

# Technology for Today

*Enhancing America Through Federally Developed Research and Technology*





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# Advancing Technology

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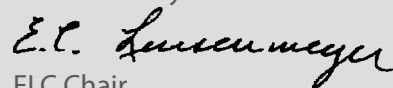
Welcome to the exciting world of federal technology transfer. Every day, hundreds of federally funded laboratories apply their research and development expertise for the advancement of science.

More than 250 laboratories and research centers—representing almost all federal departments and agencies—conduct over \$100 billion in research and development annually and employ more than 100,000 scientists and engineers. Their science has the capacity to enrich our lives by making them safer, more convenient, and more fulfilling. From medicine to transportation to communications, these research facilities investigate everything that is known and extract knowledge from the previously unknown. The effort, desire, and creativity of these scientists are unparalleled.

But all of this work is for nothing if the “genius” is not let out of the bottle. It is essential that the fantastic developments happening behind laboratory doors be transferred from the theoretical to the practical. To capitalize on the nation’s investment in federal research, the expertise and technology must be brought to the marketplace. This commercialization enhances not only the nation’s socioeconomic well-being in the global marketplace, but also ensures its security and prominence. This transfer is accomplished through the outstanding work of scientists, agency representatives, and technology transfer professionals.

This achievement requires a vision, a plan, and a methodology. It is with great honor that the members of the Federal Laboratory Consortium for Technology Transfer (FLC) assist with generating this vision, plan, and methodology. Since its organization in 1974 and its formal charter through the Federal Technology Transfer Act of 1986, the FLC has developed tools and services to ensure that the efforts of federal engineers and scientists are not left on a shelf. The publication you are about to read is only a small representation of how cutting-edge federal laboratory expertise becomes prevalent in our everyday lives through the execution of technology transfer.

Ed Linsenmeyer



FLC Chair



# Killing Metal Contaminants, Saving Lives

*“The Centers for Disease Control and Prevention believe that roughly eight percent of American women of childbearing age have mercury concentration in their bodies that exceeds safety limits.”*

The Environmental Protection Agency estimates that coal-fired power plants contribute about 48 tons of mercury to the United States’ environment each year. The Centers for Disease Control and Prevention believe that roughly eight percent of American women of childbearing age have a mercury concentration in their bodies that exceeds safety limits. Clearly, mercury is a serious threat to the environment and human health.

In March 2005, the EPA issued the first federal rule to permanently cap and reduce mercury emissions for coal-fired power plants, making the U.S. the first country in the world to regulate mercury emissions.

Pacific Northwest National Laboratory (PNNL) researchers have developed an innovative technology that quickly and easily reduces or removes mercury content without creating hazardous waste or byproducts and can be disposed of as a nonhazardous waste.

SAMMS™ (Self-Assembled Monolayers on Mesoporous Supports) is simple, inexpensive and easy to use; is highly adaptable for use in reducing and removing metal contaminants from aqueous and nonaqueous materials; and has numerous applications, including water treatment, waste stabilization, and metal processing and finishing. It is also significantly faster, more effective, and far less expensive than other mercury removal methods used in the past.

The SAMMS technology was first licensed to Steward Environmental Solutions, LLC, a manufacturer of advanced powders and nanomaterials. Steward signed its first licensing agreement in 2005, intending to initially market SAMMS for treating gaseous emissions such as those that emanate from coal-fired power plants, municipal incinerators, and other similar plants where testing has begun. In March 2006, Steward signed a second license agreement with PNNL for the manufacture and sale of SAMMS for multiple fields of use.

PNNL continues to refine and test new applications that will broaden the range of contaminants effectively treated by SAMMS. Steward hopes to work with PNNL on the production of these applications; it currently produces SAMMS on an industrial scale.

Additional technology transfer activities for SAMMS have engaged Perry Equipment Company (to remove mercury from “produced water” resulting from offshore drilling) and Chevron (formerly Unocal, to remove mercury from crude oil).

The technology continues to garner international recognition, including features in numerous high-profile scientific, technical and trade publications, and nods from the scientific community, including an R&D 100 award and recognition as a finalist in the environmental category in *Discover* magazine’s annual awards for technological innovation.





*Steward Environmental Solutions, LLC, has signed two licensing agreements for the production of SAMMS, a simple, inexpensive and easy-to-use technology that absorbs mercury in liquids and can be easily disposed of afterwards.*

**Pacific Northwest National Laboratory**  
**[www.pnl.gov](http://www.pnl.gov)**

Pacific Northwest National Laboratory is one of ten Department of Energy multi-program national laboratories. PNNL delivers breakthrough science and technology to meet selected environmental, energy, health and national security objectives; strengthen the economy; and support the education of future scientists and engineers.

# AFRL Provides Aviation Safety Through 3-D Audio

*“That could be as simple as a two-person teleconference or as complicated as air traffic control systems, where an operator has to listen to nine or ten radios at once.”*

*Douglas S. Brungart, Ph.D.  
AFRL Technical Advisor*

Scientists at the Air Force Research Laboratory (AFRL) are working to improve general aviation safety with three-dimensional (3-D) sound cues that can help air traffic controllers monitor aircraft and help pilots fly straight and level.

Normally, humans hear sound from all around. The human auditory system can discern, to a certain degree, both the location of a sound and its distance from a listener.

In some situations, however—such as when pilots and air traffic controllers are wearing monaural communications headphones—lack of natural audio cues can cause confusing and potentially hazardous situations when multiple talkers “stack up” in a listener’s head.

The basic concept of 3-D audio is to use stereo headphones to simulate spatially separated sounds when natural cues are not available. Aviation communications typically provide flat, one-dimensional sound with no indication of direction or distance. But with 3-D audio, a person wearing stereo headphones hears sounds as he would normally, coming from varying directions and distances.

In multi-talker situations, 3-D audio improves speech intelligibility by spatially separating the sources, thus helping a listener track and understand multiple simultaneous conversations, according to Douglas S. Brungart, Ph.D., technical advisor for AFRL’s Human

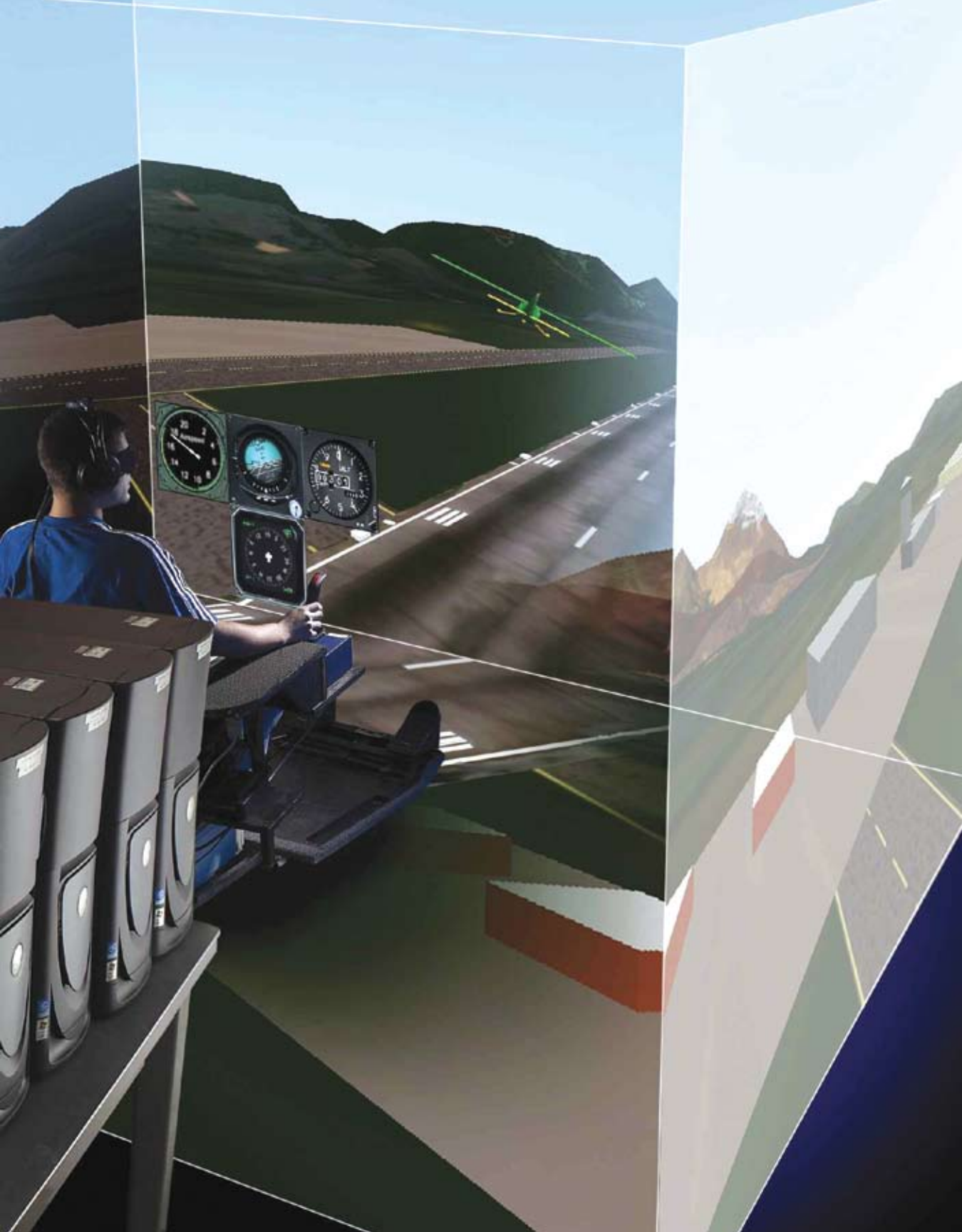
Effectiveness Directorate, Warfighter Interface Division, Battlespace Acoustics Branch.

“Any communications situation with more than one talker is a potential application,” Brungart said. “That could be as simple as a two-person teleconference or as complicated as air traffic control systems, where an operator has to listen to nine or ten radios at once.”

With 3-D audio, air traffic controllers could more easily distinguish between radio transmissions from multiple aircraft pilots, and tower controllers could keep track of the locations of aircraft taxiing to and from the runways of a busy airport. This could increase their situational awareness and potentially help prevent accidents both on the ground and in the air. For pilots, AFRL researchers developed an artificial audio horizon to augment a pilot’s visual horizon.

AFRL partnered with commercial vendor Compunetix, Inc., to upgrade its commercial software and install it at the Nellis Air Force Base weapons test range in Nevada, where operators talk to multiple aircraft during training exercises.

Other potential 3-D audio applications include providing sound cues to alert blind persons to the location of objects; improving situational awareness for foot soldiers in combat situations and firefighters in smoke-filled buildings; and integrating realistic audio into video/PC games and training simulators.



*The AFRL technology will help pilots keep track of the locations of other aircraft, maintain course while engaged in other tasks, and avoid disorientation. As shown here, this project uses a flexible flight simulator that allows rapid and economical integrations of new instrumentation concepts, and safe replication of dangerous or unusual flight situations.*

**Air Force Research Laboratory**  
**[www.afrl.af.mil](http://www.afrl.af.mil)**

The Air Force Research Laboratory is headquartered at Wright-Patterson Air Force Base, Ohio. AFRL's mission is leading the discovery, development, and integration of affordable warfighting technologies for Air Force air and space forces. The Human Effectiveness Directorate is one of ten AFRL technology directorates. Its mission is to lead revolutionary science and technology for superior airman cognition, readiness, performance, and survival.

# Getting More Value Out of a Diamond

*“This triad of technical barriers (synthesis, materials integration, and deposition platform) has critically hindered thin-film diamond as an industrial material.”*

**D**iamond is nature’s extreme material. In any list of material properties, diamond is almost always superior, and if diamond could be easily rendered as a thin film, it would be used in many high-technology products.

The list of potential applications is endless, from low-friction, wear-resistant coatings in applications ranging from mechanical pumps to hip joints, to high-temperature, high-voltage electronics, to high bandwidth radio-frequency telecommunications devices, and to biocompatible implants and biosensors.

For the past 30 years, since it became possible to make diamond thin films, various attempts have been made to develop diamond-based products.

Nearly all of these efforts have failed due to the fact that diamond is notoriously hard to synthesize and even harder to integrate with other materials. In addition, a lack of sufficient market pull has unfortunately resulted in no deposition platforms that are capable of depositing diamond over large areas suitable for industrial settings.

This triad of technical barriers (synthesis, materials integration, and deposition platform) has critically hindered thin-film diamond as an industrial material. To meet this challenge, research-

ers from Argonne National Laboratory (ANL) have created an ultrananocrystalline diamond (UNCD) coating technology. The technology captures many natural diamond properties in thin-film form and greatly surpasses other diamond film technologies with commercial potential.

UNCD films can be used in a broad and diverse range of applications from macro to nanodevices, such as energy-saving ultra-low friction and wear coatings for mechanical pump seals, and tools such as high-performance microelectromechanical and nanoelectromechanical system (MEMS/NEMS) based telecommunication devices, the next generation of high-definition flat panel displays, in-vivo biomedical implants, and biosensors.

Despite ANL’s many interactions with industry, the nature and maturity of the technology made it unsuitable for licensing directly to established companies.

To work around this barrier, the novel UNCD thin-film technology was successfully transferred to an ANL-founded startup company, Advanced Diamond Technologies, Inc. The ANL staff worked closely with ANL’s Office of Technology Transfer, as well as officials from the University of Chicago and the U.S. Department of Energy (DOE), in founding ADT.



*The ultrananocrystalline diamond (UNCD) coating technology, invented and developed at Argonne National Laboratory, captures many natural diamond properties in thin-film form and greatly surpasses other diamond film technologies with commercial potential.*

**Argonne National Laboratory**  
**[www.anl.gov](http://www.anl.gov)**

Argonne National Laboratory is one of the U.S. Department of Energy's largest research centers. It is also the nation's first national laboratory, chartered in 1946. Today, the laboratory has more than 2,700 employees, including 1,000 scientists and engineers, 600 of whom hold doctorate degrees. Argonne supports upwards of 200 research projects, ranging from studies of the atomic nucleus to global climate change research. Its five research areas include broad basic science, scientific facilities, energy resources, environmental management, and national security.

# Saving American Agriculture by Protecting Honeybees

*“The California almond industry, for instance, requires more than a million bee colonies annually to pollinate a crop worth about \$1.5 billion.”*

The honeybee is an important beneficial insect. In addition to the \$300 million of honey, beeswax, and other hive products produced annually, crop growers rent more than two million honeybee colonies every year to assist with pollinating a wide variety of crops with an added market value exceeding \$15 billion.

American foulbrood disease is a highly contagious disease among honeybee larvae. The only approved antibiotic for treating this devastating disease was oxytetracycline (marketed as Terramycin). In 1999, reports of bacterial resistance started to surface. New and effective controls were urgently needed to ensure honeybee availability for pollination and honey production.

Agricultural Research Service (ARS) scientists in Beltsville, Md., initiated a laboratory screening program to identify a suitable antibiotic alternative. Their research indicated that tylosin tartrate, an antibiotic marketed as Tylan—which was already approved for use in chickens, turkeys and swine—is also highly effective in inhibiting foulbrood disease in bees.

Tylan Soluble, produced by Elanco Animal Health of Greenfield, Ind., was approved by the U.S. Food and Drug Administration in 2006 following a review of research data compiled by ARS scientists. From conception, design and research, through drug approval and labeling, ARS scientists played a crucial role in answering customer and stakeholder needs. Agriculture and Agri-Food Canada has also requested ARS’s research findings to support Canadian registration of this product. ARS researcher efforts have made it possible to protect nearly four million bee colonies at risk in North America.

While the value of these colonies can be modestly estimated at about \$1 billion, the impact on U. S. crop production is far broader. The California almond industry, for instance, requires more than a million bee colonies annually to pollinate a crop worth approximately \$1.5 billion. From apples in Washington to Florida citrus and numerous other fruit, vegetable and seed crops, ARS’s research efforts have contributed to maintaining the vitality of U.S. agriculture.



*Honeybee on honeycomb cell*

Agricultural Research Service  
[www.ars.usda.gov](http://www.ars.usda.gov)

The Agricultural Research Service is responsible for developing new knowledge and technology to solve agricultural problems; ensure the productivity of high-quality food and agricultural products to meet the nutritional needs of U.S. consumers; sustain a viable food and agricultural economy; and maintain a quality environment and natural resource base.

*Jack DyKinga*

# Soviet Weapons Makers Move on to Peaceful Missions

*“IPP focuses on reducing the proliferation of weapons of mass destruction by redirecting the skills of former weapons workers to developing and manufacturing commercial, non-weapons products.”*

What do miners, oil companies, environmentalists, private businesses, the U.S. government, and Russian former weapons of mass destruction workers have in common? They all benefit from the new Drillstring Radar (DSR) technology. An advanced geophysical exploration system, the DSR was engineered by Stolar Research Corporation as part of the National Nuclear Security Administration's (NNSA) Global Initiatives for Proliferation Prevention (GIPP) program.

GIPP focuses on reducing the proliferation of weapons of mass destruction by redirecting the skills of former weapons workers to developing and manufacturing commercial, non-weapons products. Under GIPP, the NNSA's national laboratories and manufacturing facilities form partnerships with U.S. commercial industries and ex-weapons scientists in the former Soviet Union to evaluate opportunities for commercial projects.

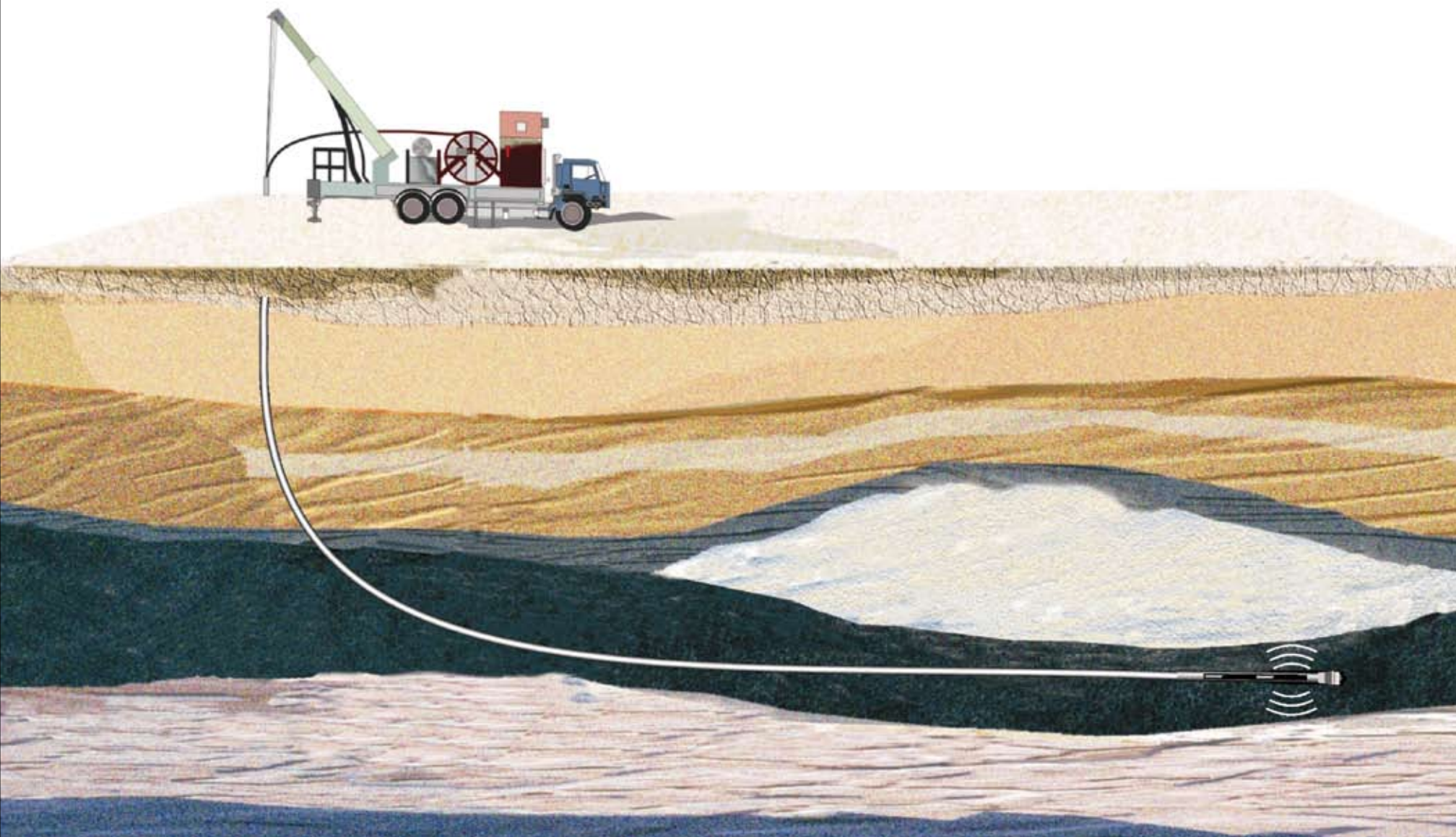
The DSR was developed through a GIPP partnership between the NNSA's Kansas City Plant; Stolar Research Corporation, a New Mexico radio geophysics engineering company; and scientists

from the Measuring Systems Research Institute (NIIS) in Nizhny Novgorod, Russia. Stolar saw the need for this technology and recognized the GIPP program as the opportunity to realize its vision. The Kansas City Plant provided the technical expertise to solve problems as they arose, and also served as project facilitator and manager between NIIS and Stolar.

The new DSR provides a radar navigation tool to determine the height of a coal seam, geologic conditions, and seam undulation without the need to drill to the roof and floor boundary rock. NIIS is collaborating with Stolar to refine and commercialize the tool. Deemed one of most technologically significant products introduced into the marketplace over the past year, the DSR received a 2005 R&D 100 award.

DSR's many benefits include reduced cost, more efficient mining, accurate information about geologic structures to maximize extraction of a higher-quality product, increased oil or natural gas produced, reduced dependence on foreign energy, increased safety for miners, and preservation of the environment.





*The Drill String Radar (DSR) technology recently received the prestigious 2005 R&D 100 award. Part of the NNSA's Initiative for Proliferation Program, the DSR project received funding, technical support and facilitation from NNSA's Kansas City Plant.*

**Kansas City Plant**  
<http://www.honeywell.com/sites/kcp>

As part of the National Nuclear Security Administration's (NNSA) nuclear weapons complex, the Kansas City Plant's primary mission is to assemble and manufacture components for national defense systems. However, it is a multi-mission facility that supports other government agencies as well as national laboratories, universities, and U.S. industry.

# NASA Rehab Tool Brings People to Their Feet

*“When we first put him in the walker, he was up and going for 25 minutes,” explained Messier. “He’s now walking for up to 25 minutes every day and even using S.A.M. to perform exercises to strengthen his leg muscles.”*

**Ken Messier**  
**President**  
**Enduro Medical Technology**

**W**alter Reed Army Medical Center in Washington, D.C., has begun using the Secure Ambulation Mode (S.A.M.) physical therapy device to rehabilitate patients with spinal cord or traumatic brain injuries.

A product of Enduro Medical Technology (East Hartford, Conn.), S.A.M. is based on technology developed at NASA Goddard Space Flight Center (GSFC). Enduro donated the S.A.M. unit to Walter Reed to facilitate rehabilitation for military patients, including soldiers returning home from service in Iraq.

“We felt S.A.M. would be an ideal fit for Walter Reed because it makes the rehabilitation process less taxing on both the patient and the medical staff,” said Enduro’s president Ken Messier. According to Messier, S.A.M. allows patients to stand or walk—partially weight bearing, full weight bearing or non-weight bearing—whether they have a sense of balance or not. “It allows them to be up in a standing position without having three or four therapists having to help them stand,” explained Messier. “So it gets the patient up sooner in the rehab process without a fear of falling and without an injury to the patient or staff members.”

At Walter Reed, the device is being used to help patients with a variety of traumatic injuries to the spinal cord and brain. According to Messier, one active military patient who was wheel-

chair-bound for two years due to a thoracic spinal cord injury is now up and walking with S.A.M. “When we first put him in the walker, he was up and going for 25 minutes,” explained Messier. “He’s now walking for up to 25 minutes every day and even using S.A.M. to perform exercises to strengthen his leg muscles.”

Developed at GSFC, the patented technology behind S.A.M. includes an earlier model walker device and a cable-compliant joint mechanism. Unlike a fixed joint, which can move in only one or two directions, NASA’s compliant joint allows subtle movement in six directions with variable degrees of stiffness. Enduro licensed both patents from NASA and added the joint mechanism to the walker’s harness, enabling greater flexibility in the walker’s use and creating a commercially viable product.

The donation of S.A.M. to Walter Reed was made possible with support from The Henry M. Jackson Foundation for the Advancement of Military Medicine (HJF). HJF is a nonprofit organization that provides a resource link between military medicine organizations and private industry. “I commend Enduro for donating its medical devices to help with rehabilitation efforts at Walter Reed,” said HJF president John Lowe. “We’re very glad to be able to facilitate this collaboration, which provides additional resources for the treatment of our military personnel.”



Asia Proctor

*Enduro Medical Technology President Ken Messier assists with a demonstration of the company's NASA technology-based youth walker, SAM-Y, at Space Day 2006.*

**NASA Goddard Space Flight Center**  
**<http://ipp.gsfc.nasa.gov>**

The mission of NASA Goddard Space Flight Center is to expand knowledge of the Earth and its environment, the solar system, and the universe through observations from space. To assure that our nation maintains leadership in this endeavor, Goddard is committed to excellence in scientific investigation, in the development and operation of space systems, and in the advancement of essential technologies.

# Sandia's TufFoam™ Churns Up Waves of Industry Interest

*"It's the equivalent of removing lumber from the housing industry."*

*Matt Warshaw  
Surf Historian*

When surfboard material manufacturer Clark Foam closed last year, the nation's \$200-million surfboard manufacturing market appeared headed for a wipeout.

Hearing the news, Sandia National Laboratories' (SNL) LeRoy Whinnery, who describes himself as "a warm-water surfer" (as opposed to his wife, whom he says "will surf anywhere"), believed he just might have a solution—TufFoam™, which was initially developed to protect sensitive equipment from harsh mechanical environments.

Now two licensees are evaluating the SNL-developed foam for this use, and scores of inquiries are being explored about this field and other uses, including insulation and structural core applications. The material is a water-blown, close-cell, rigid polyurethane foam that features formulations with densities as low as 2 pounds per cubic foot.

News of TufFoam™ being considered as a potential replacement for surfboard manufacturing has spread rapidly through news agencies, television, magazines, newspapers, and trade journals since the licensing opportunity was announced in February.

"It can be used for thermal and electrical insulation, and potentially as a core material for the automobile and aerospace industries," said Scott Vaupen, who began the commercialization effort in Business Development Support Dept. 8529, where Jim Wilhelm is now

handling TufFoam™ agreements and inquiries. Jim points out that the material is unique in its ability to withstand high-rate impact without fracture or loss of structural integrity. In addition, it's also being considered for use as industrial thermal insulation for liquefied natural gas storage tanks.

Clark Foam closed its doors suddenly late last year, citing the impact of ever-tightening environmental regulations on the manufacturing of its polyurethane surfboard blanks. The move led to near-panic, particularly in California, by manufacturers and sellers of surfboards who fear they will not be able to find the high strength-to-weight ratio surfboard blanks necessary to make the boards. Surf historian Matt Warshaw, in an article in the *Santa Barbara News-Press*, said "it's the equivalent of removing lumber from the housing industry."

Another attractive feature of the SNL product is that all of the chemicals used to make TufFoam™ are commercially available in commodity quantities. The material is currently formulated to be processed in a batch mode, but the processing schedule can be modified for machine mixing or injection molding.

So, will a foam developed for America's nuclear weapons program save the American surfboard industry? Maybe. LeRoy hopes so. "Yeah, I'm really looking forward to surfing on a TufFoam™ board," he said. "That would be pretty awesome."



*Originally created for the National Nuclear Security Administration to protect sensitive electronic and mechanical structures from harsh environments, SNL's foam may be ideally suited for surfboard blanks, car bumpers, and airplane wings.*

**Sandia National Laboratories**  
**[www.sandia.gov](http://www.sandia.gov)**

Since 1949, Sandia National Laboratories has developed technological solutions to support our national security and to counter national and global threats. Through science and technology, people, infrastructure and partnerships, SNL's mission is to meet national needs in five key areas: nuclear weapons, nonproliferation and assessments, military technologies and applications, energy and infrastructure assurance, and homeland security.

# ARS Discovers Bacteria to Treat Birds, Make Money, and Save Lives

*"As many as 9,000 deaths  
in the United States each  
year are caused by eating  
contaminated foods."*

*Council for Agricultural  
Science and Technology*

A team of Agricultural Research Service (ARS) and University of Arkansas scientists in Fayetteville, Ark., discovered "good" bacteria that could help protect poultry from pathogens such as Salmonella and Campylobacter, which can cause illness in humans who eat foods contaminated with either of these bacteria.

The good bacteria can be fed to poultry as a probiotic treatment—a dietary treatment containing good bacteria. Probiotic treatments are a healthier, safer alternative to antibiotic treatments because they help poultry resist harmful pathogens and grow more efficiently—leading to a safer poultry product for consumers. Probiotics reduce the opportunity for pathogenic (or bad) bacteria to become established in newly hatched poult when they are most susceptible to infection.

The team screened more than 8 million intestinal bacteria to come up with several promising probiotic combinations. They have developed multiple techniques for identifying potential probiotics—making probiotic production less expensive.

This technology led to the formation of a startup company in Arkansas, Sigrah-Zellet, LLC, which employs five people in Arkansas and seven internationally. The company uses a subcontractor that accounts for 2 full-time employees and more than 80 sales and technical

support staff distributing the product worldwide. Sigrah-Zellet specializes in probiotics and poultry health and production. The company licensed the patent-pending technology and is selling the treatment under the commercial name of FloraMax-B11. The product was made available in 2004, making a profit the first year (approximately 100 million birds treated). In 2005, the product was marketed in 16 countries, with more than 1 billion doses sold. The company expects a 50% increase in total usage in 2006. The product is being marketed in South Korea, Japan and Mexico, and six additional countries are in the final stages of acquiring import permits. The product increases meat yields, which translates to a greater than \$6-million increase in production yields for every 300 million birds treated in the United States annually.

This technology will increase poultry production efficiency, safety and profitability worldwide, and will likely be extended to other animal species. This new alternative to antibiotic treatment could also help reduce the incidence of foodborne illnesses by reducing the presence of Salmonella and Campylobacter in commercial chickens. The Council for Agricultural Science and Technology estimated that as many as 9,000 deaths and 6.5 to 33 million illnesses in the United States each year are caused by eating contaminated foods.



*Physiologist Annie Donoghue gives a combination of good bacteria to a turkey poult to test their efficacy in the live bird.*

Agricultural Research Service  
[www.ars.usda.gov](http://www.ars.usda.gov)

The Agricultural Research Service is responsible for developing new knowledge and technology to solve agricultural problems; ensure the productivity of high-quality food and agricultural products to meet the nutritional needs of U.S. consumers; sustain a viable food and agricultural economy; and maintain a quality environment and natural resource base.

Stephen Ausmus

# NASA Kennedy Tech to Reduce Groundwater Contamination Around the World

*“EZVI shows significant promise as a cost-effective remediation technology capable of expediting DNAPL source zone remediation and groundwater cleanup.”*

A groundwater treatment technology developed at NASA Kennedy Space Center (KSC) has won NASA's Government Invention of the Year and Commercial Invention of the Year awards for 2005.

The emulsified zero-valent iron (EZVI) technology was developed by a team of researchers from NASA and the University of Central Florida. NASA inventors include Dr. Jacqueline Quinn, an environmental engineer in the Applied Sciences Division of the Kennedy Applied Technology Directorate, and Kathleen Brooks, an analytical chemist in KSC's Materials Science Laboratory of the Center Operations Directorate. Drs. Christian Clausen, Cherie Geiger, and Debra Reinhart are co-inventors from the university's Departments of Chemistry and Civil Environmental Engineering.

During the early history of the space program, the ground around KSC's Launch Complex 34 (LC-34) was polluted with chlorinated solvents used to clean Apollo rocket parts. Dense non-aqueous phase liquids (DNAPLs) left untreated in the ground contaminated fresh water sources in the area.

A DNAPL is a liquid that is denser than water and does not dissolve or mix easily in water. DNAPLs are a common cause of environmental contamination at thousands of Department of Energy, Department of Defense, NASA, and private industry facilities. Current approaches for remediation of DNAPL source areas are either inefficient, slow (e.g., pump and treat), or costly (e.g.,

thermal treatment). In response to this environmental contamination, KSC developed EZVI for the in situ treatment of DNAPLs.

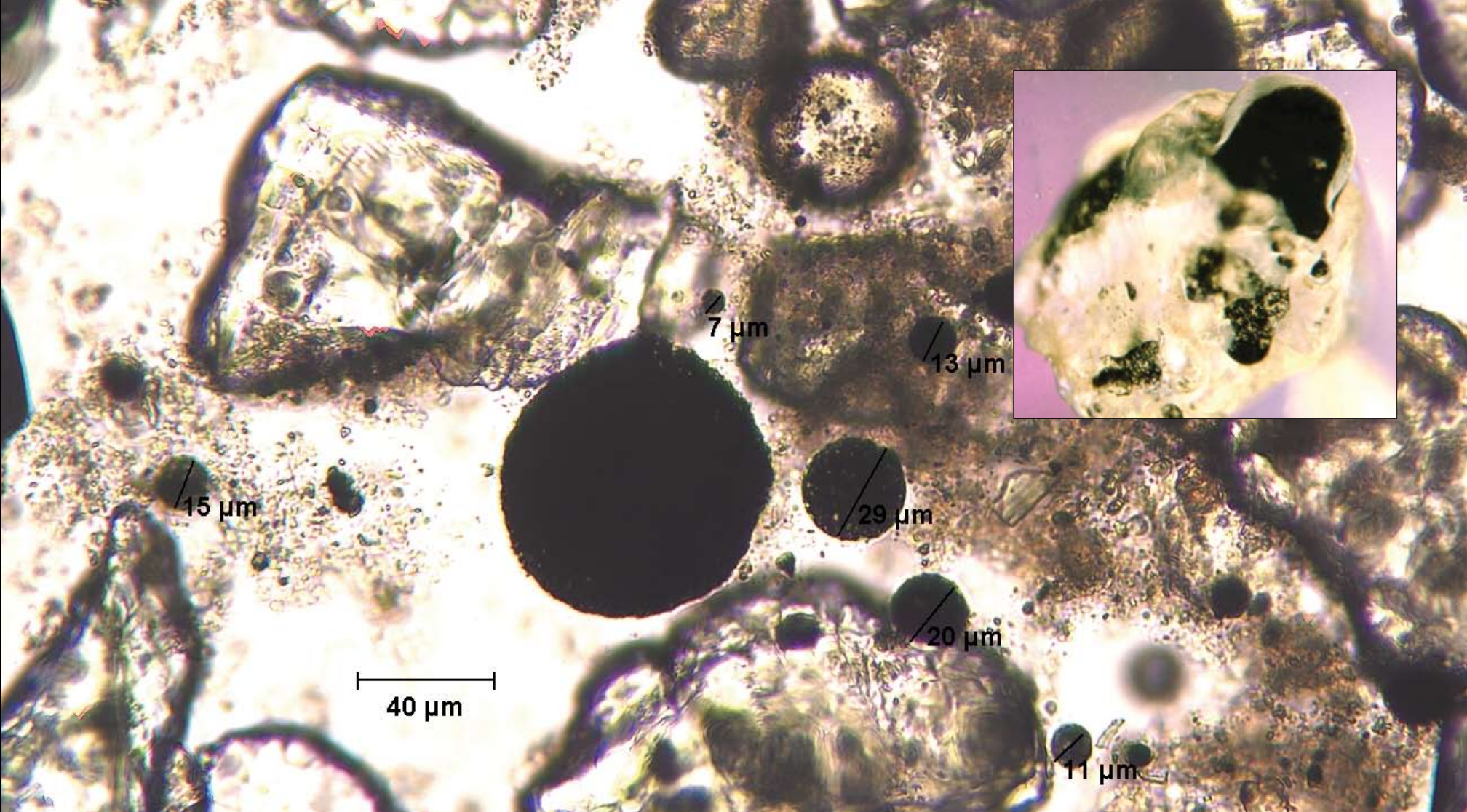
EZVI shows significant promise as a cost-effective remediation technology capable of expediting DNAPL source zone remediation and groundwater cleanup. EZVI is composed of a food-grade surfactant, biodegradable vegetable oil, water, and ZVI particles (either nano- or micro-scale iron), which form emulsion particles that contain the ZVI in water surrounded by an oil-liquid membrane.

The conventional approach to this type of contamination is to use pump-and-treat systems that extract and treat the groundwater above ground.

This technology overcomes the previous understanding that the incorporation of zero-valent metal particles, such as iron particles, into a liquid membrane micelle would lead to passivation of the particle surface with regard to its ability to dehalogenate compounds. In addition to being quick, effective and cost-competitive, the technology also provides for direct treatment of the contaminant source, does not mobilize contaminants, produces less toxic and more easily degradable by-products, and is environmentally safe. KSC signed five nonexclusive licenses with companies wanting to market and further develop EZVI.

One company in particular, GeoSyn-tec, intends to market this innovation to clients across North America, Europe, and Australia.





*Multiple sand grains show how EZVI looks among a cluster of sand grains. A closer look reveals a single grain of sand with EZVI droplets on it.*

NASA Kennedy Space Center  
[www.nasa.gov/centers/kennedy](http://www.nasa.gov/centers/kennedy)

The mission of the Innovative Partnerships Program Office (IPPO) at the Kennedy Space Center is to provide leveraged technology alternatives to the Mission Directorates, Program and Projects through joint partnerships with industry, academia, government agencies and national laboratories. This mission dictates that the Center IPPO work in close coordination with its primary customers in the Constellation Project Office, Shuttle Processing, Launch Services, and Space Station/Payload Processing Directorates in order to provide meaningful solutions to their problems.

# Small EPA-Local Agency Invention Spawns Big Applications

*“More than 3,200 samplers have been sold domestically and internationally, with total revenues exceeding \$6,000,000.”*

Imagine being able to get fast and accurate data on the level of contaminants accidentally released into the air during an emergency. Likewise, think how important a rugged, portable air monitoring device could be to military personnel regarding airborne hazards in military zones. Or, perhaps you would you like to study the ambient air quality in your offices in order to provide a healthy workspace for your employees. The saturation sampler is an outstanding example of a collaborative development that is reaching the international marketplace and serving needs worldwide. Numerous efforts, ranging from monitoring indoor air quality to responding to catastrophic events, have incorporated this advanced air sampling technology.

Jointly developed by the Environmental Protection Agency (EPA) and the Lane Regional Air Pollution Authority (LRAPA), the saturation sampler reflects a unique integration, expansion, and implementation of existing technologies. A U.S. patent was awarded to inventors Jon W. Schweiss (EPA) and Gerald A. Boyum (LRAPA) for its ability to collect both filter and whole-air samples in simultaneous, overlapping, and/or individual monitoring regimes. The inexpensive, low-volume sampler is used in a broad variety of sampling environments by virtue of its compact,

lightweight, highly portable, weatherproof, and rugged design. It is used by private and public sector entities in a wide array of applications worldwide, including:

- Evaluating the representativeness and informing the design of fixed monitoring air monitoring networks and programs
- Informing the development and verifying the performance of air quality dispersion models
- Developing air emissions permits and monitoring compliance
- Conducting indoor air quality studies
- Conducting occupational air quality studies
- Conducting exposure/epidemiological studies
- Conducting air toxics studies
- Performing surveillance on airborne hazards to military personnel (e.g., at deployments in Afghanistan and Iraq)
- Responding to emergencies (e.g., measuring impacts in the aftermath of the World Trade Center attack and Gulf War/Kuwait oil well fires, and volcanic eruptions).

More than 3,200 samplers have been sold domestically and internationally, with total revenues exceeding \$6,000,000. Approximately one-half of the 200-400 samplers sold annually are purchased by international clients.



*Numerous efforts, ranging from monitoring indoor air quality to responding to catastrophic events, have incorporated the saturation sampler technology.*

Environmental Protection Agency  
**[www.epa.gov](http://www.epa.gov)**

The mission of the Environmental Protection Agency is to protect human health and the environment. Employing more than 18,000 people, the EPA staff is comprised of highly educated and technically trained engineers, scientists, and policy analysts.

# PNNL Helps Deliver Breakthrough Prostate Cancer Treatment

*“Because of its unique characteristics, Cesium-131 has the potential to benefit hundreds of thousands of people each year who suffer from a wide variety of cancers.”*

*Dr. Dave Swanberg  
Executive Vice President  
of Operations  
IsoRay Medical, Inc.*

Prostate cancer is the most common cancer, excluding skin cancer, and is the second leading cause of cancer-related death in men in the United States. Statistics such as these and technical know-how inspired the formation of a medical isotope company that today delivers one of the most effective cancer treatments available.

This technology transfer story epitomizes the value of a national laboratory in enabling a small business to develop its breakthrough cancer therapy technology to the point where it is helping treat and cure cancer patients. Pacific Northwest National Laboratory (PNNL) provided access to equipment and two user facilities in a unique way to transfer its radiological expertise to IsoRay Medical, Inc., resulting in the successful launch of its commercial product. Located in Richland, Wash., IsoRay is producing a powerful new kind of brachytherapy seed made from Cesium-131 (Cs-131) for treating prostate and other cancers.

IsoRay's partnership with PNNL began almost as informally as the company did. In 1998, Lane Bray, a PNNL retiree and internationally recognized expert in medical isotopes, and Don Segna, a retired engineer formerly with the Department of Energy, met with PNNL project lead Larry Greenwood to discuss technical issues related to the fledgling company. This meeting led IsoRay to PNNL's Economic Develop-

ment Office and access to PNNL expertise in the form of laboratory technical assistance.

Following several more R&D collaborations over the next seven years, IsoRay was producing and marketing its Cs-131 seeds to hospitals across the nation. The company initially produced the seeds using PNNL's Radiochemical Processing Laboratory.

As a small startup company, IsoRay did not have the physical or financial resources to conduct extensive testing in a radioactive environment. The company began by performing non-radioactive testing in a technology incubator facility at Richland's Science and Technology Park before conducting the radioactive work at PNNL.

The Cs-131 seed—used to treat prostate and other cancers—offers a significantly shorter half-life than the two other isotopes commonly used for brachytherapy. A shorter half-life means faster delivery of therapeutic radiation to the tumor and a decreased likelihood of cancer cell survival.

In October 2004, the world's first Cs-131 seed implant was performed at the University of Washington Medical Center in Seattle.

As of October 2006, more than 500 patients had received Cs-131 implants to treat their prostate cancer. Brachytherapy procedures using Cs-131 have grown to include 26 treatment centers across the United States, and it is expected to continue growing.



*IsoRay's brachytherapy seeds use Cesium-131. The low-energy x-ray emissions effectively provide a cancer-killing dose to a tumor in a short period of time.*

Pacific Northwest National Laboratory  
**[www.pnl.gov](http://www.pnl.gov)**

Pacific Northwest National Laboratory is one of ten Department of Energy multi-program national laboratories. PNNL delivers breakthrough science and technology to meet selected environmental, energy, health and national security objectives; strengthen the economy; and support the education of future scientists and engineers.

# NIH Develops Multivitamin for Preventing Macular Degeneration

*“AMD affects 10 to 15 million people, and this number is expected to double as baby boomers age.”*

Age-related macular degeneration (AMD) is the leading cause of visual impairments and legal blindness in Americans age 50 and over. It affects 10 to 15 million people, and this number is expected to double as baby boomers age.

While recently developed treatments may stop the progression of AMD once the disease is diagnosed, there was no way to prevent onset of the disease.

The National Eye Institute (NEI) of the National Institutes of Health believed that development of a treatment modality that slowed the progression of AMD could have a tremendous impact on the number of affected patients.

To further this aim, the NEI established the Age Related Eye Disease Study (AREDS) to determine the effects of a high-dose vitamin and antioxidant regimen on the development and oc-

currence of macular degeneration and cataracts. Entering into a CRADA, Dr. Frederick L. Ferris from NEI partnered with the Storz Division of American Cyanamid on a ten-year clinical study.

The clinical trials tested a novel combination of vitamins A, C and E, as well as the minerals zinc, copper, and selenium. When Bausch & Lomb acquired Storz and rights to the CRADA, it continued to develop the AREDS formula. Based on a positive outcome of the clinical trial results, NIH and Bausch & Lomb filed a joint patent application claiming the use of this formula reduced the likelihood of developing age-related macular degeneration, and Bausch & Lomb exercised its option to license the CRADA invention.

The multivitamin and mineral formula that aids in the preservation and maintenance of healthy eyes is now available over the counter as Ocuvite®.



*Based on a positive outcome of clinical trial results, NIH and Bausch & Lomb filed a joint patent application claiming the use of this formula reduced the likelihood of developing age-related macular degeneration.*

National Institutes of Health  
[www.nih.gov](http://www.nih.gov)

The National Institutes of Health (NIH), a part of the Department of Health and Human Services, is the primary federal agency for conducting and supporting medical research. Helping to lead the way toward important medical discoveries that improve people's health and save lives, NIH scientists investigate ways to prevent disease as well as the causes, treatments, and even cures for common and rare diseases.

# Army Delivers Water to Katrina Victims, Makah Indian Reservation Residents

*“...to support the Federal Emergency Management Agency’s Hurricane Katrina relief effort...TARDEC provided two 100,000-gallons-per-day purification systems, along with ten technicians and engineers, to the disaster area.”*

The U.S. Army Tank Automotive Research Development and Engineering Center (TARDEC), the Department of Interior’s Bureau of Reclamation (BoR), and the Office of Naval Research (ONR) have provided potable water for various disaster and emergency relief efforts across the U.S.

Originally designed to support large military units during deployment and sustainment operations, the Expeditionary Unit Water Purifier (EUWP) is capable of supplying potable water from virtually any water source, including nuclear, biological and chemical contaminated sources. A single EUWP can produce up to 100,000 gallons of potable water per day from seawater or 200,000 gallons of potable water from freshwater.

“Using the EUWP technology to aid in state-side humanitarian relief not only supports the near term needs of our citizens, but allows the Army to see how the technology works in real-world scenarios. It gives us (TARDEC) an opportunity to validate years of R&D desalination efforts,” stated Col. Bryan McVeigh, TARDEC Military Deputy.

The purifier consists of two separate configured platforms that are compatible with the military’s palletized load system trucks and most commercial line haul transports. The system uses ultra-filtration to process freshwater and reverse osmosis technology to filter sea-

water. The use of large water bladders enables the EUWP to store up to 40,000 gallons of potable water. The self-contained purification system is powered by a 60-kilowatt diesel generator.

Putting the EUWP into action, TARDEC and the Office of Naval Research deployed an Army-Navy team of engineers and technicians, along with two EUWPs, to Mississippi to support the Federal Emergency Management Agency’s (FEMA) Hurricane Katrina relief effort.

Under a formal mission assignment, TARDEC provided two 100,000-gallons-per-day purification systems, along with ten technicians and engineers, to the disaster area. The purification systems provided potable water to the Biloxi Regional Medical Center and the Port of Pascagoula, 24 hours per day for several weeks, meeting the 72,000-gallons-per-day demand.

In September 2006, an EUWP platform was deployed to Neah Bay, Wash., where the Makah Indian reservation had nearly run dry. The diesel-powered desalination system turned seawater into drinking water for 1,800 residents.

The Indian Health Service contacted the Army after learning of TARDEC’s role during the Hurricane Katrina relief effort. The EUWP was transported to Neah Bay from the Navy Facilities Engineering Service Center at Port Hueneme, Calif.





*Image courtesy of U.S. Army TARDEC*

*Located in what was the outdoor pool area of the Biloxi Hard Rock Hotel, the EUWP consists of two major components: a reverse osmosis skid for purification of salt water and an ultra-filtration skid for freshwater. The entire system can be set up and operational within six hours and is transportable by military C-130 or any line haul truck.*

Tank Automotive Research Development and Engineering Center  
**[www.tacom.army.mil](http://www.tacom.army.mil)**

TARDEC, part of the U.S. Army Research, Development and Engineering Command (RDECOM), is the nation's laboratory for advanced military automotive technology. TARDEC develops and integrates the right technology solutions to improve the effectiveness of the current force and realize the superior capability of the future force in order to facilitate Army transformation. Its technical staff leads research in ground vehicle survivability, mobility, intelligent systems, and maneuver support and sustainment.

# SPAWAR Tech to Assist First Responders, Architects, Oil Companies, and the Family Car

*“These accelerometers are so sensitive that they can measure the natural movement of a building or even the blood flowing in your brain.”*

What do navigation systems and vibration monitoring have in common? They both use accelerometers to make their measurements.

Accelerometers are sensors that measure acceleration. Navigation systems use them to measure the changes in acceleration for the craft they are navigating. Vibration monitors use them to measure the force of vibrations for applications ranging from earthquake measurements to machine monitoring. After all, a vibration occurs because a system accelerates back and forth. Navigation-grade accelerometers are the “top gun” of the accelerometer world, offering performance capabilities that are the envy of the industry, but at a price that only the U.S. government can afford. However, all of this is about to change thanks to some extremely innovative work over the past six years by Dr. Richard Waters at the Navy’s Space and Naval Warfare Center Systems Center, San Diego (SPAWAR).

The problem with navigation-grade accelerometers is that they are very expensive to manufacture. They are precision-crafted instruments that require a great deal of care to make properly. But Dr. Waters has developed an entirely new accelerometer technology that can be batch manufactured using microelectromechanical systems (MEMS) techniques. MEMS-based accelerometers have been around for decades,

but existing examples operate using a capacitive technique. Dr. Waters’ approach is a complete departure from traditional MEMS accelerometers and utilizes an all optical technique. The benefits of this technique are staggering. Sensitivity over traditional MEMS accelerometers has been improved by four orders of magnitude, and low frequency response, a weakness for traditional MEMS accelerometers, is a strong suit of the new optical approach.

Through SPAWAR’s Technology Transfer Office, Omega Sensors, Inc., has licensed this technology and is in the process of bringing navigation-grade accelerometer performance to countless other applications. With an accelerometer technology like this one, the applications are limited only by your own imagination.

These accelerometers are so sensitive that they can measure the natural movement of a building or even the blood flowing in your brain. This improved sensitivity will allow significant improvements in robotic control, vibration monitoring, and more. Imagine a building that inspects its own structural integrity after an earthquake, or a personal locator device that works even in areas where a global positioning system is unavailable.

Oil and gas companies will be able to locate oil before drilling, and the family car will be able to drive itself home using its own high-end navigation system.



*Dr. Waters' new accelerometer technology could lead to buildings that inspect their own structural integrity after an earthquake, oil and gas companies being able to locate oil before drilling, and the family car driving itself home using its own high-end navigation system.*

**Space and Naval Warfare Systems Center**  
**<http://enterprise.spawar.navy.mil>**

Space and Naval Warfare Systems Center San Diego (SSC San Diego) is responsible for development of the technology to collect, transmit, process, display and, most critically, manage information essential to successful military operations. The Center develops the capabilities that allow decision-makers of the Navy, and increasingly of the joint services, to carry out their operational missions and protect their forces.

# Working to Better Clothing, Military Armor, and Car Seats

*“CAESAR unfolded via a CRADA between AFRL and SAE, with 35 commercial companies in the original partnership, including apparel makers Gap, Inc. and Levi Strauss & Company, defense contractor The Boeing Company, farm equipment manufacturer John Deere, and the Ford Motor Company.”*

One researcher’s vision of a three-dimensional (3-D) anthropometric database has generated a nascent worldwide organization, uniting ten countries on six continents in a quest to better fit the human body with its clothing, technology and environment.

Kathleen Robinette, Ph.D., principal research anthropologist for the Air Force Research Laboratory’s Human Effectiveness Directorate (AFRL/HE), had the vision and persistence to lead a series of groundbreaking anthropometric advances, including formation of the World Engineering Anthropometry Resource (WEAR). Sponsored by the Air Force Office for Scientific Research, WEAR bills itself as “an international collaboration between researchers and users of anthropometric databases for practical application.”

Through WEAR, a not-for-profit organization headquartered in France, Dr. Robinette nurtures a worldwide user consortium and is building a database of engineering, anthropometry and fit data. Through multiple Cooperative Research and Development Agreements (CRADAs) and Small Business Innovative Research (SBIR) contracts, Dr. Robinette has advised companies on applications ranging from better fitting clothing, protective equipment and military body armor, to more comfortable and ergonomically correct car inte-

riors and office chairs. WEAR’s vanguard was a precedent-setting collection of 3-D human body surface scans known as CAESAR—the Civilian American and European Surface Anthropometry Resource—which cataloged 3-D scans of 2,375 North Americans and 2,056 Europeans of various weights, shapes and sizes, ages 18 to 65, plus 40 hands-on measurements of each subject.

CAESAR unfolded via a CRADA between AFRL/HE and the Society of Automotive Engineers (SAE), with 35 commercial companies in the original partnership, including apparel makers Gap, Inc. and Levi Strauss & Company, defense contractor The Boeing Company, farm equipment manufacturer John Deere, and the Ford Motor Company. General Dynamics Advanced Information Systems (GDAIS) now has a CRADA to operate AFRL’s Computerized Anthropometric Research & Design (CARD) laboratory and serve as liaison for commercial companies to gain access to AFRL’s anthropometric research facilities.

Direct private-industry involvement “was extremely valuable,” said Dr. Robinette. “It helped me understand the knowledge level of ergonomics and anthropometry in the different industries, which is really helpful in determining how to solve the unique problems facing each industry.”



*Daisy Veitch, founder and operating manager of SHARP Dummies Pty. Ltd., Australia, demonstrates how lifelike mannequins are used for fitting jeans and other clothing. Ms. Veitch designed the mannequins using CAESAR data and her proprietary design process.*

**Air Force Research Laboratory**  
**[www.afrl.af.mil](http://www.afrl.af.mil)**

The Air Force Research Laboratory is headquartered at Wright-Patterson Air Force Base, Ohio. AFRL's mission is leading the discovery, development, and integration of affordable warfighting technologies for Air Force air and space forces. The Human Effectiveness Directorate is one of ten AFRL technology directorates. Its mission is to lead revolutionary science and technology for superior airman cognition, readiness, performance, and survival.

# ARS Helps 20 Million People Avoid the Sting of Fire Ants

*"This fiery pest now infests over 130 million acres in the southeastern United States, including Puerto Rico."*

A team of researchers led by Agricultural Research Service (ARS) scientists in Gainesville, Fla., joined forces with federal, state and local officials to combat fire ants. The team developed and demonstrated an area-wide integrated pest management approach for imported fire ant suppression.

Fire ants are thought to have spread to the United States from their native South America via contaminated ships in the early 1900s. This fiery pest now infests over 130 million acres in the southeastern United States, including Puerto Rico. They have also recently become established in California, Arizona, New Mexico, and Maryland. ARS researchers believe fire ants have flourished in the United States because they have no natural enemies here—at least until now.

The control techniques used to suppress the pests include releasing several parasitic phorid fly species, distributing a fatal fire ant-specific pathogen (*Thelohania solenopsae*), and developing baits containing a quick acting toxicant and a growth regulator that stops egg production in the queen. Phorid flies are a highly specific, natural enemy of fire ants. The female phorid fly pierces a fire ant's head and deposits an egg. The egg quickly hatches into a fly larva

that moves into the ant's head. When the maggot is mature, it releases an enzyme that causes the ant's head to fall off—decapitation.

*Thelohania* is a microorganism from South America that infects fire ant colonies and causes disease. Fire ant workers transfer the pathogen to the queen by food exchange. As the disease slowly reduces the queen's weight, she lays fewer and fewer eggs—all infected with the pathogen, further weakening the colony.

ARS scientists developed rearing and distribution techniques for both fire ant defenses—critical to the program's success. Fire ant populations have been reduced by more than 80% in demonstration sites. Sustainable biological control agents have been released in much of the ant-infested area, and phorid flies are well established in 8 states with over 100,000 square miles and 20,054,000 people impacted. The program's impact is critical since fire ants pose threats to humans and animals from their defensive stings. The pests also have an ecological impact, especially on endangered species like Stock Island tree snails, gopher tortoises, Florida grasshopper sparrows, salt marsh rabbits, and sea turtles that hatch their eggs on land.



*Black imported fire ant traveling on a plastic strip that hangs from a lifter cup, which is part of a system designed to make fire ants susceptible to phorid fly attack.*

*Scott Bauer*



*Daniel Wojcik*

*A scientist was stung over 250 times on one leg when he carelessly knelt on a collapsed fire ant mound.*

**Agricultural Research Service**  
**[www.ars.usda.gov](http://www.ars.usda.gov)**

The Agricultural Research Service is responsible for developing new knowledge and technology to solve agricultural problems; ensure the productivity of high-quality food and agricultural products to meet the nutritional needs of U.S. consumers; sustain a viable food and agricultural economy; and maintain a quality environment and natural resource base.

# Keeping Natural Gas Affordable and Environmentally Friendly

*“Since April 2005, one-third of Fresno’s school buses have been filling up at the INL-developed, state-of-the art, natural gas fueling station at the Southwest Education Support Center (SESC) in Caruthers, California.”*

Affordable energy is a key concern in the 21st century. Since the late 1980s, natural gas has become more widely available, more popular and environmentally friendly. As a result, gas demand is outrunning the current supply system, causing both high prices and price volatility. According to the Department of Energy, the demand for natural gas is expected to increase 25% over the next decade.

Researchers at Idaho National Laboratory (INL) have developed the first liquefaction technology that is very compact, yet able to use natural gas directly from transmission lines without costly pretreatment to remove water and carbon dioxide contaminants. The INL technology produces liquefied natural gas (LNG) that is competitive with that produced in some of the largest facilities on the planet. The secret of this highly efficient technology is that it uses “free” energy from pipeline pressure letdown to liquefy the natural gas, and it incorporates a patented centrifugal solids separation step to remove frozen carbon dioxide that could clog the system.

INL recognized the far-reaching applications of this technology when it was first disclosed in 1997. In 2000, a Cooperative Research and Development Agreement (CRADA) with PG&E and Southern California Gas Company (SCGC) led to the construction of a 10,000-gallon-a-day plant located in Sacramento. Its compact size and auto-

mated operation allowed the liquefaction facility to be located within Sacramento’s Historic District.

Following the success of the PG&E and SCGC CRADA, INL and the Southwest Transportation Agency in California, the Hanover Compression Limited Partnership and the San Joaquin Valley Air Pollution Control District partnered to develop and demonstrate a liquid and compressed natural gas (L/CNG) fueling station. Since April 2005, one-third of Fresno’s school buses have been filling up at the INL-developed, state-of-the art, natural gas fueling station at the Southwest Education Support Center in Caruthers, Calif. Not only does this station help decrease the use of imported petroleum, it also serves as a testing facility for new L/CNG fueling technology.

The INL Compact High Efficiency Natural Gas Liquefier has generated worldwide licensing interest with inquiries received from 36 countries. Representatives from many of these countries, including Canada, Mexico, Argentina, Brazil, Peru, Chile, Kazakhstan, Thailand and Bangladesh, have visited INL in Idaho Falls, Idaho, or the liquefaction facility in Sacramento, Calif.

In 2006, the technology received an R&D 100 Award recognizing the 100 most technologically significant products and advancements in the world and an FLC Far West Region Award for Outstanding Technology Development.





*Compact High Efficiency Natural Gas Liquefier located at 2001 Front Street in Sacramento, Calif.*

Idaho National Laboratory  
[www.inl.gov](http://www.inl.gov)

In operation since 1949, INL is a science-based, applied engineering national laboratory dedicated to supporting the Department of Energy's missions in nuclear and energy research, science, and national defense. INL is operated for the Department of Energy by Battelle Energy Alliance and its partners, each of which provides unique educational, management, research and scientific assets to a world-class national laboratory.

# Army Laboratory Boosts Security at the Super Bowl

*"ODIS is a significant technology improvement from the old-fashioned 'mirror on a stick' approach to searching the underside of vehicles."*

*Henry Andrusz  
TARDEC ODIS Project Manager*

To help support heightened homeland security efforts, the U.S. Army deployed several Omni-Directional Inspection System (ODIS) robots during Super Bowl XL and the 2006 Major League Baseball All-Star Game.

Developed by the U.S. Army's Tank Automotive Research, Development and Engineering Center (TARDEC) and built by Kuchera Defense Systems in Windber, Pa., ODIS is a robotic system that assists in under-vehicle inspections at military and other security checkpoints. FirstLink, a Department of Defense Center for National Excellence located at the University of Pittsburgh, facilitated the introduction of TARDEC and Kuchera to the NFL Security Office, leading to ODIS's involvement in Super Bowl security activities.

Currently used by soldiers in Iraq and Afghanistan, ODIS provides users with a highly mobile platform that can be controlled from a safe standoff position, putting the user out of harm's way while giving them enhanced visibility and sensor placement capability for inspections. "ODIS is a significant technology improvement from the old-fashioned 'mirror on a stick' approach to searching the underside of vehicles," said Henry Andrusz, TARDEC ODIS Project Manager.

At only 4 inches high and weighing about 30 pounds, ODIS can travel under virtually every type of vehicle while its multiple onboard computers and video

camera capture detailed images and relay them to an operator safely removed at distances up to 100 meters.

Soldiers from the 110th Fighter Wing Security Forces Squadron of the Michigan Air National Guard operated ODIS during 24-hour security inspections at NFL headquarters in Detroit and during the 15th annual America Online NFL Experience at Cobo Center.

ODIS represents a solid example of technology transfer from the military to first responders. After successfully completing its mission in Detroit, FirstLink saw that ODIS would fit the needs of the Pennsylvania Region 13 Task Force, a first responder hazards and counterterrorism emergency management unit, during the 2006 All-Star Game and the 2006-2007 National Football League season.

Region 13 purchased six ODIS robots from Kuchera for deployment at several security checkpoints around Pittsburgh's PNC Park.

"Given the increased importance of unmanned robotic vehicles for both military and civilian operations that present high risk to personnel, the future of ODIS is a bright one," said Jim Rooney, Director of FirstLink. "FirstLink continues to explore with Kuchera and TARDEC new adaptations of ODIS technology, such as survivor missions and detection of chemical or biological hazards in contaminated areas."



*Image courtesy of U.S. Army TARDEC*

*Soldiers from the 110th Fighter Wing Security Forces Squadron of the Michigan Air National Guard operate ODIS during the 15th annual America Online NFL Experience at Cobo Center in Detroit.*

Tank Automotive Research, Development and Engineering Center  
**[www.tacom.army.mil](http://www.tacom.army.mil)**

TARDEC, part of the U.S. Army Research, Development and Engineering Command (RDECOM), is the nation's laboratory for advanced military automotive technology. TARDEC develops and integrates the right technology solutions to improve the effectiveness of the current force and realize the superior capability of the future force in order to facilitate Army transformation. Its technical staff leads research in ground vehicle survivability, mobility, intelligent systems, and maneuver support and sustainment.

# Berkeley Device Predicts Ocean's Response to Rising CO<sub>2</sub>

*"...this technology will provide the observational basis for accurate models of the carbon cycle and thus guide human efforts to control the release of CO<sub>2</sub> to the atmosphere."*

Imagine waking up each morning and discovering that 20% of all plants in your garden had been eaten overnight.

Equally astonishing would be the discovery in the afternoon that new plants had taken their place. This is the norm of life in the ocean. Without the ability to accurately observe these daily changes in ocean life cycles over vast spatial scales, we cannot predict how the ocean will respond to rising CO<sub>2</sub> levels, crippling our ability to develop accurate models of global warming or devise strategies to prevent it.

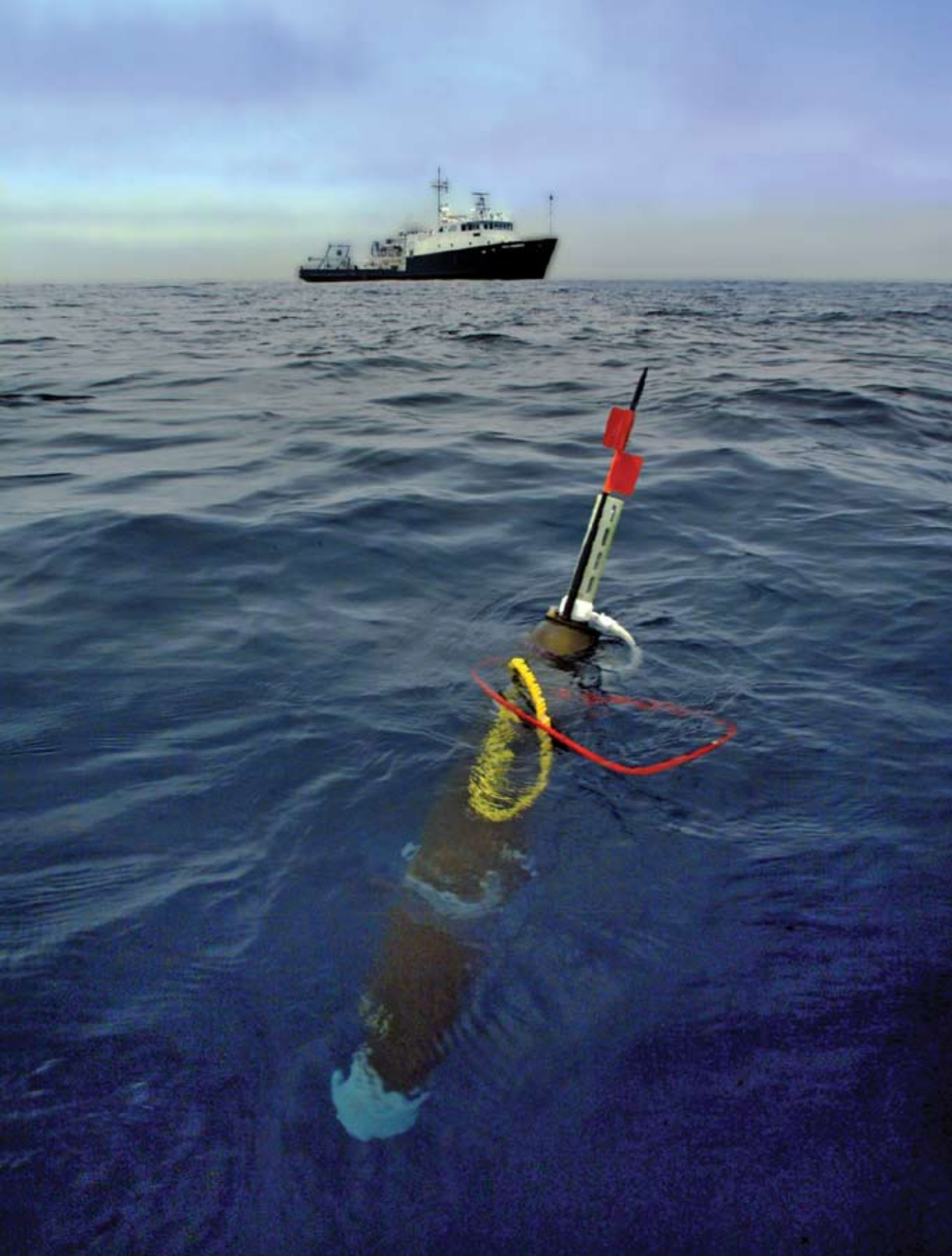
The Carbon Explorer, conceived by Lawrence Berkeley National Laboratory's James K. Bishop in collaboration with Scripps Institution of Oceanography (La Jolla, Calif.) and WET Labs, Inc. (Philomath, Ore.), bridges this observational gap.

The device is a smart, low-cost robotic ocean float that measures carbon concentrations in the ocean. With its system of optical sensors, advanced communications devices and remote operating capacity, the Carbon Explorer enables, for the first time, the continuous tracking of the biological processes of the carbon cycle in the ocean. At present, model simulations of the ocean carbon cycle, carried out using the world's fastest and most advanced computers, are the only way to attempt to predict the future of the ocean's impact on climate change. The current generation of models includes biological processes, but only in a very simplistic way. The observations guiding model predictions are largely based on data collected from

ships—which cannot work safely in bad weather or in remote ocean locations for very long.

By contrast, Carbon Explorers have been deployed to date in some of the world's most remote and extreme ocean environments, consistently yielding data that have never before been generated. Once placed in the water by research vessel, small boat or aircraft, the Carbon Explorer activates and locates itself in space using signals from global positioning system (GPS) satellites, and then begins a mission based on a set of preprogrammed instructions. The Carbon Explorer collects temperature, salinity, and particulate carbon data at various depths down to several kilometers. Upon surfacing, the Carbon Explorer sends the data to satellites overhead.

The device can stay in the ocean year-round to observe the annual variations in the ocean carbon cycle. It measures particulate organic carbon at a level of accuracy, precision, and frequency previously unachieved, and it does so in real time. The Carbon Explorer has already led to new insights—and shown some weaknesses in current understanding—that will enable better model-simulation accuracy. In the not-too-distant future, Carbon Explorer technology will form the basis for a global carbon observing system capable of real-time assessment of atmosphere-to-ocean exchanges of CO<sub>2</sub>. Equally important, this technology will provide the observational basis for accurate models of the carbon cycle and thus guide human efforts to control the release of CO<sub>2</sub> to the atmosphere.



*Carbon Explorers are ocean floats with carbon sensors, enhanced communications, and remote programming capacity. They are enabling scientists to track variations in the ocean's carbon cycles year-round with unprecedented accuracy.*

Lawrence Berkeley National Laboratory  
**[www.lbl.gov](http://www.lbl.gov)**

LBNL has been a leader in science and engineering research for more than 70 years. Located on a 200-acre site in the hills above the University of California's Berkeley campus, LBNL holds the distinction of being the oldest of the Department of Energy's national laboratories. LBNL conducts research in fundamental studies of the universe; quantitative biology; nanoscience; energy systems; and environmental solutions.

# KCP Tech Helps Recycle 250M Pounds of Plastic, 15M Gallons of Oil a Year

*“ECO<sub>2</sub> does not create any wastestreams, unlike water-wash systems that collectively discharge 100 billion gallons of contaminated water into the environment each year.”*

Kansas City Plant (KCP) engineers have developed a cleaning process to recycle all consumer plastics, regardless of the contaminant. The new process uses liquid carbon dioxide and a proprietary solvent to remove oil residue from empty plastic motor oil bottles.

KCP transferred this technology to International Technologies Group (Itec), a company that offers solutions to pressing environmental problems faced by public agencies and private entities in plastic recycling. Upon receiving a license for this oil-removal technology from KCP, Itec developed machinery to produce marketable plastic chips out of post-consumer plastic that was previously unusable due to contamination.

Propelled by KCP’s cleaning technology, Itec’s ECO<sub>2</sub> system surpasses other methods of plastics recycling for several reasons. Most importantly, the liquid carbon dioxide and special solvent it uses are both reusable, so ECO<sub>2</sub> does not create any wastestreams, unlike water-wash systems that collectively discharge 100 billion gallons of contaminated water into the environment each year.

And because it has no environmental impact, special waste permits are not required to set up an ECO<sub>2</sub> recycling facility, which makes it less costly to start up. Overall, the ECO<sub>2</sub> system costs 30% less to operate than traditional water-wash recycling systems.

It is estimated that in the United States—from oil bottles alone—250 million pounds of plastic and 15 million gallons of oil could be recycled annually. The ECO<sub>2</sub> process not only provides a way to recycle plastic into a marketable product, but it also harvests the residual oil left in used bottles to be sent back to the refinery instead of to a landfill. No other plastics recycling method can do this.

Though originally intended for cleaning used oil bottles, this technology can completely remove glue, labels, oil and dirt from plastic containers as well. It also eliminates all odors, making the plastic cleaner, more marketable and more profitable than plastics cleaned with water-washing. ECO<sub>2</sub> generates FDA-approved clean plastics, which are in high demand in the plastics industry, especially for use in produce packaging.

This revolutionary technology is already making a big difference. In California, used motor oil bottles are now collected at certified collection centers and municipal household hazardous waste facilities, and through curbside recycling programs to be handed over to Itec for recycling.

As more cities are requiring closed-loop recycling to prevent waste from going into landfills, KCP’s cleaning process and Itec’s ECO<sub>2</sub> system will provide more opportunities for both plastics businesses and the environment to profit.



*Plastic bottles waiting to be recycled at the Itec facility. The number of bottles Itec recycles will only grow in the years to come as more cities require closed-loop recycling to prevent waste from going into landfills.*

**Kansas City Plant**  
**<http://www.honeywell.com/sites/kcp>**

As part of the National Nuclear Security Administration's (NNSA) nuclear weapons complex, the Kansas City Plant's primary mission is to assemble and manufacture components for national defense systems. However, it is a multi-mission facility that supports other government agencies as well as national laboratories, universities, and U.S. industry.

# Princeton Lab Detects Nuclear Signatures Within Moving Vehicles, Cargo Vessels

*"MINDS can detect one-billionth of the material deemed plausible to create a radiological dispersion device—a 'dirty bomb.'"*

Antiterrorism efforts are getting a boost from the Department of Energy's Princeton Plasma Physics Laboratory (PPPL). The laboratory has developed a Miniature Integrated Nuclear Detection System, called MINDS, which can be used to scan moving vehicles, luggage, cargo vessels, and the like for specific nuclear signatures associated with materials employed in radiological weapons.

MINDS could be employed at workplace entrances, post offices, tollbooths, airports and commercial shipping ports, as well as in police cruisers. A compact system that combines many off-the-shelf components with specific nuclear detection software, MINDS is capable of detecting x-rays, soft gammas, gammas, and neutrons. Radionuclides can be recognized and differentiated from one another since each has a distinctive energy signature or fingerprint. The system compares the energy spectrum of the detected radionuclide with the spectra of particular radiological materials that might be used in weapons.

In March 2005 Princeton University signed a licensing agreement with InSight, a not-for-profit organization that brings government-developed technology to market. MINDS is currently deployed at a U.S. military base, at a major rail and bus commuter center in the northeastern United States, and at

a large company that provides security services to airports worldwide. MINDS can detect one-billionth of the material deemed plausible to create a radiological dispersion device—a "dirty bomb." It is capable of differentiating among naturally occurring radioactive elements, authorized medical and acceptable industrial nuclear substances, and threat materials.

As MINDS scans a target, in approximately one second the system senses, identifies, and transmits the presence of radioactive materials at levels slightly above background. Also, since it is a passive system, it does not need to emit a radiation signal to excite the target source.

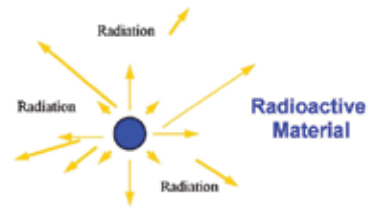
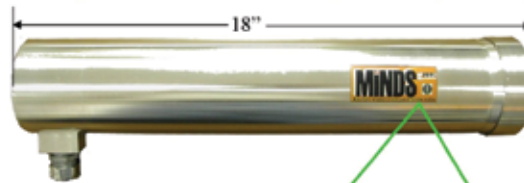
MINDS can be fitted with up to three different radiation detectors, or heads, to cover a whole gamut of nuclear radiation. The detector heads can include, for example, a boron trifluoride or helium tube to detect neutrons; a PIN diode or a cadmium zinc telluride detector to detect x-rays and low-energy gamma rays; and a sodium iodide crystal to detect higher energy gamma rays.

MINDS is typically configured to work with a laptop, but can also employ desk tops and main frames to store a library of the nuclear spectra or nuclear "signatures" of radioactive elements in conjunction with advanced artificial intelligent algorithms.





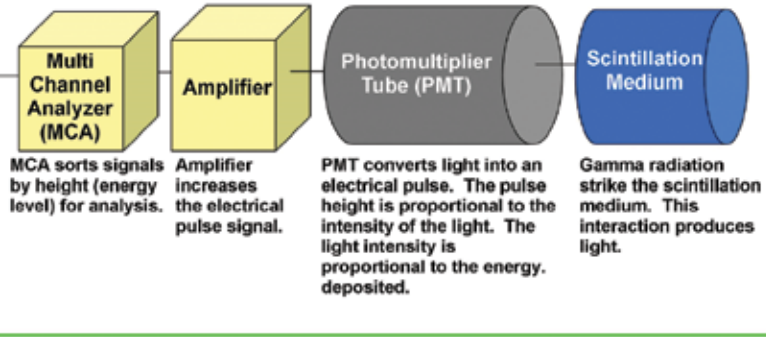
# How MINDS Works



Inside case



Two advanced algorithms analyze the data identifying in real-time radionuclides resident in the MINDS library.



**Multi Channel Analyzer (MCA)**  
MCA sorts signals by height (energy level) for analysis.

**Amplifier**  
Amplifier increases the electrical pulse signal.

**Photomultiplier Tube (PMT)**  
PMT converts light into an electrical pulse. The pulse height is proportional to the intensity of the light. The light intensity is proportional to the energy deposited.

**Scintillation Medium**  
Gamma radiation strike the scintillation medium. This interaction produces light.

*How MINDS works*

Princeton Plasma Physics Laboratory  
<http://www.pppl.gov>

The Princeton Plasma Physics Laboratory is a Collaborative National Center for plasma and fusion science. Its primary mission is to develop the scientific understanding and the key innovations that will lead to an attractive new energy source. Associated missions include conducting world-leading research along the broad frontier of plasma science and technology, and providing the highest quality of scientific education.

# NASA Invention Monitors Bridge Integrity, Shuttle Tiles, and Heart Disease

*“The capability being created in the van represents the beginning of a paradigm shift in the way states will view and be able to carry out their stewardship of the nation’s highway infrastructure.”*

*Dr. Morton Oskard  
Turner-Fairbank Highway  
Research Center*

A three-year agreement with Turner-Fairbank Highway Research Center (TFHRC) has enabled scientists to learn how to apply NASA Goddard Space Flight Center’s Hilbert-Huang Transform (HHT) technology to analyses of traffic flow data, wind and traffic interaction with bridges, and damage detection in pavement and bridges.

These analyses are the basis of TFHRC’s digital highway measurement (DHM) project and are the first steps in a dramatic shift in the way state transportation departments will be able to improve the safety and performance of the nation’s highway infrastructure.

A revolutionary, adaptive set of signal-analysis algorithms, HHT was developed as part of NASA’s oceanography research and was later applied to analysis of wing-flutter tests and the next generation of aircraft design at NASA Dryden Flight Center. The technology has also contributed to Space Shuttle mission safety by testing the tiles that insulate the Shuttle in space for the Shuttle Return to Flight Project following the Columbia accident.

Dr. Norden Huang began developing HHT in 1995. Unlike precursor technologies, HHT provides an effective method for analyzing nonlinear and nonstationary signals while improving the accuracy of linear- and stationary-signal anal-

ysis. Because analytical measurements within many areas of science benefit from a quantitative measurement of nonlinear data, HHT is widely applicable to a broad range of fields, including medicine, electronics, the environment, and business. HHT is ideal for structural engineering analyses at TFHRC.

The Space Act Agreement between TFHRC and Goddard was negotiated and administered by the Office of Technology Transfer. Initial contact was made at a seminar attended by Dr. Huang. Officials from TFHRC began discussions with Huang about the potential use of HHT in highway research, and this led to a formal agreement. During the course of the three-year agreement, TFHRC scientists have collaborated directly with Dr. Huang to build an operational model of HHT for their own analyses and to build a knowledge base for using the HHT algorithms within their own staff, working toward the successful DHM project. The resulting DHM van collects and analyzes critical highway safety data, which can lead researchers to better bridge and highway safety, design and construction.

Having successfully built an internal research team skilled in HHT, TFHRC is interested in continuing research with Goddard to address other highway and safety areas. A new agreement may be considered for ongoing collaboration.



*The technology also contributed to Space Shuttle mission safety by testing the tiles that insulate the Shuttle in space.*

*The HHT technology is widely applicable to a broad range of fields, including bridge stability analysis, medicine, electronics, and the environment.*

NASA Goddard Space Flight Center  
<http://ipp.gsfc.nasa.gov>

The mission of NASA Goddard Space Flight Center is to expand knowledge of the Earth and its environment, the solar system, and the universe through observations from space. To assure that our nation maintains leadership in this endeavor, Goddard is committed to excellence in scientific investigation, in the development and operation of space systems, and in the advancement of essential technologies.

# Making Fire-Resistant Materials

*“This technology has tremendous potential to save lives in many different environments by measuring the heat released by burning materials in a fire.”*

*Deborah Germak  
FAA Technology Transfer  
Program Manager*

A team of scientists at the Federal Aviation Administration (FAA) has patented and licensed a product that will enable private industry to more quickly create new ultra fire-resistant materials that could dramatically increase aircraft cabin safety.

Richard E. Lyon, Ph.D., manager of the FAA's Fire Research Program based at the William J. Hughes Technical Center, developed the microscale combustion calorimeter with Richard N. Walters, an FAA research chemist, and Dr. Stanislav I. Stoliarov of SRA International.

“This technology has tremendous potential to save lives in many different environments by measuring the heat released by burning materials in a fire,” said Deborah Germak, FAA Technology Transfer Program Manager.

The microscale combustion calorimeter was the first laboratory (milligram) scale test created to assess fire proper-

ties of various materials. It determines how the materials are expected to burn by using minute samples and conditions that simulate burning. The calorimeter provides quantitative results in minutes instead of the hours it takes for other testing methods.

The FAA has already signed three licensing agreements for the calorimeter, marking the first time an FAA technology developed in a federal laboratory was transferred to the commercial market under the agency's Technology Transfer Program.

The agency can now start to receive its first-ever royalty stream. Technology transfer legislation provides for inventors to receive up to \$150,000 per year from these royalties, above their salaries. The federal laboratory, in this case the Technical Center, gets the remainder of the royalty money.



*The calorimeter assesses the fire properties of various materials in just minutes. It can determine how materials such as automobiles, aircraft cabins, and clothing are expected to burn by using minute samples and conditions that simulate burning.*

**FAA William J. Hughes Technical Center**  
**[www.tc.faa.gov](http://www.tc.faa.gov)**

The FAA William J. Hughes Technical Center is the national scientific test base for FAA research, development and acquisition programs. Center activities involve test and evaluation in air traffic control (ATC), communications, navigation, airports, and aircraft safety and security. Activities involve long-range development of innovative systems and concepts, development of new equipment and software, and in-service modification of existing systems and procedures.

# PREZISTA™, A New Hope for HIV Patients

*"...one million people in the United States are living with HIV and approximately 40,000 persons become infected each year. Over 40 million people worldwide are infected with HIV."*

**H**uman Immunodeficiency Virus (HIV) is the retrovirus that causes Acquired Immunodeficiency Syndrome (AIDS). According to the Centers for Disease Control and Prevention, one million people in the United States are living with HIV and approximately 40,000 persons become infected each year.

Over 40 million people worldwide are infected with HIV, making HIV/AIDS a rapidly growing global epidemic. Upon infection, the virus targets the immune system, destroying it as it multiplies. The body consequently loses its ability to defend itself from infections, which ultimately results in death.

Since identification of the HIV virus in 1983, much progress has been made in treatment. A variety of anti-HIV drugs have been developed to control viral reproduction, leading to delayed disease progression and decreased number of HIV/AIDS deaths.

However, mutant HIV strains that are resistant to current therapies have become a major medical challenge. For patients who have developed resistance to current therapies or become infected

with a drug-resistant strain of HIV, treatment options will run out.

PREZISTA™, a new anti-HIV drug may bring hope to these patients.

PREZISTA™ embodies a breakthrough against drug-resistant HIV strains, and its underlining technology is based on a joint invention from the National Cancer Institute (NCI) and the University of Illinois-Chicago (UIC). Drs. John Erickson, Sergei Gulnik and Hiroaki Mitsuya of NCI, and Dr. Arun Ghosh of UIC determined the unique HIV-resistance profile for an early analog of PREZISTA™ and filed a patent application in 1999, which included the current molecule for PREZISTA™. The technology was then licensed to Tibotec, Inc. (recently acquired by Johnson & Johnson), which further developed PREZISTA™.

In June 2006, PREZISTA™ was granted accelerated approval by the Food and Drug Administration to treat HIV patients who were not responding to existing anti-HIV drugs. PREZISTA™ offers considerable hope for HIV patients suffering from drug resistance, and it can potentially save hundreds of thousands of lives worldwide.



Image courtesy of Tibotec Inc.

*PREZISTA™ embodies a breakthrough against drug-resistant HIV strains, and its underlining technology is based on a joint invention from the National Cancer Institute and the University of Illinois-Chicago.*

National Cancer Institute  
[www.cancer.gov](http://www.cancer.gov)

The National Cancer Institute (NCI) is a component of the National Institutes of Health (NIH), one of eight agencies that compose the Public Health Service (PHS) in the Department of Health and Human Services (DHHS). The National Cancer Institute coordinates the National Cancer Program, which conducts and supports research, training, health information dissemination, and other programs with respect to the cause, diagnosis, prevention, and treatment of cancer, rehabilitation from cancer, and the continuing care of cancer patients and their families.

# NASA Tech Makes Military, Civilian Aircraft Safer

*“The technology used in the SWR device was developed to detect problems that could lead to accidents such as the one that resulted in the catastrophic failure of TWA 800 a few years ago.”*

*Dr. Pedro Medelius  
ASRC Aerospace Corporation*

**B**agram, Afghanistan, October 2004, and one particular Prowler aircraft was exhibiting intermittent problems on a critical cockpit display panel. To make matters worse, these problems were seldom seen during troubleshooting, but occurred multiple times on nearly every flight.

It was a major safety problem, especially when flying at night in a war zone in mountainous terrain. Squadron maintainers had been troubleshooting for weeks, changing all associated removable components and performing wire checks with no discernable success. After approximately 60 hours of troubleshooting, which included phone consultation with engineering and the manufacturer of the electronic system that was providing intermittent symptoms, the Naval Air Technical Data and Engineering Service Command (NATEC) decided to try the Eclipse ESP+ Standing Wave Reflectometer (SWR), and immediately observed a measured change of conductor length compared to similar paths on the same aircraft.

The Eclipse ESP+ SWR tester was developed by NASA Kennedy Space Center, licensed to and manufactured by Eclipse International, and provided to NATEC under the Automated Wiring Analysis (AWA) Program. Eclipse is currently marketing two commercial SWRs based on the NASA patent. One is the ESP, which provides technicians with a simple, plain-English response regarding where the fault is located from the point they are testing. The second product is the ESP+, which provides added

memory and software for looking at the reflections from the aircraft, which is useful in determining some level of “soft fault.”

Future configurations of the model ESP SWR fault location technology may be seen in other products, such as onboard aircraft, and in a variety of applications other than aircraft. “The technology used in the SWR device was developed to detect problems that could lead to accidents such as the one that resulted in the catastrophic failure of TWA 800 a few years ago,” said Dr. Pedro Medelius, Chief Technologist for ASRC Aerospace Corporation, which helped invent the technology. “In that instance, a broken wire inside an empty fuel tank created a spark that ignited the remaining fuel vapors in the tank and caused a major explosion.” When looking at a massive launch vehicle or aircraft, it’s hard to imagine that a problem with one tiny wire could paralyze performance; however, with this portable tool, it is now possible to accurately pinpoint malfunctions within cables and wires to reliably verify conditions of electrical power and signal distribution.

The Eclipse Model ESP+ has undergone operational evaluation by the Navy, Marines, and Air Force, and the Army has now put these instruments into the battle damage and repair kits that go to Afghanistan, Iraq, and other parts of the world where helicopter support is required. This innovation has certainly proved to be versatile in saving time and lives.





*ESP inventor Dr. Pedro Medelius in his laboratory.*

**NASA Kennedy Space Center**  
**<http://www.nasa.gov/centers/kennedy>**

The mission of the Innovative Partnerships Program Office (IPPO) at NASA KSC is to provide leveraged technology alternatives to the Mission Directorates, Program and Projects through joint partnerships with industry, academia, government agencies and national laboratories. The Office's product elements can be broadly grouped into the following areas: 1) Emergent Technologies; 2) Technology Partnerships; 3) Intellectual Property Management; 4) Infrastructure Investments and Process Improvements; and 5) Nontraditional Partnerships.

# ARS Finds Smoke-Clearing Tech From Poultry House Tool

*“In addition, since the device can also be portable, firefighters could carry one into smoke-filled buildings to make it easier to find people who have been overcome.”*

A device invented by the Agricultural Research Service (ARS) to clean dust and microorganisms from the air of poultry houses may also help people escape during fires and make it easier for firefighters to locate people in smoke-filled rooms.

The technology was originally developed by agricultural engineer Bailey Mitchell of ARS's Southeast Poultry Research Laboratory in Athens, Ga., to trap airborne particles like dust and microbes in poultry houses. Unlike previous technology, which was typically large, bulky, expensive, and cost from \$1,000 to \$25,000, Mitchell's machine is relatively small and could be portable and battery-operated.

ARS has already licensed the device, called the Electrostatic Space Charge System (ESCS), for agricultural applications to Baumgartner Environics, Inc., of Olivia, Minn.

ESCS generates a negative electrostatic charge on dust and other airborne particles, causing them to be attracted to grounded surfaces like walls or the floor. Unlike most air cleaners, it does

not require air to move through it for cleaning to occur.

Mitchell used a smoke generator to demonstrate ESCS's abilities, which gave rise to the idea that the device can clean the air of smoke just as easily as it does dust and microbes. What remains to be tested is just how fast it can actually clear smoke to provide a reasonably clear field of vision, according to Mitchell.

By mounting the self-contained, waterproof device in areas such as stairwells or hallways, it may be able to give people a clearer path to exits in the event of a fire. In addition, since the device can also be portable, firefighters could carry one into smoke-filled buildings to make it easier to find people who have been overcome. The device is also lightweight and may be of use in clearing smoke from airplanes and trains as well.

The University of Pittsburgh's FirstLink program, which has a contract with the Department of Defense to seek out new technology for first responders, is planning a series of tests and demonstrations to document the device's ability to clear smoke from the air.



*Agricultural engineer Bailey Mitchell demonstrates an electrostatic air cleaning system. The hatching cabinet used here is a small version of ones used commercially for hatching chicks.*

Agricultural Research Service  
**[www.ars.usda.gov](http://www.ars.usda.gov)**

The Agricultural Research Service is responsible for developing new knowledge and technology to solve agricultural problems; ensure the productivity of high-quality food and agricultural products to meet the nutritional needs of U.S. consumers; sustain a viable food and agricultural economy; and maintain a quality environment and natural resource base.

*Ken Hammond*

# SRNL's RadRope™ Safely Detects Nuclear Materials in Sealed Containers

*"...a lightweight portable system for rapidly detecting the presence of nuclear materials in sealed containers without the use of harmful x-rays."*

An agreement for an exclusive commercial license has been reached with UTEK Corporation of Tampa, Fla., and its wholly owned subsidiary, Nuclear Materials Detection Technologies, Inc. (NMDT), to manufacture and commercialize the RadRope™ Nuclear Materials Detection System developed by the Savannah River National Laboratory (SRNL).

The RadRope™ is a lightweight portable system for rapidly detecting the presence of nuclear materials in sealed containers without the use of harmful x-rays. Using sensors arrayed linearly and encased in fabric, the RadRope™ system can be dangled in the 2- to 4-inch gap between stacked shipping containers on a cargo ship by a customs inspector. As the inspector walks along the top containers, a handheld PDA shows an alarm when any sensor in the array detects radiation levels above background radiation.

The RadRope™ system can be used in a straight line, a curved line or at an angle, and the length of the system can be easily customized for a variety of different uses. NMDT anticipates use of the technology in a variety of configurations for both seagoing cargo containers and air freight.



The RadRope™ Nuclear Materials Detection System

Savannah River National Laboratory  
[www.srnl.gov](http://www.srnl.gov)

SRNL was constructed during the early 1950s to produce the basic materials used in the fabrication of nuclear weapons, primarily tritium and plutonium-239, in support of our nation's defense programs. SRNL now serves the nation through safe, secure, cost-effective management of the nation's nuclear weapons stockpile, nuclear materials, and the environment.

# A Better Warning System for Diagnosing Heart Disease

*“Half of the 1.5 million heart attacks in the U.S. each year strike people without symptoms who also have normal levels.”*

Eighty percent of individuals suffering from coronary artery disease (CAD) have normal cholesterol levels. Half of the 1.5 million heart attacks in the U.S. each year strike people without symptoms who also have normal levels. In an effort to provide a better warning system, Lawrence Berkeley National Laboratory (LBNL) scientists have now developed a more complete cholesterol assessment test that will identify individuals like these who may have no idea they are at risk.

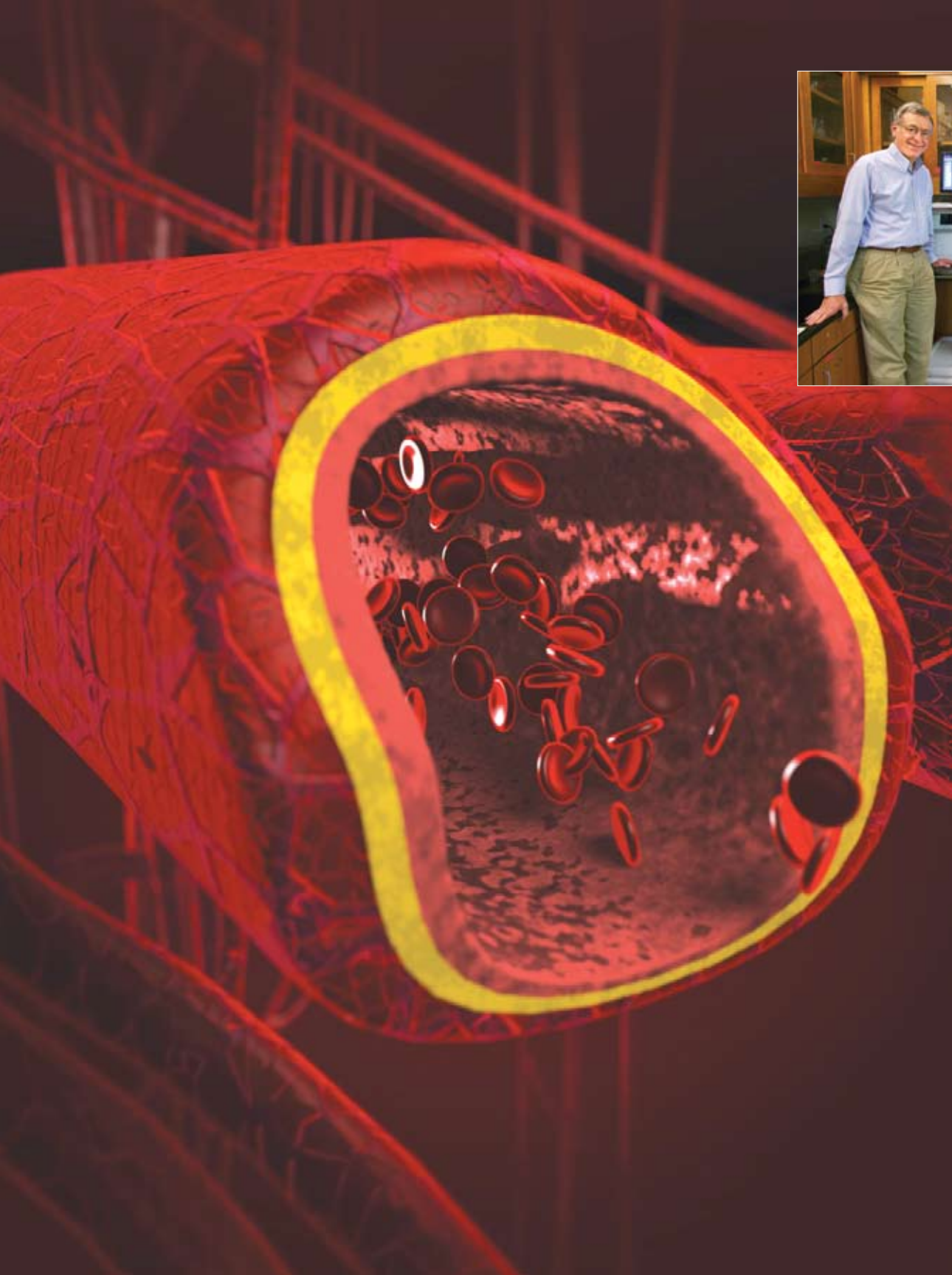
A standard total cholesterol test measures the total amount of fatlike cholesterol in the blood. A standard lipoprotein test (lipoprotein profile or lipid profile) indirectly measures levels of total cholesterol, harmful low-density lipoproteins, beneficial high-density lipoproteins, and triglycerides. For over 50 years, these types of cholesterol testing have been the standard for evaluating a patient's risk of heart disease. However, they provide limited information and do not make use of recent research on CAD.

LBNL researchers Henry Benner, Ron Krauss and Patricia Blanche have recently developed a rapid, direct method of lipoprotein assessment using aerodynamic electrical mobility measurements: ion mobility analysis. In one analytical step performed in only minutes, this technique simultaneously analyzes all classes and subclasses of cholesterol-

transporting lipoprotein particles with respect to their number, mass, and surface area. The technology is based on measuring the drift of charged particles as they are dragged through air by the force of an electric field and then determining particle size from drift velocity.

LBNL's ion mobility analysis is the first technology that can measure the size distribution and count the number of individual particles in all classes of lipoproteins. This approach requires no calibration to measure the size of the particles. Individual particles are counted, thus avoiding the need for stains. In addition, the output is easily interpreted. Scanning across the 5- to 100-nanometer range of electrical mobility, peaks in the particle spectra reveal the particle size and amount of material within specific lipoprotein classes. Doctors are then able to distinguish patients with a high risk of CAD from those with a low risk, based on their lipoprotein size distribution spectra.

Research has shown that early diagnosis and appropriate treatment can substantially reduce the risk of cardiovascular disease. Quest Diagnostics, Inc. and Berkeley HeartLab Inc., both licensees of LBNL's ion mobility analysis technology, are now developing diagnostic products that could make lipoprotein analysis tests as routine as mammograms and basic cholesterol screens are now.



*From left to right, inventors of LBNL's ion mobility analysis method, Ronald Krauss, Patricia Blanche, and W. Henry Benner. Using their technology, doctors will be able to distinguish patients with a high risk of CAD from those with a low risk, based on their lipoprotein size distribution spectra.*

**Lawrence Berkeley National Laboratory**  
**[www.lbl.gov](http://www.lbl.gov)**

LBNL has been a leader in science and engineering research for more than 70 years. Located on a 200-acre site in the hills above the University of California's Berkeley campus, LBNL holds the distinction of being the oldest of the Department of Energy's national laboratories. LBNL conducts research in fundamental studies of the universe; quantitative biology; nanoscience; energy systems; and environmental solutions.

# Starlight Brightens the Future of Information Analysis

*"Nearly 40 licenses were issued to organizations, including major automotive and consumer products companies, Ohio State University, University of Delaware, Oregon Health Sciences University, Synaptics, the government intelligence community, the Veterans Administration..."*

It's been said that we are living in an information age. With the ever increasing flow of incoming data, too frequently there is not enough time to consider the information under the demands for quick decisions. Researchers at Pacific Northwest National Laboratory (PNNL) understood the conflicting needs between capacity and reaction time, and set on a path of discovery that has proven successful on a variety of fronts.

PNNL's Starlight Information Visualization System has enabled nearly 40 entities to access and interpret information about business intelligence, consumer trends, medical records, current events, and cyber security data; and to enhance their operations by exploiting the data to their competitive advantage. Some companies report saving millions of dollars in the process. These companies use Starlight to extract consumer and product information pertinent to their business operations from enormous masses of data that previously were virtually inscrutable.

The only software of its kind on the market, Starlight performs high-speed, high-efficiency analysis, and displays the results graphically so that the relationships among the data and their implications can be quickly and easily understood. While other commercial software products support only a few predefined data types, Starlight sup-

ports the concurrent analysis of an unlimited variety of information types. Furthermore, the software combines multiple visualization techniques, allowing many different aspects of large information collections to be analyzed simultaneously.

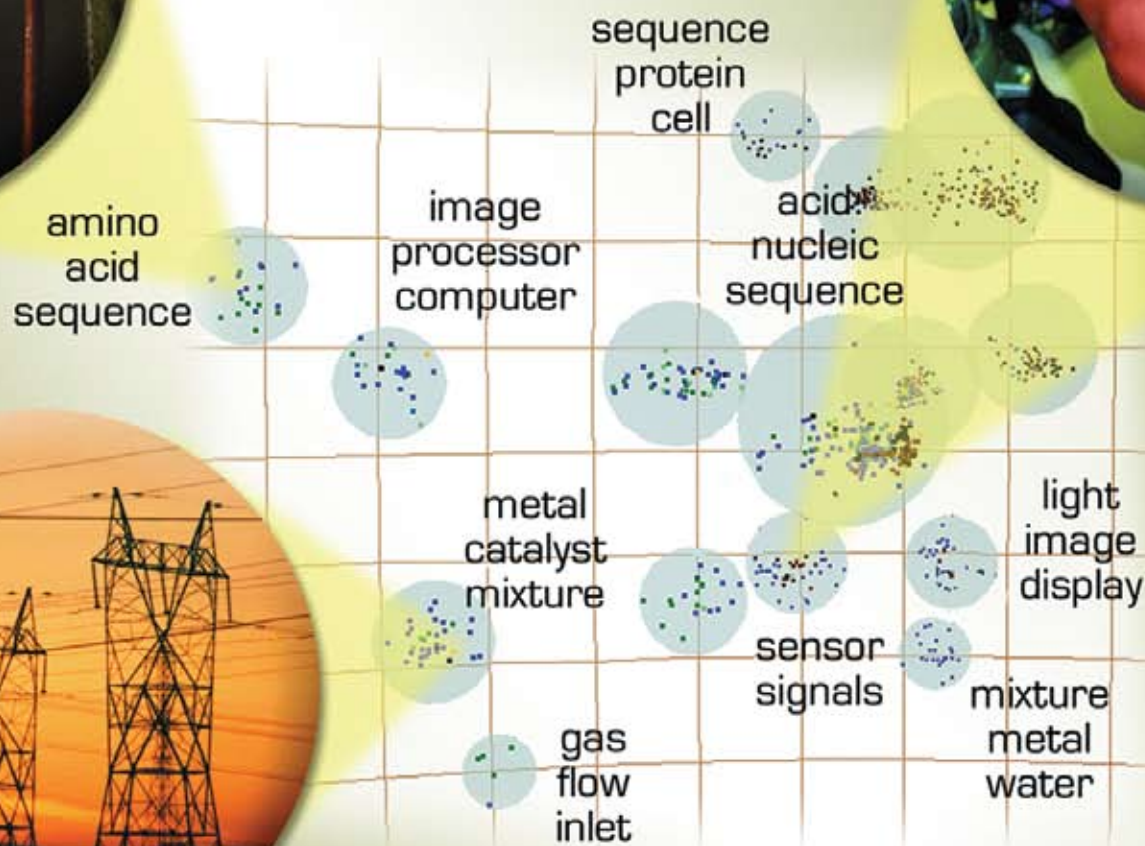
Starlight was originally developed for intelligence analysis applications, and its national security uses continue to expand. But the astute and innovative researchers who developed Starlight recognized that its capabilities were germane to many enterprises in the commercial marketplace and directed efforts to technology transfer.

Between 2000 and 2005, nearly 40 licenses were issued to organizations ranging from government offices to academia; from small competitive intelligence companies to major corporations and leading universities, including Ohio State University, University of Delaware, and Oregon Health Sciences University; government analysts; the Veterans Administration; and the Joint Warfare Analysis Center.

These customers consistently report that Starlight provides a higher level of visualization analytics capability than any other product on the market today.

With useful information generated every second of the day, the forecast for Starlight is clear and bright. For PNNL, the technology is a clear commercial success.





*Resembling tiny stars spread out against the sky, the visual perspective from Starlight analysis tools shows how individual intellectual properties can be "bundled" into complementary collective units.*

Pacific Northwest National Laboratory  
[www.pnl.gov](http://www.pnl.gov)

Pacific Northwest National Laboratory (PNNL) is one of ten Department of Energy multi-program national laboratories. PNNL delivers breakthrough science and technology to meet selected environmental, energy, health and national security objectives; strengthen the economy; and support the education of future scientists and engineers.

# Improving Apple Quality, Reducing Fungicide

*“Prior to 2002, the standard chemical treatment used several fungicides and antioxidants that could have downstream environmental effects.”*

ARS researchers in Wenatchee, Wash., spearheaded national and international efforts to improve apple storage quality while reducing fungicide use. Freshly picked apples that receive no post-harvest treatments have a relatively short shelf life of a few weeks.

Apple growers and distributors have customarily used chemical treatments to extend apple storage capacity by preventing apple physiological disorders, decay, and accelerated softening. Chemical treatments permit growers to maximize their returns, while still providing consumers with relatively unprocessed apples year round. Prior to 2002, the standard chemical treatment used several fungicides and antioxidants that could have downstream environmental effects.

ARS scientists evaluated a compound (1-MCP) for its fruit preservation properties. Because of ARS’s efforts, the Food and Drug Administration granted a GRAS (generally recognized as safe)

label in 2002 for the compound, and an Environmental Protection Agency registration for commercial use was secured shortly thereafter.

Since the registration was granted, commercial distribution of 1-MCP took off, and sales and distribution of the compound have been expanded both domestically and internationally.

The use of this compound has reduced chemical and fungicide use. Additionally, using this technology allows fruit to maintain quality during storage, transport, and marketing. Prior to its availability, only warehouse personnel were able to control the apple storage period.

1-MCP provides the most innovative technology in the last 50 years for maintaining post-harvest quality of fresh fruits and vegetables. In Washington state alone, more than 50% of apple crops (approximately 2 million tons, with an approximate \$1 billion fresh market value) are treated with this material after harvest.



*Apples are an all-American success story—each of us eats more than 19 pounds of them annually. Thanks to fruit-breeding research, we're able to enjoy more productive, healthy, and flavorful new varieties every year.*

**Agricultural Research Service**  
**[www.ars.usda.gov](http://www.ars.usda.gov)**

The Agricultural Research Service is responsible for developing new knowledge and technology to solve agricultural problems; ensure the productivity of high-quality food and agricultural products to meet the nutritional needs of U.S. consumers; sustain a viable food and agricultural economy; and maintain a quality environment and natural resource base.

Peggy Grebb

# LBL Technology Licensed to Shell, ConocoPhillips to Locate Reservoirs

*"...so we developed a processing package that takes the signals and produces three-dimensional maps of the substrata."*

*Greg Newman  
Earth Sciences Division  
LBL*

What does it take to shepherd an idea from the drawing board to the marketplace? Patience, hard work, and a little luck, according to Greg Newman of the Earth Sciences Division of Lawrence Berkeley National Laboratory (LBL). He recently won a 2005 FLC Award for Excellence in Technology Transfer for developing software that is used in electromagnetic modeling of offshore hydrocarbon reservoirs.

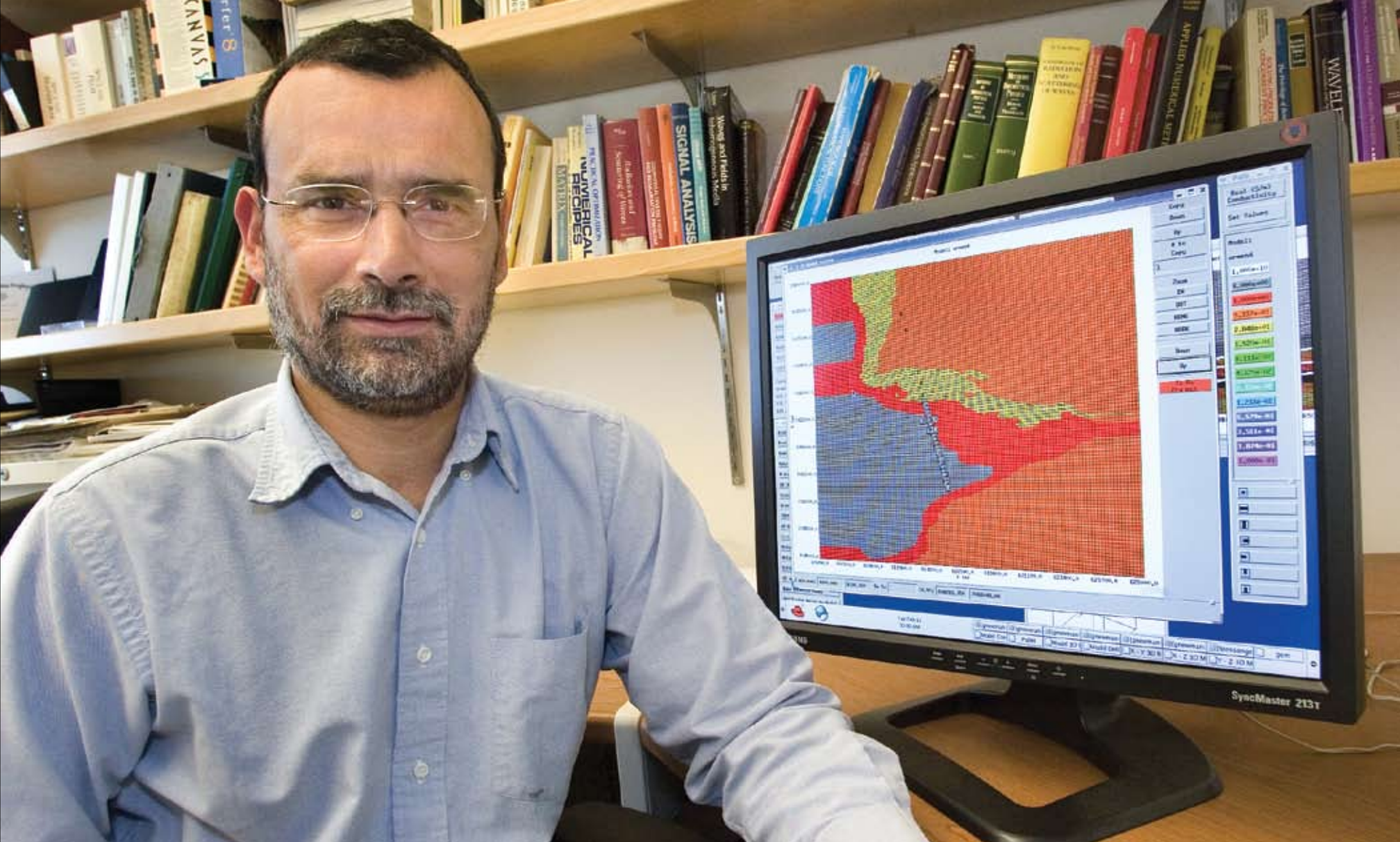
The software has been licensed to several oil and gas exploration companies such as Shell, ConocoPhillips, and a Norwegian company that uses the software to search for underwater hydrocarbon deposits. Over the past two years, these licenses and associated research funds from the oil and gas industry have brought in nearly \$1 million in revenue to LBL. "These companies have used the software to locate reservoirs that otherwise would be difficult to detect with existing technology. It has also been used to determine that some promising sites detected by other methods were in fact not hydrocarbon reservoirs," said Newman.

LBL's technology transfer department entered into an arrangement with Sandia National Laboratories (SNL) to allow LBL to license the codes Newman developed while at SNL. His software deciphers the signals captured from electromagnetic imaging of offshore hydrocarbon reservoirs, which are pockets of oil, gas, brine, or water located under the seabed. In this pro-

cess, a ship-towed transmitter sends electromagnetic signals into the sea floor. Some of the fluids within a hydrocarbon reservoir, such as oil, are insulators, so they resist the signals. Other fluids are conductive, such as water and brine. Detectors located on the sea floor gather the electromagnetic signals after they've traveled through a reservoir, giving geophysicists an indication of what it holds.

"But it is very difficult to interpret what these signals mean just by looking at the raw signals, so we developed a processing package that takes the signals and produces three-dimensional maps of the substrata," said Newman. His technology will allow scientists to tease out ever more subtle signatures of hydrocarbons from geologically challenging sites.

Newman and his colleagues, such as fellow Earth Sciences Division staff scientist Mike Hoversten and postdoctoral fellow Michael Commer, are currently working to increase the code's scale so it can map large basins that measure 2500 square kilometers. Ultimately, it is one more valuable tool in the push to secure reliable sources of energy. "This technology will help buy us time as we seek renewable energy alternatives," said Newman. "One must be dedicated to seeing that the technology being transferred is going to be a success. Be proactive and work with the lab's technology transfer people. They are there to help your technology succeed, but you must take the lead."



*Greg Newman with his software for modeling hydrocarbon reservoirs*

Lawrence Berkeley National Laboratory  
[www.lbl.gov](http://www.lbl.gov)

LBL has been a leader in science and engineering research for more than 70 years. Located on a 200-acre site in the hills above the University of California's Berkeley campus, LBNL holds the distinction of being the oldest of the Department of Energy's national laboratories. LBNL conducts research in fundamental studies of the universe; quantitative biology; nanoscience; energy systems; and environmental solutions.

# National Cancer Institute Research Leads to HPV Vaccine

*“On average, cervical cancer kills nearly 4,000 American women each year and 273,500 women worldwide. The HPV vaccine could dramatically reduce those numbers.”*

In 2006, the Food and Drug Administration announced the approval of Gardasil™, a vaccine developed by Merck & Company to prevent human papillomavirus (HPV) infection, the primary cause of cervical cancer. The vaccine marks a major advancement in cancer prevention and the protection of women’s health.

HPV is the most common sexually transmitted disease in the U.S. Although it goes away by itself in most cases, infection by certain high-risk types of HPV can lead to cervical cancer. In fact, almost all cases of cervical cancer are caused by HPV infection.

Cervical cancer is the second most common cause of cancer death in women worldwide. On average, cervical cancer kills nearly 4,000 American women each year and 273,500 women worldwide. The HPV vaccine could dramatically reduce those numbers.

Key elements of the technology for Gardasil™ originated from the HPV research in the laboratory of Drs. Douglas Lowy and John Schiller of the National Cancer Institute of the

National Institutes of Health. Drs. Lowy and Schiller began their research on the molecular biology of HPV nearly 20 years ago. That scientific quest led to the development of the virus-like particle vaccine technology on which Gardasil™ is based. The invention was licensed to Merck, the maker of Gardasil™, and also to GlaxoSmithKline, which is conducting efficacy trials of its own HPV vaccine and is expected to apply for FDA approval soon.

Gardasil™ is an immensely effective cancer vaccine. Clinical studies conducted in 13 countries, including the U.S., found it to be 100% effective in preventing HPV16- and HPV18-related cervical cancers, which represent 70% of the disease; and it is 99% effective in preventing genital warts induced by HPV6 and HPV11, which cause 90% of the disease. Gardasil™ is a remarkable advance in the field of cancer prevention and sexually transmitted disease control and represents an extraordinary proof of principle. It opens a new era in preventive cancer and sexually transmitted disease vaccines.

Newly approved HPV vaccine  
Gardasil™, developed by Merck  
& Company



Image courtesy of Merck & Company

National Cancer Institute  
[www.cancer.gov](http://www.cancer.gov)

The National Cancer Institute (NCI) is a component of the National Institutes of Health (NIH), one of eight agencies that compose the Public Health Service (PHS) in the Department of Health and Human Services (DHHS). The National Cancer Institute coordinates the National Cancer Program, which conducts and supports research, training, health information dissemination, and other programs with respect to the cause, diagnosis, prevention, and treatment of cancer, rehabilitation from cancer, and the continuing care of cancer patients and their families.

# Volpe Makes Trains Safer via Enhanced Crashworthiness

*“Metrolink, a commuter rail authority in Los Angeles, was preparing to purchase new equipment at the time of a fatal collision in Glendale, Calif. Eleven lives were lost in this incident, in which a cab car-led train ran into a locomotive-led train.”*

The presence of passengers in the lead vehicles of cab car-led passenger trains presents a particularly challenging situation in collisions with locomotive-led trains.

To overcome this challenge, researchers from the Volpe National Transportation Systems Center have developed an approach that includes crush zones in cab and coach cars. These crush zones, referred to as crash energy management (CEM), can significantly increase crashworthiness by engineering how the car structures behave when overloaded.

The cab car crush zone includes four key elements: a push-back coupler mechanism, a deformable anti-climber arrangement, an integrated end frame that incorporates an operator compartment, and a roof and primary energy-absorbing elements.

Each component operates in sequence during an impact. The push-back coupler accommodates the coupler of the impacting locomotive such that the anti-climber and integrated end frame to engage the locomotive.

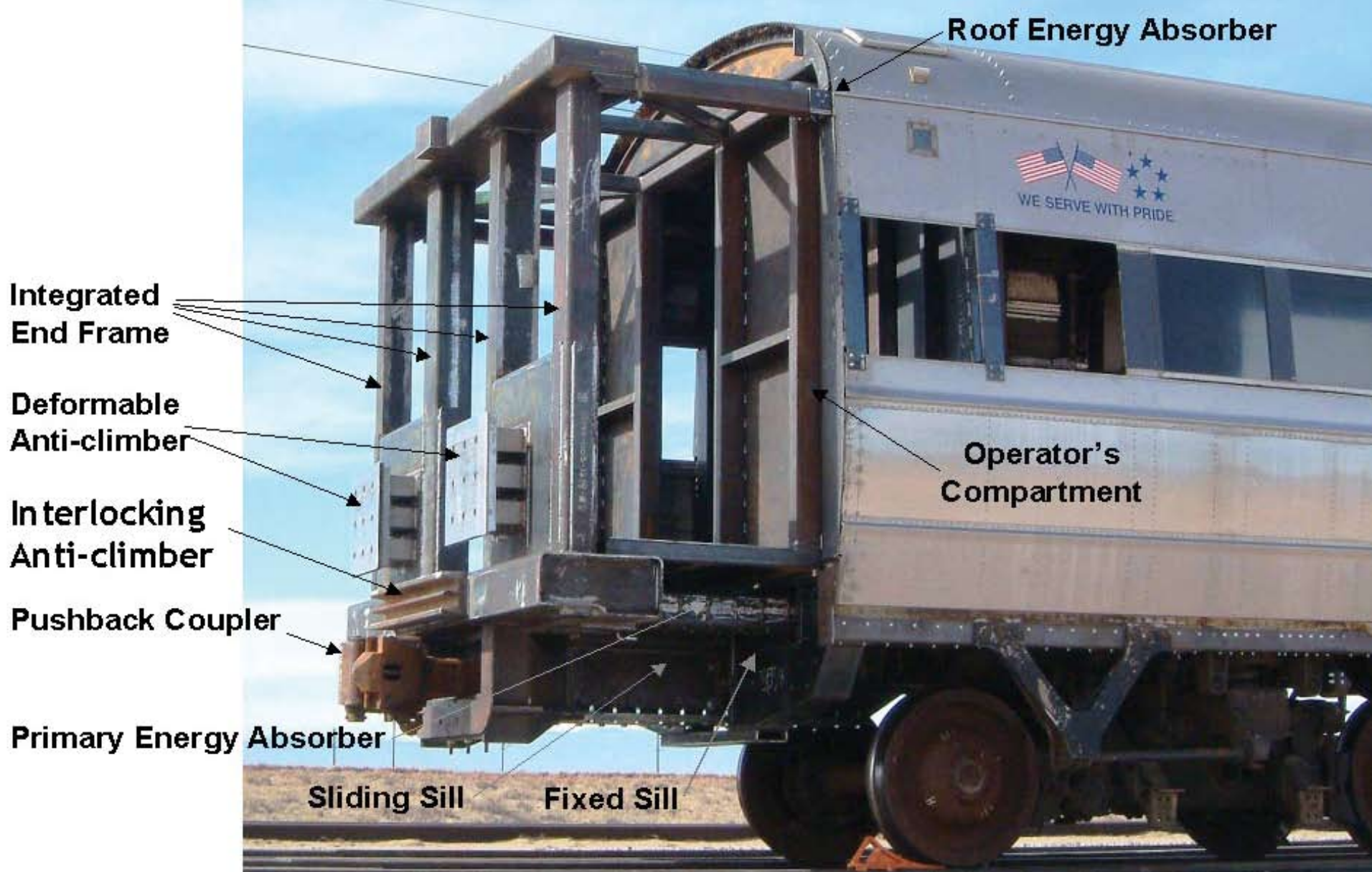
As the anti-climber deforms, it conforms to the locomotive and distributes the load over the integrated end frame. The integrated end frame transmits the impact load to the energy absorbers.

The operator's compartment can be pushed straight back into space designated for service closets.

The superior crashworthiness performance of CEM equipment has been demonstrated with full-scale impact tests. In the train-to-train test of conventional equipment, the colliding cab car crushed by approximately 22 feet and overrode the locomotive, eliminating the space for the operator's seat and approximately 47 passenger seats. During the train-to-train test of CEM equipment, the front of the cab car crushed by approximately 3 feet and the crush propagated back to all of the unoccupied ends of the trailing passenger cars. The controlled deformation of the cab car prevented override. All of the space for the passengers and crew remained intact.

Metrolink, a commuter rail authority in Los Angeles, was preparing to purchase new equipment at the time of a fatal collision in Glendale, Calif. Eleven lives were lost in this incident in which a cab car-led train ran into a locomotive-led train. As part of its response to the incident, Metrolink decided to incorporate recent results of the Volpe Center's passenger train crashworthiness research in its ongoing procurement.





*The cab car crush zone includes four key elements: a push-back coupler mechanism, a deformable anti-climber arrangement, an integrated end frame that incorporates an operator compartment, and a roof and primary energy-absorbing elements.*

**Volpe National Transportation Systems Center**  
[www.volpe.dot.gov](http://www.volpe.dot.gov)

The Volpe National Transportation Systems Center (Volpe Center) develops innovative technologies and management processes to make the transportation system safer and more effective. The Volpe Center serves as a federal bridge for transportation expertise between industry, academia, and other government agencies in order to enhance the nation's capabilities to meet its transportation needs.

# Through-the-Earth Communication Needed to Save Lives

*“Underground Radio, a Los Alamos National Laboratory technology, is the first portable radio receiver able to support two-way voice communication through hundreds of meters of solid rock.”*

Given global concerns about terrorist attacks such as 9/11, the London subway bombings, natural disasters such as Hurricane Katrina, and underground incidents such as the January 2006 Sago mining tragedy in West Virginia, there is a growing need for more reliable technology to provide through-the-earth communication, especially for those trapped underground or beneath rubble and other debris.

Underground Radio, a Los Alamos National Laboratory (LANL) technology, is the first portable radio receiver able to support two-way voice communication through hundreds of meters of solid rock. Underground Radio is a through-the-earth communications mechanism that offers high-level security to critical government, industrial, military, commercial, and public infrastructure. It also can be used to respond to threats of terrorism and natural disasters such as hurricanes, earthquakes, and fires. It uses very low frequency (VLF) electromagnetic radiation and digital audio compression technology to carry voice and text data. The VLF signals also can transmit tracking and location data for radio users in case they are unable to respond.

Using the technology developed for Underground Radio, U.S.-based Vital Alert Technologies, Inc., a subsidiary of Vital Alert Communications, Inc. of Canada, has fashioned a secure, portable,

wireless receiver system that will solve the problems with current radio technology. Underground Radio can reach the right people at the right time and in time to avoid further loss of life or property. After signing a limited exclusive license with LANL in 2004, Vital Alert, in May 2006, signed two exclusive license agreements for Underground Radio with the intention of commercialization in the mining and urban emergency and rescue industries.

Underground Radio can also be used to provide divers and small submersible craft with underwater communication capabilities, as a downhole magnetometer, and to send instructions to robotic machines.

Vital Alert is currently in the process of creating a strong prototype that will allow large-scale production of Underground Radio, being marketed on the Vital Alert website as Canary 2, as part of the Canary Mine Messenger System that uses the Vital Alert Emergency Broadcast Network, or EBN. EBN was developed based on Underground Radio technology. Both Canary 2 and the EBN are being prepared for commercial availability.

Additionally, Vital Alert is in discussion with the U.S. Mine Safety and Health Administration on a possible future relationship and has upcoming projects with Sprint Nextel and Raytheon Company.



*Underground Radio uses unique technology to provide reliable communication for miners and in emergency situations, such as terrorist attacks and natural disasters. Underground Radio allows through-the-earth two-way voice communication for the first time.*

Los Alamos National Laboratory  
[www.lanl.gov](http://www.lanl.gov)

Los Alamos National Laboratory is the largest institution in northern New Mexico. From its origins as a secret Manhattan Project laboratory, LANL has attracted world-class scientists and applied their energy and creativity to solving the nation's most challenging problems. LANL's five priorities are safety, security and compliance; the national security mission; outstanding science in support of its mission; business operations and management practices; and community partnerships.

# AFRL Teams with GNC to Study Effects of Whey Protein on Performance

*"We're asking our warfighters to do more and more physically and mentally than we ever have before, and that includes fighting hard at altitude, carrying lots of weight on their backs, staying up for hours and hours, then doing it all over again the next day."*

*Colonel Breck J. Lebegue  
Chief of Aerospace Medicine  
AFRL*

A glass of cold milk probably won't be added to pre-flight checklists for Air Force pilots, but a nutritional supplement derived from milk could become a staple of the warfighters' diet as a result of an Air Force Research Laboratory (AFRL) study.

AFRL's Human Effectiveness Directorate (HE) has partnered with GNC Corporation to determine if a specialized form of whey protein—a pure, natural, high-quality protein derived from cow's milk—can keep warfighters strong and alert during fatigue-inducing missions.

This Cooperative Research and Development Agreement (CRADA) is the first clinical collaboration between the Air Force and GNC, according to Susan Trimbo, Ph.D., senior vice president for GNC's Department of Scientific Affairs.

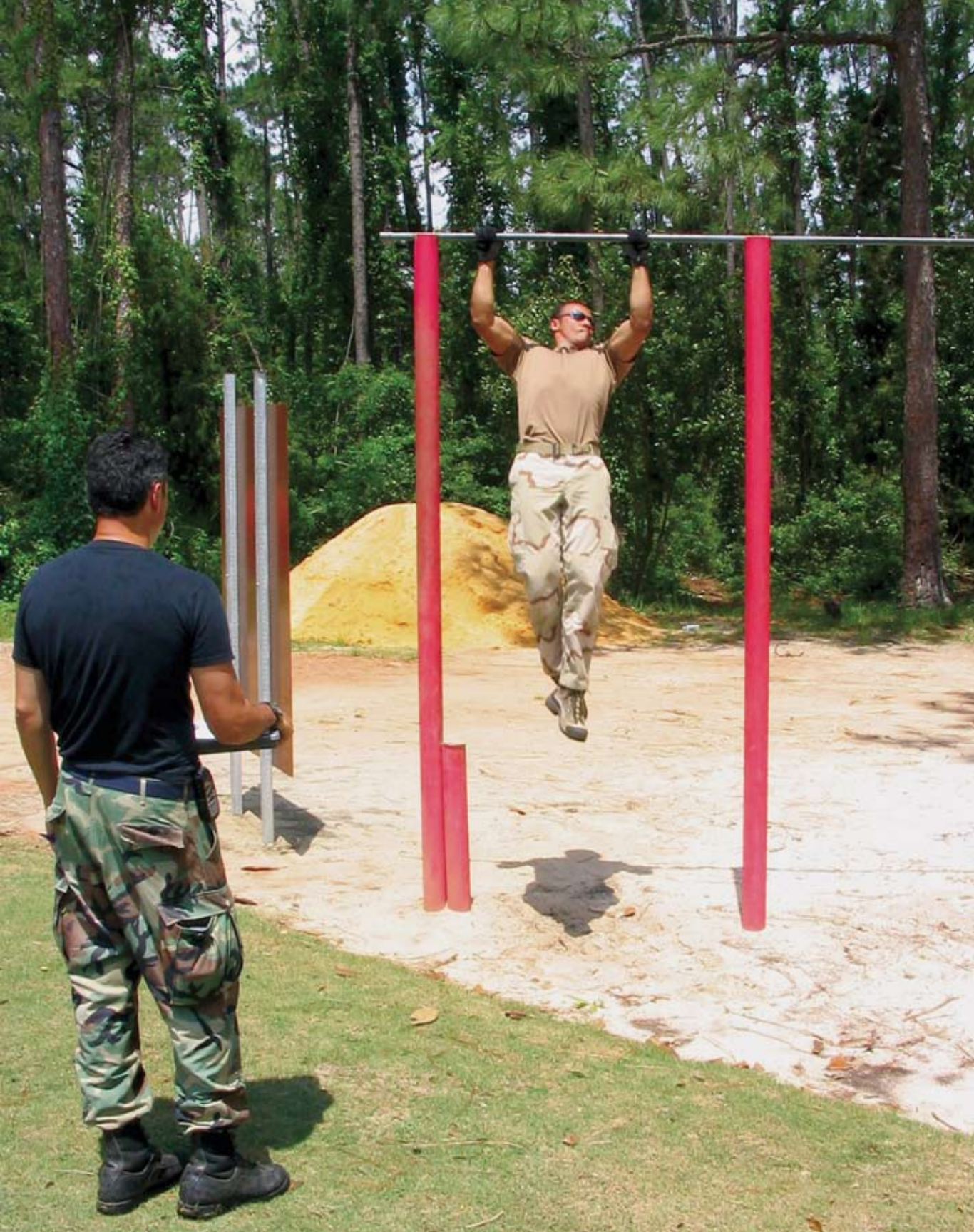
Whey protein is popular in the physical fitness world as a supplement to boost muscle growth. It contains essential amino acids that the human body needs on a daily basis and high concentrations of numerous amino acids that enhance muscle protein synthesis and muscle building. In its purest form, as whey protein isolate, it contains little to no fat, lactose or cholesterol.

Researchers want to determine the effect of this specialized whey protein on the mental and physical performance of individuals subjected to long hours without sleep. Warfighters such as aircraft pilots and crew, and particularly Special Forces operators, often must

remain awake for more than 24 hours. Many civilian occupations have similar requirements. "We're asking our warfighters to do more and more physically and mentally than we ever have before, and that includes fighting hard at altitude, carrying lots of weight on their backs, staying up for hours and hours, then doing it all over again the next day," said Colonel Breck J. Lebegue, chief of aerospace medicine for AFRL/HE's Biosciences and Protection Division.

Ultimately, the Air Force may end up with a nonpharmaceutical option for long, high-performance missions—one that is easily and more readily available, has fewer side effects, and carries less potential liability than pharmaceutical options—to bolster strength and endurance during long-duration missions. And, GNC could benefit through an enhanced commercial product line.

The study builds upon preliminary university research trials that show specialized whey protein can increase the size and strength of certain muscle groups. The Air Force wants to test a broad variety of physical tasks and mental functions to see if this specialized whey protein can increase strength, endurance and thinking capability. Researchers will look at the effects of the supplement on body composition and physical performance, and cognitive functions, including memory and the ability to stay on task, think clearly and function normally even after 24 hours without sleep.



*A test subject in a fatigue countermeasure study performs pull-ups on a 15-point obstacle course at Hurlburt Field, Fla. The subject is a pararescue airman from the Air Force Special Operations Command, 23rd Special Operation Squadron at Hurlburt. The study was entitled "A Double-blind Placebo-Controlled Investigation of the Efficacy of Modafinil for Maintaining Alertness and Performance in Sustained Military Ground Operations."*

**Air Force Research Laboratory**  
**[www.afrl.af.mil](http://www.afrl.af.mil)**

The Air Force Research Laboratory is headquartered at Wright-Patterson Air Force Base, Ohio. AFRL's mission is leading the discovery, development, and integration of affordable warfighting technologies for Air Force air and space forces. The Human Effectiveness Directorate is one of ten AFRL technology directorates. Its mission is to lead revolutionary science and technology for superior airman cognition, readiness, performance, and survival.

# AFRL Develops Solar Cells to Power NASA's Mars Rovers

*"These solar arrays provide nearly a 50% improvement in cell efficiency compared to the single-junction solar cells used on the earlier Mars Pathfinder mission."*

The Air Force Research Laboratory (AFRL) worked with Spectrolab, Inc. (a Boeing subsidiary in Sylmar, Calif.) through the Dual-Use Science and Technology program to develop ultra-triple-junction (UTJ) solar cells. These cells subsequently powered the solar arrays aboard two NASA Mars rovers.

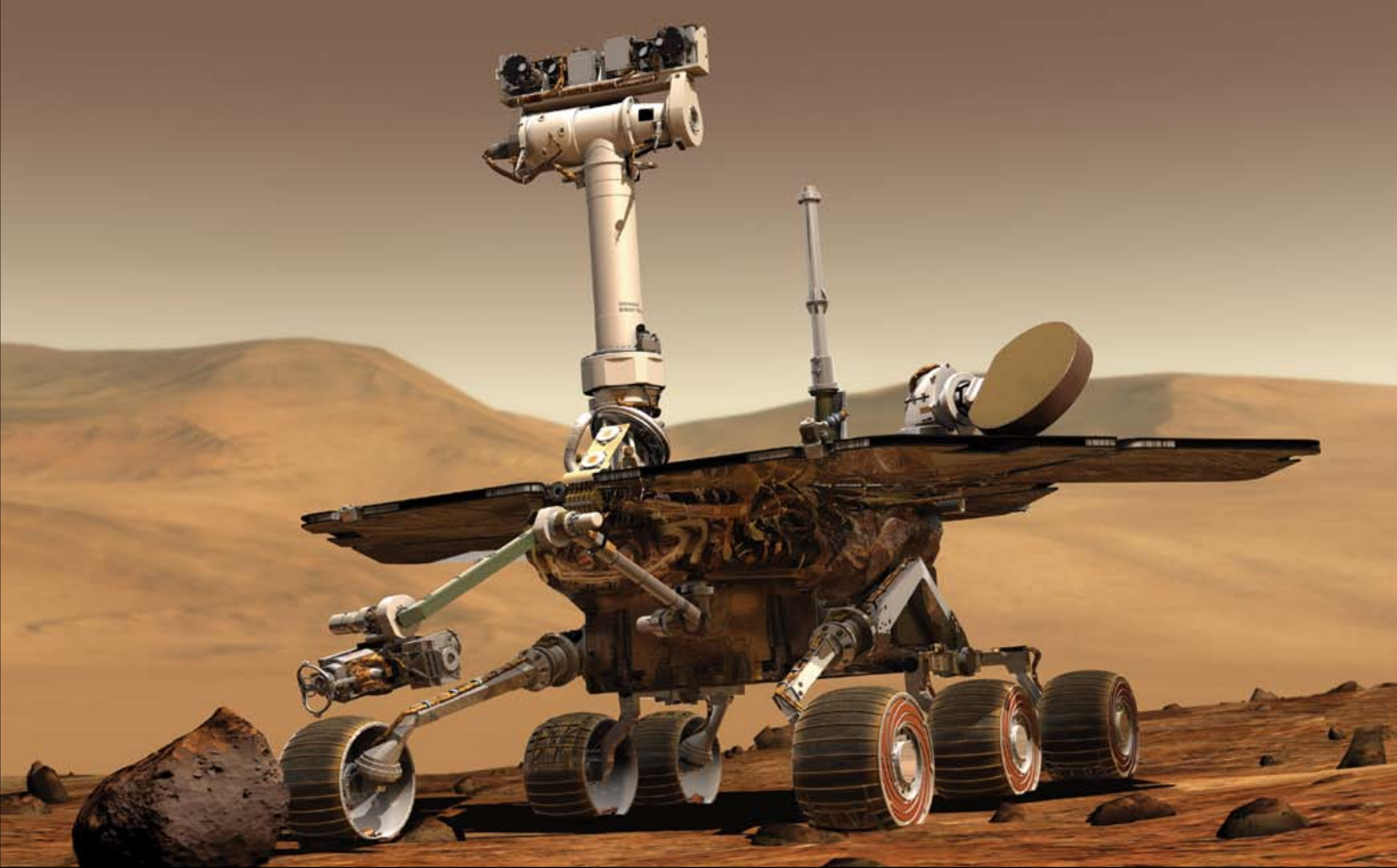
The rovers Spirit and Opportunity landed on Mars in early 2004 to continue NASA's quest to explore the role of water on the planet. Once on the Martian surface, the solar panels deployed to form a total area of 1.3 m<sup>2</sup> of UTJ solar cells that powered all spacecraft activities and instruments.

The Mars Exploration Rover (MER) program posed significant engineering and technology challenges due to many design and operational constraints, including limited available panel area, changing illumination levels and temperatures, variable shadowing and atmospheric conditions, and dust accumulation on the rovers. As highly efficient collectors of the sun's energy, single-crystal multijunction (MJ) solar cells maximize solar panel electrical output. These solar arrays provide nearly a 50% improvement in cell efficiency compared to the single-junction solar cells used on the earlier Mars Pathfinder mission. The UTJ cells employ a three-layered structure to more effectively

capture and convert solar energy into electricity. Each of the junction cells converts a different portion of the solar spectrum into electricity, greatly improving energy conversion efficiency.

The MJ solar cells used for the MER program were UTJ solar cells with a 27.5% beginning-of-life efficiency. Directly replacing lower-efficiency cells increases solar array power output without increasing solar panel size or number, thereby minimizing costs in programs such as NASA's global positioning system effort, wherein engineers accommodated the power needs of an additional payload by switching to high-efficiency cells. By maintaining the power level of a legacy spacecraft design, these cells reduce both deployed array area and stowed volume, a critical reduction for programs required to downsize from a Titan IV launch vehicle to an evolved expendable launch vehicle, which has 33% less shroud volume.

NASA also used MJ solar cells successfully in other interplanetary missions: the Mars Global Surveyor, which monitored Martian weather patterns; the Beagle 2, which served as another Mars exploration spacecraft; and the Near Earth Asteroid Rendezvous spacecraft, which reached a distance from the sun marking the farthest travel of any solar array.



*The rovers Spirit and Opportunity landed on Mars in early 2004 to continue NASA's quest to explore the role of water on the planet. Once on the Martian surface, the solar panels deployed to form a total area of 1.3 m<sup>2</sup> of UTJ solar cells that powered all spacecraft activities and instruments.*

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# The Future of America's R&D

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**T**he federal laboratories understand that the future of innovation in America begins with instilling a passion for science and technology within today's young minds.

From elementary school to the university level, federal laboratories and research centers work with students through a variety of outreach programs.

These programs involve hands-on scientific adventures in areas such as nanotechnology, aviation, medicine, and environmentally friendly energy development.

The next few pages highlight just a small sampling of this work in action. These activities demonstrate how the efforts of the federal laboratories have been set in action to ensure the United States does not lose its competitive edge in the world of technology.



# College Students Push Tech Transfer at Los Alamos

SatWest continues to entrust important marketing analysis and development research to LANL MBA interns because of the quality and accuracy of the end result and the potential for realization within the company.

Students from universities nationwide have helped Los Alamos National Laboratory (LANL) scientists working with new technologies to assess markets and develop business plans as part of a lab program to involve interns in technology transfer efforts.

Ben Warner, a chemist from LANL who launched a pharmaceutical startup in late 2005, was so impressed with the business talents of one student, Jeff Stewart, an MBA from the University of Notre Dame who did a summer internship at LANL, that he hired him as vice president of business development at his new company, Caldera Pharmaceuticals, Inc.

"I'm a pretty decent scientist, but I have no formal training in business," Warner said. "Getting this help from students is a huge boost to me. Without them, I would have missed some big opportunities."

LANL has offered summer internships (to MBA candidates) since 1996, providing business administration students with real-world experience in technology transfer. In 2005, LANL executives decided to extend the program to a year-

round format to allow MBAs to study promising technologies as part of their fall and spring semesters, said Belinda Padilla, program manager with LANL's Technology Transfer Division.

Students provide critical assessments of the market potential of emerging technologies, according to Padilla. This helps LANL decide which lab innovations to pursue for commercialization.

The pace of technology assessments has increased substantially, thanks to the program's extension.

During 10 years of summer internships, students have evaluated more than 120 technologies. But since the 2005 extension, students have assessed another 20 technologies. And this fall, they'll look at 15 more, Padilla said.

The program provides a critical tool for recruiting and retaining recent graduates.

About 30 percent of the students who participate in summer internships or in the new technology coursework are later hired by the lab or by the lab's

business spinoffs, Padilla said. To provide local students with more opportunities, LANL selected the University of New Mexico and New Mexico State University as central partners in the year-round technology courses.

So far, about 40 students have participated at NMSU, said Kevin Boberg, director of NMSU's Arrowhead Center, Inc. "It forces them to think outside the box because the LANL technologies they assess could have market potential, but there's no established product or company to evaluate. That is a much bigger challenge than working with a business that is already up and operating," Boberg said.

Mike Connolly, a principal with vSpring Capital who used to work at LANL's Technology Transfer Division, said the students help translate opportunities into plain business language.

"They serve as a bridge between the scientists and the business community," Connolly said. "They're playing a very important role in technology transfer at Los Alamos."



Located on Kirtland Air Force Base in Albuquerque, New Mexico, AF STAR-BASE La Luz is an Air Force Research Laboratory-supported education outreach activity, dedicated to raising student interest and knowledge skills in math, science, engineering, and technology.



# Air Force STARBASE® La Luz Academy

The Air Force Research Laboratory (AFRL) at Kirtland Air Force Base, N.M., is well-known for its educational partnership activities. The laboratory's fame extends beyond New Mexico, and it has been cited as a national model for educational outreach. AFRL's educational partnerships are performed jointly with the state of New Mexico and are based on long-range goals of the state and participating school districts. The programs emphasize various areas of study relating to the advancement of technology.

Among these programs is the Air Force STARBASE® La Luz Academy, supported by the AFRL at Kirtland, which is working to get students interested in math, science, engineering, and technology through an innovative educational outreach program. The Academy, which opened in 2004, was implemented to expand AFRL's existing educational outreach program and raise the interest of "at-risk" elementary through high school students in math, science, engineering, and technology. The program recruits these students from participating New Mexico public schools and has three main components: Mars Mission Flight for fifth graders, Providing Engineering and Technology Experiences for Students

(PETES) Flight for middle school students, and Students Planning and Conducting Engineering (SPACE) Flight for high school students.

The Mars Mission Flight is based on the Challenger Center for Space Science Education's Marsville, the Cosmic Village® program, modified to include Air Force core values, terminology, and missions.

The PETES Flights, which are designed for middle school students, are based on classroom teaching and projects conducted at the Academy's building at Kirtland. The flights are designed to teach math, science, and engineering through hands-on projects, presentations, and courses developed and conducted by volunteer AFRL scientists and engineers.

The PETES Flights serve as a bridge to the high school SPACE Flight, in which students receive mentorship and guidance from volunteer scientists and engineers from the laboratory.

Each student team in the program works on a three-year real-world research and development project. Seniors also complete a college-level introduction to systems engineering course to complete the SPACE Flight program.



Students representing 95 public schools, 6 private schools, 3 charter schools, and several home school organizations enjoyed the science behind the products during INL's Science and Engineering Expo.

# INL's Science and Engineering Expo Draws Thousands

Idaho National Laboratory (INL) held its fourth annual Science and Engineering Expo in Idaho Falls, Idaho, last September, proving that the next generation of innovators is eager to take the torch.

With a spotlight on energy and power, the Expo showcased 70 different indoor and outdoor exhibits, simulations and interactive demonstrations, experiments, hands-on activities, and presentations in the physical sciences, environmental sciences, life sciences, earth and space sciences, and technologies of all kinds.

Technology areas included auras and atoms, electricity and engineering, petroleum and propane, and water and wind power. Alternatively powered vehicles included cars powered by electricity, hydrogen, bio-diesel and natural gas; a glider dependent on wind currents; a 70-foot-tall propane-heated balloon; an unmanned aerial helicopter and fixed-wing vehicles; and remotely controlled robotics. Students lined up to peer through sun spotters and telescopes; they stood five-deep to "see" heat via an infrared camera; and they mobbed the

NASA exhibits to find out about space exploration.

In four years, the Expo has grown from a one-day event to a three-day extravaganza at the Museum of Idaho, reaching thousands of students, teachers, and parents in eastern Idaho and bordering states.

Through the Expo, INL partners with other national laboratories, invited businesses and industries, professional societies, and universities to interact with visitors in this massive community and educational outreach effort.

This year, more than 130 exhibitors came from 10 states across the country with the same objective in mind—to get students thinking about their interests, capabilities, and futures.

To stimulate their thinking, the Expo learning environment exposes students to new ideas and developments in science, engineering, and state-of-the-art technologies. To some, this carnival of science and technology appears to be madness, but the kids love it!

Attendance numbers have grown from 2,500 visitors in 2000 to 10,000 visitors in 2004. The students who

attended the Expo represented 104 schools: 95 public schools from a three-state area, 6 private schools, and 3 charter schools.

Numerous home school organizations, including the Idaho Leadership Academy and Teton Valley Home Educators, complemented by schooled students at home, very young students enrolled in pre-schools, and representation from Options, Inc., contributed to the population of students in attendance.

The two ages and grades of highest impact were 10 and 11 years old, and the fifth and sixth grades. The Expo program is intended to augment the traditional science curriculum taught in K-12 schools. Therefore, the technologies at the Expo are associated with a science, as much as possible, and science activities are linked to national science education content standards and correlated Idaho state achievement strands.

Historically, students have tended to rate the hands-on technology activities higher than they have the basic science activities, with the exception of chemistry. Given this

observation over the four years of the Expo for this grade range, the incorporation of technology standards into the 2005 Expo program of activities will be explored.

Although geared toward students in grades five through nine, the Expo is not age-discriminatory. It promotes equal access to information across ethnic populations and between genders. It is free to the public, making it accessible to all economic groups.

For this reason, the Expo program of activities is designed with the young and old, and the very technical and lay person in mind.

There is something for everyone—from air and space to astronomy, biological sciences, ecology, physics, nuclear energy, fire science, national security, and more.

Comments from attendees included "Awesome! And you learn a lot about science" (female, age 13, grade 8); "This is the only real science we get exposed to. Keep it up" (teacher, grade 5); "Excellent! We have loved it for two years. We wouldn't miss it" (parent).

FEDERAL LABORATORY CONSORTIUM

**FLC**

FOR TECHNOLOGY TRANSFER

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*The Only Government-wide Forum for Technology Transfer*



The Federal Laboratory Consortium for Technology Transfer (FLC), a nationwide network of over 250 federal laboratories, is the only government-wide forum for technology transfer (T<sup>2</sup>). Organized in 1974 and formally chartered by the Federal Technology Transfer Act of 1986, the FLC provides the framework for developing T<sup>2</sup> strategies and opportunities by promoting and facilitating technical cooperation among federal laboratories, industry, academia, and state and local governments.

As the recognized leader in maximizing collaborative research for the transfer of technologies, the FLC enhances the socioeconomic well-being of the nation in the global marketplace.

Industry, government, and academic personnel looking to strengthen their T<sup>2</sup> capabilities to capitalize on the nation's investment, better their position in the marketplace, or research technology can look to the FLC to foster the rapid movement of federal laboratory research results into the mainstream of the U.S. economy. The FLC advances T<sup>2</sup> by expanding communication among industry, government, and academia. The FLC's website, Technology Locator, T<sup>2</sup> Desk Reference, FLC NewsLink, trade show exhibits, awards program, education and training publications, and network of experts are only a few of the tools it provides for successful T<sup>2</sup>.

The FLC is a consortium driven by the dedicated people of the federal laboratory system.

These people are the scientists, agency representatives, and T<sup>2</sup> professionals who transfer federally funded technology and expertise to the marketplace. Serving as a gateway for industry, government, and academia to access research and development, the FLC also serves as a resource for T<sup>2</sup> education and training, news, programming, awards, and initiatives.

# FLC Tools for Technology Transfer Professionals



[www.federallabs.org](http://www.federallabs.org)

The FLC website makes it easy to find people, capabilities, and applications within the FLC's network of federal labs and centers. The site publicizes T<sup>2</sup> news and technology trends, and provides a gateway to FLC products and services.



*FLC 2007 Calendar*



## Technology Locator

The Technology Locator is a free service that provides 1:1 personalized assistance locating federal laboratories ready to transfer their technologies to the marketplace and bringing these laboratories together for collaborative R&D. Call the Locator toll-free at 1-888-388-5227.



## FLC NewsLink

A free monthly newsletter reporting on a host of technologies and training events, and highlighting the technological advances of federal laboratories, industry, and academia.



## FLC Washington, DC Representative

To keep the technology transfer community informed of changes in relevant legislation and policy, the FLC monitors congressional studies, proposals, and announcements via Washington, DC Representative Gary Jones. You can contact Mr. Jones at 202-296-7201 or [gkjones@flcdc.cnchost.com](mailto:gkjones@flcdc.cnchost.com).



## Technology Transfer Desk Reference

The desktop essential for Laboratory Representatives, Office of Research & Technology Applications personnel, business development managers, any and all T<sup>2</sup> pros!



## Education and Training

The FLC provides education and training on all aspects of T<sup>2</sup> to laboratory personnel. This service includes fundamentals, intermediate, and advanced training courses offering continuing education units (CEUs); a wide range of publications and resources; a training resources database; and an online T<sup>2</sup> curriculum.



## FLC Awards Program

The FLC honors technology transfer excellence through its awards program. Each year, the FLC recognizes those who advance federal technology and expertise to the marketplace.

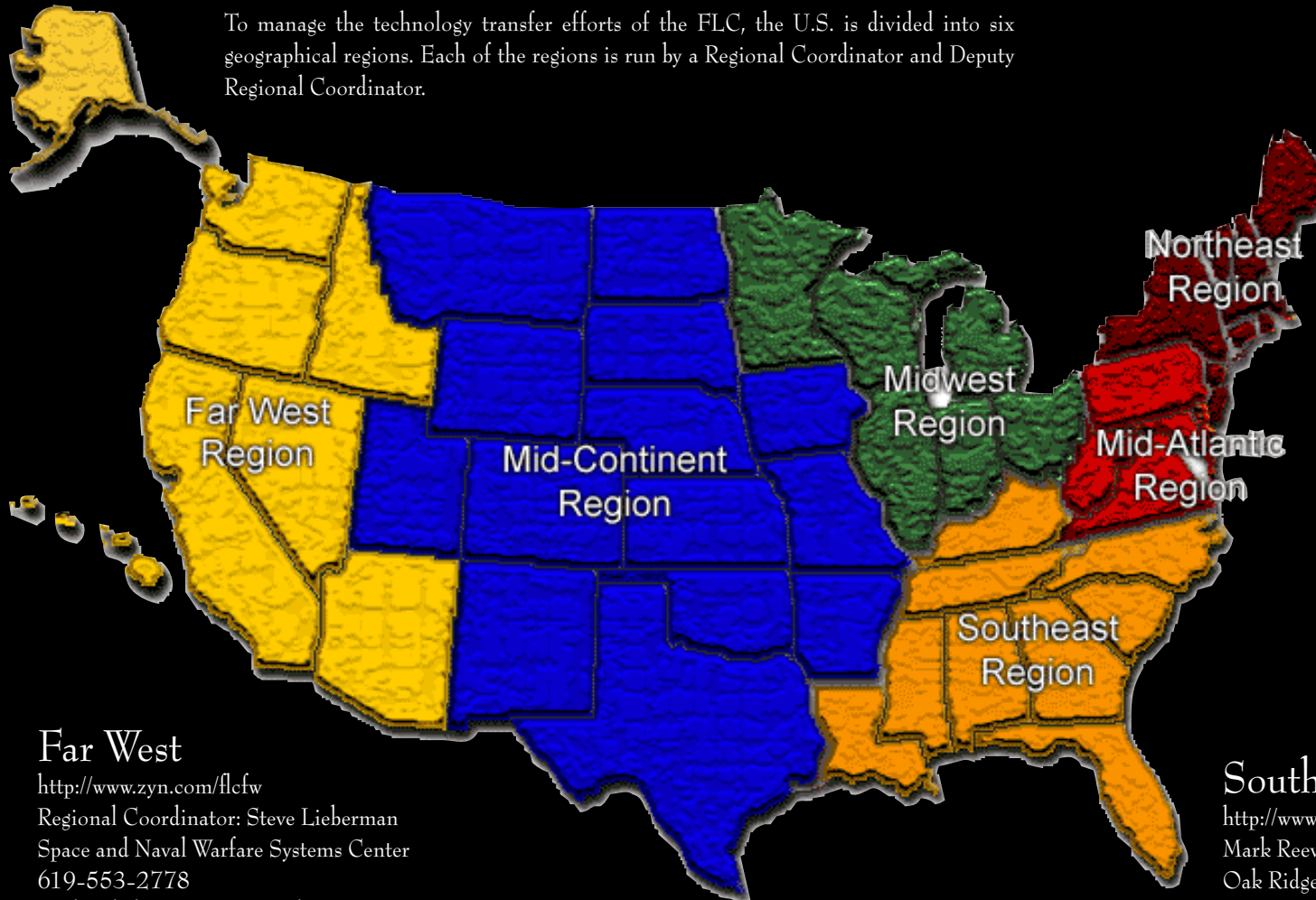


## Federal Technology Transfer Legislation and Policy

A breakdown of the principal statutory and presidential executive order policies that constitute the framework of the federal technology transfer program.

# FLC Regions

To manage the technology transfer efforts of the FLC, the U.S. is divided into six geographical regions. Each of the regions is run by a Regional Coordinator and Deputy Regional Coordinator.



## Far West

<http://www.zyn.com/flcfw>  
Regional Coordinator: Steve Lieberman  
Space and Naval Warfare Systems Center  
619-553-2778  
[stephen.lieberman@navy.mil](mailto:stephen.lieberman@navy.mil)

## Mid-Continent

<http://www.zyn.com/flcmc>  
Regional Coordinator: Patrick Rodriguez  
Air Force Research Laboratory  
505-846-0857  
[patrick.rodriguez@kirtland.af.mil](mailto:patrick.rodriguez@kirtland.af.mil)

## Midwest

<http://www.flcmidwest.org>  
Regional Coordinator: Cynthia Wesolowski  
Argonne National Laboratory  
630-252-7694  
[weso@anl.gov](mailto:weso@anl.gov)

## Southeast

<http://www.southeastflc.org>  
Mark Reeves  
Oak Ridge National Laboratory  
865-576-2577  
[reevesme@ornl.gov](mailto:reevesme@ornl.gov)

## Northeast

<http://www.flcnortheast.org>  
Dr. Theresa Baus  
Naval Undersea Warfare Center  
401-832-8728  
[bausta@npt.nuwc.navy.mil](mailto:bausta@npt.nuwc.navy.mil)

## Mid-Atlantic

<http://www.flcmidatlantic.org>  
Regional Coordinator: John Emond  
NASA  
202-358-1686  
[john.l.emond@nasa.gov](mailto:john.l.emond@nasa.gov)

# FLC Member Laboratories in Your State (websites listed where applicable)

## Alabama

Army - Aeromedical Research Laboratory  
[www.usaarl.army.mil](http://www.usaarl.army.mil)

Army - AMC - Aviation & Missile Command  
[http://ams15.redstone.army.mil:7443/pls/apws/apwsdba.apws\\_home](http://ams15.redstone.army.mil:7443/pls/apws/apwsdba.apws_home)

Army - Redstone Technical Test Center  
[www.rttc.army.mil](http://www.rttc.army.mil)

Army - Space & Missile Defense Command  
[www.smdc.army.mil](http://www.smdc.army.mil)

NASA - Marshall Space Flight Center  
[www.nasa.gov/centers/marshall/home/index.html](http://www.nasa.gov/centers/marshall/home/index.html)

## Arizona

Army - Electronic Proving Ground  
[www.epg.army.mil/](http://www.epg.army.mil/)

Army - Yuma Proving Ground  
[www.yuma.army.mil/](http://www.yuma.army.mil/)

Army Technology Integration Center

BR-Water Quality Improvement Center  
[www.zyn.com/flcfw/fwnews/fwarch/fw9901f.htm](http://www.zyn.com/flcfw/fwnews/fwarch/fw9901f.htm)

## Arkansas

HHS - FDA - National Center for Toxicological Research  
[www.fda.gov/nctr](http://www.fda.gov/nctr)

## California

Air Force - 30th Space Wing  
[www.vandenberg.af.mil/30sw/index.html](http://www.vandenberg.af.mil/30sw/index.html)

Air Force - Air Force Flight Test Center  
[www.edwards.af.mil](http://www.edwards.af.mil)

Air Force - Sacramento Air Logistics Center

Air Force - Space and Missile Systems Center  
[www.losangeles.af.mil/SMC/PK/PKHOME/pkhome.htm](http://www.losangeles.af.mil/SMC/PK/PKHOME/pkhome.htm)

Army - Aeroflightdynamics Directorate  
<http://halfdome.arc.nasa.gov/ar/rotorcraft.html>

Army - Defense Language Institute Foreign Language Center  
[www.dlifc.edu/](http://www.dlifc.edu/)

DOD - Defense Microelectronics Activity  
[www.dmea.osd.mil/](http://www.dmea.osd.mil/)

DOE - Lawrence Berkeley National Laboratory  
[www.lbl.gov](http://www.lbl.gov)

DOE - Lawrence Livermore National Laboratory  
[www.llnl.gov/](http://www.llnl.gov/)

DOE - Sandia National Laboratories – California  
[www.ca.sandia.gov/casite/](http://www.ca.sandia.gov/casite/)

DOE - Stanford Linear Accelerator Center  
[www.slac.stanford.edu/](http://www.slac.stanford.edu/)

DOE - University of California Los Angeles  
[www.ucla.edu/](http://www.ucla.edu/)

DOI - USGS - Western Regional Office  
<http://biology.usgs.gov/wro/>

FS - Washington Office Fire & Aviation Management

NASA - Ames Research Center  
[www.arc.nasa.gov/](http://www.arc.nasa.gov/)

NASA - Jet Propulsion Laboratory  
[www.jpl.nasa.gov/](http://www.jpl.nasa.gov/)

Naval Weapons Station - Indian Head Division

Navy - Naval Air Warfare Center Weapons Division - China Lake  
[www.nawcwpns.navy.mil](http://www.nawcwpns.navy.mil)

Navy - Naval Facilities Engineering Service Center  
[www.nfesc.navy.mil/](http://www.nfesc.navy.mil/)

Navy - Naval Health Research Center  
[www.nhrc.navy.mil](http://www.nhrc.navy.mil)

Navy - Naval Postgraduate School  
[www.nps.edu](http://www.nps.edu)

Navy - Naval Surface Warfare Center Port Hueneme Division  
[www.phdnswc.navy.mil](http://www.phdnswc.navy.mil)

Navy - SPAWAR Systems Center, San Diego  
[www.spawar.navy.mil/sandiego](http://www.spawar.navy.mil/sandiego)

USACE - Hydrologic Engineering Center  
[www.usace.army.mil](http://www.usace.army.mil)

USDA - ARS Pacific West Area  
[www.ars.usda.gov/main/site\\_main.htm?modecode=53-00-00-00](http://www.ars.usda.gov/main/site_main.htm?modecode=53-00-00-00)

USDA - FS - San Dimas Technology & Development Center  
[www.fs.fed.us/eng/techdev/sdttdc.htm](http://www.fs.fed.us/eng/techdev/sdttdc.htm)

## **Colorado**

Air Force Academy  
[www.usafa.af.mil/](http://www.usafa.af.mil/)

APHIS - National Wildlife Research Center  
[www.aphis.usda.gov/ws/nwrc](http://www.aphis.usda.gov/ws/nwrc)

ARS - National Seed Storage Laboratory  
Bureau of Reclamation: [www.usbr.gov](http://www.usbr.gov)

DOE - National Renewable Energy Laboratory  
[www.nrel.gov](http://www.nrel.gov)

DOE - Rocky Flats Environmental Technology Site  
[www.rfets.gov](http://www.rfets.gov)

DOE - Rocky Mountain Oilfield Testing Center  
[www.rmotc.com](http://www.rmotc.com)

FRA - Transportation Test Center  
[www.fra.dot.gov](http://www.fra.dot.gov)

National Telecommunication and Information Administration  
[www.ntia.doc.gov](http://www.ntia.doc.gov)

NOAA - Aeronomy Laboratory

NOAA - Environmental Technology Laboratory  
[www.etl.noaa.gov](http://www.etl.noaa.gov)

NOAA - Forecast Systems Laboratory  
[www.fsl.noaa.gov](http://www.fsl.noaa.gov)

NOAA/ERL - Space Environment Laboratory

NOAA/NESDIS - National Geophysical Data Center

Rocky Flats Plant

SAIC - Advanced Technology Group

USDA - ARS - Northern Plains Area  
[www.ars.usda.gov/main/site\\_main.htm?modecode=54-00-00-00](http://www.ars.usda.gov/main/site_main.htm?modecode=54-00-00-00)

USDA - FS - Rocky Mountain Research Station  
[www.fs.fed.us/rm](http://www.fs.fed.us/rm)

USGS - Central Regional Office  
[www.geology.cr.usgs.gov/crg/ocr.htm](http://www.geology.cr.usgs.gov/crg/ocr.htm)

USGS - MidContinent Ecological Science Center  
[www.mesc.usgs.gov/default.asp](http://www.mesc.usgs.gov/default.asp)

## **Connecticut**

Coast Guard R&D Center

Naval Submarine Medical Research Laboratory  
[www.nhrc.navy.mil/nsmrl](http://www.nhrc.navy.mil/nsmrl)

## **Florida**

Air Armament Center  
[www.sverdrup.com/sets/usaf\\_armament.shtml](http://www.sverdrup.com/sets/usaf_armament.shtml)

Air Force Armstrong Environics Directorate

Air Force Research Laboratory - Munitions Directorate  
[www.mn.afrl.af.mil](http://www.mn.afrl.af.mil)

ARL - Army Research Office  
[www.arl.army.mil/aro](http://www.arl.army.mil/aro)

DOE - Hemispheric Center for Environmental Technology  
[www.hcet.fiu.edu](http://www.hcet.fiu.edu)

NASA - Kennedy Space Center  
[www.nasa.gov/centers/kennedy/home/index.html](http://www.nasa.gov/centers/kennedy/home/index.html)

National High Magnetic Field Laboratory  
[www.nhmfl.gov](http://www.nhmfl.gov)

Navy - Naval Aerospace Medical Research Laboratory  
[www.namrl.navy.mil](http://www.namrl.navy.mil)

Navy - Naval Air Warfare Center Training Systems Division  
[www.ntsc.navy.mil](http://www.ntsc.navy.mil)

Navy - Naval Surface Warfare Center - Panama City  
[www.ncsc.navy.mil](http://www.ncsc.navy.mil)

## **Georgia**

Air Force - Warner Robins Air Logistics Center  
[www.robins.af.mil](http://www.robins.af.mil)

ARS - South Atlantic Area  
[www.ars-grin.gov/ars/SoAtlantic](http://www.ars-grin.gov/ars/SoAtlantic)

Atlanta Rehab R&D Center  
[www.varrd.emory.edu](http://www.varrd.emory.edu)

HHS - Centers for Disease Control and Prevention  
[www.cdc.gov](http://www.cdc.gov)

## **Idaho**

DOE - Idaho National Laboratory  
[www.inel.gov](http://www.inel.gov)

DOE - Chicago Operations Office

DOE - Fermi National Accelerator Laboratory  
[www.fnal.gov](http://www.fnal.gov)

DOE - New Brunswick Laboratory  
[www.nbl.doe.gov](http://www.nbl.doe.gov)

USACE - ERDC - Construction Engineering Research Laboratory  
[www.cecer.army.mil](http://www.cecer.army.mil)

USDA - ARS  
National Center for Agricultural Utilization Research  
[www.ars.usda.gov/main/site\\_main.htm?modecode=36200000](http://www.ars.usda.gov/main/site_main.htm?modecode=36200000)

## **Indiana**

Navy - Naval Surface Warfare Center - Crane Division  
[www.crane.navy.mil](http://www.crane.navy.mil)

## **Iowa**

Ames Laboratory  
[www.ameslab.gov](http://www.ameslab.gov)

ARS - National Animal Disease Center

## **Kansas**

Army - TRADOC Analysis Center  
[www.trac.army.mil](http://www.trac.army.mil)

## **Louisiana**

ARS - Southern Regional Research Center

## **Maryland**

ARL-Weapons & Materials Directorate  
[www.arl.army.mil/wmrd](http://www.arl.army.mil/wmrd)

Army - Aberdeen Test Center  
[www.atc.army.mil](http://www.atc.army.mil)

Army - ARL - Aberdeen Proving Ground Site  
[www.arl.army.mil](http://www.arl.army.mil)

Army - ARL - Adelphi Site  
[www.arl.army.mil](http://www.arl.army.mil)

Army - Army Medical Research Institute of Chemical Defenses  
[www.chemdef.apgea.army.mil](http://www.chemdef.apgea.army.mil)

Army - Center for Environmental Health Research  
<http://usacehr.detrack.army.mil>

Army - Edgewood Chemical Biological Center  
[www.ecbc.army.mil](http://www.ecbc.army.mil)

Army - Walter Reed Army Institute of Research  
<http://wrair-www.army.mil>

Army Medical Research Institute of Infectious Diseases  
[www.usamriid.army.mil](http://www.usamriid.army.mil)

Army Test & Evaluation Command

DOC - National Institute of Standards and Technology  
[www.nist.gov](http://www.nist.gov)

DOD - National Geospatial-Intelligence Agency  
[www.nga.mil](http://www.nga.mil)

DOD - Uniformed Services University of Health Sciences  
[www.usuhs.mil](http://www.usuhs.mil)

HHS - FDA - Center For Biologics Evaluation and Research  
[www.fda.gov/cber](http://www.fda.gov/cber)

HHS - FDA - Center for Veterinary Medicine  
[www.fda.gov/cvm](http://www.fda.gov/cvm)

HHS - National Institutes of Health  
[www.nih.gov](http://www.nih.gov)

HHS - NIH - National Cancer Institute – Frederick  
<http://ttb.nci.nih.gov>

HHS - NIH - National Cancer Institute – Rockville  
[www.cancer.gov](http://www.cancer.gov)

HHS - NIH - National Center for Research Resources  
[www.ncrr.nih.gov](http://www.ncrr.nih.gov)

HHS - NIH - National Eye Institute  
[www.nei.nih.gov](http://www.nei.nih.gov)

HHS - NIH - National Heart, Lung, and Blood Institute  
[www.nhlbi.nih.gov](http://www.nhlbi.nih.gov)

HHS - NIH - National Human Genome Research Institute  
[www.genome.gov](http://www.genome.gov)

HHS - NIH - National Institute of Allergy and Infectious Diseases  
[www.niaid.nih.gov](http://www.niaid.nih.gov)

HHS - NIH - National Institute of Child Health and Human Development  
[www.nichd.nih.gov](http://www.nichd.nih.gov)

HHS - NIH - National Institute of Dental and Craniofacial Research  
[www.nidcr.nih.gov](http://www.nidcr.nih.gov)

HHS - NIH - National Institute of Diabetes and Digestive and Kidney Diseases  
[www.niddk.nih.gov](http://www.niddk.nih.gov)

HHS - NIH - National Institute of General Medical Sciences  
[www.nigms.nih.gov](http://www.nigms.nih.gov)

HHS - NIH - National Institute of Mental Health  
[www.nimh.nih.gov](http://www.nimh.nih.gov)

HHS - NIH - National Institute of Neurological Disorders and Stroke  
[www.ninds.nih.gov](http://www.ninds.nih.gov)

HHS - NIH - National Institute of Nursing Research  
[www.nih.gov/ninr](http://www.nih.gov/ninr)

HHS - NIH - National Institute on Aging  
[www.nia.nih.gov](http://www.nia.nih.gov)

HHS - NIH - National Institute on Alcohol Abuse and Alcoholism  
[www.niaaa.nih.gov](http://www.niaaa.nih.gov)

HHS - NIH - National Institute on Deafness and Other Communication Disorders  
[www.nidcd.nih.gov](http://www.nidcd.nih.gov)

HHS - NIH - National Institute on Drug Abuse  
[www.nida.nih.gov](http://www.nida.nih.gov)

HHS - NIH - National Library of Medicine  
[www.nlm.nih.gov](http://www.nlm.nih.gov)

NASA - Goddard Space Flight Center  
[www.nasa.gov/centers/goddard/home/index.html](http://www.nasa.gov/centers/goddard/home/index.html)

National Institute of Arthritis and Musculoskeletal and Skin Diseases  
[www.niams.nih.gov](http://www.niams.nih.gov)

National Institute of Biomedical Imaging and Bioengineering  
[www.nibib.nih.gov](http://www.nibib.nih.gov)

National Oceanic and Atmospheric Administration  
[www.noaa.gov](http://www.noaa.gov)

Naval Explosive Ordnance Disposal Technology Division  
<http://naveodtechdiv.navsea.navy.mil>

Navy - Naval Air Warfare Center Aircraft Division - Patuxent River  
[www.nawcad.navy.mil](http://www.nawcad.navy.mil)

Navy - Naval Medical Research Center  
[www.nmrc.navy.mil](http://www.nmrc.navy.mil)

Navy - Naval Surface Warfare Center - Carderock Division  
[www.dt.navy.mil](http://www.dt.navy.mil)

Navy - Naval Surface Warfare Center - Indian Head Division  
[www.ih.navy.mil](http://www.ih.navy.mil)

Navy - U.S. Naval Academy  
[www.usna.edu](http://www.usna.edu)

U.S. Army Medical Research and Materiel Command  
<https://mrmc.detrick.army.mil>

University of Maryland  
[www.umd.gov](http://www.umd.gov)

USDA - ARS - Beltsville Area Research Center  
[www.ba.ars.usda.gov/](http://www.ba.ars.usda.gov/)

## **Massachusetts**

Air Force Electronic System Center  
<http://esc.hanscom.af.mil>

Air Force Research Laboratory - Space Vehicles Directorate - Hanscom AFB  
[www.vs.af.mil](http://www.vs.af.mil)

Army - U.S. Army Research Institute of Environmental Medicine  
[www.usariem.army.mil](http://www.usariem.army.mil)

DOT - RITA - The Volpe National Transportation Systems Center  
[www.volpe.dot.gov](http://www.volpe.dot.gov)  
National Marine Fisheries Service  
[www.nmfs.noaa.gov](http://www.nmfs.noaa.gov)

Navy - Navy Clothing and Textile Research Facility  
[www.navy-nex.com/command/nctrf/nctrf-index.html](http://www.navy-nex.com/command/nctrf/nctrf-index.html)

## **Michigan**

Army - Tank Automotive Research, Development & Engineering Center  
[www.tacom.army.mil/tardec](http://www.tacom.army.mil/tardec)

Army National Automotive Center  
[www.tacom.army.mil/tardec/nac](http://www.tacom.army.mil/tardec/nac)

ARS - Midwest Area  
[www.ars.usda.gov](http://www.ars.usda.gov)

## **Minnesota**

FS - North Central Research Station  
[www.ncrs.fs.fed.us](http://www.ncrs.fs.fed.us)

## **Mississippi**

Army - USACE - ERDC - Information Technology Laboratory  
<http://itl.erd.c.usace.army.mil>

NASA - Stennis Space Center  
[www.nasa.gov/centers/stennis/home/index.html](http://www.nasa.gov/centers/stennis/home/index.html)

Navy - Naval Oceanographic Office  
[www.navo.navy.mil](http://www.navo.navy.mil)

USACE - Engineer Research and Development Center  
[www.erd.c.usace.army.mil](http://www.erd.c.usace.army.mil)

USDA - ARS - Mid South Area  
<http://msa.ars.usda.gov/>

## **Missouri**

DOE - NNSA - Kansas City Plant  
[www.kcp.com](http://www.kcp.com)

DOI - USGS - Upper Midwest Environmental Sciences Center  
[www.umesc.usgs.gov](http://www.umesc.usgs.gov)

FS - Forestry Sciences Laboratory

## **Montana**

ARS - Northern Plains Agricultural Research Laboratory

Rocky Mountain Laboratories

USDA - FS - Missoula Technology & Development Center  
[www.fs.fed.us/eng/techdev/mtdc.htm](http://www.fs.fed.us/eng/techdev/mtdc.htm)

## **Nebraska**

Air Force - Air Weather Agency  
[www.af.mil/news/factsheets/Air\\_Force\\_Weather\\_Agency.html](http://www.af.mil/news/factsheets/Air_Force_Weather_Agency.html)

ARS - Roman L. Hruska U.S. Meat Animal Research Center (MARC)  
[www.marc.usda.gov](http://www.marc.usda.gov)

ARS - Soil & Water Conservation Unit  
[www.ianr.unl.edu/arslincoln/swcru/home.htm](http://www.ianr.unl.edu/arslincoln/swcru/home.htm)



## **Nevada**

DOE - Bechtel Nevada  
[www.bechtelnevada.com](http://www.bechtelnevada.com)

National Exposure Research Laboratory  
[www.epa.gov/nerl](http://www.epa.gov/nerl)

## **New Hampshire**

USACE - ERDC - Cold Regions Research and Engineering Laboratory  
[www.crrel.usace.army.mil](http://www.crrel.usace.army.mil)

## **New Jersey**

Army - Communications-Electronics Command  
[www.monmouth.army.mil/CELCMC](http://www.monmouth.army.mil/CELCMC)

Army Communications and Electronics Command  
[www.monmouth.army.mil/cecom.html](http://www.monmouth.army.mil/cecom.html)

Army Tank-Automotive and Armaments Command  
[www.tacom.army.com](http://www.tacom.army.com)

Army/CECOM-Intelligence and Information Warfare Directorate

Army/CECOM/RDEC-Command & Control/Sys. Int. Directorate  
[www.monmouth.army.mil/cecom.html](http://www.monmouth.army.mil/cecom.html)

Army/CECOM/RDEC-Software Engineering Directorate  
[www.monmouth.army.mil/cecom.html](http://www.monmouth.army.mil/cecom.html)

Army/CECOM/RDEC-Space & Terrestrial Comm. Directorate  
[www.monmouth.army.mil/cecom.html](http://www.monmouth.army.mil/cecom.html)

DOE - Princeton Plasma Physics Laboratory  
[www.pppl.gov](http://www.pppl.gov)

FAA - William J. Hughes Technical Center  
[www.tc.faa.gov](http://www.tc.faa.gov)

## **New Mexico**

Air Force Research Laboratory - Directed Energy Directorate  
[www.de.afrl.af.mil](http://www.de.afrl.af.mil)

Air Force Research Laboratory - Space Vehicles Directorate  
[www.vs.afrl.af.mil](http://www.vs.afrl.af.mil)

Air Force Research Laboratory/Directed Energy

Army White Sands Missile Range  
[www.wsmr.army.mil](http://www.wsmr.army.mil)

ARS - Southwestern Cotton Ginning Research Lab

DOE - Los Alamos National Laboratory  
[www.lanl.gov](http://www.lanl.gov)

DOE - Sandia National Laboratories  
[www.sandia.gov](http://www.sandia.gov)

Lovelace Respiratory Research Institute  
[www.lrri.org](http://www.lrri.org)

I2WD: The McAfee Center

Naval Surface Warfare Center

Navy - Naval Air Warfare Center Aircraft Division  
[www.nawcad.navy.mil](http://www.nawcad.navy.mil)

NOAA/OAR - Geophysical Fluid Dynamics Laboratory

## **New York**

Air Force Research Laboratory-Information Directorate  
[www.rl.afrl.af.mil](http://www.rl.afrl.af.mil)

Army - Benet Laboratories  
[www.benet.wva.army.mil](http://www.benet.wva.army.mil)

ARS - Plant Genetic Research Unit  
[www.agron.missouri.edu/ars\\_comlumbia/pgru.html](http://www.agron.missouri.edu/ars_comlumbia/pgru.html)

Brookhaven National Laboratory  
[www.bnl.gov](http://www.bnl.gov)

## **North Carolina**

Duke University - Computer Science

EPA - National Exposure Research Laboratory  
[www.epa.gov/nerl](http://www.epa.gov/nerl)

EPA - ORD - National Health and Environmental Effects Research Lab  
[www.epa.gov/nheerl](http://www.epa.gov/nheerl)

FS - Southern Research Station  
[www.srs.fs.fed.us](http://www.srs.fs.fed.us)

HHS - NIH - National Institute of Environmental Health Sciences  
[www.niehs.nih.gov](http://www.niehs.nih.gov)

Navy - Space and Naval Warfare Systems Center – Charleston  
<http://ssc.spawar.navy.mil>

## **North Dakota**

ARS - Grand Forks Human Nutrition Research Center  
[www.gfhnrc.ars.usda.gov](http://www.gfhnrc.ars.usda.gov)

ARS - Northern Great Plains Research Laboratory  
[www.mandan.ars.usda.gov](http://www.mandan.ars.usda.gov)

USGS - Northern Prairie Wildlife Research Center  
[www.npwrc.usgs.gov](http://www.npwrc.usgs.gov)

## **Ohio**

Air Force - Aeronautical Systems Center  
[www.wpafb.af.mil](http://www.wpafb.af.mil)

Air Force - Air Force Institute of Technology  
[www.afit.edu](http://www.afit.edu)

Air Force Packaging Technology & Engineering Facility

Air Force Research Laboratory  
[www.afrl.af.mil](http://www.afrl.af.mil)

Air Force Research Laboratory - Air Vehicles Directorate  
[www.va.afrl.af.mil](http://www.va.afrl.af.mil)

Air Force Research Laboratory - Human Effectiveness Directorate  
[www.he.afrl.af.mil](http://www.he.afrl.af.mil)

Air Force Research Laboratory - Materials and Manufacturing Directorate  
[www.ml.afrl.af.mil](http://www.ml.afrl.af.mil)

Air Force Research Laboratory - Propulsion Directorate  
[www.pr.afrl.af.mil](http://www.pr.afrl.af.mil)

Air Force Research Laboratory - Sensors Directorate  
[www.sn.afrl.af.mil](http://www.sn.afrl.af.mil)

Air Force Research Laboratory - Wright Site  
[www.wrs.afrl.af.mil](http://www.wrs.afrl.af.mil)

Argonne National Laboratory  
[www.anl.gov](http://www.anl.gov)

ARL - Vehicle Technology Directorate - Propulsion Program  
[www.arl.army.mil/vtd/vtcindex.html](http://www.arl.army.mil/vtd/vtcindex.html)

EPA - National Risk Management Research Laboratory  
[www.epa.gov/ord/nrmrl](http://www.epa.gov/ord/nrmrl)

HHS - CDC - National Institute for Occupational Safety and Health  
[www.cdc.gov/niosh](http://www.cdc.gov/niosh)

Mound Applied Technologies  
[www.em.doe.gov/tie/egmound.html](http://www.em.doe.gov/tie/egmound.html)

NASA - Glenn Research Center  
[www.nasa.gov/centers/glenn/home/index.html](http://www.nasa.gov/centers/glenn/home/index.html)

National Center for Atmospheric Research  
[www.ncar.ucar.edu/ncar](http://www.ncar.ucar.edu/ncar)

## **Oklahoma**

ARS - Grazinglands Research Laboratory  
[http://ars.usda.gov/main/site\\_main.htm?modecode=62180000](http://ars.usda.gov/main/site_main.htm?modecode=62180000)

ARS - Plant Science & Water Conservation Research Laboratory  
[www.pswcrl.ars.usda.gov](http://www.pswcrl.ars.usda.gov)

ARS - South Central Agricultural Research Laboratory  
[www.lane-ag.org](http://www.lane-ag.org)

FAA - Civil Aeromedical Institute  
[www.cami.jccbi.gov](http://www.cami.jccbi.gov)

National Institute for Petroleum & Energy Research

National Petroleum Technology Office  
[www.npto.doe.gov](http://www.npto.doe.gov)

NOAA/ERL - National Severe Storms Laboratory

## **Oregon**

Albany Research Center  
[www.alrc.doe.gov](http://www.alrc.doe.gov)

USDA - FS - Pacific Northwest Research Station  
[www.fs.fed.us/pnw/](http://www.fs.fed.us/pnw/)

## **Pennsylvania**

Army Military History Institute  
[www.carlisle.army.mil/ahec/MHI.htm](http://www.carlisle.army.mil/ahec/MHI.htm)

CDC - NIOSH - National Personal Protective Technology Laboratory  
[www.cdc.gov/niosh/npptl](http://www.cdc.gov/niosh/npptl)

Center for Advance Technology for Large Structural Systems

FS - Northeastern Area  
[www.na.fs.fed.us](http://www.na.fs.fed.us)

HHS - CDC - NIOSH - Pittsburgh Research Laboratory  
[www.cdc.gov/niosh/im-prl.html](http://www.cdc.gov/niosh/im-prl.html)

Institute for Research in Cognitive Science

Naval Surface Warfare Center - Carderock Division  
[www.dt.navy.mil](http://www.dt.navy.mil)

Software Engineering Institute  
[www.sei.cmu.edu](http://www.sei.cmu.edu)

USDA - ARS - North Atlantic Area  
[www.ars.usda.gov/main/site\\_main.htm?modecode=19-00-00-00](http://www.ars.usda.gov/main/site_main.htm?modecode=19-00-00-00)

USDA - FS - Northeastern Research Station  
[www.fs.fed.us/ne/](http://www.fs.fed.us/ne/)

## **Rhode Island**

Naval War College  
[www.nwc.navy.mil](http://www.nwc.navy.mil)

Navy - Naval Undersea Warfare Center Division Newport  
[www.npt.nuwc.navy.mil](http://www.npt.nuwc.navy.mil)

## **South Carolina**

DOE - Savannah River National Laboratory  
<http://srnl.doe.gov>

## **Tennessee**

Air Force - Arnold Engineering Development Center  
[www.arnold.af.mil](http://www.arnold.af.mil)

DOE - Oak Ridge National Laboratory  
[www.ornl.gov](http://www.ornl.gov)

DOE - Oak Ridge Operations Office

DOE - Y-12 National Security Complex  
[www.y12.doe.gov](http://www.y12.doe.gov)

Oak Ridge K-25 Site  
[www.nefsc.nmfs.gov](http://www.nefsc.nmfs.gov)

Office of Scientific & Technical Information  
Tennessee Valley Authority

## **Texas**

Air Force - 311th Human Systems Wing  
[www.brooks.af.mil](http://www.brooks.af.mil)

Army - Clinical Investigation Regulatory Office  
[www.cs.amedd.army.mil/ciro/default.htm](http://www.cs.amedd.army.mil/ciro/default.htm)

Army - Institute of Surgical Research  
[www.usaisr.amedd.army.mil](http://www.usaisr.amedd.army.mil)

Army Center for Healthcare Education and Studies  
[www.benet.wva.army.mil](http://www.benet.wva.army.mil)

ARS - Children's Nutrition Research Center

ARS - Food Animal Protection Research Laboratory

ARS - Grassland, Soil & Water Research Lab  
<http://arsserv0.tamu.edu>

ARS-Southern Cross Research Laboratory

DOE - Institute for Fusion Studies  
<http://peaches.ph.utexas.edu/ifs>

NASA - Johnson Space Center  
[www.nasa.gov/centers/johnson/home/index.html](http://www.nasa.gov/centers/johnson/home/index.html)

NOAA/NMFS - Galveston Laboratory

USDA - ARS - Southern Plains Area  
[www.ars.usda.gov/main/site\\_main.htm?modecode=62-00-00-00](http://www.ars.usda.gov/main/site_main.htm?modecode=62-00-00-00)

## **Utah**

Air Force - Ogden Air Logistics Center  
[www.hill.af.mil](http://www.hill.af.mil)

Army - Dugway Proving Ground  
[www.dugway.army.mil](http://www.dugway.army.mil)

Brigham Young University  
[www.byu.edu](http://www.byu.edu)

## **Virginia**

ARL - Vehicle Technology Directorate - Structures Program  
[www.arl.army.mil/vtd/vtcindex.html](http://www.arl.army.mil/vtd/vtcindex.html)

Army - Aviation Applied Technology Directorate  
[www.aatd.eustis.army.mil](http://www.aatd.eustis.army.mil)

Army - RDECOM - CERDEC - Night Vision and Electronic Sensors Directorate  
[www.nvl.army.mil](http://www.nvl.army.mil)

Army - U.S. Army Research Institute for the Behavioral and Social Sciences  
[www.ari.army.mil](http://www.ari.army.mil)

Army - USACE - Institute for Water Resources  
[www.iwr.usace.army.mil](http://www.iwr.usace.army.mil)

DOD - Defense Advanced Research Projects Agency  
[www.darpa.mil](http://www.darpa.mil)

DOD - Defense Technical Information Center  
[www.dtic.mil](http://www.dtic.mil)

DOE - Thomas Jefferson National Accelerator Facility  
[www.jlab.org](http://www.jlab.org)

DOI - U.S. Geological Survey  
[www.usgs.gov](http://www.usgs.gov)

Federal Bureau of Investigation  
[www.fbi.gov](http://www.fbi.gov)

Marine Corps Systems Commands  
[www.marcorsyscom.usmc.mil](http://www.marcorsyscom.usmc.mil)

NASA - Langley Research Center  
[www.larc.nasa.gov](http://www.larc.nasa.gov)

National Science Foundation  
[www.nsf.gov](http://www.nsf.gov)

Naval Surface Warfare Center - Dahlgren Division  
[www.nswc.navy.mil](http://www.nswc.navy.mil)

Navy - Naval Safety Center  
[www.safetycenter.navy.mil](http://www.safetycenter.navy.mil)

Navy - Office of Naval Research  
[www.onr.navy.mil](http://www.onr.navy.mil)

USACE - ERDC - Topographic Engineering Center  
[www.tec.army.mil](http://www.tec.army.mil)

VA - Rehabilitation Research & Development Service

## **Washington**

CDC - NIOSH - Spokane Research Laboratory  
[www.cdc.gov/niosh/im-srl.html](http://www.cdc.gov/niosh/im-srl.html)

DOE - Hanford Site  
[www.hanford.gov](http://www.hanford.gov)

DOE - Pacific Northwest National Laboratory  
[www.pnl.gov](http://www.pnl.gov)

Navy - Naval Undersea Warfare Center - Keyport Division  
[www-keyport.kpt.nuwc.navy.mil](http://www-keyport.kpt.nuwc.navy.mil)

## **Washington, DC**

Ballistic Missile Defense Organization

CIA - Gain Laboratory

EPA - Office of Science and Policy  
[www.epa.gov/osp](http://www.epa.gov/osp)

HHS - FDA - Center for Food Safety and Applied Nutrition  
[www.cfsan.fda.gov/list.html](http://www.cfsan.fda.gov/list.html)

NASA - Space Partnership Development  
<http://spd.nasa.gov>

Naval Sea Systems Command  
[www.navsea.navy.mil](http://www.navsea.navy.mil)

Navy - Naval Research Laboratory  
[www.nrl.navy.mil](http://www.nrl.navy.mil)

## **West Virginia**

CDC - NIOSH - Morgantown Research Laboratory  
[www.cdc.gov/niosh](http://www.cdc.gov/niosh)

DOE - National Energy Technology Laboratory  
[www.netl.doe.gov/](http://www.netl.doe.gov/)

## **Wisconsin**

USDA - FS - Forest Products Laboratory  
[www.fpl.fs.fed.us](http://www.fpl.fs.fed.us)





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- Lowering your heating bill

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