercial, noncommercial, and government licenses on behalf of Los Alamos National Security (LANS) LLC, manager of the Laboratory for the Department of Energy (DOE). Through these agreements, we create vital links between the Laboratory and the private sector, leading to innovative and effective solutions to problems that affect the Laboratory, the private sector, and society.



David Montgomery heads the Laboratory's Trident high-power laser facility, available to researchers nationwide to explore high-energy-density physics.

Nurturing Startups

The Laboratory has instituted a variety of mechanisms to encourage the creation of new businesses based on Laboratory technology and expertise. To encourage regional economic development, Technology Transfer works with technical staff to assess and package technologies that could form the basis of a new company. And to encourage participation in these activities, the Laboratory maintains an Entrepreneurial Leave Policy that allows employees to support these new ventures while maintaining ties with the Laboratory. In addition, Technology Transfer works with investors, existing small businesses, and entrepreneurs to inform them about new commercialization opportunities, sponsored training and networking events, and access to business assistance through our MBA Internship Program.

Energy Security: Addressing Global Challenges

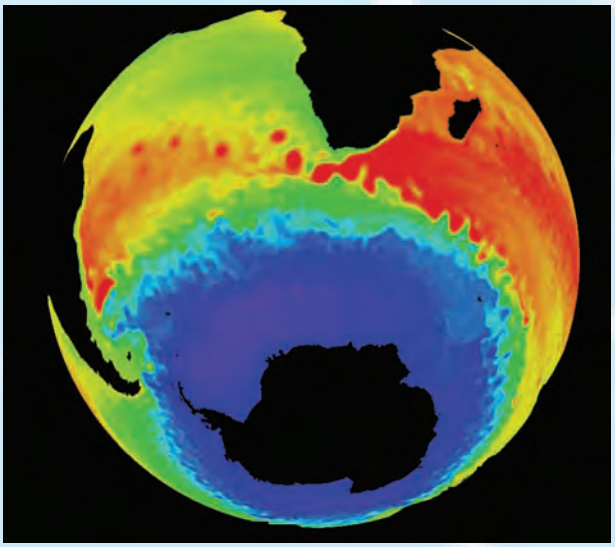
Few issues have captured national attention during the past year as consistently as energy security. Energy is the lifeblood of the world economy, and global energy demand continues to escalate. Ensuring that the United States has a reliable, affordable, and clean energy supply is critical to our national security. Los Alamos is providing science, technology, and engineering leadership today for highly innovative solutions to meet the nation's energy needs. These solutions impact energy generation, storage, transmission, and use through breakthroughs in understanding from new materials to complex global systems.

Los Alamos research and development (R&D) priorities for energy security fall into three categories: sustainable nuclear energy; materials and concepts for clean energy; and mitigating impacts of global energy demand growth. In each of these areas, partnerships will be essential to accelerate the discovery cycle from invention to implementation. Over the years, we have had successful industry partnerships in each of these areas, some of which are highlighted in this report, and our research in these areas generates a large fraction of the Laboratory's intellectual property.

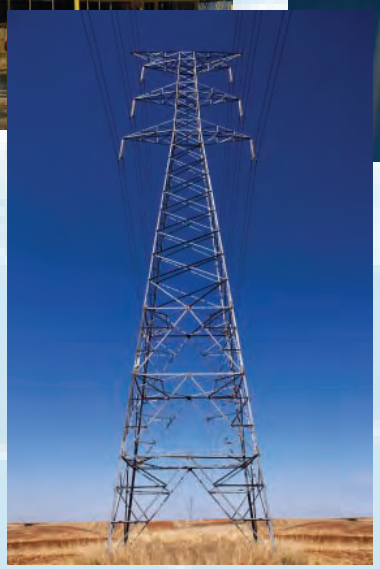
For sustainable nuclear energy, Los Alamos developed much of the technology that enables today's safe and reliable nuclear reactors (supplying 20 percent of the nation's electricity with near-zero carbon dioxide generation). We continue to innovate in designing fuels that enable higher amounts of energy to be extracted with less waste, in leading international collaborations to ensure safeguards and security from weapons proliferation, and in providing science support for the nation's waste repositories.

In the area of materials and concepts for clean energy, Los Alamos has led in nanoscience discoveries leading to potentially more efficient solar generation, superconducting cables for lossless transmission of electricity, and new materials for electrical and chemical energy storage. We provide modeling and measurement tools that are essential to designing and testing large-scale capture and sequestration of carbon dioxide to mitigate climate change driven by fossil fuels. And we are working on a range of technologies with industry to accelerate discovery and recovery of unconventional oil such as oil shale and deepwater reservoirs.

To mitigate the impacts of energy demand growth, we are extending our global leadership in climate modeling of the ocean and sea ice, as well as our capabilities to model complex energy infrastructure. There is an urgent need for predictive tools to advise policymakers on the best strategies for scaling up renewable energy and evaluating



Los Alamos' ocean and sea ice models are used throughout the international climate modeling community and were part of the Intergovernmental Panel on Climate Change Assessment that won the 2007 Nobel Peace Prize.



climate impacts on energy use, infrastructure investments, and natural resource availability. Finally, we provide science leadership in support of a national strategy for verification for potential global treaties on greenhouse gas emissions, a role that springs from our historic mission to provide measurement, monitoring, and verification technologies in support of global nuclear test ban treaties.

Meeting our nation's energy needs will require a sustained commitment and substantial breakthroughs in science and technology. Our national laboratories play an essential role in bridging between basic science and commercial application. As we have done for the last six decades, Los Alamos will help the nation meet these challenges through partnerships. Through our partnerships with industry stalwarts such as Chevron, Procter & Gamble and others, together we are exploring new ways to harness these capabilities into practical, deployable solutions for our energy future.

—Duncan McBranch
Science, Technology, and Engineering Directorate

The Laboratory's capabilities to model our energy infrastructure and to develop new approaches to improving domestic energy resources enhance the nation's energy security.

Large Strategic Partnerships

Unlocking Domestic Oil Reserves

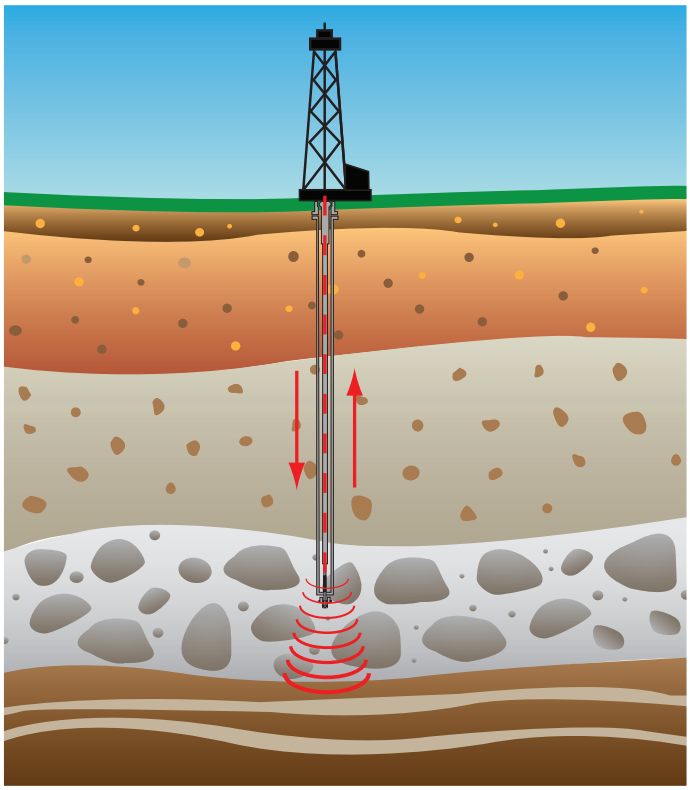
As we enter the next decade, energy will become increasingly important to our national economy and military defense. In short, energy security will be a major challenge for the United States. As time passes, so will our access to easy oil. By that we mean large reservoirs of oil and gas in the continental U.S. Today's challenge is to acquire energy from difficult and unconventional carbon-based sources. These include oil shales and oil sands in the western states and Canada, deepwater reserves in the Gulf of Mexico, heavy oils in California and South America, and natural gas at greater depths. These challenges include environmental issues, materials and physics issues, and new technologies to access, extract, and refine these resources.

Chevron Corporation, the second largest energy company in the U.S., has tapped a petroleum pool deep beneath the Gulf of Mexico that could boost the nation's reserves by more than 50 percent. In recent years, Chevron has placed great importance on developing and implementing technology to improve all its existing processes. Technology is being used to reduce the time as well as energy required for various processes executed during exploration, production, and refining of oil.

The Chevron Energy Technology Company within Chevron is responsible for developing and fielding advanced new technologies across the corporation under a business model in which it works with oil and gas service suppliers to develop, demonstrate, and deploy new technologies and products. In 2003, under the leadership of Chevron Chief Technology Officer Donald Paul, Chevron set an ambitious target: identify partners who could change the nature of technology in its business. This effort was part of a corporation-wide commitment to create a new world energy equation.

The Alliance for Advanced Energy Solutions between the Chevron Energy Technology Company and Los Alamos exemplifies a productive strategic alliance that has grown through a confluence of success factors. The Alliance, developed in late 2004, addresses critical technology needs of the oil and gas industry while advancing national energy security. Through the Alliance, Chevron has direct access to a range of experts in almost every scientific discipline.

The Laboratory is able to leverage its strong networks with universities and other national laboratories to bring in the necessary partners, skill sets, and technologies required to address the technical challenges of each project. Hence, while Los Alamos lacks the applied engineering expertise needed to move technologies out of the laboratory into the oil and gas industry, Chevron has the expertise and the network of suppliers and manufacturers. This synergy makes the relationship between Los Alamos and Chevron highly complementary. The transition from the laboratory to the marketplace is essential to achieve a lasting impact on U.S. energy security and to enhance U.S. economic competitiveness—crucial elements of the Laboratory's national security mission. Los Alamos is also addressing the Department of Energy mission to "advance the national, economic, and energy security of the United States; and to promote scientific and technological innova-



Inficomm, a downhole, wireless communication system, is a key enabling technology for the fully integrated oil field. Chevron hopes to commercialize the technology by early 2010.

tion in support of that mission." In addition, Los Alamos is addressing a DOE Strategic Theme, "Energy Security: Promoting America's energy security through reliable, clean, and affordable energy."

The Alliance agreement instituted a formal governance structure that included a Decision Review Board (DRB) to direct, review, and provide leadership and guidance to the Alliance relationship. Manny Gonzalez (Chevron) and I were assigned Alliance management responsibilities for our respective organizations. The importance of the Alliance is reflected in the high level of commitment and joint decision making by senior executives of both organizations. The DRB meets twice a year to discuss new and ongoing projects. These meetings are extremely important to the vitality and success of the Alliance.

Today the Alliance has nearly 20 diverse projects that include long-term, high-value, cutting-edge technologies in oil shale extraction, down-hole communications, subsea technologies, refining separations, and imaging and modeling. At least three of these projects are in the final commercialization stage and several will be disruptive and game changing for the oil and gas industry. Chevron also sponsors an Industrial Fellow from Los Alamos who moves between Houston and the Laboratory to keep current projects on track, understand the problems and challenges facing Chevron, and ascertain potential solutions to these challenges by Los Alamos.

The technologies currently on the commercialization route include a downhole wireless communications technology being commercialized through a startup business, an acoustic separation technology, and a process to reduce pressures in an annulus in deepwater wells being commercialized with oil and gas service providers.

—John Russell
Chevron Advanced Energy Alliance
Manager for Los Alamos

The Enduring Challenge of Finding New Solutions to Old Problems

Fiscal years 2007 and 2008 have brought dynamic evolution in the relationship with the Procter & Gamble Company, one of the Laboratory's longest continuous partnerships. In 2006, both Laboratory and P&G executives agreed that we wanted fewer but bigger collaborative projects, intending to consciously address particularly important and strategic issues. At about the same time, I assumed the role of Industrial Fellow to P&G and applied strategic program development principles adapted from my own industry experience. With the generous assistance and commitment of P&G's Bruce Brown (Chief Technology Officer), Jeff Hamner (Vice President of Corporate R&D), and Tom Lange (Director of Modeling and Simulation), I can report significant headway has been made to extend and deepen our collaborative interaction.

For instance, a new project was funded to model and predict phase stability—a phenomenon similar to how oil and water separate into distinct layers. When a commercial product exhibits similar tendencies on the store shelf, it indicates to consumers that the product has "gone bad." Procter & Gamble spends millions of dollars annually developing product improvements of high quality. Ensuring that they do not disrupt product stability is a time-consuming process requiring testing every formula for weeks or months before finally committing to manufacture.

The three-year phase stability project entered its final phase in late 2008 and will finish in 2009. By faithfully simulating the phenomenon in a computer, it promises to accelerate innovation processes and decrease product time to market. The method will be extensible to a broad range of liquid formulation products ranging from laundry brands to shampoos, conditioners, toothpastes, and skin care.

Also during the 2007–2008 period, the price of oil became a major business issue for the nation. Not simply the dramatic run up to $147 a barrel, but also the uncertainty surrounding price stability that makes effective decision making extremely problematic, threatening core business performance. Everything from plastics for packaging to the liquid products mentioned above is based on petrochemical feedstock.

In keeping with the fewer-bigger strategy, with P&G Los Alamos undertook an effort to identify basic materials research that would develop renewable substitutes for industrial chemicals that are currently derived from oil. These include growing plastics and liquid products from renewable and sustainable plant materials rather than cracking them from crude. Success in this one area alone will be a noteworthy contribution to reducing global dependence on oil and increasing national energy independence.

P&G and the Laboratory propose to address a variety of other strategic issues as well, ranging from defeating counterfeits, to forecasting consumer response to disruptive market innovations, to predicting material properties of polymers knowing only their molecular structure. Collaborations in these arenas bring technological diversity and fresh vitality that is adapted and re-applied for the benefit of the Laboratory's core mission.

—Steve Stringer
Los Alamos Industrial Fellow at
Procter & Gamble

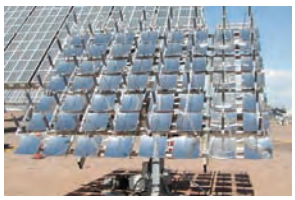
Alan Graham, the project leader for the Laboratory's work with P&G on a variety of material issues, is developing a new process for producing nanofibers from cost-effective polymer systems.

Large panels of catalyst being lowered into an E-POD, an SCR filter/silencer unit with selective catalytic emissions reduction.

Other Commercialization Partnerships

RoseStreet Labs Energy Inc.

At the center of the Laboratory's collaboration with RoseStreet Labs Energy Inc. is an innovative technology called ENABLE, which comprises the use of an energetic neutral atom beam to synthesize high quality thin films critical to the development of full spectrum photovoltaics. The cooperative relationship between Los Alamos and RoseStreet is targeted toward producing cutting-edge photovoltaic technology with many valuable applications including more efficient solar energy generation. Wladek Walukiewicz, Chief Technical Officer of RoseStreet Labs Energy, stated, "We are excited about this R&D collaboration. ENABLE's excellent control of material composition, combined with high deposition rates, offers a unique opportunity to improve performance and lower costs of our full spectrum, multi-junction solar cell technology." Los Alamos' work with ENABLE captured a prestigious R&D 100 Award in 2006 leading to the collaboration with RoseStreet in 2008.



Mark Hoffbauer, the Laboratory's lead developer of the ENABLE technology, said, "We are confident that the CRADA collaboration between Los Alamos and RoseStreet Labs Energy offers unique synergies between R&D and manufacturing capabilities. We are excited about this project and committed to the successful commercialization of what we believe will be an important technology that will enhance RoseStreet's full spectrum of products."

CleanAIR Systems Inc.

For several years, Los Alamos has been collaborating with Santa Fe-based CleanAIR Systems Inc. to commercialize a novel technology that virtually eliminates nitrogen oxides (NOx) from exhaust streams. In 2008, CleanAIR signed an agreement for an exclusive patent license with the Laboratory.

Developed by Kevin Ott of the Laboratory's Materials Physics and Applications Division, the ENDURE™ SCR Catalyst operates over a full range of temperatures—from 150 degrees Celsius to more than 540 degrees Celsius—and reduces NOx emissions by up to 95 percent. CleanAIR is developing the technology for applications in stationary diesel and natural gas engines, pipeline compressors, on- and off-road equipment, and gas turbines.

Established in 1993, CleanAIR manufactures emissions control systems with a worldwide distribution. Its products are designed to control air pollution such as diesel particulate matter, carbon monoxide, and NOx for internal combustion engines and gas turbines. The company recently introduced a new product that incorporates the Lab technology called the E-POD™—a hybrid technology designed for large diesel and natural gas stationary engines that dramatically reduces emissions. It has been installed in the oil and gas fields of Wyoming.

In June 2008, the Caterpillar Corporation announced its selection of CleanAIR as its strategic alliance partner for emissions control products. CleanAIR's reduction technology will be installed on existing Caterpillar commercial engine applications to reduce diesel particulate matter, hydrocarbons, carbon monoxide, and NOx. CleanAIR President Michael Roach said "The alliance will increase our market exposure as well as introduce CleanAIR products to Caterpillar dealers around the world."

Homeland Security: Reducing National and Global Threats

Since its birth in 1943 as the secret site of the renowned Manhattan Project, Los Alamos has created and applied advanced science and technology to solve critical challenges in national defense and civilian research. Los Alamos researchers are developing technologies that defend the nation against a number of international threats, such as

- the proliferation of nuclear weapons and offshoots like dirty bombs;
- chemical and biological agents;
- information terrorism and computer infiltration; and
- attacks on critical infrastructure.

Among our major technology transfer projects related to the ongoing effort to reduce national and global security threats are our collaborative projects with Canberra Albuquerque, a regional branch of international nuclear measurement device manufacturer Canberra, and our license agreement and cooperative work with San Diego-based Decision Sciences Corporation.

Improving Detection of Radioactive Materials

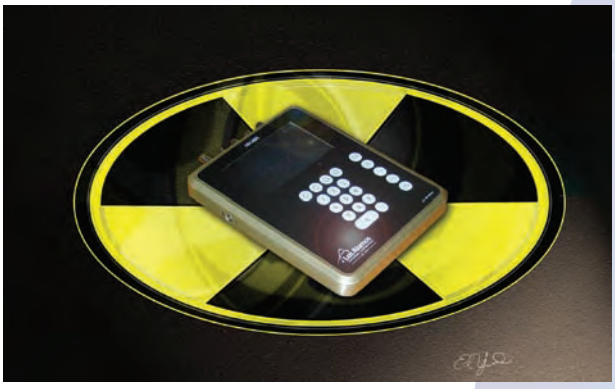
Development and commercialization of a new generation of multiplicity shift registers—devices used to better detect plutonium and other radioactive materials—are now underway. Under a CRADA, Los Alamos and Canberra Albuquerque are developing new benchtop and handheld devices that have the potential for use in homeland security applications domestically and abroad. First developed by the Laboratory more than 15 years ago, these instruments count and analyze pulse streams generated by neutron detectors to quantify radioactive materials. They are currently used by the International Atomic Energy Agency (IAEA) to ensure that radioactive materials are not lost, stolen, or used for military purposes.

According to Los Alamos researcher and principal investigator Matt Newell, the new multiplicity shift registers are needed because existing devices are nearly 10 years old and becoming incompatible with other detection technology the IAEA uses.

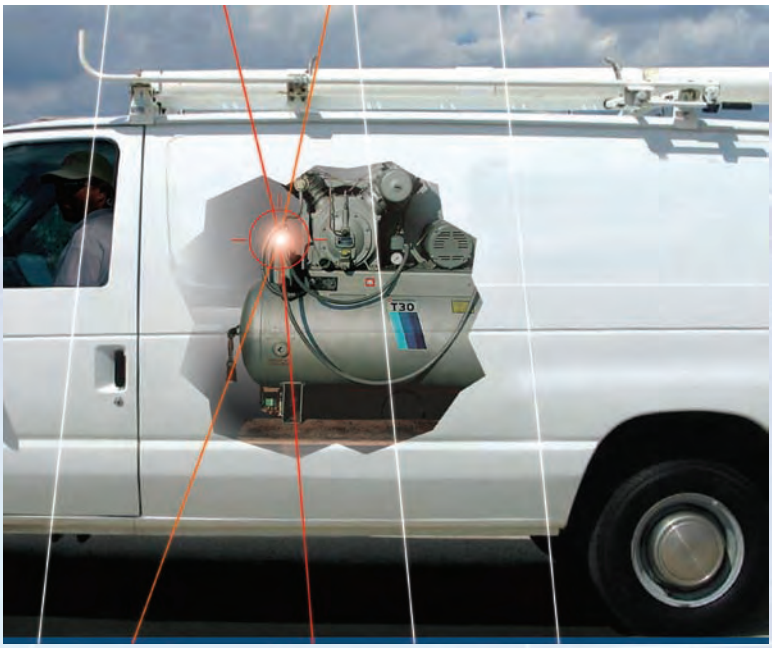
"We were contacted by people who use the current technology, asking us to do some new development," Newell said. "Many of the parts used to make the current shift registers are obsolete or becoming obsolete."

The Laboratory and Canberra expect testing and commercialization to take approximately two years, after which Canberra Albuquerque will manufacture the instruments at its Albuquerque (N.M.) facilities.

"Our collaboration with Los Alamos National Laboratory is vital to Canberra's work extending the boundaries of neutron-counting technology," said Dr. Markku Koskelo, Vice President of Special Projects for Canberra. "Together we have built a roadmap for the next generation of shift registers."



The Laboratory and Canberra Albuquerque are jointly developing new, handheld, multiplicity shift registers to detect radioactive materials to meet IAEA standards.



New scanning devices use muon tomography to detect and identify threat materials in cargo or vehicles. The system relies on ambient radiation from cosmic rays for imaging.

Gathering Knowledge Through Cosmic Rays

Decision Sciences Corporation (DSC), based in San Diego, Calif., and Los Alamos scientists are investigating the use of Laboratory-developed muon tomography technology for detecting and identifying high-density, potential threat materials like uranium or plutonium. Muon tomography uses only ambient radiation from cosmic rays as a source for imaging high-density materials. Thus, the technology can be used in situations in which active radiation sources could not be used because of possible health risks. Because materials typically used to shield threat objects from traditional radiation detectors are also very dense, detectors that use muon tomography cannot be fooled by shielding or concealing the target.

The Laboratory's scientific team developed this technology based on its experience in advanced physics and radiography technology. DSC is a small company dedicated to improving infrastructure security in the U.S. It proposes using the muon tomography technology to detect and identify potential terrorist threats in shipping containers and vehicles. Los Alamos has granted DSC an exclusive worldwide license to commercialize muon tomography.

"This is a perfect example of the Lab's technology-transfer mission. Through the collaboration with Decision Sciences, Los Alamos has taken a compelling technology from scientific theory to practice and has found the right partner to transform this technology into a vital commercial product that is urgently needed in the marketplace," said Christopher Morris, principal inventor for muon tomography at Los Alamos. "The Laboratory and Decision Sciences teams have worked closely over the last two years and achieved huge technical advances in the development of the technology. We're pleased to see this technology reach the marketplace through successful commercialization."

Electronics Security: Testing the Limits of Integrated Circuits

One of the few places worldwide for chipmakers to test the reliability of their products is at the Los Alamos Neutron Science Center's (LANSCE's) Weapons Neutron Research (WNR) Facility. Every year, between 15 and 20 electronics manufacturers perform accelerated testing of chips and other equipment using the neutron beam produced by LANSCE's linear accelerator.

Behind the program is Steve Wender of the Neutron and Nuclear Science group. "It's a wonderful example of the Laboratory collaborating with the private sector," said Wender, adding that companies first began testing at LANSCE in the early 1990s. "Boeing was the first company that came here to test the reliability of the circuitry in their Boeing 777 aircraft," he said.

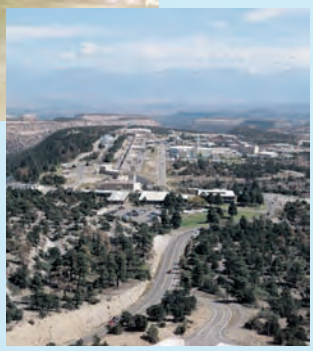
Integrated circuit devices are subject to "single event effects" (SEEs) or changes in state caused by ions or electro-magnetic radiation striking a sensitive node in the device, Wender explained. SEEs occur when cosmic rays interact with the earth's atmosphere. The resulting showers of neutrons interfere with electronics and cause disruptions including what are known as single-event upsets, latchups, transients, burnouts, or ruptures, he said. Depending on the nature and severity of the upset, SEEs may trigger glitches in output, changes of memory or register, or other damage to the device or the system.

"The high-energy neutron source at LANSCE generates energies similar in shape to the atmospheric neutron spectrum of cosmic rays but with a neutron flux a million times higher, depending on altitude," Wender said. "Testing a chip for an hour in LANSCE's neutron beam allows users to predict how that chip is likely to behave in the real world in a year. This helps manufacturers identify and correct weaknesses in their design early on in the production process in order to decrease the probability of SEEs occurring at a later date," he said.

A number of industry users tested their equipment at LANSCE during fiscal years 2007 and 2008 through User Facility Agreements with the Laboratory managed by the Technology Transfer staff.

Steve Wender aligns a beam at WNR's ICE House located on the 30-degree flight path of the facility. Companies from around the world use this resource to characterize semiconductor components and study various failure modes caused by neutron radiation.

The half-mile long, high-intensity, proton linear accelerator powers LANSCE's many experimental facilities including the Lujan Neutron Scattering Center and the WNR Facility.



For example, the California-based firm iRoc Technologies Corporation used LANSCE's continuous energy neutron source to measure neutron-induced events on the latest complementary metal-oxide-semiconductor technologies. iRoc Technologies provides design tools and test services to improve chip reliability and quality. Both Honeywell Inc. and High Reliability Engineering & Components Corporation tested electronics for SEEs at LANSCE's neutron source during the summer of 2007. Scientists from each firm set up separate experiments to collect data at the flight path instrument at LANSCE's Irradiation of Chips and Electronics (ICE) House. Honeywell International is a diversified technology and manufacturing leader, serving customers worldwide with aerospace products and services; control technologies for buildings, homes and industry; automotive products; turbochargers; and specialty materials. High Reliability Engineering & Components Corporation, headquartered in Tokyo, services Japan's space industry by developing and supplying high-quality, high-reliability components for space applications.

Other firms that used the LANSCE facilities during this period included Altera Corporation, KVA Engineering Inc., and Rockwell Collins Inc. All used the continuous energy neutron source to test electronics for SEEs. Altera, based in San Jose, Calif., designs, manufactures, and markets programmable logic devices, HardCopy structured application-specific integrated circuit devices, pre-defined design building blocks known as intellectual property cores, and associated development tools. KVA Engineering is an aerospace engineering company based in Grand Rapids, Mich. Rockwell Collins, based in Cedar Rapids, Iowa, develops innovative communication and aviation electronics solutions for the defense and aerospace industries.

Texas Instruments Inc., involved in digital signal processing and analog technologies, has been conducting accelerated testing for SEEs at LANSCE since 2004. "We come to Los Alamos about once a year," said Rob Baumann of the Dallas, Texas-based firm, and added, "The experience keeps getting better every time."

"For my industry, the service Los Alamos provides is unique and essential because of the similarity of the LANSCE spectrum to actual terrestrial cosmic rays, as well as the ease of use: just pop it [your sample] into the beam and you get your answers," Baumann said. Texas Instruments used the LANSCE facility in late fall 2006 and again in fall 2007.

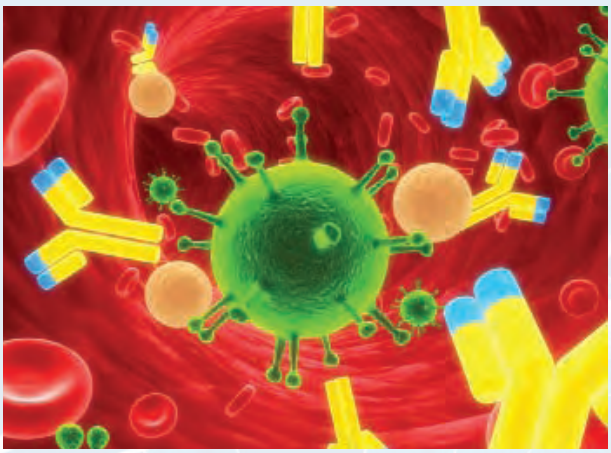
Wender said he is looking forward to having more manufacturers use the LANSCE facilities as a resource. "It's a great opportunity for the Lab to support research in the civilian sector," he said, adding that his team is planning the construction of an additional flight path to allow for more testing.

Health Security: Decoding Disease

While Los Alamos has long been know for its expertise in nuclear physics and defense technologies, it is less well known that we contribute to many industries and disciplines including health. Offering our expertise and understanding of cells and proteins, Los Alamos teamed with universities, government agencies, and hospitals to develop revolutionary diagnostic tools and drug discovery processes during fiscal years 2007 and 2008.

With our roots based in understanding the effects of radiation on the human body, a wealth of diagnostic tools and analytical techniques have sprung from the Laboratory including genomic sequencing, flow cytometry, and advanced diagnosis and detection platforms. Our scientists are applying their basic skills in computation, modeling, and statistics to unlock the mysteries behind fundamental building blocks to solutions for disease. For example, Los Alamos researchers have made large contributions to finding a cure for Acquired Immune Deficiency Syndrome (AIDS)—a virus that has killed more than 25 million people. Research at the Laboratory targeting the immune response to Human Immunodeficiency Virus (HIV) and viral mutation could, conceivably, halt the pathogen that causes AIDS.

Although current HIV treatment hinders the infection rate and delays death, there is no HIV vaccine or cure available for AIDS. The United Nations estimates 14 million children have been orphaned by this disease, and 40,000 Americans will likely become infected this year. Possibly the most dangerous disease the world has witnessed, solving the AIDS puzzle is multi-faceted in nature, requiring in-depth research at multiple levels of the equation. In 2007 and 2008, Los Alamos collaborated with a cadre of top-tier universities and public health organizations to decode mysteries regarding the genesis, evolution, and cure for the AIDS virus.



Los Alamos researcher Bette Korber of Theoretical Biology and Biophysics and her university collaborators are solving challenging problems in the area of HIV evolution and transmission and, importantly, how the human immune system reacts to the virus. They are designing three vaccines to target this rapidly mutating virus. Animal tests are underway with promising results, and human trials will begin soon. These vaccines might finally deal a lethal blow to the AIDS virus.

Thanks to Korber and her collaborators, knowledge of the virus's evolution and its diversity—aided by the Lab-designed GenBank, a database of all publicly available genetic sequences of nearly all organisms and the first pathogenic database—is impressive. Los Alamos scientists work in a unique interdisciplinary environment that creates groundbreaking research. Our researchers used the Lab's world-class supercomputing facility to optimize data that aligned HIV sequences, revealing that the virus's evolution began spreading through the human population as far back as 1930. Further modeling ruled out controversial theories about HIV's origin.

With expertise in modeling the effects of antiretroviral therapy and Hepatitis C (HCV) dynamics, Los Alamos

Los Alamos researcher Bette Korber received an E.O. Lawrence Award in 2004, the Department of Energy's highest commendation for scientific achievement, for her basic theoretical research on HIV.

researchers worked with the University of Cincinnati Medical Center in 2006 and 2007 to develop a model that combines these two disparate areas and used it to analyze data collected by the university. Internationally known for neuroscience, cardiovascular, cancer, environmental, and women's health education and research, the university seeks to understand why antiretroviral therapy, aimed at treating HIV infection, can cause an increase in HCV viral load.

In 2007, in collaboration with Harvard Public School of Health, Los Alamos researchers began developing protocols, methods, and software programs for the analysis of data being analyzed by the Harvard AIDS Institute's Statistical and Data Analysis Center using the Laboratory's HIV databases. These databases are the global repository of HIV-1 DNA and protein sequence data, as well as data on HIV-1 drug resistance mutations. Los Alamos' analyses will help predict treatment failure and design new treatment protocols composed of different drug combinations less likely to facilitate the development of multiple drug resistance mutation combinations in treated patients.

"When researchers have questions about the patterns of evolution that have led to antiretroviral drug resistance among HIV strains isolated from patients, we search for suitable software for detecting and quantifying the patterns," said Brian Thomas Foley of Theoretical Biology and Biophysics, principal investigator for the project.

The Laboratory is also working with Emory University to understand how HIV escapes the effects of T cells, the normal cells that tag foreign cells for destruction. The project, which began in November 2007, is designed to increase understanding of the role genetics play in allowing HIV infection.

The extraordinary scale of HIV variation makes it difficult to develop effective AIDS vaccines that contain a large spectrum of highly immunogenic antigenic sequences that provide maximal coverage for all circulating HIV variants. In December 2007, Los Alamos began a Work for Others agreement with Massachusetts General Hospital called "Breadth and Functional Assessment of Toggle-Peptide-Specific T Cell Responses."

Preliminary testing indicates that traditional approaches to HIV vaccine development underestimate the breadth and magnitude of T cell immune responses, suggesting possible peptide antagonism—a potentially important factor for vaccine design—and emphasizes the importance of understanding toggled-peptide responses. "Vaccines must target not only HIV regions that are targets of the natural human protective immune responses, but they must also allow cross-recognition between vaccine strains and circulating strains of the virus," said Korber.

Concept to Product

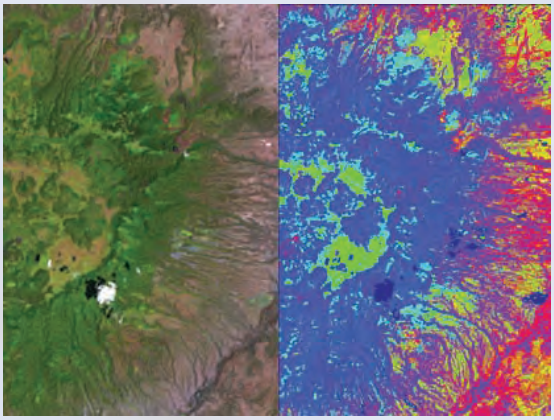
The process of solving challenging national security problems often produces technology innovations with commercial potential. The following stories exemplify how Technology Transfer, responsible for readying Laboratory-developed technology for commercialization, strives to bring these valuable innovations to the world.

Turning Satellite Images into Useful Information

Satellite imagery data are being captured at higher quality and in greater amounts than ever before. Unfortunately, few organizations are capable of analyzing so much complex data. A Los Alamos team has developed a remarkable automated feature extraction software system called Genie Pro® that makes the job easier by reducing the time and skill required for analysts to perform their task. Genie Pro is a machine-learning software that analyzes spectral and spatial information in image data to find features of interest. It uses evolutionary programming to evolve a sequence of image processing steps that results in a feature-finding algorithm.

An analyst uses a simple point-and-click graphical interface to identify a small set of example data in a satellite image, say a region of conifer forest or a particular agricultural crop. Genie Pro then learns a new algorithm that can detect and map out that feature using the selected data. This new algorithm can then be applied to similar images, for example, to map a type of forest across a large region or an entire country.

Developed and funded by DOE and the Department of Defense, Genie Pro has been used to analyze damage caused by natural disasters such as wildfires, hurricanes, and earthquakes; to evaluate terrorist attacks; and to monitor environmental changes and crop health. Genie Pro can also be applied to a wide range of non-satellite imagery such as microscope images of tissue samples.



A NASA satellite image (left) was analyzed using Genie Pro (right). It identifies land areas of interest: forests in blue, grasslands in green, scrub and bare ground in yellow/red.

Future developments will expand its analytical capabilities for video and three-dimensional data and extend its application to more fields of science and industry. In 2007 and 2008, Los Alamos signed exclusive field-of-use license agreements for Genie Pro with Observera Inc. of Chantilly, Va., a high tech remote sensing and image science company, and Aperio Technologies Inc., a digital pathology company based in Vista, Calif.

In May 2008, Observera Inc. announced the debut of Genie Pro 2.0, the first commercial release of advanced technology licensed from Los Alamos in late 2007.

Todd Jamison, Observera's CEO, said the company's long history of working with Los Alamos and the technology behind Genie Pro make the partnership particularly gratifying. "We have experienced the value of Genie Pro first hand and believe it is a milestone application of machine learning concepts. We are striving to improve the experience of Genie Pro users, and our goal is to make it the easiest to use and most accurate tool in its class." Observera's release of this software marks the beginning of a line of new geospatial products under its license.

Nontoxic, lead-free primary explosives invented at the Lab will be manufactured for use in the quarrying, mining, and construction industries by Austin Powder Company.

Green Primaries

Primary explosives (primaries) are extremely sensitive energetic materials used in small quantities to generate a detonation wave when subjected to flame, heat, impact, electric spark, or friction. Detonation of a primary initiates a secondary explosive, propellant, or some other form of thermomechanical motion. Primaries are found in ammunition, military ordnance, mining detonators, and motors, actuators, valves, and fuses that serve as mechanical devices in industrial and military applications.

The Laboratory's Green Primaries are designed to replace the ubiquitous lead-based primary explosives currently polluting human tissues and the environment with neurotoxic lead residues. Nontoxic in both their manufacturing processes and detonation products, Green Primaries are superior to lead primaries and all other current experimental substitutes because they are insensitive to spark and can be manufactured in several variants. Both green and simple, Green Primaries entail no risk, generate no toxic waste, and yield qualitative as well as quantitative products.

In 2007, the Austin Powder Company of Cleveland, Ohio, agreed to exclusively license and commercialize the Laboratory's Green Primary technology. Austin Powder, the second oldest manufacturing company in Ohio, manufactures a full line of industrial explosives and accessories and provides blasting services to customers throughout North America and worldwide. It plans to make lead-free primary explosives commercially available for use in the quarrying, mining, and construction industries at its facility in Brownsville, Texas.

Better Tools for Examining Proteins

Scientists who study how proteins assemble and fold into distinct shapes may soon see shape-shifting in the very methods they use, thanks to a partnership between Los Alamos and Theranostech Inc., an Albuquerque, N.M., biotechnology company.

The New Mexico startup honed its skills in protein purification by developing an efficient test for HIV. Now Theranostech is packaging the Split GFP reagents, part of the Green Fluorescent Protein (GFP) Toolbox developed by Los Alamos biochemist Geoff Waldo. Derived from glowing jellyfish, GFP attaches to parts of the protein researchers study, creating a tag that glows bright green in blue light. This enables investigators to deduce structure, function, and location in samples. Prior incarnations of GFP were expensive, labor intensive, or clunky, changing the behavior of proteins or disrupting their natural folding. Promising improvements in flexibility, cost, and time, Waldo's system uses GFP to measure the quantity and solubility (a measure of activity) of important proteins.

The kits are aimed at scientists in academia and other areas outside the commercial arena to study the molecular conditions that cause Alzheimer's or other diseases involving proteins. "Split GFP is the easiest to use and most stable *in-vitro* protein assay kit in the world right now," said Waldo, whose innovations are receiving international recognition.

Split GFP reagent kits developed at Los Alamos are simplifying the study of disease-causing proteins for academic researchers.

Los Alamos as a Regional Business Resource

"Our programs are growing a dynamic ecosystem for enterprise development and networking for long-term economic growth in Northern New Mexico."

—Belinda Padilla
Program Manager for Regional Development

In addition to our mission to serve the nation, as the region's largest economic driver, the Laboratory also seeks to better leverage Los Alamos technology and expertise for regional impact. Regional technology commercialization is often challenged by the basic nature of our research and the facility's remote location.

- Most new venture ideas from the Laboratory require significant maturation in technology, business, and management.
- Only a limited number of Los Alamos startups are fundable through conventional venture investment.
- The business infrastructure in Northern New Mexico, including facilities, management talent, and other professional services, remains weak.
- Los Alamos is geographically remote from national labor markets and shipping routes.

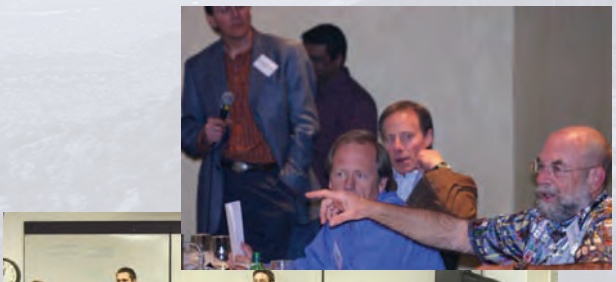
Because of this unique and sometimes challenging environment, Technology Transfer, through its Technology Commercialization Program, and the Laboratory's Community Programs Office, through the LANS Community Commitment Plan, together provide a variety of customized DOE- and LANS-funded programs to facilitate the creation and growth of new businesses in the region based primarily on Los Alamos technology and expertise.

Connecting Northern New Mexico

The LANS Community Commitment Plan includes a set of aggressive initiatives branded as Northern New Mexico (NNM) Connect to facilitate broader and more effective economic development within the region. NNM Connect inspires and empowers innovative entrepreneurs by pioneering initiatives that foster connections and accelerate business growth. Below is a comprehensive description of its programs and accomplishments to date:

Springboard: Propels companies and ideas to the next level through expert coaching and in-depth examination by providing high-tech startups with opportunities to network with experts from the targeted market. In fiscal years 2007 and 2008, four Springboard events addressed six companies and six technologies.

LINK: Connects business networks and know-how for community success by directing entrepreneurs to a network of educational resources, entrepreneurial support services, and experienced guidance to facilitate successful business creation and expansion for regional economic development. To date, LINK has helped secure over $200,000 in outside financing to support programs that include direct investment and buy-in by several of the region's communities.



Top: Experts give advice to a small business presenter during a Springboard event.

Below: Laboratory summer students participate in Innovation Challenge.

New Mexico Small Business Assistance: Provides Technical Assistance to small businesses using a portion of gross receipts taxes paid to the state by LANS. Technology Transfer matches companies with Lab technical staff to help small businesses resolve specific technical and business problems. During 2007 and 2008, our team completed nearly 30 individual agreements and initiated nine leveraged projects—those involving a group of small businesses with a common problem.

Education and Networking: Provides entrepreneurs with opportunities to gain business know-how and establish new networks. In fiscal years 2007 through 2008, Technology Transfer hosted 12 education and networking events including Innovators' Forums, Small Business Innovative Research (SBIR) Training, and Innovation Challenge events to introduce summer students to technology commercialization through informal competition.

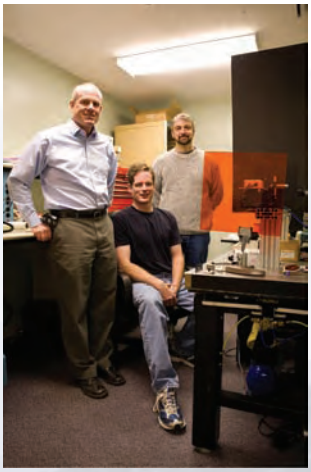
Market Intelligence Resource: Helps Northern New Mexico businesses become more successful and competitive by providing timely, reliable, and actionable information on markets, customers, competitors and industry conditions. In fiscal year 2008, a consultant conducted a needs assessment and developed an implementation plan. A pilot-scale program is launching in 2009.

Venture Acceleration Fund (VAF): Provides investments of up to $100,000 to Northern New Mexico startups to promote technology commercialization, new company formation, and business growth. In fiscal years 2007 through 2008, the VAF awarded approximately $600,000 to six regional startups that have licensed technology from the Laboratory.

Getting Regional Innovations into the Market

The LANS VAF is the flagship offering of the NNM Connect program. Launched in fiscal year 2007, the fund invests $350,000 per calendar year to support regional businesses. It is already having a positive economic impact on the Northern New Mexico business community, attracting additional investment, creating jobs, and enabling startups to reach larger markets faster.

Acoustic Cytometry Systems Inc.



Los Alamos-based, biotech startup Acoustic Cytometry Systems (ACS) is commercializing a Lab-developed portable acoustic flow cytometer, an apparatus used for counting and measuring cells in medical research and diagnostics. Relying on acoustic waves to focus cells into a tight, concentrated stream for analysis by a laser beam, this patented approach yields more sensitive, compact, and rugged, yet less expensive cytometers than conventional ones that rely on a complex fluid-handling system. This makes them ideally suited to diagnostics fieldwork in third-world countries where large quantities of purified water and the expensive light sources used by conventional cytometers are scarce.

"A LANS VAF award was crucial in helping ACS develop its first integrated working prototype," said John Elling, founder, president, and CEO of ACS. The company was recently acquired by global biotechnology tools company Invitrogen.

Company for Information Visualization and Analysis (CIVA)

CIVA was created in 2006 to commercialize the Laboratory's epidemiological modeling and simulation system, EpiCast. EpiCast helps epidemiologists understand the spread and impact of an avian influenza pandemic by modeling the thread of an epidemic at the individual human level using current data. Based in Santa Fe, N.M., CIVA used its VAF award to support commercial testing of EpiCast in a real environment. CIVA worked with the State of Iowa to run the EpiCast model using actual demographic data.

"The LANS grant provided CIVA the funds necessary to validate the technology we licensed from Los Alamos and to capture the all-important first customer," said Jamey Shelton, CIVA's director of development.

APJeT Inc.

Santa Fe's APJeT Inc. uses Laboratory-developed atmospheric-pressure plasma jet technology for advanced textile finishing applications. APJeT's process allows fabric manufacturers to use a blast of ionized gas to make textiles resistant to water, stains, and other substances in an environmentally friendly manner. APJeT used its VAF award to accelerate development of a large-scale commercial machine in 2008, which helped it to attract new private equity financing and two critical partnerships: one with a production and equipment services company, the other with a university that provides APJeT a showcase and a limited production facility.

Packet Analytics Corporation

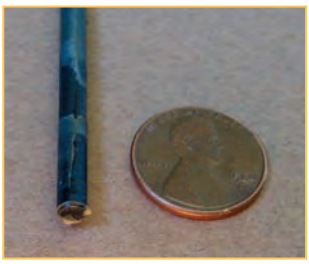
Santa Fe-based startup Packet Analytics Corporation provides a new security software system that can collect the entirety of an enterprise's Internet Protocol-based network security information in one place and analyze millions of network events daily. Packet's Network Forensic Search Engine, Net/FSE, is based on technology developed at Los Alamos that allows security analysts to investigate and analyze suspicious incidents in minutes. Packet used its VAF award to make its software commercial-ready and develop a business strategy.

"In the short time since our award, Packet has received a combination of funding from a New Mexico venture capital firm and a professional technology investor from Silicon Valley," said Andy Alsop, Packet CEO.

Knowledge Reef Systems Inc.

Knowledge Reef Systems Inc. of Santa Fe, N.M., is developing a social networking platform that will enable a new generation of online communities with an interest in sharing knowledge. In contrast to entertainment-based venues such as MySpace.com and Facebook, Knowledge Reef is enabling thousands of knowledge workers to find each other for online collaborations and information sharing.

"The selection of Knowledge Reef as a VAF recipient was the compelling event that drove formation of the company. Not only was the award instrumental in securing additional funding, but it also permitted us to accelerate building our engineering team and meeting our goal of delivering an early prototype," said Gary Ebersole, Knowledge Reef's president and CEO.



A non-invasive fiber-optic probe compared with a penny.

CNT Technologies Inc.

Using technology licensed from Los Alamos, Seattle-based CNT Technologies Inc. is developing the capability to produce yarns from carbon nanotubes, the strongest materials ever produced on a strength-to-weight basis. With a lab in the Los Alamos Research Park, CNT will produce arrays of carbon nanotubes and spin them into yarn at speeds hundreds of times faster than any existing approach. At the end of fiscal year 2008, CNT was applying its VAF funds to install the capital equipment required to achieve sufficient capacity to produce kilograms of fiber in kilometer lengths.

"The availability of these quantities will allow customers to validate our product in their applications," said former Lab employee and CNT president Randy Tremper.

Maturing Basic Research

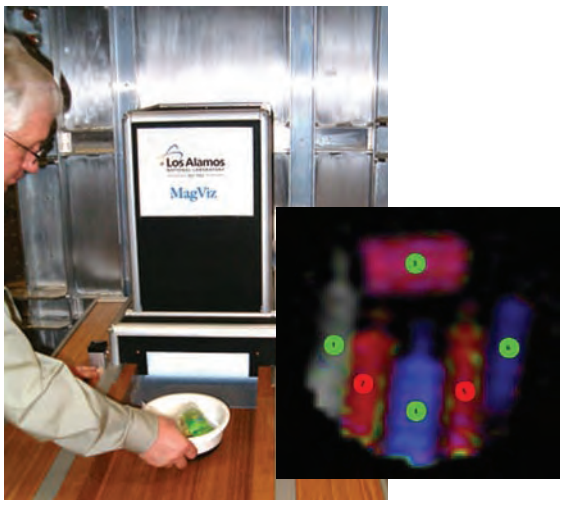
The Technology Transfer Technology Maturation Fund provides small amounts of funding for highly focused projects within the Laboratory to move early stage technologies along the road to commercialization. In fiscal years 2007 through 2008, this program funded 11 projects with an average award of $46,200.

The "Fiber-optic probe for diagnosis of precancerous conditions" is a good example of the type of project funded and how funding was applied. Researcher Judith Mourant and her team used Tech Mat funding to develop a prototype of their fiber-optic probe for diagnosing cancers and precancerous conditions. The team had determined that several of the probe's parameters were sensitive to the pressure applied by holding the probe against human tissue, giving it diagnostic potential. The team used its award to design a pressure sensor to increase the accuracy of measurements, enhancing the probe's commercial viability.

Understanding Markets through Future Business Leaders

Technology Transfer's summer MBA Internship Program hires MBA candidates to evaluate Los Alamos inventions for commercialization potential. In addition, Technology Transfer also works with students during the academic year by embedding commercialization projects into a university's MBA curriculum. During fiscal years 2007 and 2008, Technology Transfer worked with three partner universities on this initiative: the University of New Mexico, San Diego State University, and the University of Arizona, completing 22 projects.

One of the most successful projects in this program was carried out by University of Arizona students. They completed a market analysis of the MagViz technology—an innovative application of a technology first used for medical imaging that can enhance airport security. Los Alamos scientists adapted Magnetic Resonance Imaging (MRI) from medical applications to create a new tool that distinguishes potential-threat liquids from the harmless ones an average traveler might take aboard an aircraft. MagViz is a new, ultra-low-field MRI approach with unique variations. For example, containers are viewed as red, yellow, or green.



The Laboratory's MagViz technology will enhance airport screening by indicating whether liquids are threatening, non-threating, or require additional screening.

"Since writing this software for the Lab, I have had a strong desire to get it to market, said Uphoff, who created the software. "It's really rewarding to speak with potential customers who see our software as a solution to their problems."

The system highlights the image in red if the liquid poses a threat, green if non-threat, and yellow if security screeners need to examine it. Students completed an in-depth assessment and analysis of the airport security market, providing insights into the market needs as well as potential partners who could help deploy the technology.

Leveraging Entrepreneurial Talent

The Laboratory's Entrepreneurial Leave Policy provides incentives for employees who wish to start a business but want to reduce the risk related to launching a new venture. In 2007 and 2008, six Laboratory employees took advantage of this unique program. Ben UpHoff was one of those courageous employees who took the leap.

When Los Alamos National Bank sought to consolidate the entirety of its network security information in one place and efficiently analyze so-called network events, it turned to Packet Analytics Corporation. According to Uphoff, Packet's former vice president of research, "If a computer on the network is compromised, a security analyst can use our software to determine the scope and extent of the incident, possibly going back through years of data."

Uphoff exited the Laboratory's program to join the Milwaukee School of Engineering in the fall of 2008. Prior to this, Packet had renegotiated its contract with Los Alamos so that it could release the licensed DisARM code to the public as open source software. Uphoff is able to focus his professional development time at the university on continued development of the Packet Analytics open source code.

The Los Alamos Venture Acceleration Initiative

In September 2008, the Laboratory and its manager, LANS, announced the selection of ARCH Venture Partners and the Verge Fund as the entity selected to partner with the Lab in the Los Alamos Venture Acceleration (LAVA) Initiative. This pilot program is aimed at strategically spinning off technology-based companies from the Lab with emphasis on establishing new businesses in Northern New Mexico. The partners negotiated an agreement with a Laboratory contribution from retained license income valued at up to one million dollars over three years, and a contribution of time and effort from the ARCH-Verge team of 20 investment professionals, including seven located in New Mexico and an Entrepreneur in Residence at the Laboratory.

The LAVA Initiative leverages the experience and knowledge of serial entrepreneurs and investment professionals to foster creation of new companies. ARCH Venture Partners, a venture capital firm established in 1989, has over $1.5 billion total capital under management. The Albuquerque-based Verge Fund invests in seed-stage, high-growth ventures in New Mexico.

"The Venture Acceleration Initiative is an innovative program in a comprehensive Laboratory strategy to increase the impact of our cross-cutting R&D in creating technology jobs in the regional economy. We are excited to partner with ARCH and Verge in this initiative because they have an unmatched combination of national reach, local depth, and a sustained track record of excellence in fostering new company growth in New Mexico."

—Duncan McBranch, Science, Technology, and Engineering

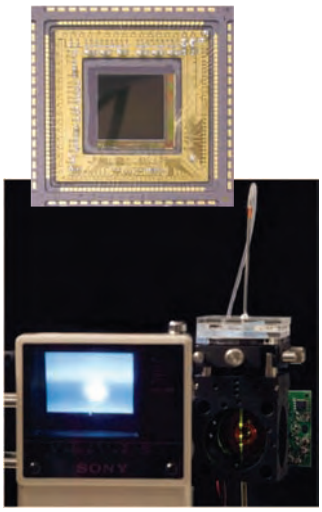
Recognizing Excellence

The Laboratory's innovators and their technologies that have been transferred or are available for transfer are recognized in multiple ways throughout the year through a variety of international, national, and institutional awards. Among these coveted awards we include winners from the Laboratory's participation in the internationally recognized R&D 100 Awards, the *Wall Street Journal* Technology Innovation Awards, the Federal Laboratory Consortium Awards, and the Laboratory's Technology Transfer Awards.

R&D 100 Award Winners

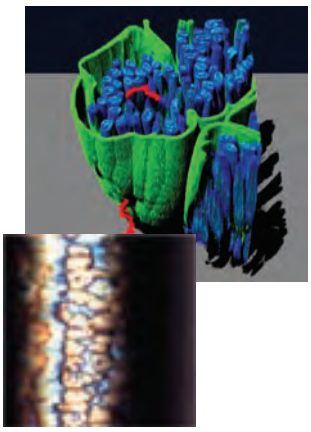
R&D Magazine annually recognizes 100 scientific and technological advances from around the world for innovations that show the most significant commercial promise in products, materials, or processes. These awards have often been dubbed "the Oscars of invention." Los Alamos scientists won two R&D 100 Awards in 2007 and two in 2008, bringing the Laboratory's total to 107 awards received since we first entered the competition in 1978.

"I am impressed with and proud of the ingenuity of our R&D 100 Award-winners," said Laboratory Director Michael Anastasio. "These awards demonstrate the Laboratory's powerful role in developing innovative concepts and translating them into practical solutions."



2007 Winners

- **Camera on a Chip** – Kris Kwiatkowski and Chris Morris, Physics
- **Portable Acoustic Cytometer** – Steven Graves, Gregory Goddard, Robert Habbersett, Gregory Kaduchak, John Martin, Mark Naivar, and Michael Ward, National Flow Cytometry Resource



2008 Winners

- **3-D Tracking Microscope** – Jim Werner, Materials Physics and Applications
- **Laser-Weave** – James Maxwell, International and Applied Technology

Wall Street Journal Technology Innovation Awards

The *Wall Street Journal* Technology Innovation Awards, selected by a panel of distinguished international judges from business, research, and academia, recognize technologies that represent a true breakthrough from traditional methods, not simply an incremental improvement. Two Los Alamos technologies were winners in 2007.

- **Energy: Process that uses the heat from highly compressed sound waves to convert natural gas to a liquid** – Gregory Swift and the Condensed Matter and Thermal Physics team, Materials Physics and Applications
- **Semiconductors: Camera on a Chip** – Kris Kwiatkowski and Chris Morris, Physics

Federal Laboratory Consortium Awards

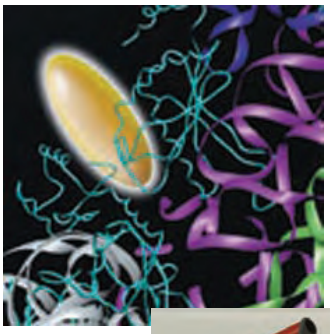
The Federal Laboratory Consortium annually presents national awards for Excellence in Technology Transfer to recognize federal laboratory employees who have accomplished outstanding work in the process of transferring a technology developed at a federal laboratory to the commercial marketplace.

2007 Award for Excellence in Technology Transfer

- **MESA (Measuring Enzyme Substrate Affinities)** – Benjamin Warner, Caldera Pharmaceuticals Inc.

2008 Awards for Excellence in Technology Transfer

- **High Definition Laser Scanners for Surveying** – James Lunsford, S. Kerry Wilson, and R. ClaytonSmith, retired
- **Attila (radiation transport software)** – John McGhee and Todd Wareing, Transpire Inc.
- **Second-Generation High Temperature Superconducting Wire** – Paul Arendt, Stephen Foltyn, and Quanxi Jia, Materials Physics and Applications



MESA

Leica Geosystems' ScanStation (High Definition Laser Scanner)

Attila

Superconducting Wire

Los Alamos Technology Transfer Awards

This celebration is a joint effort by the Technology Transfer Division and Laboratory Counsel to honor Los Alamos researchers for their contributions to technology transfer during the preceding fiscal year. More than 300 Laboratory innovators are recognized annually for their participation in research leading to patents, copyrights, licenses, research agreements, and work that has impacted regional economic development.

The **Distinguished Patent Award** honors inventors whose patented invention exhibits outstanding innovation exemplifying significant technical advance, adaptability to public use, and noteworthy value to the mission of the Laboratory.

- **Through-the-Earth-Radio (2007) –** David Reagor and Jose Vasquez-Dominguez, Materials Physics and Applications
- **Noninvasive Characterization of a Flowing Multiphase Fluid Using Ultrasonic Interferometry (2008)** – Dipen Sinha, Materials Physics and Applications

The **Distinguished Copyright Award** honors authors of disclosed copyrighted materials considered to be extraordinary creations that demonstrate a breadth of commercial applications, potential to create economic value, and the highest level of technical excellence.

- **EnergyFit (2007)** energy-conserving software – Chung-Shing Hsu, Computer, Computational, and Statistical Sciences, and Wu-Chun Feng, Virginia Polytechnic Institute
- **EpiCast™ (2008)** modeling and simulation software – Tim Germann, Theoretical

The **Distinguished Licensing Award** recognizes innovators who proactively engage in commercialization activities at the Laboratory and have had a positive impact on its Licensing Program.

- **Selective catalytic reduction catalyst for reducing levels of nitrogen oxides (2007)** – Kevin Ott, Materials Physics and Applications
- **Superhard, Ultratough Nanocomposites (2008)** – Yusheng Zhao, LANSCE

The **Programmatic Impact Award** honors individuals or groups who have made significant advancements to the programmatic mission of the Laboratory through their interactions with industry partners.

- **Muon Tomography Team (2007)**, Physics, for development of an advanced 3-D muon tomography scanning technology
- **Geoff Waldo and Stephanie Cabantous (2008),** Bioscience, for their work on the Green Fluorescent Protein Toolbox

The **Regional Impact Award** honors individuals, organizations, or programs that have made a significant contribution to the Northern New Mexico economy with a tie to Laboratory technology, personnel, or expertise.

- **CleanAIR Systems Inc. (2007)** of Santa Fe, N.M., and Kevin Ott, Materials Physics and Applications
- **Acoustic Cytometry Systems (2008)** of Los Alamos, and Steven Graves, Gregory Goddard, John Martin, Robert Habbersett, and Mark Naivar, Bioscience Division, and Gregory Kaduchak and Michael Ward, ACS

Fiscal Years 2007–2008 Performance

FY 2007 Revenue by Category
$Millions

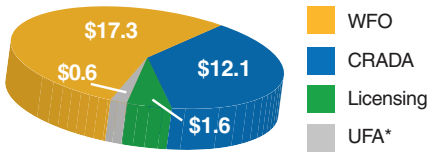


Figure 1

FY 2008 Revenue by Category
$Millions

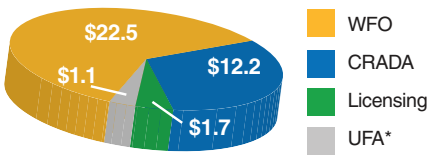


Figure 2

FY 2007 Active Agreements

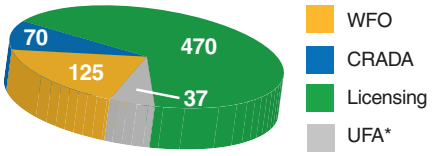


Figure 3

FY 2008 Active Agreements

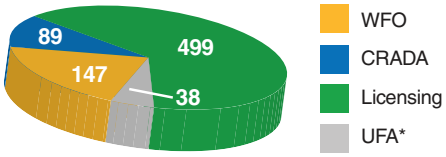


Figure 4

*User Facility Agreements

Financial Summary

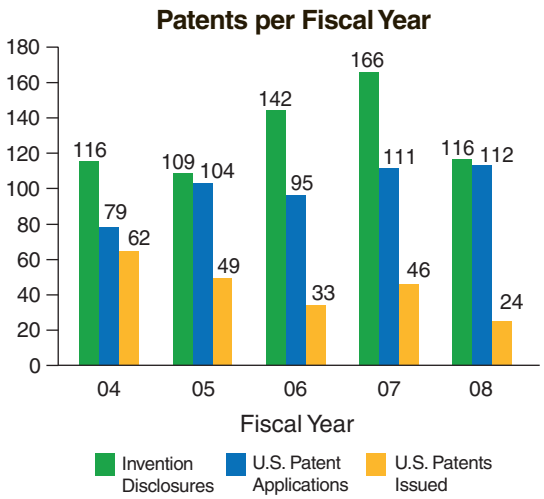
The Technology Transfer Division's Fiscal Year (FY) 2007 performance on its financial metrics and agreements is summarized in Figures 1 and 3. Our total revenue received in FY 2007 was $31.6 million, an increase of approximately 64 percent from FY 2006. The most dramatic increase came in Technology Transfer's collaborative interactions with industry as we saw a 218 percent growth in the Cooperative Research and Development Agreement (CRADA) funding component. Overall, we actively managed over 700 revenue agreements in FY 2007 and FY 2008, 33 percent of which comprised some type of sponsored research for the Laboratory.

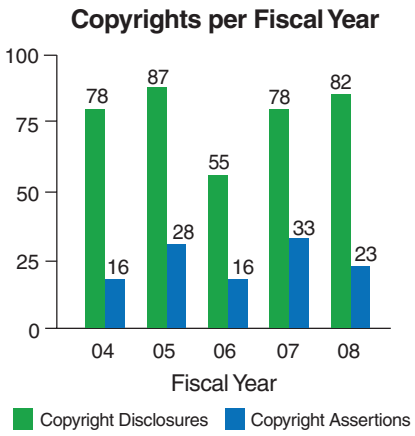
Technology Transfer's FY 2008 performance is summarized in Figures 2 and 4. Our total revenue received in FY 2008 was $37.5 million, an increase of approximately 19 percent over FY 2007. The Work for Others (WFO)–Non-Federal Entity component saw the most dramatic increase in FY 2008 as funding levels rose over 31 percent from the previous year. The total portfolio of revenue generating agreements continued to rise in FY 2008 as well. Technology Transfer closed the year actively overseeing 773 agreements—the largest percentage increase being in the area of CRADAs.

As demonstrated above, FY 2007 and FY 2008 illustrated tremendous success for Technology Transfer and the Laboratory in all of our revenue metrics with totals up significantly over previous years, and well above five-year averages in most categories. We continue to grow a healthy portfolio of agreements with leading companies, including one third of the Fortune 50 companies and one quarter of the Fortune 100 companies. Additionally, almost 30 percent of our agreements are with small companies.

Patent Activity

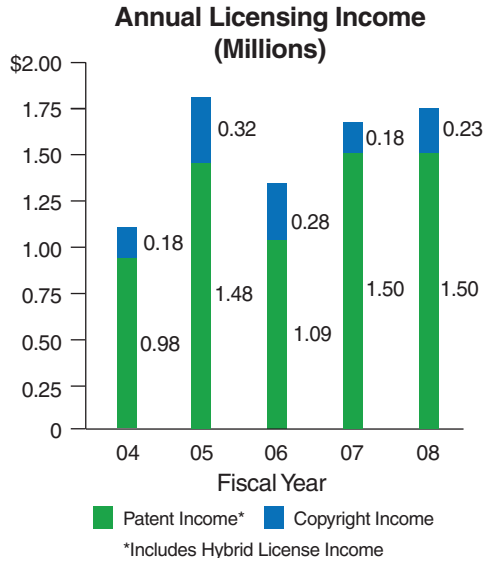
Beginning in 2006, when LANS assumed the operating contract for the Laboratory, Technology Transfer has seen increased interest in intellectual property protection and management. This reflects LANS' commitment to DOE to raise the level of awareness about intellectual property as a valuable asset for the Laboratory. Although FY 2008 shows a drop in actual number of disclosures submitted, the two-year trend is positive. The most recent two-year period demonstrates a 12 percent increase over the previous period (FY 2005–2006). This increase can be attributed to Technology Transfer's emphasis on intellectual property education and the new suite of tools implemented to support intellectual property management. The IDEAS system, which allows inventors to disclose inventions online, has been integrated with the new IP Master data solution, an invention tracking and docketing system shared with the Laboratory Counsel-Intellectual Property (LC-IP) group. These tools have facilitated and streamlined the evaluation of inventions and filing of patents. Patent applications submitted to the U.S. Patent and Trademark Office (USPTO) have kept pace with the increased number of disclosures submitted. The 112 applications submitted in FY 2008 are a testament to the outstanding support by LC-IP as well as to the improvement in quality of disclosures Technology Transfer is receiving. The number of patents issued depends on the USPTO and the number of applications submitted. Over the last five years, the number of patents issued has trended down, due partly to the USPTO's backlog but also to the Laboratory's temporary slump in application submissions in the early 2000s. If the current upward trend continues, the number of issued patents should return to or exceed the highs established early in the decade.

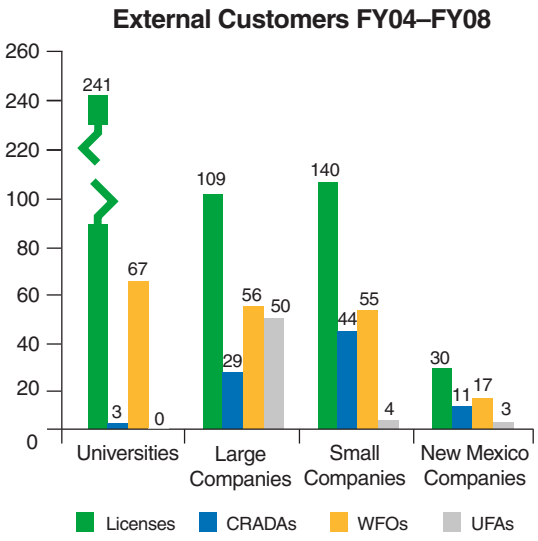


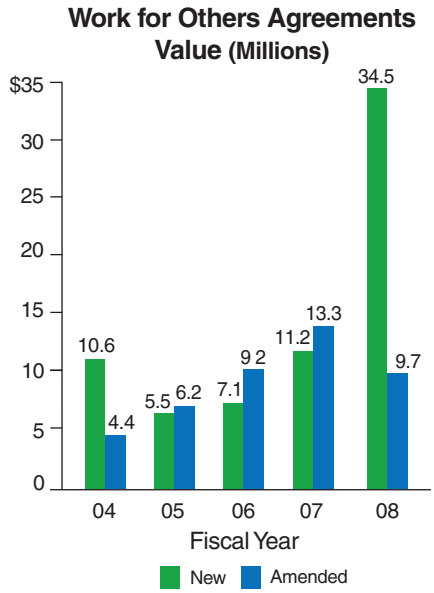


Copyright Activity

In early 2006, Technology Transfer established a team dedicated to the commercialization of software. Many of the Laboratory's copyrightable innovations reside in software. With Technology Transfer's new emphasis on software, the Laboratory has seen a resurgence in the number of disclosures and a far greater percentage of assertions (requests to DOE for permission for Los Alamos to assert ownership rights) that demonstrate its intention to seek commercialization or development partners, or both.







Licensing Activity

The Laboratory's licensing program continues to be a growing portion of its technology transfer program, as reflected by the number of newly executed licenses over the last two years. A total of 141 new fee-bearing licenses (including fee-bearing Bailments and Material Transfer Agreements) were executed over the past two fiscal years making this period one of the most productive licensing periods since the licensing program was established in 1993. In addition, as Technology Transfer's outreach programs mature, we have created a nurturing environment and provided numerous opportunities for the Laboratory to assist small startups by taking equity in companies as a portion of consideration in lieu of cash. Over the past two years, Technology Transfer has executed six equity deals compared to only four in all previous licensing years. The Laboratory earned over $3.3 million in license and royalty revenue during the past two fiscal years. Over half of this income was reinvested by the Laboratory for technology transfer, education, and R&D purposes. The balance was disbursed as personal income to Laboratory innovators.

External Customers

The figure at left shows that the bulk of Technology Transfer's customer base in the period between FY 2004 and FY 2008 continues to be with universities. However, for the two-year period ending in FY 2008, the trend appears to be lessening as both large and small businesses have found the Laboratory an equitable partner and one that can bring dynamic expertise to their unique technological problems and concerns. The Laboratory's technology transfer interactions with universities have been centered predominantly around the field of noncommercial research licensing, whereby most of these licensing agreements have been for Laboratory-developed software. The Laboratory's other significant external private industry customer in the past was large business. Recent trends however have indicated that small business has found the Laboratory and has become willing to work with us in all aspects of technology transfer activities with licensing leading the way. Our interactions with large business, like those with universities, are centered around the licensing function. This figure also shows the breadth of our customer base and the variety of agreements we have with large, small, and New Mexico companies.

Work for Others (WFO) – Non-Federal Entity

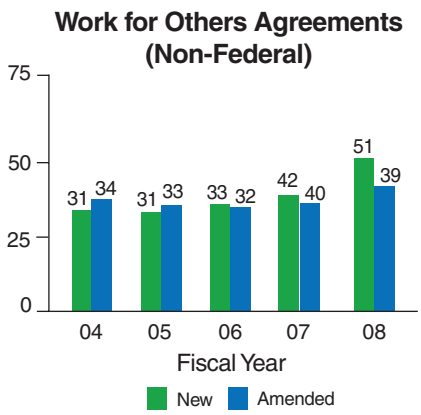
The WFO agreement establishes a contract between a university, a company, or a nonprofit partner and Los Alamos National Laboratory to perform a defined scope of work or list of tasks. The number of WFO agreements executed during FY 2007 and FY 2008 showed a marked increase over the previous two-year period. Additionally impressive was the increase in number of amended agreements indicating additional work scope for existing sponsors. The total planned value (proposed expenditures over the life of the agreement) of the newly executed agreements during this period includes one substantial outlier. If this were removed, the total value for the two years would still exceed the previous two-year period by over 17 percent. Discounting the large agreement executed in FY 2008, the value of amended agreements continues to exceed that of newly executed agreements, indicating tremendous satisfaction on the part of our research partners and bright expectations for future activities.

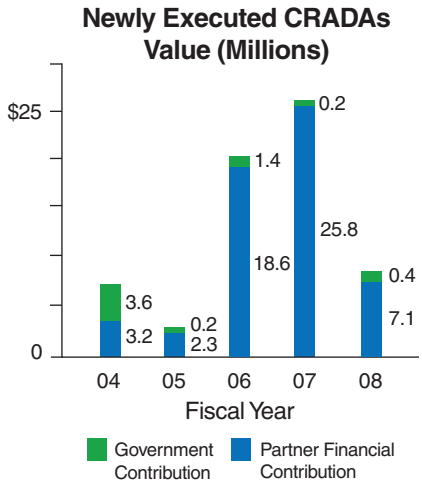
Cooperative Research and Development Agreements (CRADAs)

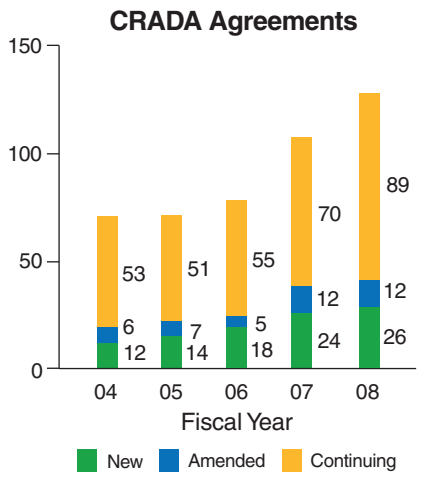
CRADAs are the contractual agreements that enable industry, academia, and/or a nonprofit entity to collaborate with Los Alamos on specific R&D efforts consistent with the mission of the Laboratory. Industrial interactions using this mechanism continue to grow. Without a substantial input of DOE programmatic funding, in FY 2008 the planned value (proposed expenditures over the life of the agreement) for CRADAs once again increased. With the value of newly executed agreements exceeding $30 million, Technology Transfer has restored the program value to a level not seen since the end of the DOE-Defense Programs' Technology Partnerships Program in 2000.

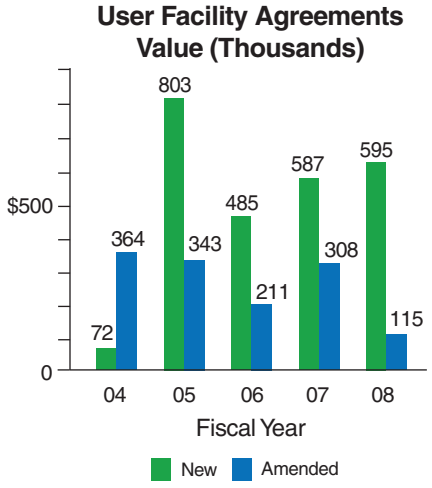
User Facility Agreements (UFAs)

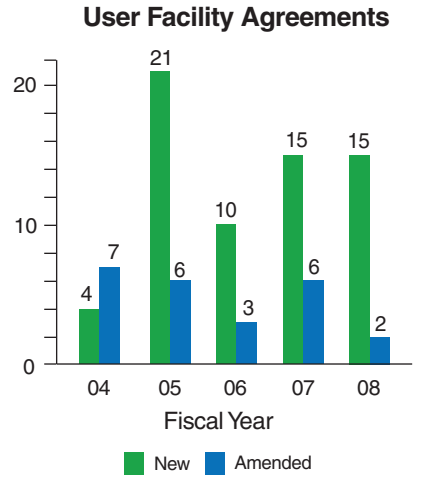
The UFA program, which permits outside users, including scientists and engineers from industry, universities, and other governmental agencies, to conduct research using the Laboratory's unique facilities, seems to have settled in to a sustainable level of activity. Fiscal years 2007 and 2008 saw a consistent level of activity integrating with the Laboratory's programmatic mission. The Laboratory's Weapons Neutron Research Facility leads the way within the UFA portfolio in its industrial interactions with commercial and academic entities.

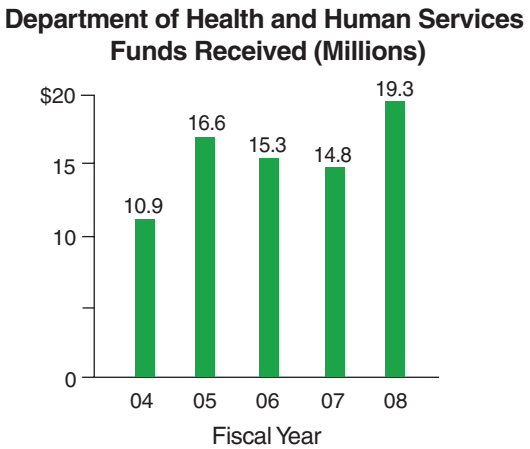












Appendix N Accomplishments

In FY 2007 and FY 2008, Technology Transfer assisted in the creation of nine new startup companies and executed 15 new licenses with New Mexico companies or companies with an R&D satellite in the region. All nine startups were Laboratory affiliated (based on Lab technology or expertise) and three relied on the Laboratory's Entrepreneurial Leave Policy to help fulfill staffing needs. During this period, six Los Alamos staff members took Entrepreneurial Leave, which brought the total number of Lab employees who have participated in this program to 37 since 1997. Collectively, the startup companies created 33 new jobs in FY 2007–2008.

Over the past 14 years, the Equity Capital Symposium sponsored by Technology Ventures Corporation (TVC) of New Mexico has become a showcase for regional technology companies, helping them connect with investment opportunities. Historically, one in three of the presenting companies has been funded as a result of this opportunity to network.

The 2007 TVC lineup included four Laboratory technologies licensed by regional startups and Laboratory spinoffs: Packet Analytics Corporation, Acoustic Cytometry Systems Inc., Caldera Pharmaceutical Instruments Inc., and CIVA. The 2008 TVC lineup included three Laboratory-affiliated technologies: Hyperion Power Generation, Knowledge Reef Systems, and EQSolaris.

Proposal and Grant Administration

In FY 2005, the Laboratory's Chief Science Office (CSO) initiated support to help principal investigators manage their National Institutes of Health (NIH)- and Centers for Disease Control (CDC)-funded projects and with the proposal submission process. In mid-September 2005, the CSO funded creation of a team of grant specialists to "provide staff with improved services of grant administration and management to assist in the growth of biosciences Labwide." Support for the team was moved from the CSO to the Science, Technology, and Engineering (STE) directorate in 2007, and relocated to the Technology Transfer Division (within STE) in 2008. Since the move to Technology Transfer, the team has expanded its proposal and grant services. The chart at left demonstrates the definite benefit of this team to the Laboratory. Since its creation, we have seen an annual increase of close to 19 percent in funding to the Laboratory through the NIH and CDC programs.

New Patents in 2007

Preparation of High Nitrogen Compound and Material Therefrom
U.S. Patent 7,119,179

Durable Electrooptic Devices Comprising Ionic Liquids
U.S. Patent 7,119,937

Photoinduced Charge-Transfer Materials for Nonlinear Optical Applications
U.S. Patent 7,125,578

Stable Isotope, Site-Specific Mass Tagging for Protein Identification
U.S. Patent 7,125,685

Vectorized Image Segmentation via Trixel Agglomeration
U.S. Patent 7,127,104

Quantitative Method of Determining Beryllium or a Compound Thereof in a Sample
U.S. Patent 7,129,093

Buffer Layer for Thin Film Structures
U.S. Patent 7,129,196

High Throughput Screening of Ligand Binding to Macromolecules Using High Resolution Powder Diffraction
U.S. Patent 7,130,747

Magnetic Infrasound Sensor
U.S. Patent 7,134,342

Method to Amplify Variable Sequences without Imposing Primer Sequences
U.S. Patent 7,135,310

Functionalized Polymers for Binding to Solutes in Aqueous Solutions
U.S. Patent 7,138,462

Preparation of Nanoporous Metal Foam from High Nitrogen Transition Metal Complexes
U.S. Patent 7,141,675

Flexible Composite Radiation Detector
U.S. Patent 7,145,149

Through-the-Earth Radio
U.S. Patent 7,149,472

Nanocrystal Structures
U.S. Patent 7,150,910

Continuous Equal Channel Angular Pressing
U.S. Patent 7,152,448

Magnetic Process for Removing Heavy Metals from Water Employing Magnetites
U.S. Patent 7,153,435

Immunogenic Peptides Comprising a T-helper Epitope and a B-cell Neutralizing Antibody Epitope
U.S. Patent 7,153,509

Nucleic Acid Sequence Detection Using Multiplexed Oligonucleotide PCR
U.S. Patent 7,153,656

Method of Transferring a Thin Crystalline Semiconductor Layer
U.S. Patent 7,153,761

Handheld Isotope Identification System
U.S. Patent 7,161,150

Statistical Density Modification Using Local Pattern Matching
U.S. Patent 7,167,808

Off-axis Cooling of Rotating Devices Using a Crank-shaped Heat Pipe
U.S. Patent 7,168,480

Polyvalent Immunogen
U.S. Patent 7,172,761

Early Leukemia Diagnostics Using Microsphere Arrays
U.S. Patent 7,179,598

Methods for Sequencing GC-Rich and CCT Repeat DNA Templates
U.S. Patent 7,179,602

Fabrication of Multilayered Thin Films via Spin-assembly
U.S. Patent 7,179,679

Waveguide-based Optical Chemical Sensor
U.S. Patent 7,190,851

Polyvalent Immunogen
U.S. Patent 7,195,768

Quenching Methods for Background Reduction in Luminescence-based Probe-target Binding Assays
U.S. Patent 7,202,036

Electrodes for Solid State Gas Sensor
U.S. Patent 7,214,333

High Specific Power, Direct Methanol Fuel Cell Stack
U.S. Patent 7,214,442

Apparatus and Method for Hydrogen and Oxygen Mass Spectrometry of the Terrestrial Magnetosphere
U.S. Patent 7,217,918

Spray Shadowing for Stress Relief and Mechanical Locking in Thick Protective Coatings
U.S. Patent 7,220,458

Gold-coated Nanoparticles for Use in Biotechnology Applications
U.S. Patent 7,226,636

Nanocrystal/Sol-gel Nanocomposites
U.S. Patent 7,226,953

Noninvasive Characterization of a Flowing Multiphase Fluid Using Ultrasonic Interferometry
U.S. Patent 7,228,740

Environmental Continuous Air Monitor Inlet with Combined Preseparator and Virtual Impactor
U.S. Patent 7,232,477

Bioassay and Biomolecular Identification, Sorting, and Collection Methods using Magnetic Microspheres
U.S. Patent 7,232,691

Method and Apparatus for Detecting Chemical Binding
U.S. Patent 7,241,381

RF Transmission Line and Drill/Pipe String Switching Technology for Down-hole Telemetry
U.S. Patent 7,256,707

High Rate Buffer Layer for IBAD MgO Coated Conductors
U.S. Patent 7,258,927

Multifunctional Nanocrystals
U.S. Patent 7,261,940

Oxygen Detection Using Evanescent Fields
U.S. Patent 7,263,246

Thin Film Mixed Potential Sensors
U.S. Patent 7,264,700

Directed Evolution Methods for Improving Polypeptide Folding and Solubility and Superfolder Fluorescent Proteins Generated Thereby
U.S. Patent 7,271,241

New Patents in 2008

Catalytic Synthesis of Metal Crystals Using Conductive Polymer
U.S. Patent No. 7,318,904

Synthesis of Isotopically Labeled R- or S- [^{13}C,^{2}H]Glycerols
U.S. Patent No. 7,321,070

Hybrid Catalyst for Selective Catalytic Reduction of Nitrogen Oxides
U.S. Patent No. 7,378,069

Polymer-Assisted Deposition of Films
U.S. Patent No. 7,365,118

Integrated Optical Biosensor System (IOBS)
U.S. Patent No. 7,289,207

Detection of Phenols Using Engineered Bacteria
U.S. Patent No. 7,303,894

Synthesis of [^{13}C] and [^{2}H] Substituted Methacrylic Acid, [^{13}C] and [^{2}H] Substituted Methly Methacrylate and/or Related Compounds
U.S. Patent 7,321,049

Ultrasonic Analyte Concentration and Application in Flow Cytometry
U.S. Patent No. 7,340,957

Reversible Electro-Optic Device Employing Aprotic Molten Salts and Method
U.S. Patent No. 7,317,106

Ice Method for Production of Hydrogen Clathrate Hydrate
U.S. Patent No. 7,371,907

Network Topology Mapper
U.S. Patent 7,319,677

Composition and Method for Removing Photoresist Materials from Electronic Components
U.S. Patent 7,381,694

Conductive Layer for Biaxially Oriented Semiconductor Film Growth
U.S. Patent 7,288,332

Microporous Crystals and Synthesis Schemes
U.S. Patent 7,361,327

Linear Electric Field Time-of-Flight Ion Mass Spectrometer
U.S. Patent 7,385,188

Method for Producting Metal Oxide Nanoparticles
U.S. Patent No. 7,357,910

Catalyst and Method for Reduction of Nitrogen Oxides
U.S. Patent No. 7,378,069

Composition and Method for Removing Photoresist Materials from Electronic Components
U.S. Patent No. 7,381,694

Linear Electric Field Time-of-Flight Ion Mass Spectrometer
U.S. Patent No. 7,385,188

Circular Permutant GFP Insertion Folding Reporters
U.S. Patent No. 7,390,640

Charge-Free Low-Temperature Method of Forming Thin Film-based Nanoscale Materials and Structures on a Substrate
U.S. Patent No. 7,393,762

Continuous Air Monitor Filter Changeout Apparatus
U.S. Patent No. 7,399,337

Quantum Coherent Switch Utilizing Commensurate Nanoelectrode and Charge Density Periodicities
U.S. Patent No. 7,408,235

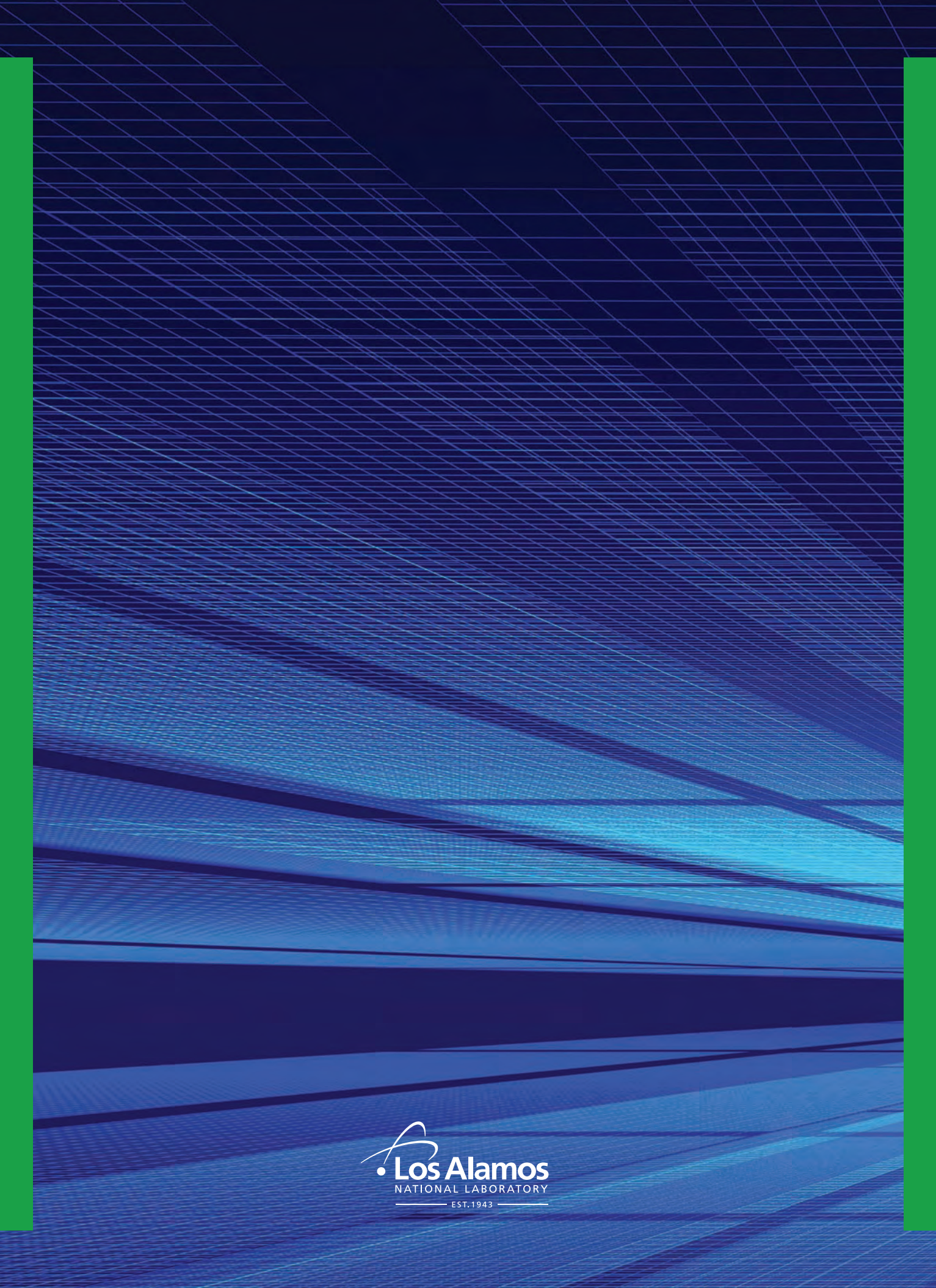
Catalyst and Method for Reduction of Nitrogen Oxides
U.S. Patent No. 7,413,720

Coherent Hybrid Electromagnetic Field Imaging
U.S. Patent No. 7,417,744

Apparatus and Method for Monitoring Breath Acetone and Diabetic Diagnostics
U.S. Patent No. 7,417,730

Agreement Types, Definitions, and Conditions

Agreement	Rights in Intellectual Property	Laboratory Resource Commitment	Industry Resource Commitment
Cooperative Research and Development Agreement (CRADA): Enables industry, academia, and non-profit entities to collaborate with the Laboratory for the purpose of joint R&D activities.	Rights to IP generated under a CRADA are negotiated separately.	When program dollars are available, the Laboratory cost shares. In the absence of program dollars, sponsor is responsible for full cost recovery.	Cost-shared through contributions of personnel, equipment, services, materials, facilities, and funds.
Non-Federal Work for Others (WFO) Agreement: Enables a non-federal partner to ask the Laboratory to perform a defined scope of work or list of tasks that draws upon the unique capabilities of the Laboratory. It may not place the Laboratory in competition with the private sector. (Also known as a funds-in agreement or a sponsored research and development agreement.)	Rights to Laboratory inventions generated under a WFO Agreement may be available to a sponsor under DOE's Class Waiver.	Personnel, equipment, materials, and facilities are used.	Sponsor covers the cost of all Laboratory work (including personnel and materials) to be completed under the Statement of Work signed by both parties.
Personnel Exchange Agreements: Industrial Fellow Agreements allow Laboratory staff members to work at a partner company.	All are subject to negotiation.	The Laboratory and partner cost-share the Industrial Fellow.	Partner pays percentage of salary; provides office space, laboratory, and associated support costs.
Industrial Assignment Agreements allow Laboratory staff members to work in the private sector.		Loan of Laboratory personnel (subject matter expert).	Company pays costs (salary and benefits) for Laboratory staff on assignment to company.
Industrial Staff Member Agreements allow private-sector staff to work at the Laboratory.		Office space, laboratory, and support costs for Industrial Staff Members assigned to the Laboratory.	Company pays costs for Industrial Staff Member assigned to the Laboratory.
User Facility Agreement: (UFA) Permits outside users from industry, universities, and other governmental agencies, to conduct research using the Laboratory's unique experimental research equipment and facilities.	User retains rights.	Partner covers all costs associated with using the facility for the tasks defined in the scope of work.	Partner covers all costs associated with using the facility for the tasks defined in the scope of work.
Non-Disclosure Agreement (NDA): Protects proprietary information exchanged between parties during initial interactions and discussions between the Laboratory and another party on specific technical areas.	None—no IP is generated by either party under an NDA.	None	None
Memorandum of Understanding (MOU) Nonbinding document signed by parties interested in pursuing a comprehensive agreement for the transfer of technology that defines specific technical areas of interest and the ground rules for interactions and discussions between the parties.	None—no IP is generated under an MOU.	None	None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