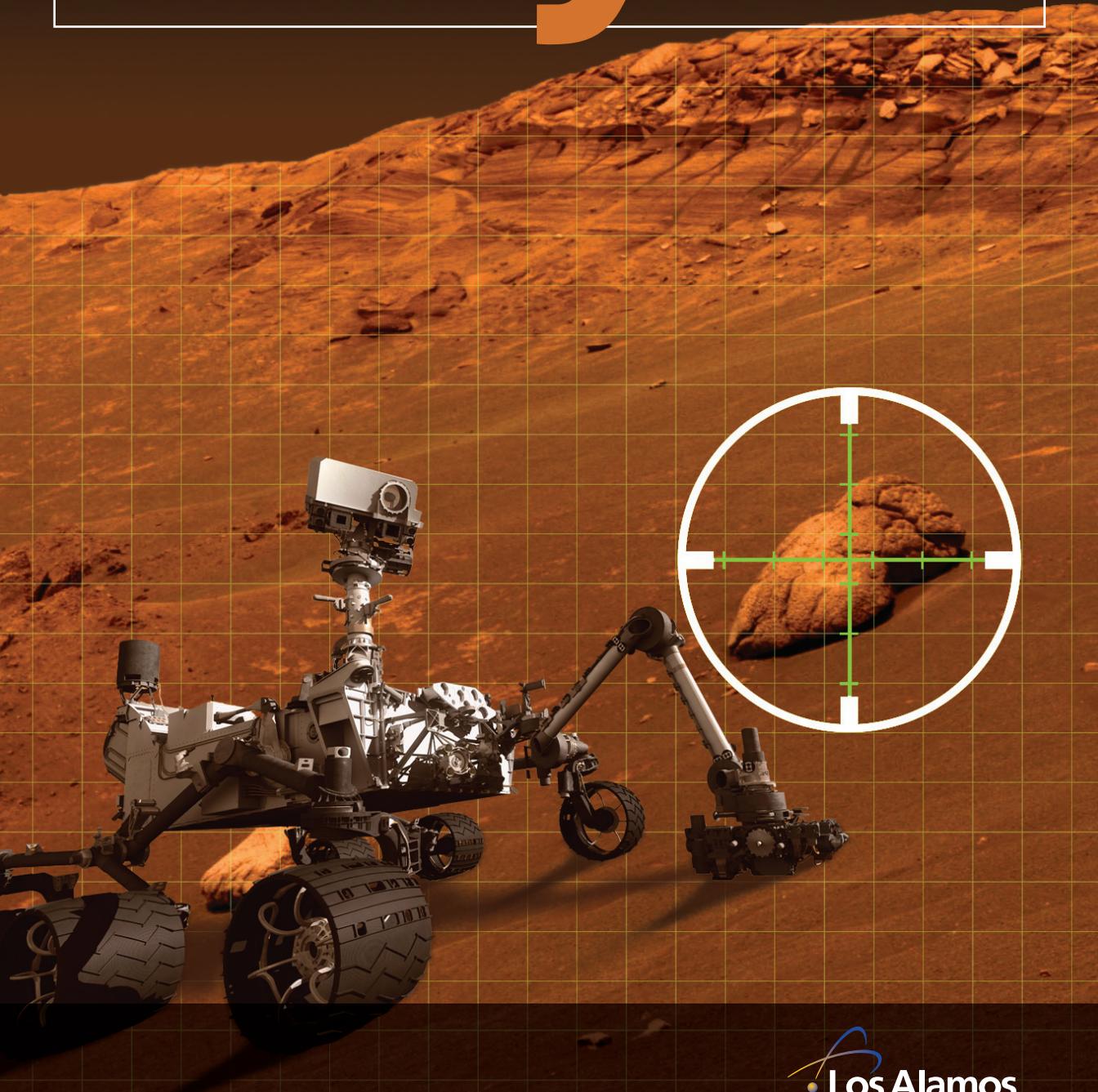


# why

scientists poke  
and prod the  
Red Planet



## About this issue

We've reached the one-year mark for *Why* magazine—one full trip around the Sun. This issue takes us to other parts of the solar system. Our cover story highlights the science—and collaboration—behind preparing a mobile laboratory for a Mars reconnaissance mission. Meanwhile, on another side of the Lab, Los Alamos researchers work on solutions to some of planet Earth's greatest energy concerns—applying cutting-edge science, technology, and engineering to study prospects for alternative fuels. Read about their work on page 14.

We hope you've enjoyed this past year of insight into the many facets of Los Alamos National Laboratory.

To those of you who responded to a recent readership survey, thank you for your feedback. Though we're still analyzing the results, we were pleased to see that 84 percent of participants rate the technical level of the content of *Why* "about right." Of course, the "degree of difficulty" may vary depending on topic or writer, but we strive to make the stories of Los Alamos understandable for all our readers.

We'll continue to use your feedback and story suggestions to improve *Why* magazine for years to come. Keep those ideas and comments coming by emailing [why@lanl.gov](mailto:why@lanl.gov).

To subscribe or edit your subscription preferences, please visit [www.lanl.gov/whysubscribe](http://www.lanl.gov/whysubscribe).

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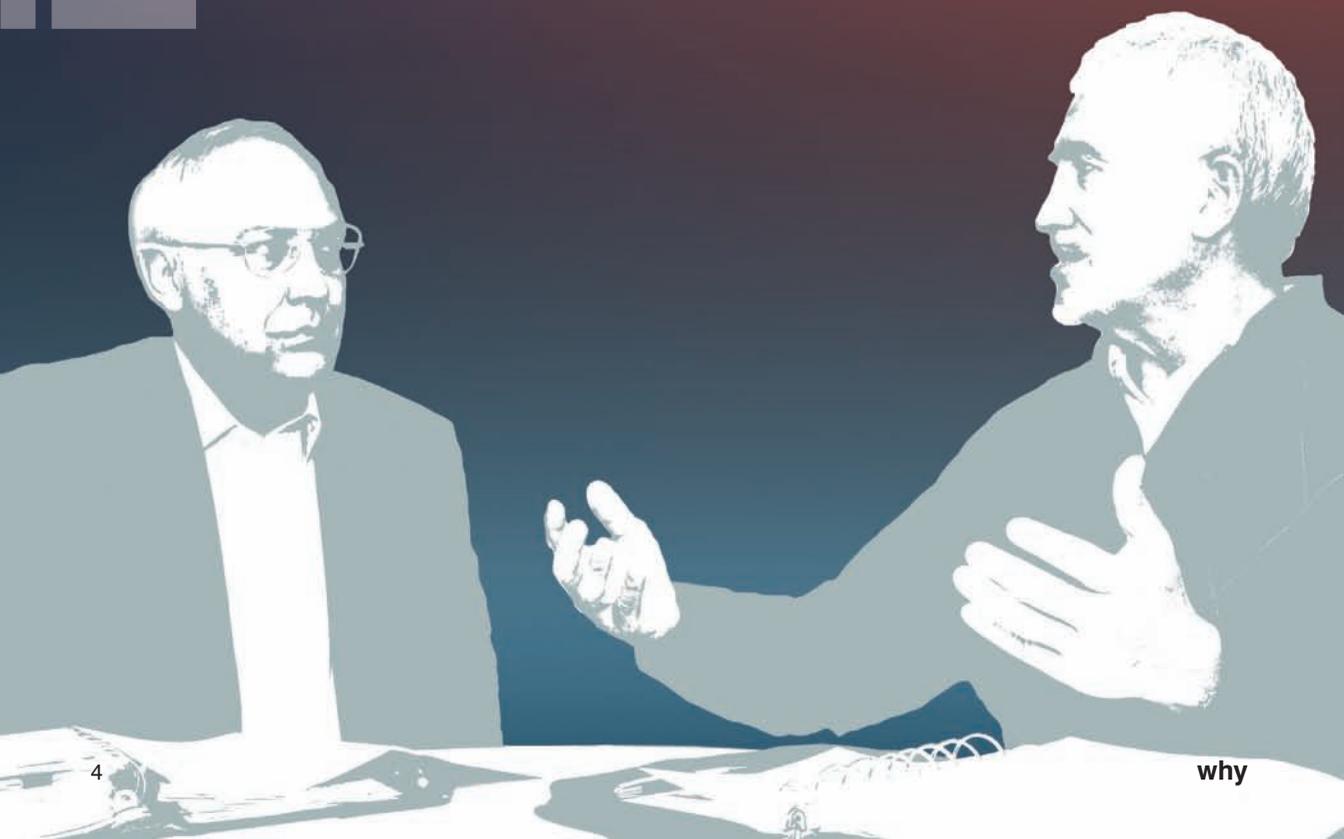
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Reducing cost and increasing efficiency

## Governance Reform

*A candid conversation about improving efficiencies—and relationships—on both sides of the fence*



We sat down with Rich Marquez, Los Alamos National Laboratory's executive director, and Kevin Smith, manager of the National Nuclear Security Administration's Los Alamos Site Office, to discuss how LANL and LASO are collaborating to meet the complex challenges of government oversight, leaner budgets, and administrative processes.

at the same time.

### **What is governance reform, who initiated it, and why?**

**KS:** Governance reform is a dedicated effort by the Department of Energy to eliminate unneeded steps or approvals in the work that we do.

Locally, it was an extension of our ongoing efforts to do things more cost effectively and efficiently. It was also a targeted response to Laboratory leader concerns that expanding government regulations were in some cases creating substantial additional work and providing insufficient benefit.

Over time, regulations and policies can grow as different interpretations arise. Sometimes requirements grow far beyond the original intent, resulting in unanticipated expenses. Good managers have to stand back periodically and ask, is the original intent still there? Do we really see value for this added effort? Are the new reports or processes serving a necessary purpose? Are the metrics we are collecting and reporting still worth the time and effort?

### **How did governance reform start here at LANL?**

**RM:** After Kevin arrived, it occurred to me that we had a great opportunity to change the business relationship we've had under NNSA's prime contract with Los Alamos National Security. I thought Kevin's perspective might offer a fresh start—a chance to step back and forget the minutia, forget arguing over DOE orders. Let's really take a hard look at the business relationship between LANL and LASO and start working together and use common sense to halt non-value-added work and, hence, increase productivity.

So Kevin joined us at LANL's fall planning retreat, and we kicked it off. Mike Anastasio was the corporate sponsor and Kevin was the federal sponsor. We came out of that retreat with about a dozen improvement, or reform, projects. [Please see page 7.]

### **Of the initiatives you identified, which have best met the goals and objectives of the reform?**

**KS:** Some of the most notable initiatives reduce cost and increase efficiency at the same time. One that immediately comes to me is equipment accountability.

Every piece of equipment valued at \$5,000 or more had to be accounted for annually. It had to have a label on it, it had to be managed, it had to have disposition, and follow a formal protocol for proper disposal. In the past, the dollar threshold had not been changed very often for inflation, but we decided to take a risk-based look at what was being tracked with this intense level of scrutiny. As a result, we've moved the threshold up to \$10,000 for most items while keeping a tight standard for high-risk items. Through this approach we've maintained a high level of accountability for the most sensitive items while reducing administrative and processing costs by more than 50 percent.

**RM:** I'll pick the Performance Evaluation Plan improvements. With Kevin's help, the government took a look at how many objectives and submeasures under those objectives were really needed. We focused on the Laboratory's current strategic goals in order to become more deliberate. We reduced the number of categories by more than 30 percent and reduced the number of individual measures by 50 percent.

That's significant in terms of low-value-added work that both sides can avoid in the upcoming fiscal year. Employees have less to enter, and the site office has less to review—saving time, saving money.

### **What were some expected—or unexpected—outcomes?**

**RM:** The best outcome is that over the past year we've not only made measurable progress on the projects we identified, but we've come away with the realization that we can take on these problems collaboratively and work together on common ground. If we rally around "yes" faster, that in and of itself is worth the investment in time.

*"It's not about the projects themselves, it's aligning the values and aligning the philosophy."*

Let me add to what Kevin said about DOE orders and regulations in the contract. We spent too much time debating about changing those, and we were losing sight of the fact that how we implement things is just as important. Our contract should encourage us to be innovative; this is research and development. Now, as we come to the table, we say let's quit trying to be so risk-averse and let's figure out together how we can execute these requirements in a way that makes sense and furthers the mission. That's the bottom line—it's not about the projects themselves, it's aligning the values and aligning the philosophy.

### **Do you regard the FY11 reform effort as a first step to future projects?**

**KS:** I do, yes. These types of initiatives should continue, and I think there are even bigger, bolder ideas out there that we'd like to capitalize on and begin addressing next year. Charlie McMillan has been very open and willing to tackle requirements that don't make good sense today. With Rich's leadership, we're aggressively scouting new opportunities. Ideally, we'd like to see new candidate initiatives identified and vetted through the Laboratory's Contractor Assurance System, and through the Process Improvement Project initiative, but we're open to any source for these ideas. We're also actively looking for successes that can be imported from other sites in NNSA and DOE.

**RM:** I agree. I'd add that this has been a true educational experience, because we don't have the same roles and responsibilities on both sides of the fence. We're contracted to perform the mission and to carry out all of the things that support that mission.

Kevin's role is different—it's to make sure that the federal government is represented here, because that's who makes the investment on behalf of the taxpayers.

Oftentimes we get to a point where we realize that it will take Kevin and his staff's help to work with the other components of NNSA, whether it's headquarters or the Service Center in Albuquerque. That's something we at LANL can't do alone.

**KS:** Exactly. The site office can't succeed without the Lab succeeding and the Lab really needs the site office to do its part. If either of the two loses momentum, we will fail as a team.

*“Clearly, trust builds trust, and success breeds success.”*

### **Why is reform so important now?**

**RM:** If you look at fiscal year 2012 and fiscal year 2013, resources are almost certainly going to get scarcer. That's all the more reason we have to find ways to be more productive. Frankly, we also need to offload requirements from the individual worker, because as we continue to recruit the top scientists, one of the things that they want is to come into an environment where all they focus on is their science. There are some administrative things that are necessary in a normal workday, but we need to keep those to a reasonable level.

### **Were there times of tension while you were working through to a positive outcome?**

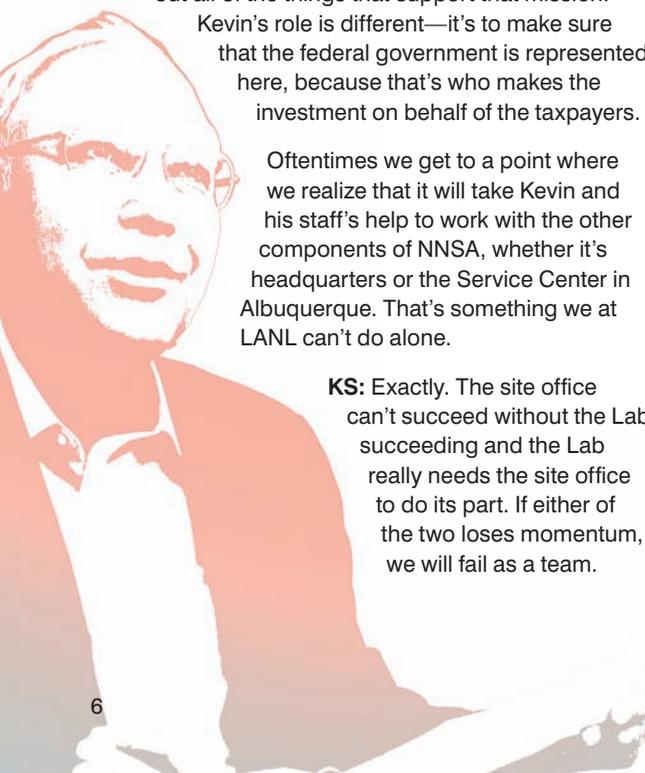
**RM:** We have great success stories where project champions hit the ground running and got their issues resolved right away.

On the other hand, we had some places where there was a little more of a rub. Those are some of the issues I'm most interested in, because they are obvious areas where the feds can't totally relax—like conduct of operations and safety, for example. I expect them to be skeptical. But I think that by the end of the year, even in those tough areas, we've had people starting to communicate more effectively and work more cooperatively.

**KS:** In the past, some of us would take a safer approach, rejecting more requests than we would today. I'm encouraging our colleagues at NNSA headquarters to keep open minds. It's not a straight black-or-white answer. We want to look rigorously to see if we have, or can get, the authority to try a new or innovative approach. If you can steer both organizations to engage with each other and build a collaborative environment where “no” is not the first answer, the reflex or default answer, you tend to have a greater upside potential.

### **Is this LASO-LANL partnership a model for other DOE sites?**

**RM:** I think we're in the lead. We're making an overture to do our best to get on board, to follow the lead on the governance, and maybe take the lead on the issue of working with the site office to improve the business relationship.



## 2011 Governance Reform Initiatives

**Two-person Rule:** Leverage administrative and engineering controls to allow single-person access to LANL Plutonium Facility work areas without sacrificing safety or security.

**Procurement Authority:** Increase LANL's internal procurement authority, excluding construction, from \$15 million to \$17.5 million for competitive contracts and from \$10 million to \$15 million for noncompetitive contracts.

**Integrated Lease Strategy:** Renegotiate current leases into a new standard lease template. Allow Los Alamos National Security to lease up to an additional 100,000 square feet of improved space.

**Revise Requirements for Updates to Documented Safety Analysis:** Change annual DSA updates to a three-year cycle for selected nuclear facilities and, in lieu of a formal annual update, submit a letter detailing safety-basis documents.

**Screening Unreviewed Safety Questions:** Establish an expert-based process for screening proposed changes to a nuclear facility's procedures, tests, or experiments and establish whether a full USQ determination is required.

**Performance Evaluation Plan:** Develop Performance Evaluation Plan for FY12 that is focused on mission deliverables, eliminates complexity, and improves alignment with DOE priorities and LANL's strategic direction.

**Non-Nuclear Operations Re-engineering:** Standardize the distinction between nuclear and non-nuclear facilities.

**Open Architecture:** Even before new facilities are tied to specific missions, enable the Lab to include science-oriented infrastructure to support various types of work over the long term with flexible, open floor plans.

**Work for Others Improvements:** Streamline processes that govern LANL's Work for Others program (serving non-DOE customers) and associated document control and work authorization processes.

**Streamlined Project Review for DOE Order 413.3B:** Submit all capital projects under this DOE order to an independent review prior to critical-decision review by NNSA or DOE to help identify issues beforehand.

**Mobile Device Improvements:** Establish reciprocity to allow LANL employees with BlackBerry® devices to use them at other sites and visitors from other DOE and NNSA sites to use their government-issued BlackBerrys in approved areas at LANL. Identify potential facilities for wireless access and implement in FY11 and FY12. In FY12, implement additional mobile device capabilities eventually to include iPads, iPhones, Android phones, and tablets.

**KS:** We've recognized that it's really a team effort. While we each have our respective roles to play, we can perform those roles in a way that is mutually beneficial. I see this as LANL starting to lead the way in NNSA in governance reform—tackling as many things as are appropriate now, and continuing to take on another increment next year. The result will be a more efficient and more effective partnership. Clearly, trust builds trust, and success breeds success.

### How far have you come?

**RM:** I come back to the real end game here. It's not the amount of the dollar savings or productivity gain—those are byproducts. I've learned a lesson while working with the government for 20 years, managing multiple contracts from the government side: the best way to leverage our resources is to have a positive working connection between the government and contractor. If we get that right, it's unbelievable what the NNSA complex can accomplish. I think history shows that.

### What's in store for 2012?

**RM:** Charlie was very pleased with the results of this reform program. More important, he was pleasantly surprised that Kevin had his management team there in force and we could agree at the end of the meeting that this was worthy of continuing into 2012.

We've decided to leverage the fact that the director wants to create a formal Labwide strategic plan. Just like in 2011, that strategic planning will likely yield places where we'll need site office help to make a particular objective happen. New initiatives will be added to our list, but now we'll have the relationships we built over 2011 to build on as we try to find smarter and better ways to get our work done. ■



# Mars to Host Yet Another Earth Visit

*Scientists send a mobile laboratory to explore the Red Planet*

by Nancy Ambrosiano



Roger Wiens with the Curiosity rover.

The planet Mars has endured a lot of interaction with Earth recently, just the opposite of the Mars invasion scenarios of 1950s flicks, with manmade instruments bouncing, floating, and occasionally crashing onto its rocky surface.

And launching this fall, from a NASA site not near you, will be the next high-tech collection of gadgetry to poke, prod, and zap the Red Planet.

The mission plans currently call for NASA's Mars Science Laboratory rover to launch from Florida's Cape Canaveral between November 25 and December 18, 2011, aboard a United Launch Alliance Atlas V rocket, arriving at Mars' Gale Crater on August 5, 2012. Its goal: determine if the landing site has or ever had environmental conditions favorable to microbial life.

Aboard the rover, called Curiosity, will be an impressive suite of 10 high-tech devices for the most comprehensive analysis to date of the Red Planet. Two of the payload items, as well as the power source, are products of Los Alamos National Laboratory and its partners.

## Zap!

The zapping part of the rover comes from "ChemCam," a laser spectrometer and telescope device aboard Curiosity. It is the brainchild of Los Alamos scientist Roger Wiens.

*For five nanoseconds at a time, ChemCam's laser packs the energy of a million light bulbs into a spot the size of a pinhead.*

Wiens, with a team of 40 people at LANL and the collaboration of the French space institute IRAP, created the ChemCam laser device. It will blast rocks from as far as 7 meters (23 feet), vaporize bits of their surfaces, and spectroscopically determine their chemical composition.

ChemCam sits high atop the rover's mast, looking a bit like E.T.'s head from the 1982 movie about a wizened extra-terrestrial who visits Earth. The ChemCam's spectrometer and a related telescope will aid in observations of Mars, allowing Earth-bound scientists to determine where the rover should travel and what it should explore.



Roger Wiens inspecting the ChemCam calibration targets, which are now mounted on the deck of the Mars rover.

"The laser technique, called LIBS for Laser-induced Breakdown Spectroscopy, is the product of 30 years of development in the Chemistry Division at Los Alamos," according to Wiens, who leads the project.

"For five nanoseconds at a time, ChemCam's laser packs the energy of a million light bulbs into a spot the size of a pinhead. The plasma created at the impact point tells us the composition of the rock," Wiens said.

## X-ray!

Poking the planet will be the job of various other tools on the Mini Cooper-sized rover, and once bits of planetary detritus have been scooped up or collected from a drill, another LANL-related instrument in the body of the rover will go to work.

The Chemistry and Mineralogy "CheMin" analyzer, whose deputy principal investigator is LANL's David Vaniman, will use X-ray diffraction and fluorescence to identify and quantify minerals in sediment and soil samples.

CheMin will take a batch of powdered samples and hit them with a narrow beam of X-rays. It then reads the diffraction pattern of the X-rays to determine, even from a complicated, multiminereral rock, exactly what's inside.

"Mineralogy provides information on a geological sample's origin and history that other modes of investigation cannot supply," said Vaniman. "This will be the first time that an X-ray diffraction instrument has been sent to another planet. It will give us a comprehensive view of the minerals on that planet."

## *The average temperature on Mars is well below freezing.*

### **Power up!**

The third part of the “LANL Visits Mars” trio is an essential component: the heat-producing Multi-Mission Radioisotope Thermoelectric Generator unit. It powers the rover and keeps the instruments from freezing solid Martian; the average temperature on Mars is well below freezing.

Pu-238 has a half-life of 87.7 years, and there are 32 plutonium “fueled clads” in the generator unit, each capable of producing about 62 watts thermal. “That’s about the heat from a 60-watt light bulb,” said project lead Craig Van Pelt. The pellets are called “fueled clads” because each has been encased in an iridium shell called a clad.

Unlike the current Mars rovers, there are no solar panels on Curiosity. This system is more like those used on NASA’s Viking Mars landers in the late 1970s. The generator has an integrated heating-and-cooling system that will reject waste heat or supply heat to various components as needed.

The generator’s Pu-238 heat sources were produced at Los Alamos several years before the mission launch, developed by a team of more than 40 staff members in the group known at the time as PMT-9 Plutonium Manufacturing and Technology. ■



The Mars Science Laboratory is managed for NASA’s Science Mission Directorate, Washington, D.C., by JPL, a division of the California Institute of Technology in Pasadena. At NASA headquarters, David Lavery is the Mars Science Laboratory program executive and Michael Meyer is program scientist. In Pasadena, Peter Theisinger of JPL is project manager and John Grotzinger of Caltech is project scientist.

#### **Related links:**

<http://mars.jpl.nasa.gov/msl/mission/overview/>  
<http://go.usa.gov/8Yh>

#### **Launch Vehicle:**

*United Launch Airforce Alliance Atlas V*

#### **Launch:**

*Nov. 25, 2011, 7:21 a.m. PST  
(10:21 a.m. EST)*

#### **Launch Window:**

*Nov. 25 - Dec. 18, 2011*

#### **Launch Location:**

*Cape Canaveral Air Force Station,  
Florida*

#### **Expected Arrival:**

*August 2012*



## A TRU Story

*A new approach to repackaging and shipping transuranic (TRU) waste will cut by more than a third the amount of waste stored at Technical Area 54, Area G.*

by Patti Jones

Sandra Valdez

**It may be one of the largest environmental cleanup projects in the Lab's history: shipping a record amount of TRU waste to the Waste Isolation Project Plant (WIPP) so that Technical Area 54 can be closed by 2015 as required by the Laboratory's 2005 Consent Order with the state of New Mexico.**

TRU waste is a byproduct of nuclear research and weapons production. It consists of protective gear, tools, residue, debris, and other items contaminated with small amounts of radioactive elements, mainly plutonium.

"In the past five years, we have been averaging about 120 shipments of TRU waste to WIPP each year," said

Kathy Johns-Hughes oversees LANL's TRU Waste Project.

Kathy Johns-Hughes, director of the LANL TRU Waste Project. "We've shipped record numbers of TRU waste the past two years, and we plan to greatly surpass those numbers next year."

Department of Energy facilities across the country ship TRU waste to WIPP. Except for Idaho National Laboratory, LANL sends more waste to WIPP than any other facility.

It's a big job. Because the overwhelming majority of the TRU inventory is legacy waste, nearly all of the 9,000 containers of TRU waste stored at Area G have to be repackaged into containers that are compliant with WIPP's rigorous acceptance standards. Meeting those

standards not only requires old containers to be safely opened and the contents repackaged, they also have to be X-rayed, characterized, and prepared for shipping.

“It’s not a simple process,” Johns-Hughes said.

## Becoming Henry Ford

To dramatically increase the number of shipments—a process complicated by the need to repackage—the TRU Waste Project team took a new approach.

“We had to look at it with a fresh perspective,” Johns-Hughes said. “We had to ask ourselves, ‘what’s the most efficient way to get it out of here?’”

To achieve that efficiency, Steve Clemmons, deputy director of the LANL TRU Waste Project, led a small team that opted to take a factory approach. They decided to group the population of TRU waste by how it needed to be processed and to create “solution packages” just like factories do for production runs.

“We created 60 solution packages for 9,000 containers based on the size of the original containers, the characteristics of the waste, and how it needed to be remediated,” said Dan Cox, deputy associate director of environmental programs. “We created four ‘factories’ that repackage and process waste according to these criteria, and we can have as many as 10 solution packages in play at any time.”

The four “factories” include:

- the Waste Characterization, Reduction, and Repackaging (WCCR) facility, which processes drums containing highly radioactive material;
- Dome 231, which processes containers with low levels of radioactivity;
- the Building 412 “box line” facility, which processes small fiberglass-reinforced plywood boxes; and
- the Building 375 box line facility, set to open in January, which will process larger plywood boxes.

“We can do all 9,000 drums in these four facilities, except for about 100 drums that will require special handling,” Johns-Hughes said.

Since the Lab has to process large containers of waste, the team installed a high efficiency neutron counter as well as a high energy real time radiography instrument to measure radioactivity and X-ray the contents of the boxes.

“We can now characterize even larger containers,” Johns-Hughes said. “It’s a crucial part of the process.”

## Working smart as a WIPP

To further promote success, members of the TRU Waste Project team collaborated with other TRU waste experts, namely, personnel from WIPP and the Central Characterization Project. CCP is the WIPP contractor that characterizes waste onsite at LANL.

“Working together helps us identify issues before they become problems and ensures that waste is characterized and shipped according to WIPP standards,” Johns-Hughes said.

It’s a partnership that’s working well, as the TRU Waste Project closes in on another year of record-breaking shipments and gears up to double production.

In order to close TA-54 in compliance with the Consent Order, the Lab must remove thousands of drums of legacy waste stored at the site. Safely storing TRU waste at WIPP is also a priority of the Department of Energy’s Environmental Management division.

And if that’s not enough, the Las Conchas Fire, which did not threaten TA-54 but nevertheless caused national concern about the consequences of a wildfire at the site, underscored the urgency of getting the waste off of the Hill and safely stored at WIPP. ■



Staging drums at Technical Area 54.

## A Drum's Trip to WIPP

Because much of the transuranic (TRU) waste stored at LANL was generated long ago, Lab personnel subjects each drum of waste to an extensive process, ensuring that it meets the stringent acceptance requirements of the Waste Isolation Pilot Plant (WIPP). This is a broad overview of a drum's trip to WIPP.



**1. Venting.** A small HEPA (high-efficiency particulate air) filter is inserted into each drum to ensure that it does not have any buildup of flammable or explosive gas.



**2. Real-time radiography.** Each drum is X-rayed to verify that it does not contain items prohibited by WIPP, such as aerosol cans or corrosive or ignitable materials.

- If a drum contains no prohibited items, it moves to step 3.
- If a drum contains a prohibited item, it goes to remediation, meaning the item is removed and the contents are repackaged. The drum is then X-rayed again or receives a visual examination from specially trained staff.

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**3. Radioassay.** Each drum undergoes a two-step process in a high-efficiency neutron counter. This process determines the identity of radioactive materials and how much of each constituent it contains.



**4. Headspace gas analysis.** The area between the waste in a drum and the top of a drum is called headspace. The headspace in each drum is tested to make sure it does not contain prohibited quantities of gases and meets WIPP standards.



**5. Staging.** Because there are strict requirements for transporting drums to WIPP, drums are staged in preparation for shipment.



**6. Loading.** The drums in each payload are loaded into large, steel shipping containers, called a TRUPACT, at the TRU loading facility. The load is inspected, the TRUPACT is sealed, and the shipment is transported to WIPP.

# Fueling Innovative Research

*Scientists seek solutions to energy problems*



**As the birthplace of the atomic bomb, Los Alamos National Laboratory is sometimes mistakenly pegged as a place focused solely on nuclear weapons research.**

Some of our nation's thorniest problems are simply consequences of the daily progression of the natural world—the sudden, unexpected appearance of a deadly strain of influenza, for example, or the growing demand for finite resources, such as oil or rare materials, by an exploding human population.

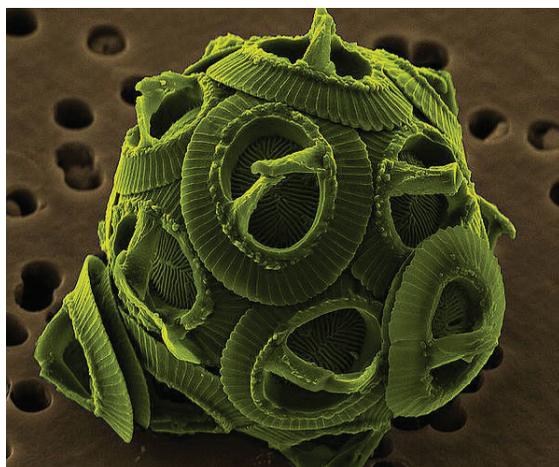
Solving energy security challenges is a natural role for Los Alamos, which has always applied cutting-edge science, technology, and engineering to solve some of the nation's toughest problems. During the past several years, the Laboratory has increased its energy security efforts by nearly 50 percent. This investment has yielded results in the quest to secure new, sustainable, environmentally friendly alternatives to fossil fuels.

**Going green—really, really green**

Crude oil greases the wheels of our nation's transportation sector by providing fuel for industrial and personal transport. Planes, trains, and automobiles all rely on refined oil products, which are becoming scarce due to finite supplies and increasing demand. While entrepreneurs have dabbled with the idea of converting waste kitchen grease into "biodiesel," and consumers have toyed with the notion of curtailing travel as an antidote to rising fuel prices, Los Alamos scientists are converting pond scum into transportation fuels.

Algae show promise as an alternative energy source because many of these organisms can store energy in the form of lipids—lots of lipids under the right conditions, oils that can potentially be captured and refined into fuel. Each microalgae cell can be thought of as a micro-droplet of oil, kind of like a fatty piece of M&M's® candy or an itty-bitty bath-oil bead. A pond covered with algae provides a preponderance of potential power. One recent study by DOE's Pacific Northwest National Laboratory indicated that algal biofuels could replace up to 17 percent of oil imported for transportation use. Unfortunately, corralling enough algae from the surface of a pond to run an automobile is a daunting task.

Researchers are working to overcome this obstacle by optimizing the R&D 100 Award-winning Ultrasonic Algal Biofuel Harvester developed by Los Alamos scientists to obtain concentrated biofuel from algae. The Ultra-



Algae up close.

sonic Algal Biofuel Harvester uses select sound wave frequencies to focus and concentrate the fluid-borne algal cells. Then the harvester uses other frequencies to break open the cells, release the lipids, and separate the oils, proteins, and water. The researchers are developing a single device to combine the individual processes.

Based on laboratory-scale devices, researchers believe they can develop a portable, energy-efficient, ultrasonic algae harvesting device to concentrate 25 gallons of algae per hour for less than a penny per gallon of lipid. Such an improvement would drastically reduce the cost of separating water from algae and demonstrate that algae can be an economically and ecologically friendly alternative to fossil fuels.

This groundbreaking—or, rather, pond-shaking—breakthrough has been refined under the auspices of a LANL collaborative agreement with Solix Biosystems and, now, the National Alliance for Advanced Biofuels and Bioproducts (NAABB), a consortium of public- and private-sector research organizations funded by the American Recovery and Reinvestment Act.

*Solving energy security challenges is a natural role for Los Alamos*

## Oil and water

But the goals of NAABB and Los Alamos extend well beyond simply harvesting algae. Researchers affiliated with the NAABB are sequencing the genetic code of three different types of algae. This work may provide clues about why some strains are oilier than others or how to fatten up an algae strain. Sequencing the genes could also tell researchers which types of algae will most readily survive less-than-optimal growing conditions.

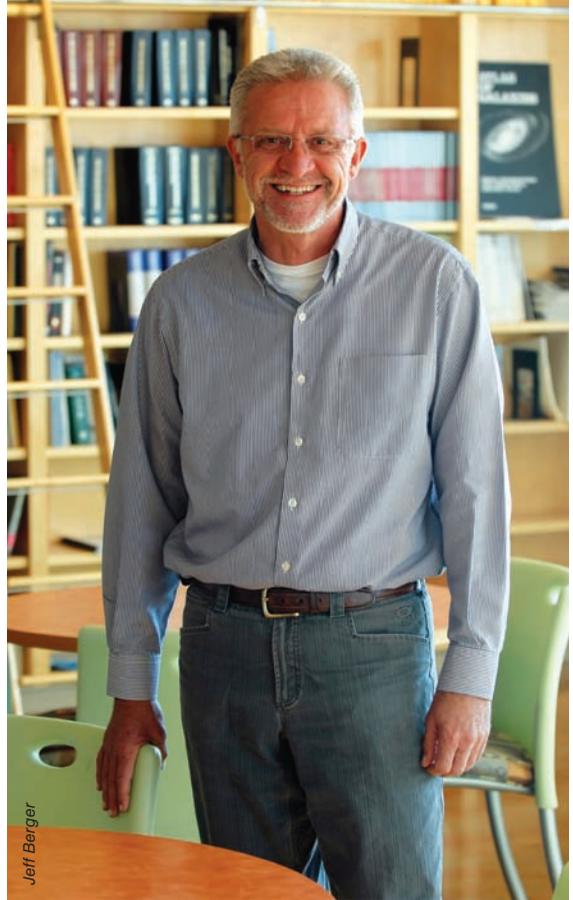
*Advanced computers aren't the only tools Los Alamos researchers are using to crack open cellulose.*

Because water—apart from land—is a resource required in great abundance for algal biofuel production, LANL researchers and NAABB are deeply interested in water conservation. Accordingly, LANL scientists along with Eldorado Biofuels (a small New Mexico company) recently conducted the first pilot-scale tests using water from an oil-production well in Jal, New Mexico, to grow algae. This impure water, called “produced water,” is pumped to the surface along with oil, gas, and coal-bed methane extraction from underground formations.

U.S. oil and gas production yields about 800 billion gallons of produced water annually. After some cleanup, the water has characteristics suitable for growth of marine algae. Yet, up to 98 percent is routinely disposed as a waste product. These quantities of produced water show great potential for algal biofuel production.

Further, in collaboration with the Texas AgriLife Research facility in Pecos, Texas, researchers grew salt-tolerant, oil-producing algae in small reservoirs. Initial algae growth with low concentrations of produced water was similar to city water results. Higher concentrations of produced water and associated dissolved solids, however, seemed to limit growth. Testing is set to continue, with scientists adjusting their treatment methods.

Under the auspices of NAABB, a dedicated segment of the scientific community has taken a holistic approach to using a very promising resource as an alternative fuel source for transportation, said LANL's José Olivares, biofuels program leader in the Lab's



José Olivares, biofuels program leader in the Bioscience Division, also serves as executive director for the National Alliance for Advanced Biofuels and Bioproducts.

Bioscience Division, who also serves as NAABB's executive director. “The number of publications coming out of the alliance is huge. We've had more than 20 publications in peer-reviewed journals in the past year alone and more than 120 presentations by NAABB members around the world.”

## Grass, husk, and ammonia

Algae isn't the only plant-like thing auditioning as an alternative fuel source. Ethanol has been used for years as a fuel or fuel additive. Ethanol is the same alcohol moonshiners of the past distilled from corn squeezings. Unfortunately, using a food crop as a fuel source has the potential to create even bigger problems for humankind. Ethanol would become much more attractive as an alternative fuel if we could find a cost effective way to convert nonedible plant matter—such as corn leaves and stalks, or grasses—into the alcohol. The process would involve breaking down cellulose (the key structural component of plant matter) into sugars that could be converted to alcohol.

## Scientists are helping secure reliable energy sources for our nation.

One barrier is that cellulose tends to orient itself into a sheet-like network of highly ordered, densely packed molecules. These sheets stack upon themselves and bond together very tightly due to interactions between hydrogen atoms—somewhat like sheets of chicken wire stacked together and secured by loops of baling wire. This stacking-and-bonding arrangement shields most of the cellulose molecules and isolates the sugar chains (which make up cellulose) from direct attack by enzymes.

Currently, ethanol can only be extracted in usable quantities if the biomass is pretreated with costly, potentially toxic chemicals in an energy-intensive process.

Enter Los Alamos researchers, who've used state-of-the-art computational methods and molecular modeling to examine how cellulose changes structurally into an intermediate form that can be pretreated with ammonia and made more vulnerable to attack by enzymes. The insight led to a potentially viable,

cost-effective method for using fungi to chew through the ammonia-laden cellulose.

Advanced computers aren't the only tools Los Alamos researchers are using to crack open cellulose. Recently, a group of them used neutrons at the Los Alamos Neutron Science Center to spy on hydrogen atoms during a key chemical reaction that takes place when cellulose is converted into sugar. The findings illustrated the crucial role that a chemical intermediate plays in converting plant matter to sugar. By viewing a poorly understood chemical process firsthand, scientists may be able to engineer more favorable conditions that can render the reaction on an industrial scale.

The people of Los Alamos still work on the cutting edge to reduce the danger posed by nuclear weapons, and through research that cuts across many disciplines Lab scientists are helping secure reliable energy sources for our nation. ■

*For an in-depth look at biofuel research at Los Alamos, see the upcoming issue of LANL's 1663 magazine.*

### Star scientist to help drive vision for bioenergy and plant science

Renowned scientist and entrepreneur Dick Sayre joined the Lab's Bioscience Division last month to help boost cutting-edge research into algae and other energy-producing plants. Cited by *Nature* magazine as "one of five crop researchers who could change the world," Sayre brings a crew of postdoctoral researchers and a range of funding to LANL.



Sayre and his Los Alamos colleagues will tackle a variety of research pursuits, including how to make photosynthesis more efficient and advances in algae production and harvesting.

Sayre came to Los Alamos from Donald Danforth Plant Science Center in St. Louis. He is also the chief technology officer for Phycal Inc., a biotechnology startup in Ohio developing microalgal-based biofuel production systems.

Sayre was formerly chair of the Department of Plant Cellular and Molecular Biology at The Ohio State University. He was a Fulbright Scholar at the University of São Paulo in 2007. Sayre received his doctorate from the University of Iowa.

# What Goes out with a Boom?

*They're called dynamic experiments because at some point there's almost always a bright flash and a loud ka-boom.*

by Kevin Roark

**Most dynamic experiments at Los Alamos National Laboratory stem from the need to understand how various materials, such as metals, plastics, or foams, will behave under conditions found during a nuclear detonation. Full nuclear testing ended in the U.S. in 1992—so scientists have been conducting smaller-scale experiments ever since.**

The initiating force in a nuclear weapon is high explosives. Without those explosives, no nuclear weapon would work. So high explosives research in a wide variety of areas is essential to the Laboratory's ongoing mission to annually certify the safety, security, and effectiveness of the U.S. nuclear deterrent.

Dynamic experiments also support basic research, counterterrorism, and detecting and defeating improvised explosive devices (IEDs). Understanding explosives allows the nation to remain one step ahead.

Invaluable data is the desired result—data that both advances the science of energetic materials and informs or confirms computer models of weapons systems. A byproduct of this data gathering is high explosives waste.

In many cases, the waste consists of excess high explosives that have been machined into various shapes for research purposes, but are not needed for explosive tests. Some of the waste has been in short- or long-term storage and may be less stable than when it was new. All of it has to be disposed of.



Pancho Sena at LANL's Minie firing site.

## *The best way to get rid of it: blow it up.*

Although pristine explosives are often transported on public roads, it is much more difficult to transport waste explosives to an offsite facility for destruction. Since waste explosives may be damaged or in some way altered from their original state, these materials must first pass a series of sensitivity and thermal tests before they can be approved by the Department of Transportation for movement over public roads. If the waste does not pass the tests, it cannot be transported and must be dealt with onsite.

“Getting approvals from the Department of Transportation to transport these materials can be a multiyear process. These approvals are needed to move materials from Los Alamos to an approved disposal site permitted under the Resource Conservation and Recovery Act [RCRA],” said Connie Gerth of Environmental Stewardship.

Getting permission to transport the materials is one thing; making sure the materials are safe to move is another.

“While we’re waiting for approvals, this material, some of which is just barely suitable for transport in the first place, is aging and may be degrading,” Gerth said. “This is one of the reasons we choose to treat it on site—following the cardinal rule of explosives safety: ‘Expose the minimum number of people to the minimum amount of explosives for the minimum amount of time.’”

Conducting a waste explosive treatment, a process called “open detonation,” is a tried and true practice at Los Alamos National Laboratory’s remote firing sites. The excess material is transported to one of the approved sites, named many years ago for people and places in the old comic strip “Li’l Abner.” At Minie site the chunks, pellets, hemispheres, cylinders, and granules of high explosives are placed in a common cardboard box. No small measure of care is taken to pack the pieces tightly, to assure complete destruction.

“If it’s all in close contact, when you detonate, it’ll propagate all the way through the whole shot,” said Francis (Pancho) Sena, of Focused Experiments. “If there’s any separation to speak of, it’ll disperse instead of fully detonating, and if it’s dispersed, then you have to go through a whole cleanup process.”

Once the waste material, some 60 pounds of it on average, is suitably arranged, Sena adds a small amount of explosive “fuel” like ammonium-nitrate-fuel-oil (ANFO), a booster explosive, and a detonator. The configuration is expressly designed to drive the energy



*Eddie Moore, Albuquerque Journal*

Will Haynes, a radiation control technician, stands in a crater created by the detonation of high explosives.

of the explosion downward into the ground to significantly reduce any ejection of undesirable materials into the air.

Following the cardinal rule of detonation, the site is quickly cleared of personnel under a rigorous safety protocol. Sena retreats to a nearby hardened bunker that houses the control systems for the shot. After several radio checks to assure that the site is clear and that atmospheric and other conditions are within acceptable parameters, Sena counts down from five and pushes the “fire” button at zero. It all happens extraordinarily fast.

Observers, a safe distance away at nearby “Moe Hill,” see the small fireball erupt silently. The loud report from the explosion is heard a second or two later due to the fact that sound travels much, much slower than light. A small cloud of dust rises from the site and is quickly dispersed. Technicians track the movement of the dust until it is completely dissipated. The sound levels of the detonation are also monitored at several locations offsite.

“The ability to dispose of this waste material at our firing sites makes conducting our essential research more efficient and less time consuming,” said Dave Funk, Dynamic Experiments division leader. “The technicians who do this work have refined the process to such a degree that environmental impacts are negligible.”

After the detonation, there is no evidence of a cardboard box or of any of its former contents. All that’s left is a small hole at the point of detonation.

“It really is pretty amazing,” said Gerth. “One second it’s there, the next second it’s totally gone.” ■

# What do you do?

## *Jobs around the Lab*

Brad Lounsbury is an emergency response specialist—a bomb technician. He responds to reports of suspicious packages and hazardous materials.

### **What training did you receive to become a bomb technician?**

I trained with the Navy and became an explosive ordnance disposal technician in 1978. At that time explosives training was combined with dive school.

I was a Navy EOD tech for 23 years, 2 months, 17 days, 12 hours, and 13 minutes—that's true, I was bored one day. I joined LANL in June 1997 and received additional hazardous materials training here.

### **Why did you choose EOD?**

I joined the Navy to become a diver. The recruiters told me about three different ways I could join that program—SEAL, salvage, or EOD. I looked into each option, and EOD sounded the most desirable.

### **What's the best part of your job?**

I enjoy the challenge; it's a thinking person's job. I take great pride in the fact that my primary responsibility is saving lives.

### **What's the most challenging part?**

Keeping up with all the new developments in safety, where the landscape changes daily. Staying one step ahead of new technologies used by adversaries, homemade explosives, or hazardous materials is a challenge, but one I enjoy.

### **Have you ever responded to a bomb here?**

There haven't been any improvised explosive devices (IEDs) on Lab property since I've been here. Responses to unattended items are common, as are suspicious package assessments.

### **When you arrive on scene, how do you prepare?**

I evaluate the situation, talk it over with my team, and take the safest route—that might mean using our hazardous devices robot instead of suiting up in the bomb gear. I then go through the steps of equipment preparation, which helps me prepare mentally as well.

Every situation is different. In all my years, no two responses have ever been the same.

### **How do you remain calm under extreme conditions?**

If you don't have a calm demeanor, you won't make it in this field. The best bomb techs have a calm outlook—sometimes you're born with that and sometimes you grow into it.

### **What do you do in your free time?**

My hobbies include pottery, ceramics, beekeeping, and ballroom dancing.

It's not an escape. It's complementary because they all take concentration and tranquility. The bees sense fear, so I have to be slow and methodical and keep my wits about me—just like my day job.

### **What do you want people to know about your job?**

Here at the Lab we have a very professional group of emergency responders. They are the best of the best from a variety of industries and some of the greatest people I've ever worked with. I want people to have confidence in the fact that we know what we're doing and we take our jobs very seriously.



Richard Robinson

Brad Lounsbury's many hobbies help him stay focused when he responds to emergency situations.

**Sarah Maynard is a property manager with the Customs Office and chair of the Lab's Export Working Group. Her team is primarily responsible for commodity exports and reviews of high-risk property.**

### **What is export control?**

Export control focuses on compliance with U.S. regulations important to national security. Anything that's not publicly available is subject to export control.

Controls depend on technology level, what country the item is going to, who's receiving it, and how it's to be used.

### **What special training or education do you need to work in customs?**

My MBA and Management and Leadership Institutes training were instrumental in preparing me for this job. Learning regulations while preparing for my customs broker's exam was also extremely helpful.

### **What skills or traits help you do your job?**

Teamwork is critical to success. I work closely with regulatory agencies, program offices, and other labs.

### **What's your typical day?**

I review excess property for concerns about nuclear proliferation. We confer with counterparts at other sites about regulatory changes. I submit license applications. I work with other members of the Lab's Export Working Group to strengthen our export control program.



Richard Robinson

Sarah Maynard works with global export control rules to help employees across the Lab.

I also witness the destruction of property that we can't sell to the public or transfer to another agency. It must be destroyed in accordance with Department of Defense guidelines and might include everything from an infrared camera to a military tank.

### **Why did you choose this field?**

It chose me. In 1988, a Commerce Department enforcement agent pointed out that we had no export control program at the Lab. I was asked to help put together a program, and the rest is history. I've had this job for 22 years.

### **What's the best part of your job?**

Finding ways to please a customer, which can be difficult in the compliance arena.

### **What's the most challenging part?**

Staying on top of the ever-changing regulations and trying to make sense of them. They are gray and change often, depending on the political climate and emerging technologies.

### **What do you want people to know about your job?**

That the Customs Office is here to help keep employees safe—we don't want to be seen as a barrier, but rather as a team that can help with compliance.

### **What do you do on your days off?**

I spend time outdoors. I love to ski, whitewater raft, and scuba dive. My husband, Toran, and I run an International Defensive Pistol Association match every month at the Northern Rio Grande Sportsmens Club. ■

## Wagging Tails and Happy Faces

by Tatjana Rosev



**By participating in the Laboratory's giving campaigns, LANL employees make an enormous difference in the lives of thousands of Northern New Mexico children and adults. But they have a big heart for animals, too. So much so that, of the top five volunteers who logged volunteer hours through VolunteerMatch last year, two worked with critters (see "Top dog" sidebar).**

Wendee Brunish of Geophysics heads "Friends of the Shelter" to support the Los Alamos Animal Shelter, and Donna Leshne of Occupational Medicine runs "Dew Paws" animal rescue (see "Dewclaws" sidebar). "Los Alamos is an outstanding community with educated, caring pet owners who generally spend lots of time—and money—making sure that their pets are happy and healthy," said Brunish. Leshne added that the levels of education and income typically found in Los Alamos likely contribute to why the community is so animal-friendly. "Los Alamos also has an amazing 'Friends of the Shelter' group that does wonderful work and supports us and other small rescue organizations in the area, including the Española Valley shelter," she continued.

### **Jake's tale: a doggone miracle**

Jake's story is a wonderful example of the lengths Los Alamos residents are willing to go for animals.

Just a few days before the Las Conchas Fire roared through Northern New Mexico, a hungry and footsore Siberian husky named Jake who'd gone missing in Los Alamos' rugged canyons was found and reunited with his owner. Jake, who belongs to Steve Estep of the state's Siberian Husky Rescue, had come to the Hill to find his "forever home." But when the couple that wanted to adopt the shy young husky took him for a walk, he slipped from his collar and ran off into the wilderness.

For an entire month, Los Alamos residents, many of them LANL employees, searched dawn to dusk. Brunish hiked in Los Alamos Canyon and along the Rim Trail with her search dogs. Tatjana Rosev of the Communications Office alerted area animal shelters, friends, and coworkers about Jake. She also walked canyon trails armed with a bag of bacon and distributed fliers. Estep placed ads in the local paper, and Physical Security Division Leader John Noon told his personnel to be on the lookout for the lost dog.

Wendee Brunish and Moo at the Los Alamos County Animal Shelter.

After several weeks, Jake was finally sighted. Brunish put one of Estep's shirts and a water bowl near where the dog had been seen. "I went out with Tom Beyer of Los Alamos County Animal Control, showed him where Jake had been spotted, and helped him decide where to place the trap," she recalled. After catching a fox, Beyer finally got lucky; he baited the trap with turkey hot dogs from his mom's refrigerator and waited patiently until the hungry husky showed up.

Jake was reunited with his teary-eyed owner, who had kept hoping against hope that the little runaway would turn up. In gratitude, Estep wrote in the *Los Alamos Monitor*, "A special thanks goes to the folks of Los Alamos and White Rock, undoubtedly two of the most dog-friendly communities in New Mexico. Wow—it was like having [thousands of] people all looking for him!" After his ordeal, Jake became inseparable from Estep, and Estep said that he will keep the husky with him as long as he lives.

### **Astrophysicist heads shelter group**

Employees from all over the Laboratory devote their free time to animals. Wendee Brunish, who holds a doctorate in astrophysics, is the project leader for the Source Physics Experiments—high-explosive tests in the Climax Stock granite formation at the Nevada National Security Site. In 1998, she took over Friends of the Shelter in Los Alamos, and in 1999, she co-founded the Los Alamos Volunteer Shelter Program.

"Working with the Los Alamos Police Department, we recruited volunteers to visit the shelter to exercise, socialize, and give love and affection to the shelter cats and dogs," she said. "And, 12 years later, we are still going strong!"

Brunish's biggest challenge is to educate owners to spay or neuter their pets. To that end, FOS sponsors a spay week every year at the Española Valley Humane Society. "FOS pays for all of the surgeries during that week, which is heavily advertised," she said. FOS also sends more than \$2,000 every year to McKinley County in northwest New Mexico to pay for spay surgeries in very poor areas, including a portion of the Navajo Nation.

*"When we adopt a dog into a good home and see the joy that it brings, it makes all the work worthwhile."*



Donna Leshne volunteering at Petco.

What keeps her motivated, she says, is “the gratitude and affection you receive from a frightened animal that has been dumped at the shelter, never having been loved or cared for and not trusting humans.”

## A haven for second-chance dogs

Donna Leshne, who owns Dew Paws animal rescue, is a nationally certified sign-language interpreter with a master’s degree in rehabilitation counseling. After working as the Laboratory’s sign-language interpreter, she now coordinates the Human Subjects Research Review Board.

Dew Paws is a member of the Companion Animal Alliance of Northern New Mexico and works with alliance members, area shelters, and other groups to rescue dogs outside the group’s catchment area. In addition to fostering animals, the coalition transports dogs to rescue organizations in Colorado, works with rescue groups in Texas, Oklahoma, and Arizona, and educates people about responsible pet ownership.

The greatest challenge she faces, Leshne noted, is finding volunteers and coming up with the funds to have every dog the coalition takes in vetted medically. Her post-retirement dream is to find a way to spearhead a statewide educational program with a mobile van. She also wants to establish a sanctuary for dogs that are not ready for adoption within the proscribed timelines of animal-control facilities.

Asked what keeps her going, she smiled and replied, “When we adopt a dog into a good home and see the joy that it brings, it makes all the work worthwhile.” ■

## Top-dog volunteers

*Laboratory employees and retirees last year logged more than a quarter-million hours of volunteer service for a wide variety of organizations. Two of the top five individual volunteers worked with animals.*

*Debbi Maez of Classified Matter Protection racked up 2,988 hours with the Mountain Canine Corps Search and Rescue Team.*

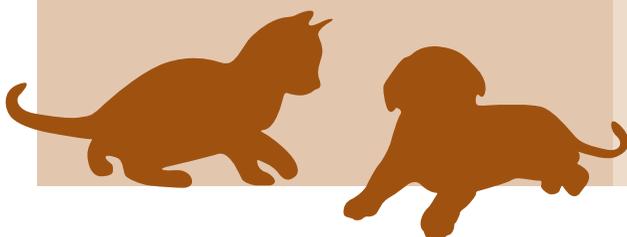
*Lisa Henne, a retiree, formerly of Community Programs, registered 1,224 hours, at Española Valley Humane Society.*

## Dewclaws: Sharpening your understanding

*LANL’s Donna Leshne owns the Santa Fe-based “Dew Paws” animal rescue organization. In a bit of wordplay, Dew Paws takes its name from dewclaws. Because not everyone’s familiar with dewclaws, here’s a brief primer:*

*Dewclaws, also referred to first digits or toes, are claws on either the inside front or rear of dog paws. They don’t generally touch the ground—except when particular breeds of dog are running. Many species of other mammals, birds, and reptiles also have dewclaws.*

*Dogs may use dewclaws to lightly grip with their paws bones and other objects. Dewclaws help some types of dogs gain traction when they run (at which time the nail makes contact with the ground). Dewclaws are often removed in the first few days of a puppy’s life to prevent loosely attached nails from catching on furniture, carpet, or other objects and sustaining damage or to comply with specific breed standards.*





# Lab serves as steward of cultural treasures

*7,000 years and counting*

observer

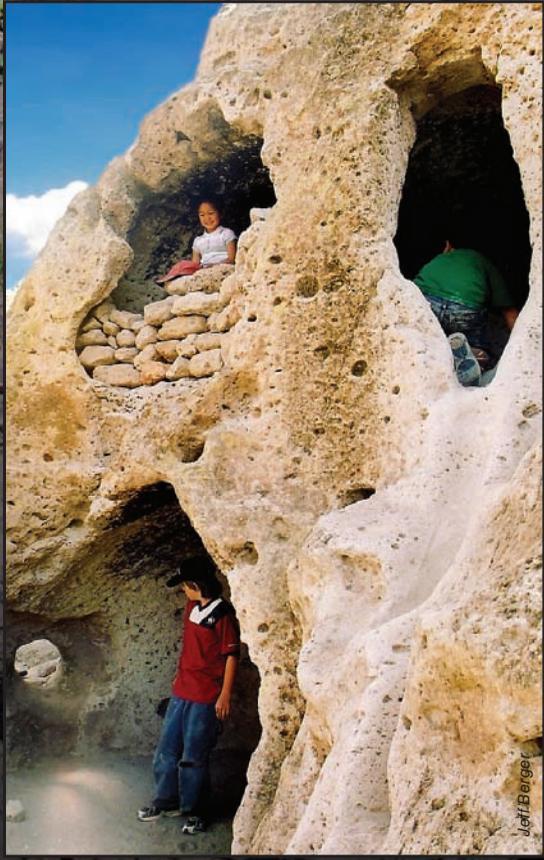
Stephen Lee



Stephen Lee



Stephen Lee



Jeff Berger



LeRoy N. Sanchez



LeRoy N. Sanchez

### Prehistory of the Pajarito Plateau

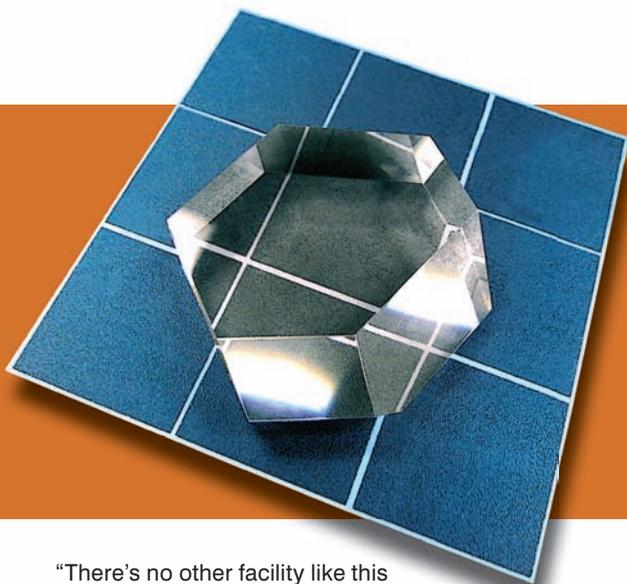
Los Alamos is rich with native antiquities. LANL archaeologists have identified 1,800 archaeological sites on Lab property, with history spanning 7,000 years.

The oldest locations identified on the Pajarito Plateau are Archaic (5500 BC to AD 600), and represent the remains of temporary campsites. The majority of sites at LANL date to the Ancestral Pueblo Period (AD 600 to AD 1600). Ancestral Period sites are represented by artifact scatters, one- to three-room structures, cave rooms, and masonry room pueblos. By AD 1600, Pueblo peoples had largely abandoned the Pajarito Plateau as a residential area. ■

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## Research gems

As any middle-school science student can tell you, growing crystals is easy—under the right conditions. Dissolve a compound in a solution, then alter the solubility somehow— typically by cooling—and over time, *viola*, crystals will form.

But what if you wanted to make very large, single crystals of, say, an explosive like RDX (Research Department Explosive, also known as Royal Demolition Explosive) or HMX (High Melting Explosive, also known as Her Majesty's Explosive)? Then you'd need a facility like the Explosive Crystal Laboratory at Los Alamos.

In a repurposed, solid concrete high-explosives testing bunker in a remote area of the Laboratory, scientists are creating one-of-a-kind explosive crystals for use by Los Alamos researchers and for customers that include other NNSA labs, Department of Defense labs, and academia.

"There's no other facility like this in the United States," said Dan Hooks, one of the scientists who uses the crystal lab. "The place is solid as a rock—the building does not move. Due to the building's well-engineered air-handling system, the temperature and low humidity inside haven't fluctuated in decades, so it's ideal for growing crystals."

The crystals, some as big as the palm of your hand, look very similar to clear gemstones, almost like diamonds. In addition to growing the crystals, the facility has equipment for cutting and polishing them into a wide variety of shapes and sizes, depending on the requirements of the research.

"It turns out that there are still a lot of unknowns when it comes to understanding the physical, optical, and mechanical properties of these single crystals," said Hooks. "And the research isn't limited to explosives. There are avenues of study in things like radiation detection devices and pharmaceutical development."