October 2010

Los Alamos National Laboratory Advancing National Security Through Scientific Inquiry

why

LANL is a key player in energy security | pg. 14

In this Issue Take a look at LANL's visualization environment | pg. 20

Los Alamos NATIONAL LABORATORY EST.1943

why

About this magazine

Why magazine is a new publication primarily for employees and retirees of Los Alamos National Laboratory. The Lab will publish *Why* four times a year and develop for it an online presence.

This periodical is named for the crucial nature of scientific inquiry at Los Alamos National Laboratory. True, many working at Los Alamos aren't scientists or engineers. But the efforts of all employees support the technical output of the nation's most storied and multifaceted laboratory.

The creators of *Why* considered many titles. What led to this name was discussion of an even more unusual candidate, one of historic origin: *Y* magazine. (At the outset of the Manhattan Project, what eventually came to be known as Los Alamos National Laboratory was called Site Y.)

In the end, we decided on *Why* because it's distinctive, memorable, relevant, and short.

For this and future issues, we welcome comments, suggestions, and corrections. Please send them to why@lanl.gov.

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In this Issue LANL Launch Pad

Stosh Kozimor talks about his love for actinide chemistry | pg. 18

Table of Contents

Smart and Resilient Infrastructure

Computing power and a lot of human smarts combine to protect and preserve the nation's infrastructure.

by Nancy Ambrosiano

Photo by LeRoy N. Sanchez

In the world of infrastructure—the roads, power lines, Internet, and the systems that keep us moving, talking, cooking, and computing—nothing is simple. From little to big, descriptions of failures in the systems of our modern world tend to include the word *cascade*, because so much is interconnected.

What better area of focus, then, for the clever minds of a national security science laboratory than these interconnected networks of technology?

Through the Global Security program area known as Resilient Global Infrastructure and its predecessors, people at Los Alamos have, for more than a decade, applied their brainpower to understanding the Gordian knot of networked systems and their impact on our way of life.

Why it matters

Deciding what to study takes a series of hard questions, in addition to specific requests from sponsoring agencies including the U.S. Department of Homeland Security, which funds a large portion of the infrastructure teams' work.

Teams from across the Laboratory with varied computational tools tackle components of the big questions. The largest overall effort on site is known as NISAC (*NEE-sack*), denoting the National Infrastructure Simulation and Analysis Center led by Alan Berscheid of the Energy and Infrastructure Analysis Group, D-4.

The NISAC team is a cross-disciplinary group that analyzes potential consequences of infrastructure disruption to answer such questions as:

- How do the risks to infrastructures affect national security?
- What are the threats to infrastructure systems, communities, and the economy?
- Are certain systems, networks, or parts of the country more at risk than others? Why?
- Have interdependencies increased or changed the risks?
- Are there trends in the evolution of the infrastructures toward more vulnerable conditions or configurations?
- How can we reduce the risks to infrastructure?

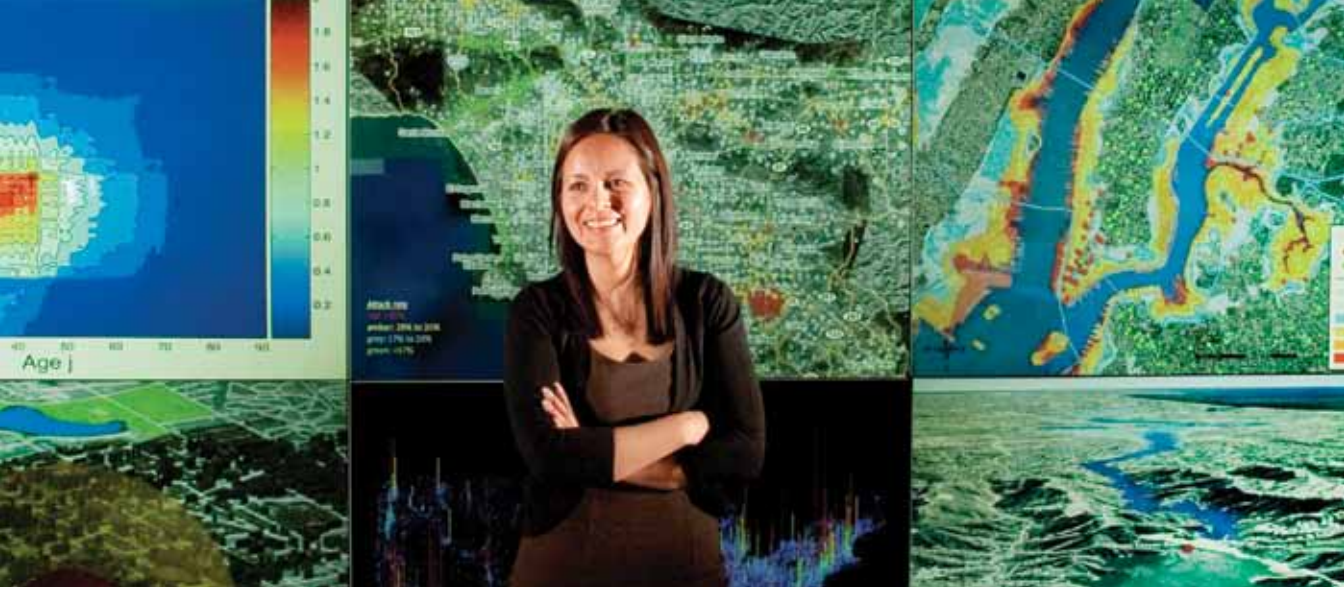
And since humans are essential to all of these hardware and software components, such threats as avian influenza and smallpox have to be taken into account as well.

Last year, Sara Del Valle, also in D-4, led extensive analyses of the potential population impacts of 2009 influenza A (H1N1) and projected low workforce absenteeism across the nation.

The results of the analyses were provided to policy makers, including where the sick, the dying, and the "worried well" will find hospital beds or advice, so they can recover and resume the work of the nation.

The national security component is of first-order importance, as decision makers in Washington and around the country have to have the best possible insights at hand.

A decision that on one level seems reasonable might start a domino effect in other areas, and that's where Los Alamos scientists step up to show all the possibilities. Ensuring, for example, that a substation's power outage in western North Carolina doesn't cripple the deployment of soldiers from Fort Bragg takes a deep familiarity with all the dominoes that lie between the two sites.



When nature knocks

Understanding not only who runs the power lines between Point A and Point B, but how nature complicates things is useful as well. NISAC staff provided rapid response analysis of potential U.S. coastal tsunami impacts following the 2010 Chilean earthquake this past February, correctly indicating that the impact on the United States would be minimal.

"NISAC supports the mission-critical needs of the Department of Homeland Security at the timescale necessary for the problem at hand. LANL staff working on the project report to work at any hour to help the country during national emergencies," said Tim McPherson, D-4 group leader. "This reach-back capability is an important part of the DHS response to incidents of national significance."

After the Chilean project, the team went on to model flooding patterns and possibilities in the Midwest, and back when Hurricane Katrina battered the Gulf Coast, the NISAC team modeled the event, evacuation paths, restoration of power, economic impact, and more.

NISAC reports circulate at the highest levels in Washington and elsewhere, providing a clear, concise assessment of situations for policy makers to consider.

NISAC also is using these capabilities in the response to the recent BP oil spill, in support of both DOE and DHS. These diverse and ongoing efforts demonstrate how a national lab can be a key contributor to resolving a disaster that, at its heart, is an energy infrastructure challenge.

Sara Del Valle and colleagues provided policy makers valuable projections of H1N1 flu impacts. They won a 2009 LANL Distinguished Performance Award.

Boom, then what?

Recently, the NISAC team's efforts were broadly recognized and applauded by the National Exercise Division of the Department of Homeland Security for its support of National Level Exercise (NLE-10) planning activities. This task involved estimating critical infrastructure, key resources, and economic impacts of a hypothetical improvised nuclear device detonation in a major Midwestern city.

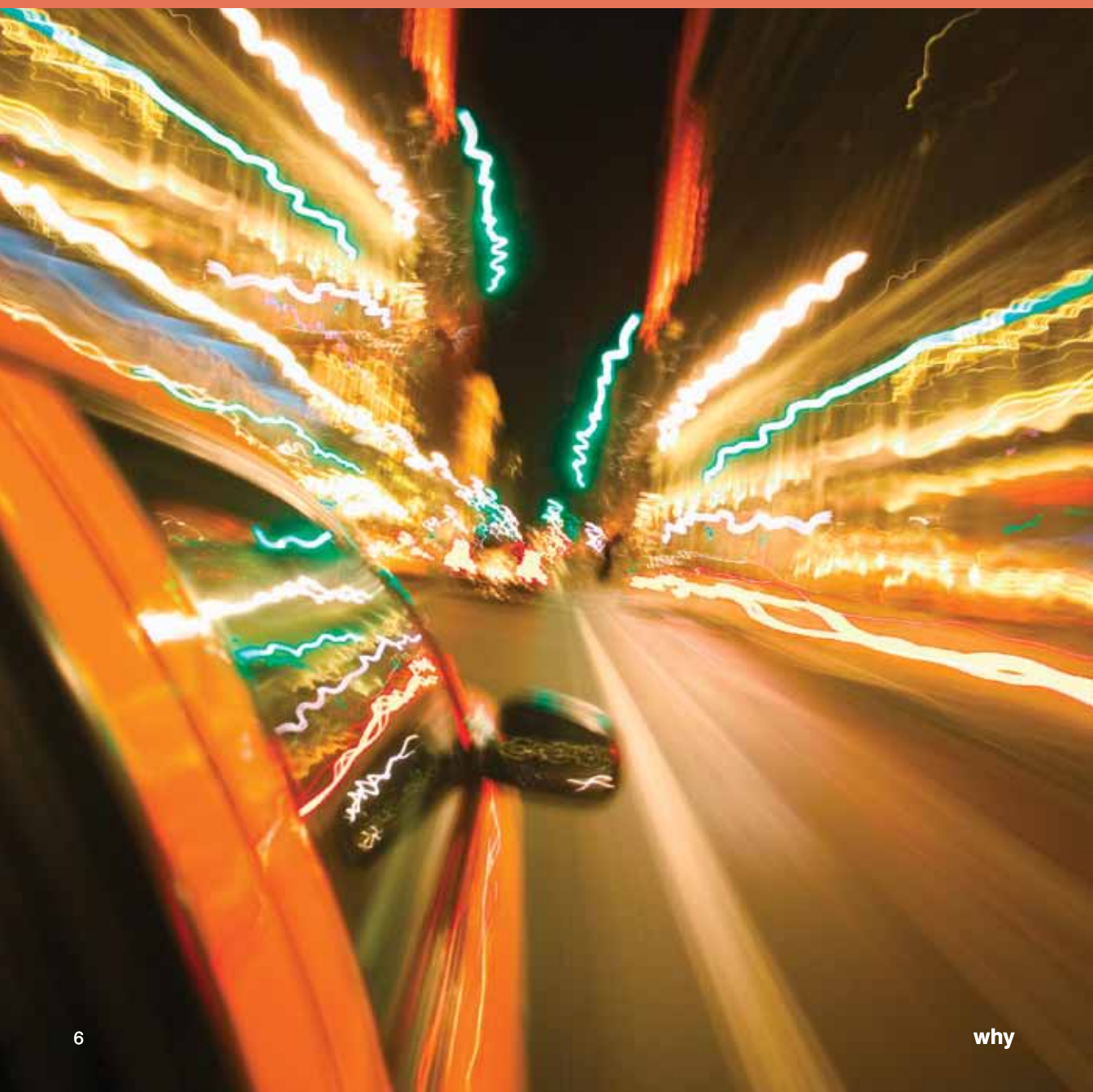
"Key impact analysis," said Resilient Global Infrastructure Program Manager Donald O'Sullivan, included "estimating the casualties, hospital facility demand, telecommunications, electrical power, electromagnetic pulse, transportation, and economics." This work was coordinated with Sandia National Laboratories.

"These examples represent a very small slice of the total effort being put forth in support of NISAC—but they indicate the important service that these LANL employees provide in support of the nation's safety and security," said O'Sullivan. ■

Technologies for a Nuclear Energy Future

What are Los Alamos experts doing to develop and refine rectors, fuels, and new materials suited for the extremes of nuclear environments?

by Kevin Roark



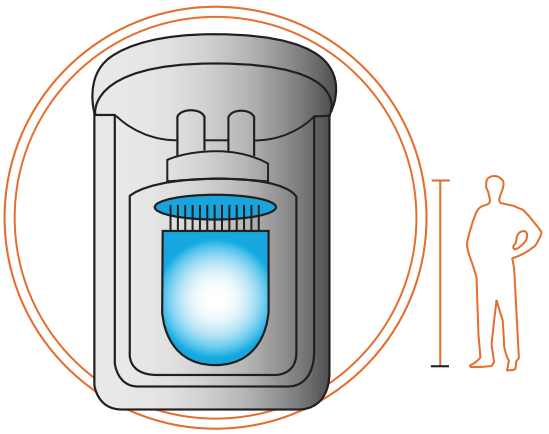
The United States emits nearly 6 billion tons of carbon dioxide annually. That's nearly one-sixth of the global total of carbon dioxide emissions. More than 70 percent of electrical energy generated in the U.S. comes from coal and other fossil fuels, which generate carbon dioxide when burned.

If our nation is to play a significant role in the global effort to reduce carbon dioxide emissions, nuclear power—one of very few large-scale sources of reliable low-carbon electrical power—must become a much larger part of the United States energy portfolio.

Energy Secretary Steven Chu has created the Blue Ribbon Commission on America's Nuclear Future, and Los Alamos National Laboratory, with its long-standing expertise in nuclear and materials technology, is poised to provide a path to solving the daunting technological challenges associated with the nuclear fuel cycle and nuclear waste. These challenges must be addressed if nuclear energy is to become a safe, sustainable solution to global energy needs.

Fortunately, scientists at LANL are making progress. Multidisciplinary research at the Laboratory has led to the design of small modular reactors, and new reactor fuels that burn more efficiently while reducing the proliferation of weapons-grade materials.

The Lab's research also is inspiring the design of next-generation reactor materials that can heal themselves and extend reactor life, as well as energy systems to harness the source of power of the stars.



The Hyperion Power Generation "nuclear battery" is a self-contained, automated, liquid metal nuclear reactor. It measures 1.5 meters, or 4 feet 9 inches, across.

Extending the lives of operating reactors and ushering in the next generation

For 30 years, Los Alamos scientists have developed advanced computational tools to simplify reactor designs.

For example, the Nuclear Regulatory Commission uses a Los Alamos code known as the Transient Reactor Analysis Code (TRAC) to certify and license light-water reactors (common in naval propulsion), which are an evolutionary advancement over the typical nuclear power plant. Light-water reactors have an excellent safety and reliability record, but they are expensive and difficult to build.

A new energy innovation partnership established by the U.S. Department of Energy is leveraging the Laboratory's computational and materials expertise to help keep the nation's existing fleet of reactors healthy and aid in the development of new cost-effective light-water reactors.

The partnership, known as the Consortium for Advanced Simulation of Light Water Reactors (CASL), is based at Oak Ridge National Laboratory and includes Los Alamos and partners from universities, industry, and other national labs. Announced last June as the first DOE Nuclear Energy Modeling and Simulation Energy Innovation Hub, CASL will use the advanced capabilities of the world's most powerful computers to make leaps forward in nuclear reactor design and engineering.

Los Alamos researchers, in conjunction with CASL partners, are creating a "virtual reactor" to realistically model the behavior of key materials such as reactor fuel and fuel cladding. The desktop reactor will help provide better estimates of how those materials perform or fail within the extreme environment of a reactor core. In addition to allowing engineers to virtually and more quickly test new designs, operating improvements, and materials, the simulations can guide regulators in approving new light-water reactors in much shorter time spans. The overall results will be lower costs, shorter licensing periods, and improved safety for new reactors.

continued

The “back yard reactor”

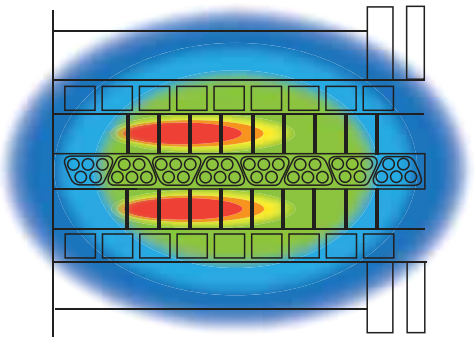
Beyond the Innovation Hub, the virtual reactor approach is also being applied to small modular reactors—devices that may one day become commonplace fixtures in American households.

Los Alamos is collaborating with a company called Hyperion Power Generation, Inc. on the conceptual design of a small, sealed, portable reactor about 2 square meters with no moving parts.

This new reactor is designed to deliver electricity or heat continuously for 7 to 10 years. Once the reactor is used up, the entire module is replaced—and since access to the low-enriched uranium fuel on site is eliminated, spent material can’t be used as a weapon.

This effort recently won an Award of Excellence in Technology Transfer from the Federal Laboratory Consortium.

Hyperion is one of many new U.S. companies targeting modular reactors, including mPower, TerraPower, and NuScale. Los Alamos experts and computer models will play a vital role in maturing these technologies.



LANL’s Monte Carlo N-Particle computer code simulates performance tests for nuclear fuels and reactor materials.

Material differences

The environment at the core of a nuclear reactor is a study in extremes. Better nuclear reactor design relies on materials that can withstand being bombarded by neutrons and cooked at outrageously high temperatures. Reactor fuel cladding and reactor core materials can undergo deformation, swelling, or cracking as atoms and jostled out of place by radiation.

As pioneers of the nuclear age, Los Alamos researchers are experts in the science of extremes.

Recent research at LANL has provided new understanding of how, under certain conditions, displaced atoms can fill voids left behind by other vagrant atoms. Too many voids can cause materials such as those used in reactor cores to swell or fail. This new research paves the way for the design of self-healing materials that can keep reactors online longer and dramatically extend the life of fuel.

Los Alamos scientists are perfecting ways to strengthen materials by creating them out of repeating nanolayers. When stresses are applied to these materials, the forces are absorbed by the surrounding layers, making these metals hundreds of times more resistant to damage than traditionally manufactured materials. This technique may someday be applied to toughen up reactors where it counts.

Materials science expertise is also being applied to reactor fuels. As the plutonium laboratory for the United States, Los Alamos has unique capabilities in many areas involving actinides and mixed plutonium and uranium fuels.

For example, the Lab is developing a Materials Test Station at the Los Alamos Neutron Science Center (LANSCE) to provide a dynamic facility for testing fuels and reactor materials under neutron bombardment similar to a next-generation reactor.

Coupled with Los Alamos’ Monte Carlo N-Particle computer code—the gold standard for predicting nuclear reactions used by more than a thousand users at 250 institutions—realistic neutron interactions at the Materials Test Station could lead to a new type of “TRU” (named for the transuranic elements it would contain) fuel that creates more energy while reducing waste products that could be diverted for weapons use.

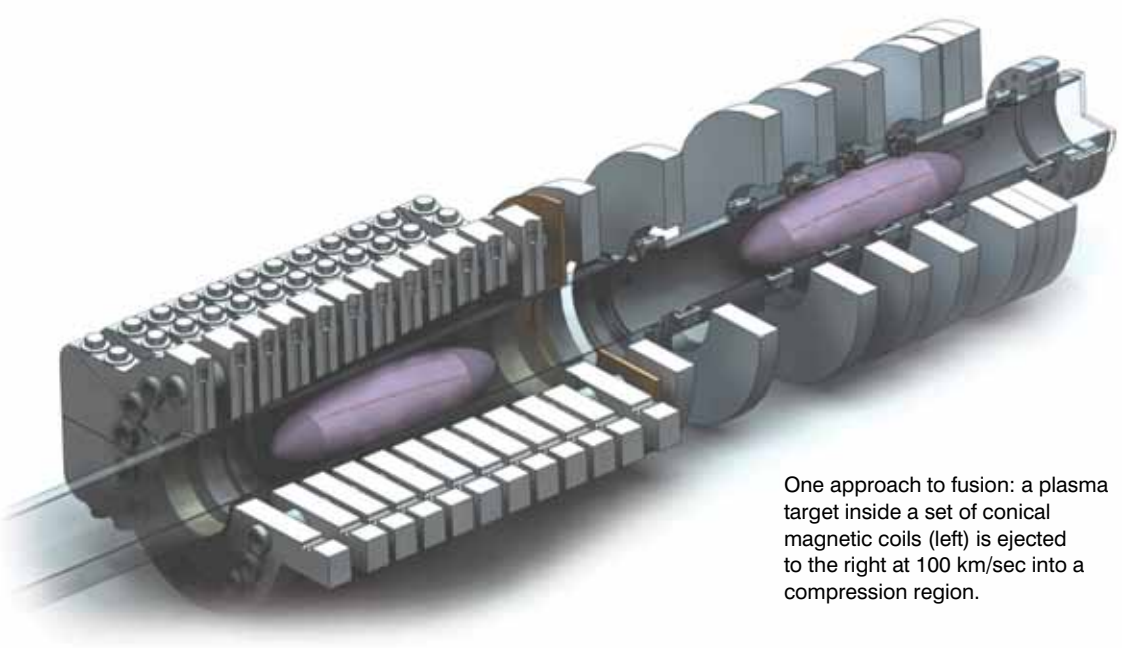


Illustration by Paul Sieck, LANL

One approach to fusion: a plasma target inside a set of conical magnetic coils (left) is ejected to the right at 100 km/sec into a compression region.

Waste not, want not

In terms of nuclear power, radioactive waste is the 50,000-ton gorilla in the room. With no current repository for waste and more than a million tons of spent fuel sitting in temporary storage—much of it in pools of water on reactor back lots—the safe storage and disposal of nuclear waste is an obstacle that must be overcome.

Los Alamos plays a leading role in modeling the migration of radioactive materials in geological formations, and analyzing systems for the long-term safety of waste repositories. It's no wonder that Los Alamos has been called upon in the operation of DOE's Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, and to assess the safety and performance of the Yucca Mountain high-level radioactive waste repository concept.

This same expertise will be used to evaluate new waste-disposal options. New fuels that create less heat and shorter radioactive lifetimes could extend temporary storage options. New assessments of locations for permanent storage, such as salt caverns at WIPP, are already under way.

Whatever approach to nuclear waste disposal the United States takes, the scientific tools being developed at Los Alamos will continue to be essential to the nation for long-term prediction of safety, risk, sustainability, and nonproliferation.

Putting star power to work on Earth

Fusion energy is a long-term, carbon-free energy source that has the potential to power our planet, and propel spacecraft on missions into deep space. But achieving controlled fusion energy in the laboratory remains a fundamental and grand challenge to the scientific and engineering communities.

Los Alamos researchers have studied fusion plasmas since the 1950s. Today, LANL is working with the global community to explore laser fusion at the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory, and magnetic confinement fusion at the ITER facility under construction in southern France.

Los Alamos is also leading an approach called magnetized target fusion that involves compressing plasma containing its own magnetic fields. This innovative approach to fusion is much more compact than ITER and less power intensive than NIF. It is being tested in collaboration with the Air Force Research Laboratory in Albuquerque, New Mexico.

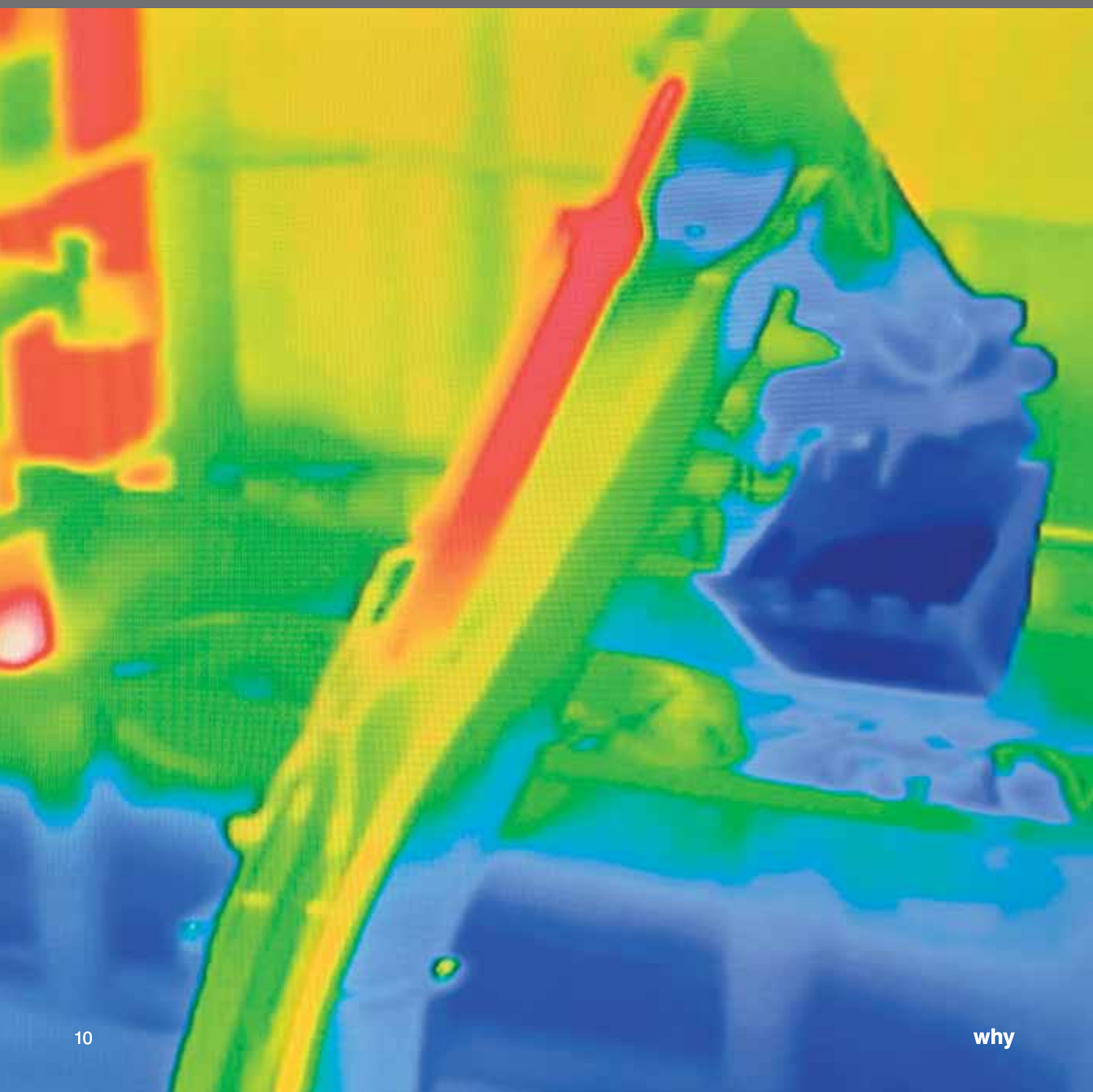
From extending the lifetime of existing reactors to designing radical new energy solutions, Los Alamos provides capabilities our nation needs to develop nuclear power as an essential component of the nation's energy mix. ■

Excavation Digs into Manhattan Project History

Buried treasure or 66-year-old trash?

by Fred DeSousa

Photos by Patricia Leyba



An excavation now under way at LANL's World War II-era landfill is getting nationwide attention—for a number of reasons.

First, despite years of analysis and more than 150 soil cores, no one knows exactly what's buried at the six-acre strip of land. That raises safety questions and rampant speculation about what crews will unearth—rumors of a truck and two Sherman tanks persist. More on that later.

Second, the landfill, known as Material Disposal Area B, is located in LANL's historic but unused Technical Area 21, right across the street from several Los Alamos businesses and the *Los Alamos Monitor newspaper*.

Third, the project's deadline. Under the 2005 Consent Order on Lab cleanup with the state of New Mexico, the excavation and backfill with clean soil must be complete by December 2010.

And fourth, the spotlight of the American Recovery and Reinvestment Act. The excavation of hazardous, nonhazardous, and some radioactive trash will cost about $90 million and is LANL's most expensive Recovery Act project.

What's really buried there?

Although disposal records from 1944 to 1948 don't exist, purchasing records do. Former Lab employees were interviewed and Manhattan Project documents scoured.

Lab legend holds that a truck used at the Trinity atomic bomb test near Alamogordo was driven back to Los Alamos and buried whole at MDA B.

A less likely but wilder favorite among old-timers: two Sherman tanks used at the Trinity test.

"We might uncover something that could go to the Bradbury Science Museum in Los Alamos," said LANL Program Director Andy Baumer.

None of these objects showed up on ground-penetrating radar surveys.

Crews expect to find mostly Lab trash in MDA B's 10, 15-foot-deep trenches—what's left of gloves, clothing, lab equipment, bottles, boxes, and building rubble. Some of it will be contaminated with chemicals or radioactive material.

Testing and risk analysis studies postulated a scenario in which bottles containing crystallized chemical leftovers could burst if punctured.

Despite the Lab's mission at the time—producing the world's first nuclear weapons—crews do not expect to find much radioactive material. Any plutonium created in those days was precious, zealously recovered, and reused. Scientists estimate between three and seven ounces of plutonium may be scattered across the site. That's about the weight of a small mobile phone.

But the uncertainty and location of the landfill has lead to extensive safety precautions.

A remote-controlled excavator is on hand for trickier or dangerous parts of the job.

Safety first

Project managers estimate they'll remove 22,000 cubic yards of material from MDA B, enough to cover a football field to a depth of about 11 feet.

But there will be no open-air digging. Instead, the Lab is erecting metal enclosures with air filtration, fire suppression, remote cameras, and sensing equipment.

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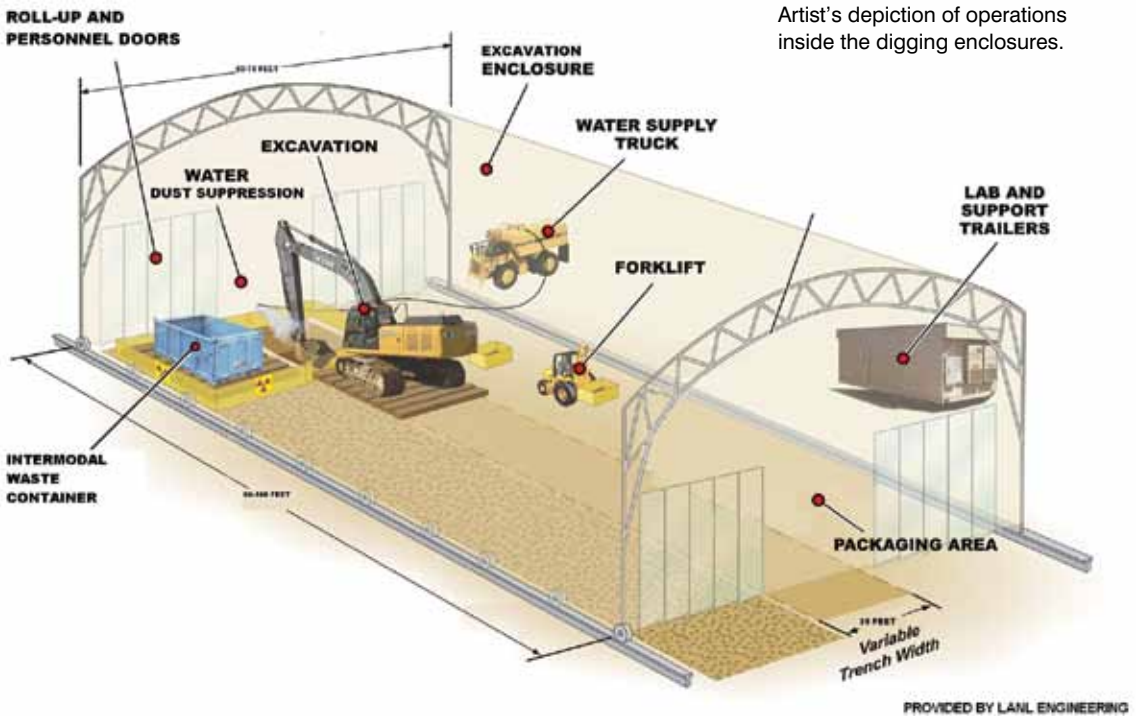
For safety's sake, the cleanup excavation team uses infrared images to signal potential fire hazards. The lighter the color, the hotter the object.

The site will be so clean that people could live, play, and grow a garden without adverse health effects.



Artist's depiction of operations inside the digging enclosures.

Each enclosure is connected to a dedicated control room where operators can monitor the cameras and sensors as well as trigger fire suppression if necessary.

Two of those enclosures are 60-foot by 60-foot behemoths on wheels. Once digging is complete at one location, crews will use hydraulic jacks to raise the building and a bulldozer to tow it to the next location.

No one will be allowed inside the enclosures during digging, except the heavy equipment operator in a blast-shielded cab. An unmanned, remote-controlled excavator is on standby for the trickiest or most dangerous jobs.

Technicians sorting and testing the dirt and trash will use full respirators and supplied air. Waste bins will be loaded and sealed inside the enclosure. Contracts are already in place to transport the bins to a disposal facility in Utah.

A temporary siren is parked on site, and Lab emergency response teams have coordinated drills with Los Alamos County emergency responders.

As extreme as this may sound, Baumer has done it all before at sites in Idaho.

"We're being extra cautious with our workers and with our neighbors," said Baumer.

Operators in a control room can monitor standard and infrared video, as well as chemical sensing equipment.

The deadline

Crews at MDA B have little time to spare. LANL must complete excavation by December, so the team is working seven days a week and ramping up to six crews.

The majority of workers will come from small business subcontractor Portage, Inc., which in turn is subcontracting to other firms.

They'll scoop out the dirt and trash, test the empty trenches, and replace the dirt with clean soil that meets residential standards. That means people could live, play, and grow a garden at the site with no adverse health effects.

It's the Lab's job to clean the site and make it available for transfer to Los Alamos County. The Department of Energy takes it from there.

"This project marks major environmental cleanup progress for the Lab," said Everett Trollinger, Recovery Act project manager for NNSA's Los Alamos Site Office. "We look forward to the day we are able to transfer this land for other uses."

And while Los Alamos County has no specific plans for the site, those wheels are starting to turn. ■

Energy Security Depends on Science

Demand climbs while environmental concerns grow. Los Alamos seeks solutions.

by James Rickman

To retain its competitive edge, America must develop and secure sustainable sources of renewable energy. Beyond providing the conveniences of a comfortable, modern lifestyle to which we have become accustomed, energy is a growing security concern for our nation—and, for that matter, the entire planet.

The current world population annually consumes a mind-numbing 15 terawatts of power. That's roughly equivalent to the juice needed to illuminate a trillion fluorescent light bulbs.

Our modern, virtual world inundates and delights many of us with constant, easy access to information and entertainment.

People can now carry in their pockets the computing and communications capacity that decades ago filled an entire building.

These personal electronic devices provide an ever-increasing drain on available energy resources. In the United States alone, energy consumption from PEDs doubles every decade.

While the United States accounts for about 5 percent of the world's population, we consume about 25 percent of the world's energy. In the coming decade, developing nations will require greater shares of the global energy supply.

With finite sources of fossil fuels and a wildly increasing demand for power, it becomes obvious that energy—and the ability to create and use it—may likely become the #1 concern for the U.S. and the rest of the world as well.

How Los Alamos fits in

Los Alamos National Laboratory is rising as a key player in energy security. With a workforce of diverse technical talent accustomed to quickly solving the most complex problems on Earth, what better place than Los Alamos exists to tackle the daunting problem of energy security?

Energy security is such an important facet of the Laboratory's mission that it has become a separate item in the Laboratory's Goals and Commitments. The Laboratory focuses three specific aspects of the energy security issue: renewable energy sources, energy transmission and storage, and understanding the effects of energy usage on our climate.

Los Alamos scientists already are making headway in renewable energy. As part of a consortium of academic institutions, national laboratories, and private industry, Los Alamos is at the forefront of potentially turning algae-based derivatives into fuel for automobiles or aircraft—and in a manner that will minimize water and land usage yet maximize the potential energy yield from each tiny algae plant.

Because the sun has long been recognized as an underutilized power source, Los Alamos material scientists have undertaken groundbreaking research that may allow us to more efficiently harvest its power.

Imagine if instead of capturing one energy unit from a single photon of light striking a solar panel, we were able to convert that power into two units of energy or more, effectively doubling the output of solar panels? What if we were able to create super-efficient solar panels that could be painted onto a building or other convenient surface?

Such questions are among the types being asked—and answered—by Los Alamos experts conducting research into quantum dots, a special class of nanocrystal semiconductors.

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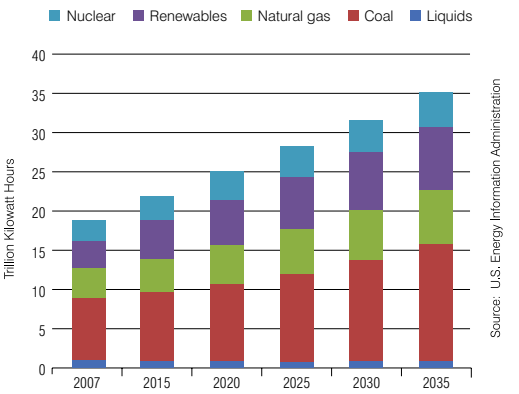
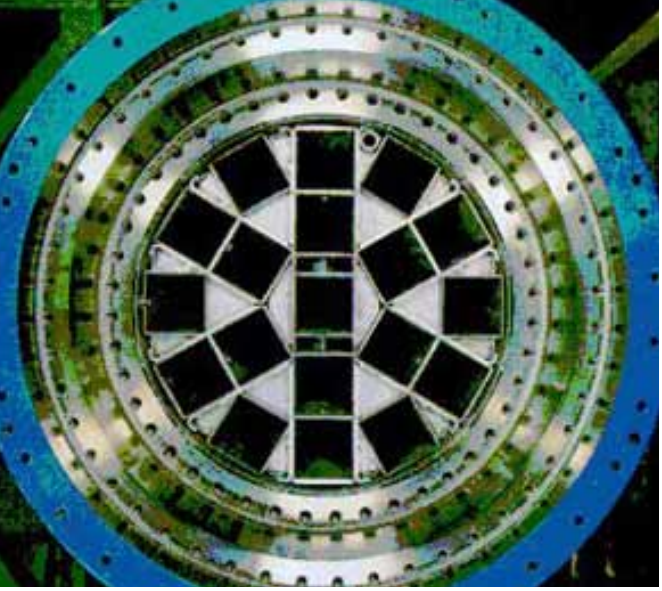


World net electricity generation by fuel.



LANL researchers seek to increase the safety and reduce the lifespan of nuclear waste in storage.

Newly minted nuclear fuel rods, which now yield only about 15 percent of their energy.

Speaking of efficiency, Los Alamos researchers also are looking at ways to increase yields of ethanol fuels derived from such waste materials as cornhusks or weeds.

Using the power of the Los Alamos Neutron Science Center (LANSCE) —the world's highest-intensity linear proton accelerator—scientists were able scrutinize the tough bonds between atoms that make biomass so difficult to convert into ethanol. In doing so, the researchers were able to find a potential Achilles heel in the materials that may allow for less-energy-intensive conversion of plant matter into ethanol.

The future of nuclear energy

With a firm foundation in nuclear materials at the core of Los Alamos' mission, no talk of renewable energy development would be complete without a focus on nuclear energy.

If nuclear energy is to be successful over the long haul, humanity must find a way to deal with nuclear waste. Los Alamos approaches the problem on two fronts.

First, scientists are exploiting the Lab's expertise in materials science to create materials to make the cores of nuclear power plants last longer.

Right now, only about 15 percent of the fuel in a reactor core is used for power because the cladding around each fuel rod is bombarded with such intense radiation that the cladding swells, compromising the strength and performance of the material.

Los Alamos researchers recently created a computer model to explain why such damage occurs and identified a natural mechanism in certain materials that mitigates the damage.

With this understanding and a directed focus on the behavior of materials in extreme environments, it may become possible in the not-so-distant future to design materials that will heal themselves, extending the life of fuel rods.

Second, scientists are attacking the nuclear waste problem by exploring how waste can be stored more safely in geologic repositories and how the lifespan of waste may be reduced through transmutation—a process once only dreamed of by alchemists, but now something entirely possible thanks to the LANSCE proton accelerator and an advanced understanding of nuclear materials.

Photos by Zvonko Lovasic, IAEA (left) and Dean Calma, IAEA (right)

Alternative sources

Although such alternative sources of energy as the wind or the sun can augment conventional energy sources, the wind rarely blows when people need power most, and the sun shines only half the day.

Our nation's ability to store power so it can be used when needed represents a major hurdle in energy security.

Conventional batteries are relatively inefficient and costly, and their disposal creates environmental challenges. It's not a stretch to say that battery technology hasn't progressed fundamentally beyond the ancient Baghdad battery created 2,000 years ago with vinegar and metal spikes inside a ceramic jar.

Laboratory researchers developed the first commercially available hydrogen fuel cells. Now Los Alamos chemists and materials scientists are pursuing new-generation batteries and advanced concepts for energy storage in chemical bonds. These efforts could someday allow us to harness the power of the sun or the wind whenever we need it.

Like anything, energy use comes at a cost—not necessarily economic.

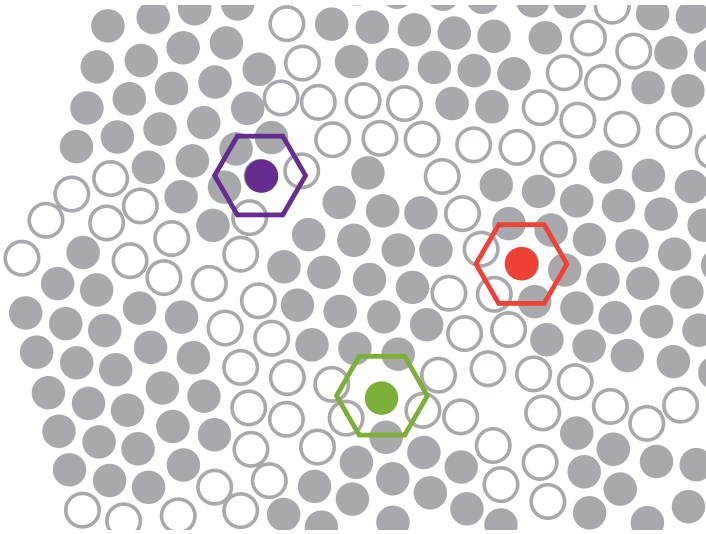
Researchers are using the advanced computing capability at Los Alamos to better understand the impacts of energy use on our environment and on our planet.

The same computer codes that model the complex behavior of hydrodynamic systems are being used to understand how ocean currents flow from one edge of the globe to the other, or how greenhouse gases mix with other atmospheric components and are dispersed across the planet.

Scientists are validating Los Alamos climate models with on-the-ground observations. These validations help improve the accuracy of models and the computer codes that drive them.

Eventually, Los Alamos computer modelers may develop a predictive capability to forecast humanity's impact on global climate systems. The information could be used to help us understand how best to use scarce energy resources or mitigate their effects.

As long as humans require energy to fuel their daily lives, Los Alamos National Laboratory will have a compelling mission to offer to the nation and the world. ■



Radiation damage—and healing—take place at grain boundaries in nanolayered materials.

LANL Launch Pad

A look at how postdoctoral associates and fellows start and propel their careers at Los Alamos National Laboratory.

Photos by Sandra M. Valdez

Stosh Kozimor

I wanted nothing to do with radioactive elements while I was growing up in New Mexico, with its nuclear history. But in graduate school I became interested in actinides, and I realized actinide chemistry was where I wanted to focus my efforts and try to make a difference.

Los Alamos is the place to study actinide science, so I came here in 2006. In the Inorganic, Isotope, and Actinide Chemistry group, I'm on a multi-disciplinary team focused on studying actinide electronic structure.

One aspect of this research involves using synchro-tron-generated radiation to measure covalency in metal-ligand bonding for plutonium and the other actinides.

Although this is fundamental research, we have begun investigating extraction agents used to separate actinides from nuclear waste. We anticipate these studies will provide unique insight to evaluate the relative roles of d- and f-orbitals in bonding.

These results hopefully will help us understand the effectiveness of certain actinide separation schemes, which is not easily explained using a traditional description of f-element electronic structure.

I couldn't have come so far without the people who believed in me. Dave Clark and Carol Burns always provided solid feedback while encouraging me to be creative and explore what I want.

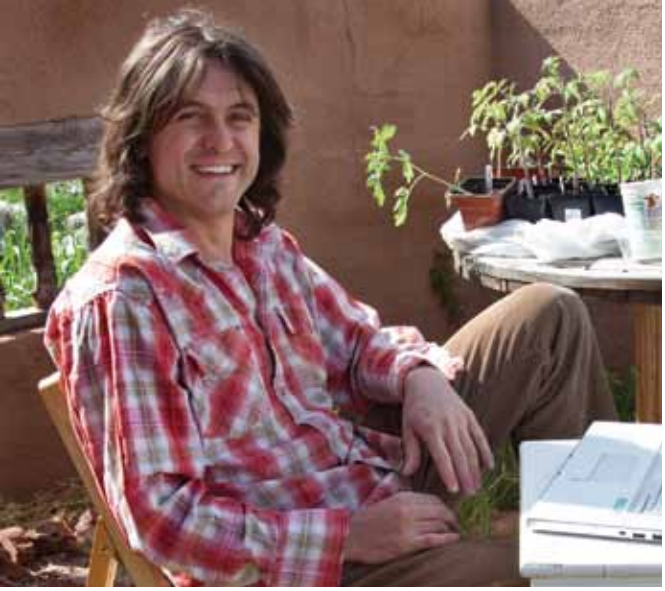
I'm the first person in my family to go to college. My family runs a small construction company in Farmington, New Mexico. I loved working up there, but I was always given the worst possible jobs. It was my folks' attempt to keep me in school. It worked.

I laughed when one of my professors suggested grad school. I said I couldn't afford it. But he laughed back and said, "They'll pay for you."

I got a teaching assistantship, after graduating from Fort Lewis College in Durango, and my wife and I made it work.

We lived in a 35-by-7-foot travel trailer when I went to school. I got my Ph.D. in inorganic chemistry from the University of California at Irvine and worked as a postdoc at UC Berkeley before coming here. In both places I focused on studying the unique chemistry of uranium.

The most important thing in my life is my family. My wife, Branden, and I just had our first baby in March. His name is Ezra Ansel, and this is by far the most exciting and fulfilling adventure that we have been on yet.



Early on, Stosh Kozimor wouldn't have dreamed of being a Ph.D. or specializing in actinide chemistry.

Harshini Mukundan's team is developing optical biosensor technology to rapidly diagnose tuberculosis.

Harshini Mukundan

My name, Harshini, means *happiness* in Sanskrit. I am a happily married mother of two. My son, Nilesh, is an amazing seven-year-old. My daughter, Nishta—which means *determination*—even at two years is a very determined little girl.

I came to UNM grad school from India in 1998 to study biomedical science. My professors there respected my opinions and encouraged me to think for myself. That really motivated me to pursue a career in science.

Grad school was a challenge because of the commute, first from Los Alamos, and then from Santa Fe, where I lived with my family. I defended my dissertation when Nilesh was only three months old.

I worked for two years at a start-up biotechnology venture in Santa Fe, then I joined the Lab with a post-doctoral fellowship from the National Institutes of Health in 2006. I became a staff member in 2009.

My group is developing new technology for the detection of biomarkers associated with such diseases as influenza and cancer. Loosely defined, biomarkers are biological molecules that are differentially expressed during disease.

We're also working to develop rapid diagnostics for one of the toughest pathogens known to man—tuberculosis. Many people worldwide, especially in India, Africa, and Eastern Europe, are carriers and don't even know it until their immune systems are compromised—by HIV, for instance—resulting in active infection. TB is the major cause of death among HIV-infected people.

The methods currently used to diagnose TB are severely inadequate. The problem has been exacerbated by the development of resistant strains. Our team is working on TB diagnostics by rapid detection of biomarkers in patient samples using an optical biosensor platform developed at LANL about a decade ago.

Success, I believe, is due to hard work and most importantly, the team of people you work with. At LANL, I've got the support of great mentors, colleagues, and students.

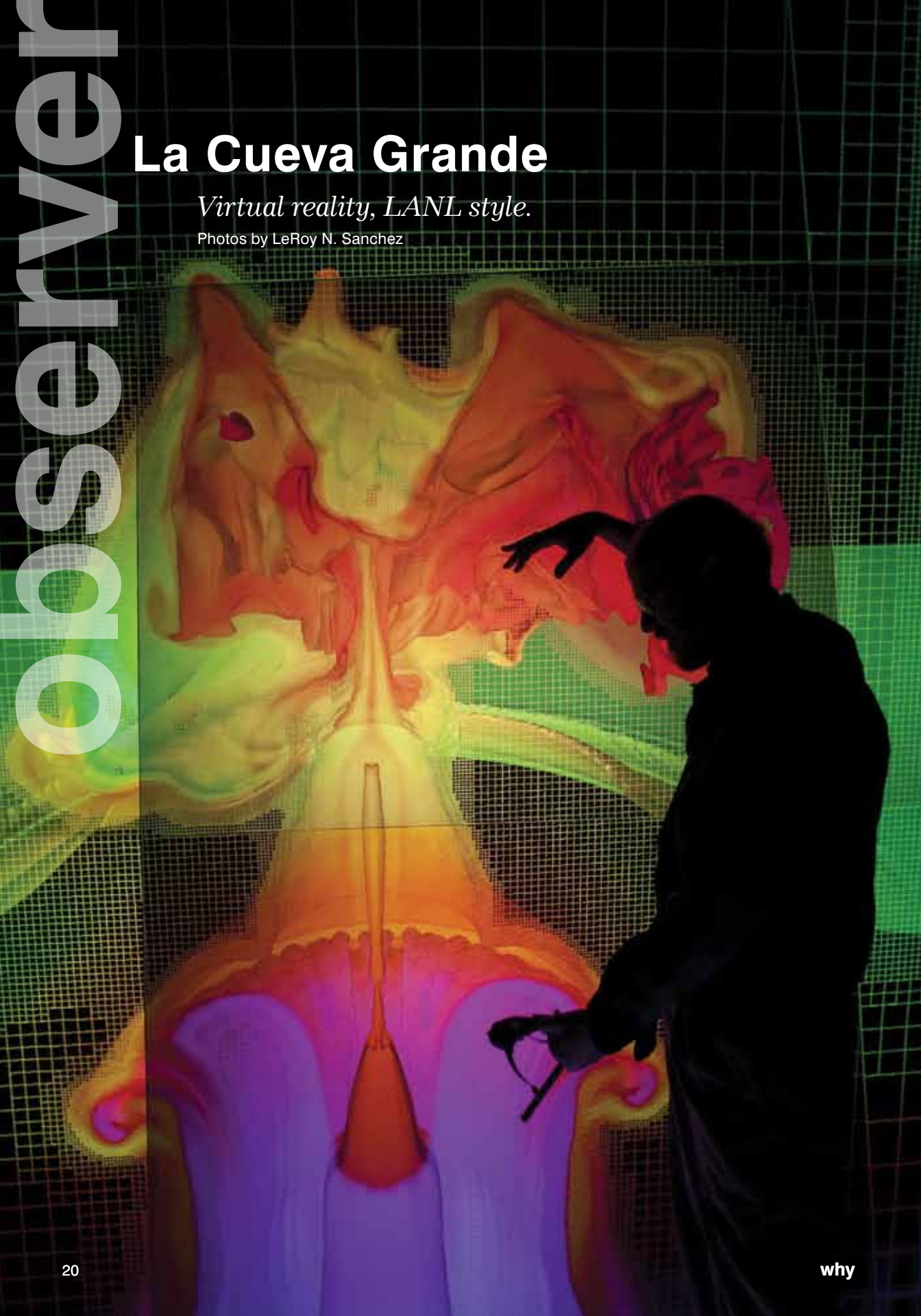
My heroes are LANL's Bette Korber and Basil Swanson. I admire their values and scientific integrity.

I hope that one day I'll have half the publications they have and be half the people they are today. ■

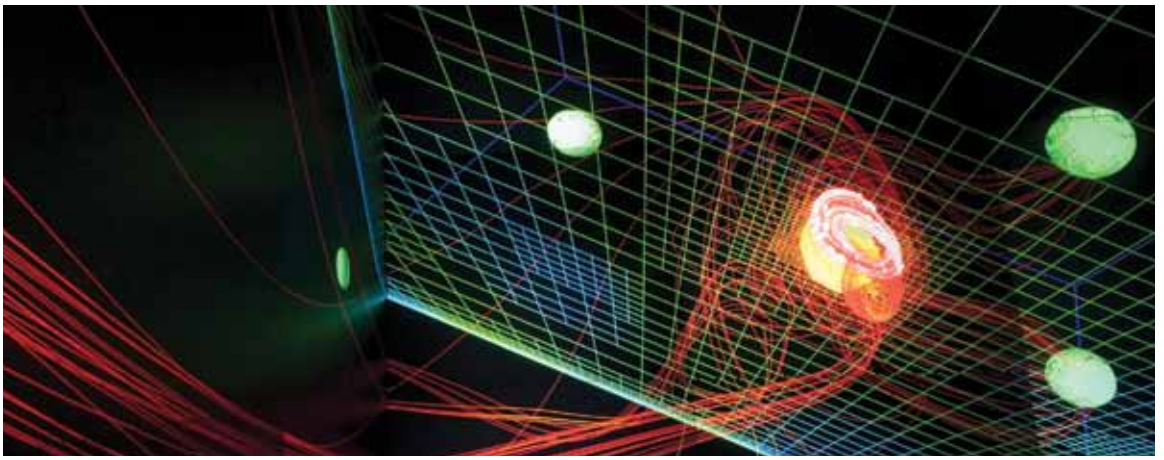
La Cueva Grande

Virtual reality, LANL style.

Photos by LeRoy N. Sanchez



The Big Cave is a paradox. Researchers and decision makers interact with virtual environments that boggle the mind—and at the same time provide clarity. La Cueva users and visitors wear special glasses to view 3D animated projections of extremely high resolution. They experience vividly everything from incredibly close views of nuclear detonations and working with new glove box designs to observing biological functions at the molecular level and the behavior of entire galaxies.



La Cueva Grande is a CAVE virtual reality system. It's geared for the visualization of data from LANL's Advanced Simulation and Computing (ASC) program. CAVE stands for *cave automatic virtual environment*.

Rear-screen projectors fill peripheral vision with images appearing on three walls, ceiling, and floor. This arrangement provides a real sense of three-dimensional space. Electromagnetic sensors enable users of the CAVE to feel as though they're walking around objects and even manipulate them. The CAVE approach engages more parts of the brain to help a person understand problems and solve them faster.

When the facility opened in 2005, La Cueva Grande boasted the highest resolution of any CAVE in the world. It still ranks near the top. Located at the Nicholas Metropolis Center for Modeling and Simulation and operated by the High Performance Computing Division's Systems Integration Group, La Cueva has 33 digital projectors. They display 43 million pixels.

The CAVE is part of LANL ASC's larger visualization environment, which includes the adjacent PowerWall Theater and many desktop systems. ■

Tesla Titans

A team of scientists at Los Alamos works to break its own record for the world's strongest magnetic field.

by Fred DeSousa

Photos by LeRoy N. Sanchez

Magnetic fields strong enough to vaporize copper are difficult things to comprehend.

To put it in context, the magnets that lift cars at junkyards operate at about two teslas—the unit of measure for magnetic field intensity.

Magnets at the National High Magnetic Field Laboratory Pulsed Field Facility routinely generate magnetic field pulses to 85 teslas—the only research facility in the world that can generate that much magnetic field without destroying the sample unlucky enough to be inside.

"Our goal is to nondestructively reach 100 teslas within the next year to year-and-a-half," said Chuck Mielke, who heads the LANL facility. "At the field levels we generate, material structures will start to change and realign."

Unlocking the secrets behind those changes could someday lead to better superconducting wires, stronger electric motors, or more efficient data storage. Users from around the world come to Los Alamos for just such research.

"The classic example of applying this science is superconductivity," said Jon Betts, head of the facility's user program.

Superconducting materials can transmit electricity without resistance—wasted energy that heats wires and saps power over long distances. Superconductors must be cooled to extremely low temperatures—at least 300 degrees Fahrenheit below zero. Any warmer, and they begin to lose their superconducting properties.

Powerful magnets suppress superconductivity at a given temperature, allowing scientists to experiment with what stops superconductors and how, thus mapping out the superconducting phase space.

"Even more important is the 'why,'" Betts adds.

Inside a concrete-walled chamber within the Pulsed Field Facility sits a 12-foot-high metal cylinder about five feet across. Running around the inside of the cylinder is 7 tons of thick, high-strength copper wire, which, 12-foot-high when energized-generates about 40 teslas.

But that's not enough.

A smaller but equally powerful magnet (about the size of two large coffee cans) rests in a compartment inside the larger cylinder.

Dwight Rickel ensures that moist air won't condense in the liquid nitrogen in which the magnet is submerged. The purpose: prevent an ice buildup that would impede magnet cooling.

Seven transformers such as this one convert the incoming 21 kilovolts at 2 kiloamps to 4 kilovolts at 20 kiloamps.

It takes a generator the size of two semi-trucks five full minutes at five megawatts to build up the power for a pulse. That's enough to run a small town for that same five minutes.

Inside the inner compartment sits the sample—usually about the size of a grain of salt or small cat's whisker.

The pulse is over in less than two seconds, with the highest teslas occurring during the middle tens of milliseconds.

As sensitive recording instruments watch, "The magnet nondestructively affects the sample, more importantly, the electrons. As the magnetic field intensity drops back down the sample goes back to where it was when it started," said Mielke.

"Nondestructively" being the key, allowing scientists to adjust various parameters and study the results.

Results that could help create an electric motor efficient and powerful enough to lift a helicopter, or fit more data into smaller spaces on a computer hard drive.

The Pulsed Field Facility at LANL is one of three campuses of the National High Magnetic Field Laboratory, the other two being at Florida State University in Tallahassee (continuous fields, magnetic resonance, and general headquarters) and the University of Florida in Gainesville (ultralow temperatures at high magnetic fields).

The NHMFL is sponsored primarily by the National Science Foundation, with additional support from the State of Florida and the U.S. Department of Energy.

The NHMFL is a user facility, allowing qualified researchers from undergraduate students to Nobel laureates to use its magnets for free as long as the results are published and not proprietary. ■

What do you do?

Jobs around the Lab.

by Ed Vigil

Photos by LeRoy N. Sanchez

Build a Following for Our Museum

Robert Naranjo of the Community Programs Office fabricates museum displays and interactive science learning activities for the Lab's Bradbury Science Museum. More than 85,000 visitors each year experience Naranjo's work.

What skills are needed to be a museum exhibit fabricator?

The skills and experience I have are in cabinetry, machine, and metal work.

What special training or education do you need?

It's best if you go through a machinist training program. I went through a 14-week Lab program where I learned basic machining. I later did some on-the-job training making architectural and engineering models, which led to my job at the museum.

Why did you choose this field?

I've always been interested in building and making things. In high school I took a lot of cabinetry classes. I enjoyed those classes very much. In fact, I made all the cabinets in my house. A lot of what I do today I learned as a student at Española High School.

How long have you had this job?

I've been at the Lab about 34 years, and I've been with the museum since 1994. Most of the time I've done work for the Bradbury. That has been my career at the Lab.

How did you get this job?

Before the Lab, I used to work all kinds of hours as a police dispatcher for Santa Clara Pueblo. Growing up in Española on the Santa Clara Pueblo, I was looking for a regular schedule and an opportunity to join the Lab.

A couple of friends told me that the Lab was looking for people to participate in the machinist's training program, so I drove up the hill and dropped off my application at Human Resources, and it wasn't too long before I was working up here.

What's the best part of this job?

Seeing how happy members of the public get when they see the exhibits. And the opportunity I have to work with everyone at the Lab, from scientists to technicians. The work is unique, always challenging, and a lot of fun.

What's the most challenging part?

With all our visitors, young and old, it's important—and challenging—that I make sure that their visit to the Bradbury is safe and enjoyable.

What do you do on your days off?

I like to make pottery for the Indian Market in Santa Fe. In fact, I spend a good part of the year getting ready for the market. I make pottery nativity sets, figurines, and dioramas. Working on my pottery is what I enjoy doing when I'm not at work.

Robert Naranjo helps make the Bradbury Science Museum alluring to many thousands of visitors.

On a typical day, Debe Braden administers between 25 and 30 tests for drugs and alcohol.

Test for Drugs and Alcohol

Debe Braden of Personnel Security is one of four technicians who travel around the Lab in mobile test units, screening employees for alcohol and illegal drug use. The mother of two has held this job for eight years ("it's been a really great job"). She found the job and applied online, after learning about the open position from a friend. Formerly from Texas via Colorado, Braden came to New Mexico in 1995 and Los Alamos shortly thereafter.

What are the requirements to be a forensic drug and alcohol technician?

You have to know and understand all the federal regulations for each type of drug and alcohol test, you need a Q clearance, and you must be part of the Human Reliability Program.

What special training or education do you need?

A lot of the training comes from testing and certification. It helps to have a medical or police background, but most of it is on-the-job training.

It also helped that I had done some drug-test collection when I worked for Los Alamos Medical Center.

As far as certifications go, I've got three: one from the Department of Transportation, another from the Drug and Alcohol Testing Industry Association, and a third from CMI, the leading manufacturer of breath-alcohol testers. The DOT certification is every five years, DATIA is yearly, and CMI is every five years.

Why did you choose this field?

I feel it is a necessary evil. When we root out a drug user, we assure ourselves that we have a safe and secure workplace for everyone else.

What's the best part of this job?

The people I see every day, the great people who work at the Lab.

What's the most challenging part?

Most of the time I'm pretty easygoing. The difficulty comes when workers frown on the program and blame us for having to take a drug test.

The truth is, we are just doing our job. For the inconvenience of having to take the drug test, they really should blame the people who insist on using illegal drugs.

What do you do on your days off?

I visit my sons—one's a ranch manager and the other a financial advisor—and my perfect grandson in Colorado. And when I have a moment, I like to crochet. ■

Terry Wallace

Principal Associate Director for Science, Technology & Engineering

Photos by LeRoy N. Sanchez

Terry Wallace is principal associate director for science, technology, and engineering. Raised in Los Alamos, Wallace returned in 2003 after 20 years as a professor of geosciences and an associate in the applied mathematics program at the University of Arizona. In addition to teaching, he carried out research on global threat reduction, nonproliferation verification, and computational geophysics.

Los Alamos has a proud and storied history with the Manhattan Project. What do you see as the next world challenge that Los Alamos could play a significant role in solving?

Wallace: Energy. It's the biggest problem we have ever faced.

Our demand for energy in the United States is directly related to our population and our quality of life. There are many, many emerging nations right now that would like to share our quality of life. That means the global demand for energy is going to increase dramatically. It's inevitable.

Twenty to 30 years from now we'll have double the global demand for energy. How are we going to meet that demand? That is a problem that Los Alamos can help solve.

What needs to be done?

Wallace: You can't think about energy without thinking about the three consequences.

First, how are you going to generate enough energy and transport it to where it is needed?

Second: the environmental insult. Whether or not you believe in anthropogenic global warming, the fact is that if you rely on fossil fuels, you put gases into the atmosphere that affect the climate and poison the ocean. Ah, but you what if you choose nuclear? There are no greenhouse gases. But what are you going to do about the waste? If you choose solar, where are you going to find the minerals that you need to make solar films and storage systems? How do you reliably get the power to where it's needed without losing a significant portion of it in the process? If you choose wind, how are you going to store the energy so you can use it when it's needed?

The third major consequence is economic impact. In general, cheap energy is dirty, but cheap energy is the road to prosperity.

There is no silver bullet. We have a marvelous quality of life in the U.S. Everybody else has the right to the same quality of life. And that pushes the global demand for energy at an extraordinary rate. In this country, we have 300 million people of about 6.9 billion on the planet. And we use a quarter of the energy.

The only way to meet global demand is to have a long, sustained effort—sustained innovation and the occasional brilliant breakthrough. This is exactly why Los Alamos has a role to play.

Does the burden of solving the problem fall on us?

Wallace: I think the United States has an extraordinary role to play. The U.S. is still the innovation hub of the world. Energy security is a national security problem, plain and simple. Fundamentally, our job at Los Alamos is to build a vibrant science enterprise to address any national security question that comes to us.

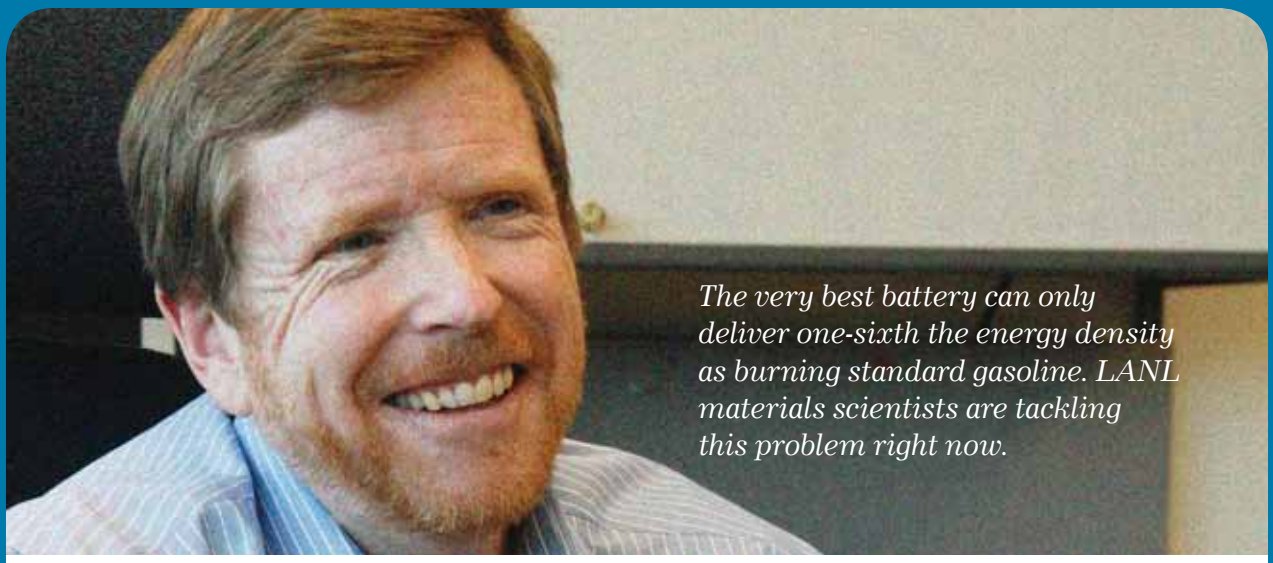
How does that relate to the Lab's core nuclear deterrent mission?

Wallace: We are the nation's premier multidisciplinary national security science Laboratory. We have research spanning every branch of science.

For example, we're world class in theoretical biology.

Why the heck do we do biology at Los Alamos when our mission is assuring the reliability of our nuclear deterrent? Because the models for simulations—the ability to put together huge amounts of data and then look at them in the context of the systems that you have—are exactly applicable to the types of questions we must ask with regard to the nuclear deterrent. Or exactly the kinds of models that we need to understand for terrorist social networks.

continued



Our ability to collaborate and use the multidisciplinary tools and infrastructure we've developed during the past 65 years makes us extremely agile. That, I believe, makes us an extremely valuable national resource.

Here's a very topical illustration of that: It turns out we've been helping with the Gulf oil spill—applying expertise to address a threat that was unanticipated six months ago.

With regard to the global energy issue, where do you see the Lab expanding in, say, the next five years?

Wallace: I see us expanding in each of our three main energy focus areas.

The first area is the impact of energy demand. We're the world's best in some aspects of climate modeling, including ocean circulation and sea ice.

Understanding this complicated system allows us to do very complicated computer models, which, in turn, allows us to learn things about complex fluid dynamics—exactly the same thing we need to do to understand the nature of an imploding primary.

The second area of focus is nuclear, where we have two huge challenges: using nuclear fuels more efficiently—we only get 15 percent out of the fuel in a given fuel rod—and improving the nuclear fuel cycle in order to use fuel more efficiently and not produce materials that are attractive to terrorists.

There are a lot of good, innovative ideas about how to reduce that waste. For example, we have at LANL a world-class facility to accelerate protons. We can use those protons to transmute some of that waste, reducing the volume of radioactive elements that have an extremely long half-life and converting it to ones that have a relatively short half-life, and thus can provide more manageable and realistic storage options.

Our third area of energy focus is materials science. A good example is storage for wind and solar energy. We have a lot of wind, and we have a lot of sunshine. But since the wind doesn't always blow and the sun doesn't always shine, we need better ways to store the electricity that we do generate. We need new ways to make better batteries or capacitors. Right now the very best battery can only deliver one-sixth the energy density as burning standard gasoline. LANL materials scientists are tackling this problem right now.

The key to success may be nanoscale engineering of materials. The Laboratory's planned signature facility, MaRIE, which stands for Matter-Radiation Interactions in Extremes, may help us find the key. As a national user facility focused on the discovery of next-generation materials—improved solar panels, perhaps, or new types of batteries—MaRIE will provide exquisite tools for collaboration and innovation, two necessary ingredients for success.

What about the role of material science at LANL in general?

Wallace: Materials science is at the heart of almost everything we do here. It's is an integrated discipline. So it is physicists, chemists, earth scientists, etc. all working on what turns out to be materials science problems.

Understanding our nuclear stockpile? It's all about materials. When we are looking at storage, how will we make a new material that stores electrical energy more effectively? It's all about materials. When we talk about global terrorism—say, for example, can we make a camera that is sensitive to pheromones from people's bodies rather than light?—well, that's materials, too.

And Los Alamos has a specialty: materials in extreme environments. A prime example is a radioactive environment. You're bombarded billions of times per second by particles. Radiation wants to strike the atoms and the bonds between them and break them. So how do you make materials resistant to that? How do you make those materials self-healing?

We think materials for extreme environments is a "sweet spot" for Los Alamos. That's why when we analyzed what kind of experimental facility we need in the future we settled on MaRIE.

Where does high-performance computing fit into the Los Alamos approach?

Wallace: We are world class in high-performance computing. What's more, the concept behind Los Alamos high-performance computing is a thing called codesign, which we first developed and many others are discovering now.

Elsewhere, for example in universities, computer scientists and high-performance computing people sit in one place. Energy scientists sit in another place. Chemists somewhere else. And so on.

At Los Alamos, we believe that you should not do simulation without experiments and without understanding what it means to conduct those experiments within the architecture of the machine. It's all one enterprise.

Codesign is something that we invented at Los Alamos and it is a way we think about simulation in science. It includes everything from experiment to final result. And that is unique.

What do you think the world is going to look like in 20 years?

Wallace: I'd prefer not to prognosticate. However, I do hope 20 years from now we would be looking at how Los Alamos National Laboratory will be celebrating its 85th anniversary. ■

More about Terry Wallace

Wallace holds Ph.D. and M.S. degrees in geophysics (California Institute of Technology) and B.S. degrees in geophysics and mathematics (New Mexico Institute of Mining and Technology).

He is the author or coauthor of more than 80 peer-reviewed publications on seismology and tectonics, including ground-based nuclear explosion monitoring and forensic seismology, as well as a widely used seismology textbook.

Wallace is a Fellow of the American Geophysical Union, and in 1992 he received the AGU's Macelwane Medal.

Wallace has served as president of the Seismological Society of America and chairman of the Incorporated Institutions for Research in Seismology.

He has testified before Congress on the comprehensive test ban and participated in numerous National Academy panels, including ones on research in support of comprehensive test ban monitoring.

community

Community Matters

LANL's role in the region.

by Tatiana Rosev & Steve Sandoval

Photo by LeRoy N. Sanchez

A regular look at the Lab's efforts to make positive and sustainable impact on Northern New Mexico's economy, education system, and quality of life.

Lab internships

A wedding in 2003 set Jake Meadows of Water Quality Permitting & Compliance on his career path.

Visiting New Mexico for the event, his dad met a former division leader who mentioned they were looking for students with environmental science education and experience. Jake was qualified and interested.

After earning his bachelor's degree in soils science from Montana State University in 2004, Meadows began an internship in the Water Quality and Hydrology Group.

"The program offered a gateway to the Laboratory," said Meadows. "I received exposure to many different regulatory programs while continuing my education at UNM. I would not be here without LANL's student internship program."

"I never [realized] how environmental science can impact our national security goals, and how important student internships are to the Lab," said Meadows. "It really serves as an integral pathway to employment here."

Meadows was president of the Lab's Students' Association in 2007 and was keynote speaker at the annual Student Symposium that year. He earned his master's degree in water resources from UNM in 2008.

In March 2009, Meadows converted from a graduate research assistant to a full-time staff member in the Environmental Protection (ENV) Division. In the past year, he became program lead for the Lab's New Mexico Water Quality Control Commission Regulations compliance program, including spill notifications and notices of intent.

To pass on his appreciation for environmental science and conservation practices, Meadows participates annually in the New Mexico Envirothon, part of a nationwide conservation-based natural resources competition for high school students.

Sixth-grader a "youth interpreter" at Bradbury Science Museum

Ever since Derek Selvage was little, rocketry has been his passion.

A few years ago, when he was eight years old, he took the Bradbury Science Museum's "Summer Adventures in Science" rocketry class. There he learned to make a Skill Level 1 rocket. As a member of the Piñon School Rocket Club, he began building Skill Level 2 vehicles.

This spring, as a student at Piñon Elementary School in White Rock, Selvage worked after school to build a "Skill Level 3" model rocket. "I always wanted to launch model rockets," said the boy, whose favorite subject in school is science.

Selvage also participates in his school's science fairs and competed regionally for the first time this spring.

Now he's excited about being one of the first student "youth interpreters" at the Bradbury. This new program for middle schoolers trains them in such science subjects as water, bones, robotics, and astronomy, so that they can give demonstrations to the public as part of this year's "Summer Adventures in Science" program.

"I love being at the Bradbury myself," Selvage said, "and if I can spend a couple extra hours here every week during the summer, I'd show more people the things I love to look at and do."

continued

Jake Meadows was set upon his career path by a chance encounter between his father and a LANL veteran.

Students learn programming techniques at the Supercomputing Challenge Kickoff Conference.

A Supercomputing Challenge finalist team from Los Alamos High School. Left to right are Peter Ahrens, Stephanie Djidjev, Mei Liu, and Vicky Wang.

Supercomputing Challenge

One of the more well-known and visible science education programs at the Lab is the annual New Mexico Supercomputing Challenge.

In April, the tiny town of Melrose in southeast New Mexico grabbed the spotlight when a team from Melrose High School beat out more than 70 teams to win the 20th annual challenge.

The goal of the yearlong event is to teach teams of middle- and high-school students how to use powerful computers to analyze, model, and solve real-world problems, said David Kratzer of High Performance Computing, who coordinates the program.

Participating students improve their understanding of technology by developing skills in scientific inquiry, modeling, computing, communications, and teamwork, he said.

Brothers Richard and Randall Rush and Kyle Jacobs all garnered a check for $1,000 for their project, “Control and Spread of Wildfires II.” The team also received the Crowd Favorite Award—and $100 each—as selected by student participants, teachers, and mentors.

“I didn’t expect it at all,” freshman Randall Rush said of winning the challenge. His brother Richard added: “We thought it would be a team from a bigger school that would win.”

Second and third place went to Los Alamos High School.

Science Bowl

One Laboratory science initiative paid off big time for New Mexico schools that participated in the national Science Bowl held this spring in Washington, D.C. Albuquerque Academy trounced seven other teams to win the middle-school competition.

Los Alamos High School students Miles Carlsten, Scott Carlsten, Allen Wu, Micha Ben-Naim, and Lorenzo Venneri, coached by Barbara Wrobleski-Mullis, also competed.

“Congratulations to every single student here,” said First Lady Michelle Obama. “We want young people energized in the way that you all are, because we know that American brainpower in science and math has always driven this country’s prosperity, helping us . . . to build the industries that have transformed the way we live and work.”

Proud dad Bruce Carlsten of the Lab’s High Power Electrodynamics group said, “Science Bowl has been really motivating for my boys. The middle-school program is very good; through it, they’ve developed a broad understanding of all scientific fields, and it has enhanced their appreciation of and excitement for science in general.”

“Science Bowl has been really motivating for my boys.”

— Bruce Carlsten

The boys also got a better understanding of the science that's being done at the Lab and a better perspective on their own future career plans.

In Science Bowl competitions, middle-school and high-school science student teams solve and answer science- and math-based questions. The object is to correctly answer the most questions in round-robin and double-elimination rounds.

Pueblo elementary school program

"I would like to be a scientist when I grow up." And so Lovella Ortiz, a fourth-grader at Jemez Day School, fulfills the promise of the Lab's Robotics, Rocketry, and Tie-Dye Program, a science outreach effort involving some 500 Northern New Mexico pueblo elementary school children annually.

Now in its seventh year, the program links pueblo educators with volunteers with the Laboratory and Northern New Mexico College who promote education in science, technology, engineering and math-related (STEM) fields.

While Lab volunteers conduct hands-on science activities, teachers participate in a workshop that illustrates the scientific concepts behind each of the activities.

"Thanks for another great learning experience," said Maxine Toya, a teacher who just retired from Jemez Day School.

The activity helped the kids better understand solar energy, battery energy, design, and engineering, she explained.

"The hands-on of putting parts together and soldering those parts was so much fun for them. This engaging experience encourages them to seek more opportunities in science and math when they leave our school."

Yolanda Denny, former principal of San Ildefonso Day School, added, "One parent came in to pick up his son and commented that he had never seen his son this excited about science before!" ■

Photos by Sandra M. Valdez

Photos by Sandra M. Valdez and Leroy N. Sanchez

At top, Kaelene Browning from San Ildefonso Day School focuses intently on her tie-dye project. Middle photo: Teachers Valerie Shaw (left) and Alyssa Martinez learn to tie-dye T-shirts. Bottom: Karen Ismari participates in a robotics workshop for about two dozen teachers from four tribal schools.

Your Picks of Employee Pix

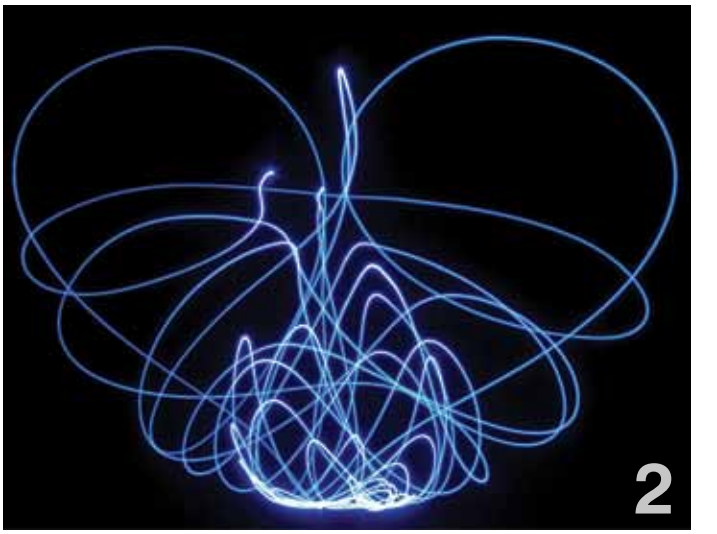
Thank you and congratulations to all who participated in our employee photo contest, generally tied to themes of complexity or simplicity. There were more than a hundred entries. A group of judges narrowed a strong field to six images and asked LANL employees in June to vote online for their favorites. Published here are the top three.

First Place: Dale Garcia of Environmental, Safety, Health & Quality

Garcia shot this eery sunrise from the top of the hill on New Mexico Highway 502, just east of De Colores Restaurant. “I used my Nikon D80 digital camera resting on the top of my car. I didn’t have a tripod available at the time.” Garcia shot a number of frames over the course of five or six minutes. He considers his photo representative of complexity.

Second place: Vadas Gintautas of Applied Mathematics and Plasma Physics

In a dark room, Gintautas made a time exposure of 15 seconds to capture the chaotic path of a double pendulum with a blue LED affixed to its end. “The motion of the double pendulum is extremely sensitive to initial conditions,” noted Gintautas. “In this photo, a simple and nearly symmetric heart shape emerges out of the chaos.”



Third place: Benny Montoya of Departmental Computing Services 4

As was the case with first-place photographer Dale Garcia, Montoya captured this image along NM 502. “Looking west towards the Jemez Mountains from San Ildefonso, I took this shot of the sun’s first light after a night of monsoon showers,” he recalled.

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Et cetera

Cool instrument for a hot planet

Cousin to R2-D2 of Star Wars fame? No, this little robot is really a lander containing instrumentation designed by LANL to explore Venus, the hottest planet in our solar system.

Late last year, NASA announced that a Venus lander called the Surface and Atmosphere Geochemical Explorer (SAGE)—including LANL-designed geochemical sampling technology—was one of three projects to receive funding for a yearlong conceptual study. NASA intends to pick one of the three for flight.

Simply put, here's how the explorer would work. SAGE descends from the spacecraft and lands. Two lasers zap the Venusian surface and gather information about composition and texture. A mechanical arm digs into the surface, and the lasers zap what's exposed.

One of two integrated components is a laser-induced breakdown spectroscopy (LIBS) unit, which would remotely vaporize a small portion of a rock and read the resulting light emissions to identify and quantify the elements. The other is a Raman spectrometer, firing a different type of laser to determine the sample's molecular structure.

The instrumentation would need to endure for several hours the harsh conditions on Venus: a constant temperature of 864°F and an atmospheric pressure at surface level about a hundred times that of Earth.

SAGE goes beyond LANL's ChemCam, a rock-vaporizing laser destined for Mars, using skills and expertise developed and proven at Los Alamos but taken in a new direction, to the surface of Venus.