

# Whole lotta shakin' goin' on

By Sue Major Holmes

*It took decades for technology to catch up with the math Sandia researcher David Smallwood worked out to control vibration table shakers.*

David, a retiree who consults at the Labs, knew that shaking in all directions at once was the key to realistic parts testing. Now Sandia is putting the algorithms he developed more than 30 years ago to the test by shaking up nuclear weapon components.

Vibration machines are crucial to test the forces that make things fall apart in the bumpy real world, from small components to complete systems like airplanes or nuclear weapons. The machines are important to the aerospace and

*(Continued on page 5)*

**GOOD VIBRATIONS** — Sandia 6DOF research team member Kevin Cross (1521), second from right, adjusts accelerometer cables on a block head test item as, from left, Davinia Rizzo (1557), David Smallwood, and Norman Hunter look on. The team is working with a new type of large vibration machine capable of shaking test items in multiple directions simultaneously. The block head is a dynamically active structure designed to challenge the team's ability to control a complex system.

*(Photo by Randy Montoya)*



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## Sandia LabNews

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## Cyber incident at OPM affects background investigation records

**Protection measures to be offered to impacted individuals**

**Sandia retirees, current and former employees could be affected**

The US Office of Personnel Management on July 9 released details of a breach involving background investigation records, potentially including those of current and former Sandia employees, contractors, and some retirees. The incident was uncovered while the OPM was investigating the earlier discovery that personnel data of federal government employees had been stolen.

### 21.5 million records compromised

In its announcement, OPM said its investigation concludes that sensitive information, including the Social Security numbers of 21.5 million individuals, was stolen from background investigation databases.

OPM noted that those who underwent a background investigation through OPM in 2000 or afterward are "highly likely" to have been affected.

The types of information in the incident include:

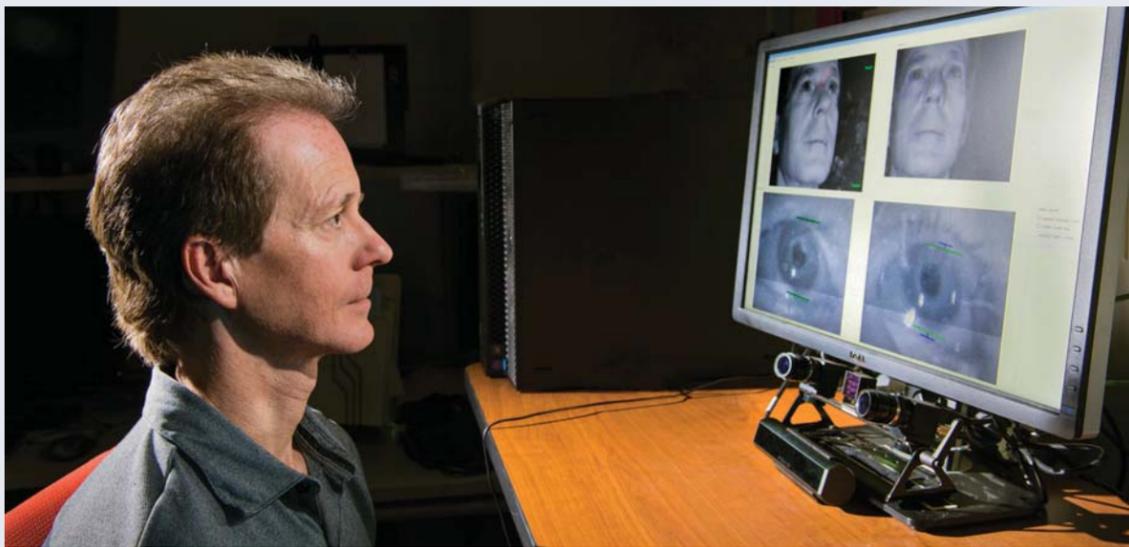
- Social Security numbers
- Residency and educational history
- Employment history
- Information about immediate family and personal and business acquaintances
- Health, criminal, and financial history

At press time for *Lab News*, notifications for this incident had not yet begun. According to OPM, the notifications will include services to be provided to those affected. These services include identity theft insurance and credit monitoring.

For the most current updates, employees and retirees can visit the OPM website set up to provide information on this theft: [www.opm.gov/cybersecurity/](http://www.opm.gov/cybersecurity/). The site includes protective measures that those likely affected can take immediately. DOE's director of Intelligence and Counterintelligence also has provided guidance on ways to reduce the risk of targeting by potential adversaries. This guidance includes the need to be wary of attempted contact by individuals or groups unknown to the Sandian, whether by email, phone, social media, or personal encounters. DOE also suggests understanding and monitoring privacy and security settings on social media sites, especially those that reveal geographic location.

OPM has had two breaches reported in June. The breach of background investigation records followed an earlier OPM announcement on June 4 that the personnel data of about 4.2 million current and former federal government employees had been stolen. The OPM said anyone affected by that breach would have been notified already.

## The eyes have it



MIKE HAASS DEMONSTRATES the set-up for the FOVIO Eye Tracker, which is placed under a computer monitor to track viewers' eye movements. The equipment is part of a partnership between EyeTracking and Sandia to develop tools to help intelligence analysts more effectively and efficiently extract useful information from vast amounts of quickly changing data.

*(Photo by Randy Montoya)*

## Sandia teams with industry to improve human-data interaction

By Heather Clark

Intelligence analysts working to identify national security threats in warzones or airports or elsewhere often flip through multiple images to create a video-like effect. They also may toggle between images at lightning speed, pan

across images, zoom in and out, or view videos or other moving records.

These dynamic images demand software and hardware tools that will help intelligence experts analyze the images

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## My Brother's Keeper



Introducing STEM to minority youth. See pages 6-7.

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## That's that

In a time when we endure a steady stream of news reports about humankind's darkest impulses – wars, greed, intolerance – NASA still has this uncanny capacity to pull off some extraordinary feat that lifts us up and reminds us of the better angels of our nature. And they've been doing it for decades.

Exactly 46 years ago as I write this, Neil Armstrong, Buzz Aldrin, and Michael Collins set forth on a mission that four days later ended with footprints on the moon. It was a high-risk, high-stakes gambit, one that Armstrong subsequently said he estimated had only a 50-50 chance of total success. He figured there was a 10 percent chance he'd never come home. That's the equivalent of playing Russian roulette with a 10-chambered revolver. Would you play that game? I wouldn't.

Han Solo famously said "Never tell me the odds." But Armstrong knew the odds – at least in his own mind – and went ahead and saddled up anyway. These guys weren't just brave; they were cool. And cool, too, in that uniquely post-World War II, 1950s/1960s way. The soundtrack of their lives was Dave Brubeck and they took Frank Sinatra quite literally when he sang *Fly Me to the Moon*.

In the wake of the success of *Apollo 11* and the other lunar missions, the astronauts understandably got the greatest share of glory, but a half-million Americans were involved in the program in one way or another. They all contributed to its success. Perhaps the greatest unsung heroes of all were the astronauts' wives, subject of a recent book called *The Astronaut Wives Club*. It's a fascinating new chapter in the endlessly fascinating story of that time. One of the smartest comments and sharpest insights about these extraordinary women is a quote from Barbara Cernan, wife of *Apollo 17* commander Gene Cernan. "If you think going to the Moon is hard, try staying at home," she said at the time. And when she participated in the rollout of *The Astronaut Wives Club*, she said, "If it weren't for the wives who committed their lives to what we were doing, I don't think we would have ever gotten to the moon." I believe that is literally true.

Under the stresses of this brutally demanding undertaking, a lot of marriages – and not just among the astronauts by any means – didn't survive, but these women sacrificed everything, including all too often their very dignity, to keep their homes together long enough for the mission to succeed.

So we got to the moon, but we did pay a very steep price. Was it worth it? I think Richard Nixon got it just right in his congratulatory phone call to the astronauts at the Sea of Tranquility: "Because of what you have done, the heavens have become a part of man's world."

\* \* \*

In the decades since that historic phone call, NASA has gone from triumph to triumph with its planetary exploration missions. Thanks to their brilliant scientists, engineers, and technicians we have extended our vision to the outer edges of the solar system and beyond.

Today, I'm looking at images returned by NASA's *New Horizons* mission, giving us our first-ever up-close and personal view of the ninth planet. We are seeing Pluto as we have never seen it before. And what a view it is: Ice mountains. Water. A crater-free surface billions of years younger than we thought it would be. Nothing like what we expected.

Over the years, NASA's fantastic voyages have given us a chance, from time to time, to ponder questions most of us don't visit too often: How vast is the cosmos? What is our place in it? What does it mean to be human in this infinite sea that either teems with life or finds us completely alone? What is our destiny?

These are the questions philosophers ask, questions for which there may be no ultimate answer.

The tagline for that 1990s TV program *The X-Files* was "The Truth is out there." Maybe so. The thing is, though, "out there" keeps receding away from us, always just a little further away than whatever our current state-of-the-art technology allows us to see. But we'll keep looking. We have to; it's who we are. As poet T.S. Eliot wrote in *Little Gidding*, "We shall not cease from exploration/And the end of all our exploring/Will be to arrive where we started/And know the place for the first time."

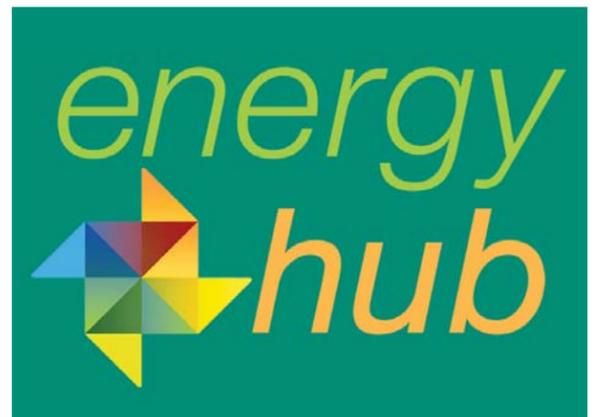
– Bill Murphy (MS 1468, 505-845-0845, wtmurph@sandia.gov)

# Energy Hubs

## Initiative around recovery, microbreaks is catching on

By Susan Kritter

Sandia's Energy Hub program is continuing to grow as more management teams are sponsoring Hubs, both inside and outside of their work areas. On June 17, Div. 6000 unveiled two new Hubs in and around Bldg. 823 during a roving Health Fair. The rollout featured tours of the Hubs, healthy snacks, and a health information session by Jon Pier (3334), a Sandia health educator and physiologist.



The Energy Hub initiative was launched in 2014 with a goal of building dedicated spaces for short breaks throughout the Labs and encouraging Sandians to manage their health, energy, and productivity by incorporating stretching, postural strengthening, stress release, and other mindfulness activities into their personal daily routines. In addition, spaces for nursing mothers are included in select Hubs, as well as rooms created exclusively for new mothers who need a clean, private area in the workplace, to ensure that Sandia maintains an inclusive environment.

### Energy Hub locations

Since the model Hub (Bldg. 831, Rm. 193) was launched in September 2014, seven new indoor and outdoor spaces have been opened across campus:

- Bldg. 892, Rm. 101Q
- Bldg. CGSC, Rm. 1127
- Bldg. 980, Rm. 39
- Mobile unit near Bldg. 957
- Bldg. 823, Rm. 2446 and outdoor patio near the breezeway
- Bldg. 831, outdoor south side near T-13

Although some Hubs provide equipment designed to assist with stretching and strengthening endeavors, the new outdoor Hub space at Bldg. 823 provides innovative ways to use the existing infrastructure (i.e., ledges and rails) to perform comprehensive body stretches.

Signs in the area provide instruction on how to practice movements that maximize benefits and promote safety. Jon notes that people "already take random breaks — leaning back in a chair or checking their phone — but we need to be purposefully active, decreasing prolonged bouts of sitting." These dedicated spaces serve as a cue to act accordingly.

Lavone Jones, manager of Transportation and Receiving Dept. 10262, heard this message and decided to "walk the talk." She spearheaded the creation of an Energy Hub in Transportation and Receiving in the mobile unit near Bldg. 957 six months ago.

Lavone says she wanted to encourage employees to take care of themselves, practice mindfulness (being present), and stretch to prevent injuries, adding that a core group of employees use and benefit from the Hub and even brag about how good it makes them feel. She and her team work closely with HBE to develop specific stretches to complement the type of work they perform.

New Energy Hubs are in the works and a Health Action Plan encourages energy management and Hub use, so stay tuned for information on additional locations to choose from. For instructions on how to create a Hub in your work area, or for comprehensive information on Energy Hubs and related topics, visit [workingwell.sandia.gov](http://workingwell.sandia.gov).

Jon says that no matter where you choose to take a break, the important thing to remember is that short breaks throughout the workday help you improve focus, manage stress, recover posture, and restore energy. "Sandia is a workforce of high performers and high performance requires recovery," he says.



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# Policy-centered engagements yield rich possibilities



JASON REINHARDT (8111), a doctoral student in Risk Analysis at Stanford University and a fellow at Stanford's Center for International Security and Cooperation (CISAC), carries on Sandia's tradition of bringing a technology focus to policy research. (Photo by Dino Vournas)

project even stronger. It could also help build a bridge, so that the project team might feel comfortable calling CISAC to discuss the project as it moves forward."

Larry and Jason also advocate for a boots-on-the-ground approach: embedding Sandia staff directly into the academic institution and bringing specialists to work in the labs in areas such as the Livermore Valley Open Campus that welcome outside researchers.

"As people work side by side, they create lasting professional relationships that maximize everyone's ability to quickly respond to new directions and ideas and to insert collaborative thinking into projects," says Jason.

Lynn Eden, associate director for research at CISAC, has witnessed the effects of the informal interplay between CISAC fellows and Sandians. "A social scientist fellow doing research on a topic that Larry knows about will come over and ask him questions. And I know that CISAC fellows and Jason routinely discuss issues related to risk. Ultimately, everyone's work is enriched by what they learn from each other."

## Building the talent pipeline

Another inestimable benefit of colocation is that it presents opportunities to expand the pipeline of talent for the national labs — a major focus of NNSA as it seeks to maintain the relevancy of the labs in the changing national security landscape of the 21st century. A case in point is new employee Robert Forrest (8116), who first became interested in Sandia when, as a CISAC postdoctoral fellow, he sat near Jason.

"I was focused on using my background in physics to solve real problems," says Rob. "After talking with Jason, I realized Sandia was a place where scientists can work on problems that make an obvious impact."

"In the Bay Area, Sandia is competing with high tech, biotech, and the universities themselves for the top talent," says Sheryl Hingorani (8110), a senior manager who has been focusing with Jason and Larry on Sandia's strategy regarding policy collaborations. "Working more closely with universities can help the intellectual community that surrounds us understand the challenging work we do and possibly decide to partner with us or join our team."

## Fueling two-way enhancements

Whatever the form of engagements, those involved agree that benefits accrue to both sides.

Says Hecker, "CISAC looks at risk reduction in global trouble spots, but often from the realm of theory and analysis. Sandia has done hands-on risk reduction work in the DOE complex, developing and applying rigorous systems analysis of actual systems. So Sandia's very grounded approaches and knowledge can be extremely useful for those who've only worked in academic settings."

Eden concurs. "CISAC's aim is to populate academia with smart people who care about the world and interact with those outside the ivory tower. Talking to Sandians, our Fellows can learn from people who've been part of the history of national security, and continue to make vital contributions. It gives our Fellows and faculty information and understanding that might otherwise be unavailable."

"We're very fortunate in California to be so near these major policy resources," adds Sheryl. "The give-and-take as we engage in areas important to our mission can open Sandia to new thinking, and also gives us a chance to ensure that science and technology can become a meaningful part of the policy equation."



## By Holly Larsen

Collaborating with universities is nothing new for Sandia. For decades, researchers from the Labs and academia have pooled their resources and talents to advance technologies to levels that might not have been possible without the combined effort.

However, a smaller group of Sandians has built ties with academics toward a different goal: bringing a technology focus into policy considerations. "The technology work we do is incredibly important, but integrating technology into the policy arena can be equally critical," says Jason Reinhardt (8111), a Sandian who is also a doctoral student in Risk Analysis at Stanford University and a Fellow at Stanford's Center for International Security and Cooperation (CISAC).

To illustrate, Jason describes a recent study he conducted of the risk of a catastrophic encounter between Earth and an asteroid. "We can quantify the risk, and we have the technology to eliminate most of the risk."

What's missing, according to Jason, is the policy framework for using the technology. Do policymakers understand the risk of catastrophic asteroid impact and the costs to mitigate the risk? Who will commit to pay for maintaining an interception device? What level of likelihood of impact warrants action? At what point in the asteroid's trajectory does someone launch an interception device to destroy it? Who makes that decision?

"In this case and many others," says Jason, "if you don't have policies and agreements in place to govern the use of the technology, it's as if the technology doesn't exist at all."

## A history of engagement

In his quest, Jason follows in the footsteps of other Sandians who have engaged with the policy powerhouses centered in two major universities near Sandia/California: Stanford and the University of California, Berkeley.

Larry Brandt (8110) was the first Sandian to perform research in residence at CISAC in the mid-1990s. He was followed in later years by Robert Rinne, Arian Pregoner, and Robert Glass, all now retired. Currently, Larry and Jason are working with CISAC Senior Fellow and professor of Management Science and Engineering Siegfried Hecker, who is perhaps best known to Sandians as past director of Los Alamos National Laboratory. Their focus is Nuclear Risk Reduction,

an initiative to promote collaboration between the United States and Russia, China, and Pakistan.

Sandia also has created ties to UC Berkeley's Goldman School of Public Policy, mainly through its long relationship with Michael Nacht (8970), as well as with the Nuclear Science and Security Consortium (NSSC) at Berkeley, which is funded by NNSA.

## Forms of engagement

In reviewing Sandia's history with universities, Jason and Larry noted the numerous forms the engagements may take. Joint research is one classic model. One early example is the Nuclear Pathways Study led by Michael and retired Sandian Patricia Falcone, now at Lawrence Livermore National Laboratory. The final workshop for that study held in September 2008 included contributed papers from a diverse set of national experts that anticipated scenarios for nuclear energy and nuclear weapons out to 2030, including implications for national policy.

In the same era, Pat and Michael also initiated a series of policy seminars at Sandia, California — yet another model for building on the intellectual diversity and convening power of the Bay Area universities.

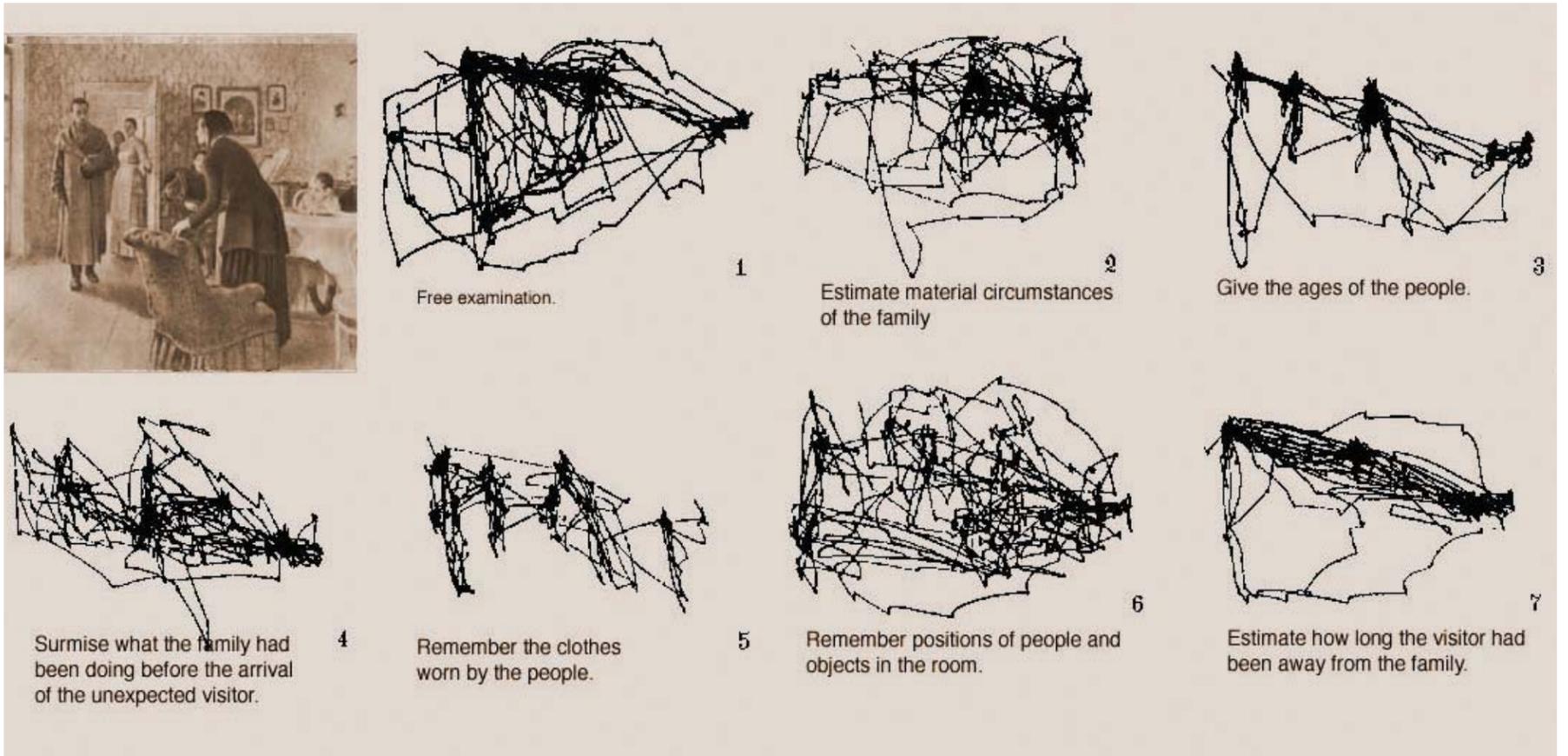
"When CISAC or The Goldman School organize a meeting, major policy thinkers, influencers, and leaders will come," says Larry. "Sandians who also participate gain new perspectives and a chance to further discuss ideas, either formally or informally with other attendees — and potentially pursue relationships to widen their networks."

Smaller gatherings also bring advantages, says Jason, citing a decision to hold an early meeting of a new Sandia cybersecurity project at CISAC. "CISAC has been doing in-depth work in cybersecurity, so talking to CISAC researchers before work even starts gives us access to a well of new ideas that stand to make the



CISAC ASSOCIATE DIRECTOR Lynn Eden, center, shown here with Jason Reinhardt, left, and MacArthur Nuclear Security Fellow Edward Geist, right, says "CISAC's aim is to populate academia with smart people who care about the world and interact with those outside the ivory tower." (Photo by Dino Vournas)

# Research to create tools to improve how intelligence analysts gather visual information



THIS ILLUSTRATION BY RUSSIAN PSYCHOLOGIST Alfred Yarbus shows top-down aspects of visual search in which the viewer looks at an image with a task in mind. Try it out and see whether your gaze follows the patterns depending on what you're looking for. Where do you look if you

are asked to estimate the peoples' ages? Where does your gaze fall if you're asked to estimate how long the visitor has been away from his family? Part of Sandia's research in this area is attempting to better understand how such top-down visual searches work.

(Continued from page 1)

more effectively and efficiently extract useful information from vast amounts of quickly changing data, says Laura McNamara (5346), an applied anthropologist at Sandia who has studied how certain analysts perform their jobs.

"Our core problem is designing computational information systems that make people better at getting meaningful information from those data sets, which are large and diverse and coming in quickly in high-stress environments," Laura says.

A first step toward technological solutions for government agencies and industry grappling with this problem is a Cooperative Research and Development Agreement that Sandia has signed with EyeTracking Inc., a San Diego small business that specializes in eye tracking data collection and analysis.

"Both Sandia and EyeTracking are being helped by a direct link between each other," says EyeTracking president James Weatherhead. "The hope is for both sides to come out with these tools and feed solutions back to different government agencies."

## Eye tracking monitors gazes, measures workload

In general, eye tracking measures the eyes' activity by monitoring a viewer's gaze on a computer screen, noting where viewers look and what they ignore and timing when they blink. Current tools work well analyzing static images, like the children's picture book *Where's Waldo*, and for video images where researchers anticipate content of interest, for example the placement of a product in a movie.

Sandia researcher Laura Matzen (1463) says such eye tracking data has been used in laboratory environments to study how people reason and differences between the ways experts and novices use information, but now the Labs needs to study real-world, or dynamic, environments.

If EyeTracking and Sandia can figure out ways to provide improved data analysis for dynamic images, Laura Matzen says researchers can:

- design enhanced experiments or field studies using dynamic images;
- compare how people or groups of people interact with dynamic visual data;
- advance cognitive science research to explore how expertise affects visual cognition, which could be used to create more effective training programs; and
- inform new system designs, for example, to help scale

up certain types of surveillance by partially automating some analyst steps or highlighting anomalies to help analysts notice them or make sense of them more quickly.

## EyeTracking provides hardware, software, Sandia offers access to analysts

EyeTracking is the exclusive distributor of the FOVIO Eye Tracker, a camera about the size of a soda can that's placed under a computer monitor to track viewers' eye movements. The company was started by Sandra Marshall, a cognitive psychologist from San Diego State University, who has worked with colleagues to develop software packages for collecting and analyzing eye tracking data.

Under the agreement, researchers Dan Morrow (5346) and Mike Haass (1461) are working with EyeTracking to figure out how to capture within tens of milliseconds the content beneath the point on a screen where a viewer is looking.

"How soon does the analyst look at the target region? How long to they linger there? Do they ever get there?" Dan asks. "If they are dwelling in another area, then we might go back after the fact to figure out why they are doing that."

Until now, eye tracking research has shown how viewers react to stimuli on the screen. For example, a bare, black tree against a snow-covered scene will naturally attract attention. This type of bottom-up visual attention, where the viewer is reacting to stimuli, is well understood, Laura Matzen says.

But what if the viewer is looking at the scene with a task in mind, like finding a golf ball in the snow? They might glance at the tree quickly, but then their gaze goes to the snow to search for the golf ball. This type of top-down visual cognition is not well understood, and Sandia hopes to develop models that predict where analysts will look, she says.

Sandia researchers have worked with intelligence analysts to better understand how they do their jobs. In one experiment, they filmed them and asked them to describe their thought processes at points in the video, but because their visual task strategies had become automatic over the course of their careers, they couldn't accurately describe how they did their jobs, Laura McNamara says.

"We know a lot about information processing, the physi-

ology and neuroscience of visual processing," she says. "How do we take that and apply it in these highly dynamic and real-world environments? The technologies are developed around a laboratory model as opposed to these real-world task environments."

## Partnership could lead to software designs that keep end user in mind

Laura McNamara says researchers need to anticipate analysts' decisions in real-world environments to create a model of top-down visual decision-making. "We want to understand

*"Where this could end up going is ensuring that as we invest money on information and analysis environments for intelligence analysts who are facing this firehose of information, we don't give them software that increases their cognitive and perceptual load or that they just can't use."*

— Laura McNamara, Sandia applied anthropologist

how fixation on something leads to analyst decisions, such as detouring to get information from a different source," she says. "Right now, there's no way to do that kind of complex information foraging modeling and incorporate eye tracking. You can't do it, unless you want to go back and hand-code every single fixation."

That's "incredibly tedious," Dan says, so he and Haass are exploring how to match time-stamped data with the content the viewer is focused on as they toggle, zoom, or pan through their work day.

"You might build this great radar, for example, but if you haven't thought through how that data is interpreted, it's not going to be successful because it's the whole system including the human analyst that creates mission success," Dan says.

The CRADA and several other projects at Sandia aim to strengthen the connections between humans and technology and to design systems with the end user in mind, Laura McNamara says.

"Where this could end up going is ensuring that as we invest money on information and analysis environments for intelligence analysts who are facing this firehose of information, we don't give them software that increases their cognitive and perceptual load or that they just can't use," she says.

# Whole lotta shakin' goin' on!

(Continued from page 1)

automotive industries, and have been in use since their invention in Germany in the late 1920s.

Large, high-frequency vibration machines that shake things in several directions simultaneously are relatively new. David's algorithms made them possible, along with developments in digital controls, sophisticated sensors, faster computers with more memory, and better mechanical designs.

The standard vibration machine has a single axis that shakes things in one direction at a time. But parts sometimes fail when the real world bounces them from multiple directions: east-west, north-south, up-down, and rotations along each of those axes, what's known as six degrees of freedom or 6DOF.

"If you tested it in each direction separately, you could get a totally different kind of failure," says Sandia systems engineer Davinia Rizzo (1557), part of a team working on test specifications for a large high-frequency 6DOF vibration machine installed at Sandia last year, one of only two in the US.

Think of 6DOF and single-axis in the context of the pat-your-head, rub-your-stomach exercise for kids. They can all pat their heads or rub their stomachs separately. "But when you combine them, you discover an undetected failure — they can't do one or the other or the timing is off or they rub their head and pat their stomach," Davinia says. "It's the same with single-axis and 6DOF. You move in one direction and the test unit appears fine. You move in the other and it appears fine. But when you move all directions at once, you discover an issue. We've demonstrated this behavior in the lab."

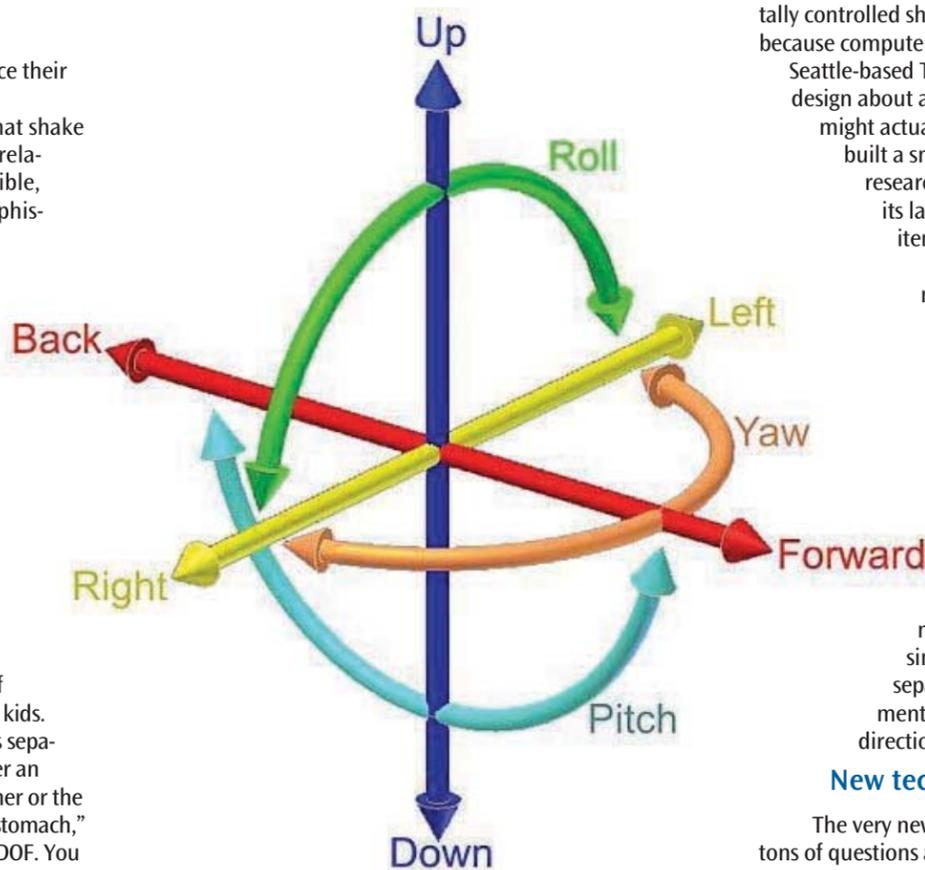
## 6DOF could revolutionize testing

Sandia wants to use 6DOF to qualify weapons components and revolutionize the way it does mechanical testing. Better tests could discover currently unknown paths to failure and reduce test time and cost.

"We're mimicking rides on airplanes, rockets, or in the back of a truck to ensure components or systems that we're testing are going to survive their environment before we fly them," says Kevin Cross (1521), who's in charge of Sandia's vibration lab. "It's one of our tools to prove reliability standards that we have to meet for our components."

David, who started doing vibration testing five decades ago at White Sands Missile Range as a New Mexico State University undergraduate, says researchers recognized long ago that single-axis vibration testing wasn't enough. "It did not represent the real world," says David, who consults with the 6DOF team.

Multi-axis shaking was the goal from the earliest days of testing. Norman Hunter, another consultant to the team,



worked on Sandia's pioneering efforts in the late 1960s and early 1970s to run two shakers concurrently using analog controls.

That didn't work at higher frequencies. "Things kind of fell apart," David says. "I used to joke that Norm would sit there with his hand on the abort button so when the system went unstable he could stop it."

## David developed breakthrough algorithms

Sandia researchers began exploring early versions of digital controllers. In 1978, David developed algorithms outlining digital control of vibration on multiple shakers, the first publication of the math needed to do that. His concept remains the foundation for today's multi-axis vibration controllers.

The breakthrough came when he figured out how to derive correlated or partially correlated multiple signals in real time. "That's what we had to do for a control system for a shaker," David says. "You can't put something out, wait to do some calculations, and then put something else out. The system insists that you have continuous output."

Sandia built a system in the early 1980s to drive two digi-

tally controlled shakers. It worked, but wasn't practical because computers of the time were too slow.

Seattle-based Team Corp. came up with a 6DOF shaker design about a decade ago. "I looked at it and said, 'That might actually work,'" David recalls. The company built a small 6DOF machine as a demonstration and research tool. After getting feedback, it developed its large 6DOF machine, capable of testing items up to 50 pounds.

The machine has 12 barrel-like electrodynamic shakers, four on each side for the horizontal X and Y axes and four underneath for the Z, or vertical, axis. Using the various shakers together in different configurations achieves rotations around each axis. The shakers, which exert 4,000 pounds of force per axis, drive a 30- by 30- by 14-inch rectangular block in the center where a test piece sits.

The machine is meant for component- or subsystem-level tests. It doesn't have enough force for very large items, and augments rather than replaces Sandia's larger single-axis shakers. Single-axis machines do separate tests at individual axes and experimentalists combine those to arrive at multiple-direction results.

## New technology brings new challenges

The very newness of 6DOF poses challenges. "There are tons of questions about how to use 6DOF in our testing philosophy, what to use for specifications, and how to control 6DOF machines," Davinia says. She's part of the team studying minimum drive, an approach David developed.

"The idea behind minimum drive is that nature likes minimum-energy solutions," David says. The team wants to find the minimum inputs needed to accelerate the system to required levels at various frequencies. "The assumption is this is close to what nature would do," he says. "We are trying to maximize the capability of the shaker system by mimicking nature."

Norman says the challenge is replicating real-world environments for multiple directions and developing specifications for minimum drive. "I think we also really need to learn a lot about the quirks of controlling these multiple degrees of freedom simultaneously. We're still fairly new at that," says Norman, who spent decades doing vibration testing at Sandia and Los Alamos national laboratories.

Sandia has performed two experimental 6DOF tests of nuclear weapons components, one for the B61-12 and one for the W88 ALT 370, says Laura Jacobs (1521), 6DOF research lead.

"These tests are a much better representation of what happens in the field so we can create better computational models and we can have more confidence in our designs," she says.

The 6DOF system is unlike any other, so it requires different ways of specifying tests — sometimes without all the data needed from the field, Laura says. "A big part of preparing for the test is determining what we need, and then how to achieve what we need."

## Using computational modeling to help fill gaps

Some field tests haven't been done; others don't capture everything that could happen. The team wants to determine how to run a successful test when they lack complete field test information. Team members have turned to computational modeling to figure out from the existing data exactly what the tests need to achieve, Laura says.

Kevin says researchers have begun combining field test data from the X, Y, and Z axes for simultaneous directional testing. But rotational data doesn't exist, and without it, no one's sure how to design a rotational test, he says.

Still, he says, "we can prove that just doing three axes together is a better representation of a real-world environment even without the rotations."

The latest international standards for vibration tests list what Davinia describes as a generic placeholder for multi-axis testing. "At least it recognizes multi-axis testing as an acceptable type of test to do, which is a big breakthrough," she says.

"It's going to be cool to develop this capability and have the research and the math and the evidence behind it to prove how this partners with single-axis testing and takes us to richer understanding," Davinia says. Then she laughs. "Until 50 years from now when they come up with new technology and we go through all of this again."



DAVINIA RIZZO (1557) checks a block head test item atop Sandia's six-degrees-of-freedom vibration table. Vibration machines are important to test forces that make things fall apart in the real world. (Photo by Randy Montoya)

# My Brother's Keeper

## 'Day at the Lab' encourages students toward STEM careers

By Valerie Larkin • Photos by Randy Montoya

**M**arvin Carr fell in love with mathematics as a teenager when his mother enrolled him in a summer math camp. He excelled in the subject, and after high school realized he wanted to pursue engineering. "That's not what a lot of young men of color say. That's not what a lot of young men say, period," said Carr, a policy adviser for the White House Office of the Chief Technology Officer.

Carr addressed 50 local middle school students who visited Sandia for a special "Day at the Lab" as part of the White House My Brother's Keeper (MBK) initiative.

"MBK is a very important program. It encompasses so much. It's about changing and adding opportunities for all young people: young men and women of color, but also all children," Carr said.

Started in 2014 by President Barack Obama, MBK connects underrepresented young people to mentoring networks and enriching educational opportunities to help them realize their full potential, regardless of their backgrounds.

As a member of the MBK Task Force, DOE has coordinated events at the national laboratories throughout the summer to introduce young learners to role models whose careers and educational backgrounds illustrate the importance of staying in school and making other positive life choices.

The students, invited to Sandia by the Albuquerque Boys & Girls Club, the Native American Community Academy, and Sandia's HMTech summer STEM program, were welcomed by community leaders and treated to a day of scientific exploration hosted by researchers who shared their work and stories about the educational and career paths that led them to Sandia.

The MBK Day at the Lab included a tour of the National Security Technology Gallery, a modeling and simulation demonstration in the Center for Global Security and Cooperation, hands-on activities such as circuit-building, and a series of demonstrations in the Environmental Testing Lab.

"We have to spike an interest in young kids. If we don't have that, who will continue doing what we do?" says Fernando Bitsie (1521), a mechanical engineer who demonstrated for the students how vibration tables are used to simulate real-world conditions that aircraft and other vehicles endure.

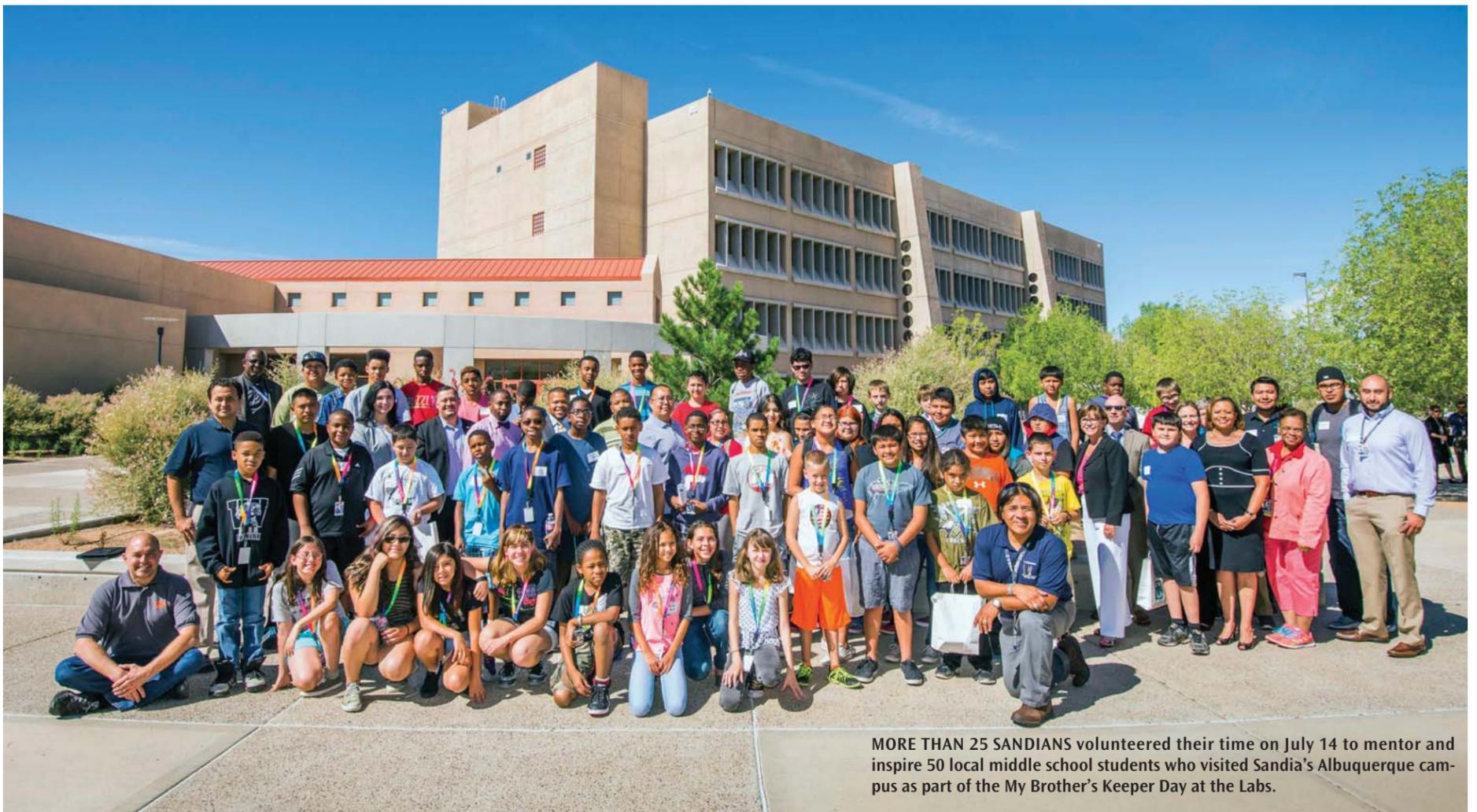
Speaking to the students at the event's opening presentation, Albuquerque Mayor Richard Berry emphasized the importance of persistence and curiosity. "Be leaders; be learners. You have the capability. Always remember: It's fun to do the work. It's fun to get into science, technology, engineering, and math. It takes effort, but everyone here is here to help you do that."



MARVIN CARR (above), policy adviser in the White House Office of the Chief Technology Officer, talks to Albuquerque middle school students who visited Sandia as part of the My Brother's Keeper initiative. Carr told the students that literacy has evolved to include not just reading and writing, but an understanding of technology. "A hundred years ago," he said, "you could make it with being able to read and write. But today you have to do much more than that. Every job that you're going to have will involve STEM and innovation. I'm hoping that today, and for the rest of your lives, you'll learn and advance those things."

In the photo at center right, Albuquerque Mayor Richard Berry welcomes students, advising them to "Be leaders. Be learners. You have the capability."

During their visit to the Labs, students toured the National Security Technology Gallery, viewed a modeling and simulation demonstration in the Center for Global Security and Cooperation, participated in hands-on science activities, and learned about the wide range of STEM career opportunities.



MORE THAN 25 SANDIANS volunteered their time on July 14 to mentor and inspire 50 local middle school students who visited Sandia's Albuquerque campus as part of the My Brother's Keeper Day at the Labs.



# 'Everyone needs a space to work'

## Sandia gains Arctic airspace to further research in many fields

By Neal Singer

The Coast Guard, oil companies, climate researchers, and unmanned aircraft and robotic vehicle manufacturers all share an interest in the changing Arctic.

Helping further those interests, Sandia researcher Mark Ivey (6913) and Sandia colleagues worked closely with DOE program managers in the Office of Science to secure formal approval for a block of Federal Aviation Administration (FAA) special-use air space. On May 28, FAA published notice of W-220, a new Warning Area in which Sandia-approved participants can gather data on clouds and atmospheric constituents, practice search-and-rescues at sea, and track the northward movement of retreating sea ice.

"Everyone needs a space to work," says Mark.

The 40-mile-wide, 700-mile-long air space stretches from just offshore at Oliktok Point, the northern end of the road system on the North American continent, to about 400 miles short of the North Pole.

The authorization by FAA rewarded roughly five years of patient effort by Mark, his team, and their program managers who supported the efforts. "In 2004, we were granted a 4-mile-diameter Restricted Area around Oliktok Point, our base of operations for atmospheric measurements," Mark says. Restricted areas are established in US airspace; warning areas apply to international airspace. "That was renewed in 2010. But we saw the possibility of more extensive, ongoing experiments, with renewed interest in operating offshore."

### Careful consideration by FAA

Still, it was clear to everyone involved that tethered, sensor-laden balloons hanging invisibly in a low cloud would present a danger to aircraft, particularly the many small and privately operated aircraft in Alaska.

So Mark, along with his predecessor, retired Sandia climate researcher Bernie Zak, applied and reapplied, revised, and reapplied again on behalf of DOE to be granted the larger air space, which extends over international waters and provides a significant safety margin to experimenters by warning pilots who might be considering entering the area.

The FAA's hesitations, Mark says, weren't arbitrary. "The FAA looks at these requests pretty carefully because if they didn't, the whole country could soon be carved up into restricted air space, making flying a nightmare."

Barrow, the other hub of activity for Mark's team on the North Slope of Alaska, was too busy an aviation area to be considered for special-use air space. But even at remote Oliktok Point, pilots protested at a meeting hosted by the FAA. "They said there's roughly 1,000 miles of coastline in the Alaskan Arctic with only two instrumented airports, Deadhorse and Barrow. 'Look what you're doing,' they said, 'these two instrumented airports are on either side of your proposed warning area. Suppose a pilot has a problem and one airport is fogged in; how does the pilot get to the other airport?'"

### A smaller set of fences

To solve the problem, the warning area was divided into 16 areas: eight horizontal areas, each with two vertical layers. One vertical layer extends from zero to 2,000 feet and the other from 2,000 feet to 10,000 feet. For further ease of transport, eight subdivisions extend south to north. "That created a smaller set of fences that people can get around if they need to," Mark says. "We also worked out ways that pilots could contact us to find out where current research activities were located."

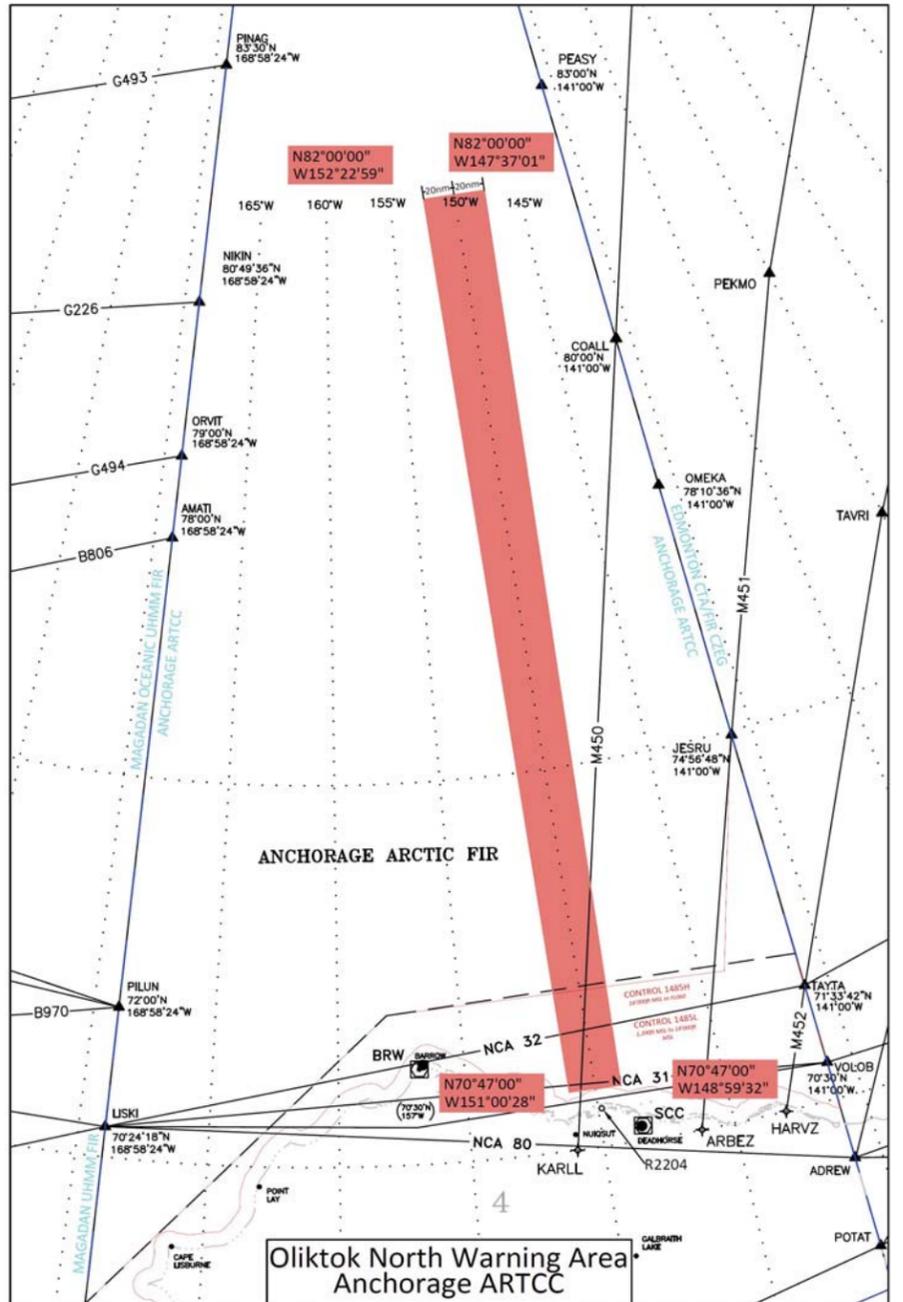
Then the question was raised in committee as to whether the warning area boundaries should follow longitudinal lines, so it would get smaller as it approached the Pole, dovetailing with Canada and Russia. After discussion, the area was set at 40 miles across from north to south. The area therefore stops short of the Pole to avoid intruding on the airspace of other countries.

"I saw gaining the warning area as a big win for DOE's Atmospheric Radiation Measurement (ARM) facilities, because it opens up the Arctic for new Office of Science research efforts," says Mark. "It makes it possible to do things out there it wouldn't be possible to do otherwise."

The facility, according to a description from DOE, "is hosting a research campaign designed to demonstrate how small, low-cost, unmanned aerial systems can be used to study and measure clouds and aerosols in the cold and harsh Arctic atmosphere."

Sandia, which started the Arctic effort, now manages Oliktok Point for the Office of Science and the ARM Program, because, Mark says, "the FAA awards special-use airspace only to other federal agencies."

But other users have other interests. The first project to make use of the restricted air space is the Coast Guard Research and Development Center's (RDC) Arctic Technology Evaluation 2015 search-and-rescue exercise (SAREX), a Cooperative Research and Development (CRADA) initiative involving the oil company ConocoPhillips and the Coast



THE RED BAR DEPICTS the 40-mile-wide, 700-mile-long Warning Air Space now under management by Sandia personnel for DOE's Atmospheric Radiation Measurement facilities. The space, approved by the Federal Aviation Administration after a five-year review, extends from Oliktok Point, the northernmost point of the US highway system, to 400 miles short of the North Pole. The monitored space will better ensure the safety of climate and other experiments taking place over international waters in the Arctic.

Guard Research and Development Center. Other partners include Insitu/Boeing, Era Helicopters, the National Oceanic and Atmospheric Administration, and multiple operational Coast Guard units. All these entities are working with Sandia on a joint effort that involves interoperability between manned and unmanned aircraft systems (UAS), sometimes referred to as drones, to conduct search and rescue operations.

### Looking for Thermal Oscar

"The Coast Guard is concerned about search-and-rescue in the Arctic; they haven't had a year-round presence there but they're interested," says Mark. "What's changed in recent years is a lot of near-shore oil exploration and production activity, including helicopter operations."

For the exercise, Coast Guard Cutter *Healy* deployed a six-person life raft and Thermal Oscar, an RDC-developed floating dummy outfitted with a heat source that makes it visible to infrared sensors, as search-and-rescue (SAR) targets for the UAS to locate. The UAS launched from land at Oliktok Point and transited out to the special-use airspace via an altitude reservation established by the FAA. Control of the UAS was passed to operators on CGC *Healy* to execute a search action plan to locate the SAR targets. Once the UAS was over the targets, CGC *Healy* passed their position to manned aircraft on shore and vectored the aircraft in for recovery efforts.

"It's testing rescue communications, among other things. Here on the North Slope, we don't have the satellite coverage or the infrastructure of the lower 48," says Mark. "Somewhere offshore, Insitu/Boeing passed control of ScanEagle to someone on the *Healy*, which is a big deal in the drone world, takes nontrivial technology, and could be important in future search-and-rescues."

The technology and practices implemented during Arctic Shield will provide useful information for future ARM/DOE UAS research activities, says Mark. "For example, electronics technologist Todd Houchens (6913) monitored radar scopes at NORAD during Arctic Shield to check air traffic near Oliktok point prior to UAS launch, and two FAA representatives on site at Oliktok provided helpful suggestions for future operations.

"And the whole event is taking place as safely as possible within this new warning area," Mark says.

For more information about ARM, see [www.arm.gov](http://www.arm.gov).



MARK IVEY (6913), left, and safety-basis engineer Al Bendure (4126) stand next to a folded SkyHook unmanned-aircraft catcher at Oliktok Point. The Arctic tundra stretches out behind them.

(Photo by Brian O'Kronley, Fairweather LLC)

# Bullseye

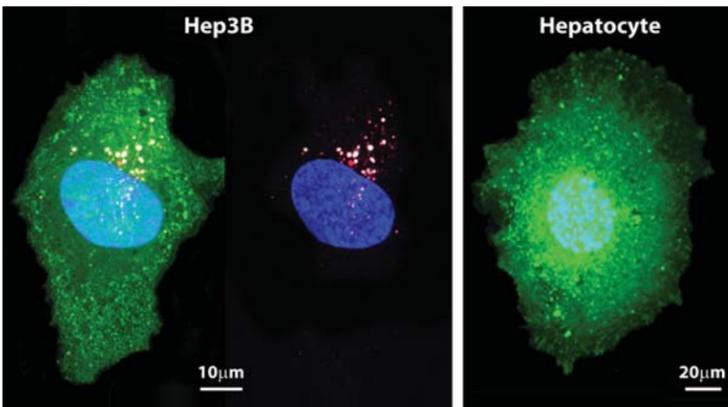
Getting a drug to the exact spot in the body that it's needed is tricky. The standard approach is to hit everything in sight and hope for the best. Protocells could change that by delivering medication right on target on the battlefield or in the civilian world.

By Neal Singer

Illustration by Janet Iwasa, Howard Hughes Medical Institute

Ten days of antibiotics sometimes just don't do the job against the disease you're unwillingly hosting. So perhaps your doctor prescribes a second round, and by the 20th day you're cured but with intestinal discomfort that makes you wish you had found some other road to health than biologically carpet-bombing your insides.

"The reason antibiotics can leave you feeling uncomfortable is because if they're taken orally in a conventional pill, the amount you take has to flood your whole body to reach the relatively few organisms you want to kill," says researcher Eric Carnes (8635). "So each pill must carry a huge amount of antibiotics." Colleague and co-investigator Carlee Ashley (8631) adds that, "In normal treatments, subcritical amounts of antibiotics go everywhere in your body, and 99 percent never get to the bacteria."



THE HEP3B IMAGE above shows a cancerous liver cell penetrated by protocells. The small red dots are lipid bilayer wrappings carrying drug-filled nanoparticles, their pores filled with white fluorescent dyes for imaging purposes. A normal cell in the hepatocyte image shows no penetration.

Carlee and Eric are working on a better way. They encapsulate a relatively huge amount of disease-fighting chemicals in an artificial construction called a protocell, to be sent into the bloodstream or nasal passages to cure and prevent diseases, particularly the nasty ones that could be sent by adversaries to sicken a civilian or military population. The protocell would be pre-programmed to attack specific intruders in the bloodstream, ending the sometimes-lethal wait for a doctor and an antidote.

## A kaleidoscope of shapes

A protocell is pretty small — about 150 nanometers in diameter or less — and made from a surprisingly simple recipe. Imagine a molecule with one end that hates water and one that loves it. Put a bunch of them — usually surfactant molecules, similar to those in kitchen soaps — together in water and either spin or aerosolize them dry. The molecules arrange themselves, or self-assemble, into very tiny circles, spheres, carpets, and cylinders, as orderly as a kaleidoscope might produce. The exterior of the structures are water-loving, hydrophilic molecules and the interior are hydrophobic molecules hanging out about as far as they can get from water. The water-hating molecules are removed, either by heat or solvent extraction.

At the center of each tiny structure where the water-hating molecules had been are vacancies, re-rentable as possi-

ble storage areas. There are thousands of them in each protocell, which self-assemble from thousands of the substructures. The vacancies have this useful property: They act as sponges to suck up the medical materials in which Eric and Carlee immerse them. This storage capability, unavailable in scope to any other method, makes protocells powerful vehicles to deliver medicine to internal sites, a kind of Death Star to invading bacteria or chemicals.

After saturating the nanosponges with medicines, Carlee and Eric immerse large groups of the particles in a lipid solution — a grease identical to the membrane material that wraps all human cells. The lipids self-assemble into protective coatings, forming protocells, tiny structures with cell-like coatings that perform microscopic activities. These coatings not only help corral medicine within the protocells, but provide a surface that the body's immune system does not view as foreign. This allows the particles to stay in the bloodstream significantly longer than typical antibiotics, making more time available for the protocells to contact and destroy invading bacteria.

To the lipid coating of the protocells, researchers install small amounts of targeting ligands, small proteins that bind like a grappling hook to a targeted cell. "When we're going after viral infections, we know how viruses enter cells, so we copy whatever the virus is ready to bind to. In effect, we use the same broken window the virus created to enter the attacked cell," says Eric. "Our protocells don't get attacked by the immune system because while viruses have a high density of protein antigens that serve as binding hooks, ours have few, shaped to

attach only to receptors of the organism we want to kill. So we need to insert far fewer carriers and far less antibiotics in sum, because ours only go where they're designed to go."

## Regain control over antibiotic resisters

The method, which the researchers have explored with research teams from UCLA, Georgetown, Duke, and the universities of Oklahoma, Washington, and North Carolina, is expected to be useful to people looking for less invasive ways to fight infections. The protocells' relatively large (because porous) carrying capabilities also could help reestablish medical control over diseases like MRSA that have developed resistance to conventional amounts of antibiotics.

And the protocells could act as an immunizer and antidote against chemical and biological attacks, fashioned to bind to particular arrangements of molecules known to host specific attackers.

Protocells themselves were the outcome of years of research by a team led by Jeff Brinker, Sandia Fellow and University of New Mexico Distinguished Professor, who mentored Carlee and Eric. The first ones, made of silica and about 150 nanometers in diameter, were a natural for the fight against cancer. That method has been licensed to a West Coast drug company through UNM's Cancer Center.

"However, to test the effect of protocells against infectious diseases — a true Sandia goal as a defense laboratory

— the spin-dry method took too long to accumulate particles for our needs," Carlee says. "We needed not only to shift the size of particle distribution but produce many more of them. Just upgrading from testing mice to testing rats is a volume issue that requires five times more protocells."

Testing people, she says, would require several orders of magnitude more protocells.

"So we went from evaporation-induced self-assembly to aerosol-induced self-assembly. We used nebulizers 5 feet long and we set up 10 of them."



SANDIA RESEARCHER CARLEE ASHLEY (8631) says "It's satisfying to know that something I helped create has the potential to save lives." (Photo courtesy of the University of New Mexico)

This elevated them from producing 0.1 grams every three weeks of precisely sized protocells for cancer research to 100 grams a day of less precisely sized but eminently usable protocells for a variety of defense purposes. "We're focusing on massively scaling up for use on humans," she says. "We have all the cell data for the project showing it would work. We've shown we can deliver antibiotics to host mammalian immune cells infected by different microbes. We've shown we can cure the problem in a dish."

## Full-scale tests coming up

The problem for the researchers is that they can do a safety study on humans to make sure using protocells does no harm, but not full-scale tests of their efficacy until such testing is approved by the US Food and Drug Administration.

The Department of Defense is funding the project at \$12 million over four years, and seems willing to wait. "We're typically among the teams awarded projects in chemical defense and biodefense," says Carlee. "We use protocells to deliver nucleic acids that prevent viral and bacterial infections by targeting the pathogen's genome to prevent it from replicating. We can use it as a pretreatment to put in the blood, ready to respond if a pathogen is released. It's a new concept that will be very powerful down the line, but those types of therapeutics require more development."

Meanwhile, she says, "we can easily adapt protocells to absorb compounds like antibiotics, antivirals, vaccines, nerve agent countermeasures, and protein RNA and DNA."

# 'A science fair for grown-ups'

## DOE hosts Lab Day on the Hill in Washington



SANDIA PRESIDENT AND LABORATORIES DIRECTOR Jill Hruby and outgoing Labs Director Paul Hommert (third and fourth from left) were among the leaders from DOE laboratories who gathered at National Lab Day on the Hill in Washington to showcase their work on critical energy and climate projects to members of Congress.

By **Rebecca Brock**

Photos by **John DeLaRosa, NREL**

DOE's National Lab Day on Capitol Hill on July 8 brought light to the importance of developing new, modernized energy infrastructure for the nation. National Lab Day allowed the 17 DOE laboratories including Sandia an opportunity to showcase their cutting-edge research to government leaders and policy makers in Washington.

Deputy Energy Secretary Elizabeth Sherwood-Randall in opening remarks called Lab Day on the Hill "basically a science fair for grown-ups," adding that DOE's labs are among the most effective venues in the nation for leveraging research breakthroughs into technologies with real-world applications. Sherwood-Randall welcomed high-profile attendees from both political parties and both chambers of Congress, including Sen. Chris Coons, D-Del.; Sen. Jim Risch, R-Idaho; Rep. Michelle Lujan Grisham, D-N.M.; Rep. Randy Hultgren, R-Ill.; Rep. Mike Doyle, D-Penn.; and Rep. Chaka Fattah, D-Penn.

At the packed event, representatives from the labs set up displays to showcase notable research in the fields of energy and climate. Among the presenters was Sandia Div. 8000 VP Marianne Walck, who highlighted Sandia's energy projects in subsurface science and technology.

"It was exciting to participate in National Lab Day on the Hill," Marianne says. "We were provided the opportunity to describe the national laboratory system's work in energy and climate to a variety of congressional members, congressional staffers, and lab officials. Sandia staff did an outstanding job representing our work in transportation, grid modernization, subsurface science and technologies, and integrated energy systems."

Sandia President and Laboratories Director Jill Hruby attended Lab Day on the Hill just prior to assuming her new role, using the opportunity to connect with other DOE lab directors and members of Congress.

Outgoing Labs Director Paul Hommert spoke on a panel of national experts about the success of the research and ongoing technology transfer programs at DOE national laboratories.



SANDIA DIV. 8000 VP Marianne Walck, who heads up Sandia's Energy and Climate Program Management Unit, speaks to, from left, Sen. Jim Risch, R-Idaho, Deputy Energy Secretary Elizabeth Sherwood-Randall, DOE Under Secretary Lynn Orr, and National Renewable Energy Laboratory Director Dan Arvizu.



SANDIA PRESENTED NEW RESEARCH projects in transportation including this advanced engine in the Sustainable Transportation exhibit.



LABS DIRECTOR Jill Hruby, left, visits with Taunja Berquam, Minority Clerk, House Energy & Water Appropriations Subcommittee.

# SANDIA CLASSIFIED ADS

## MISCELLANEOUS

**MOTORCYCLE LOADING RAMPS**, 3-pc., folding, 33" x 120", 2,700-lb. capacity, excellent condition. Tobyas, 877-0354 or 944-5422.

**BRIDGEPORT MILL 3-AXIS DRO**, lots of accessories & other tools (i.e. lathes). Mullin, 350-9959.

**MAGNETIC ELLIPTICAL**, pink, 8-level tension controller, meter function, scan, time, speed, distance, calories, total distance, \$75 OBO. Garcia, 505-506-5363.

**FURNITURE MOVING SALE**; chrome futon; teak display/hutch; glass coffee/end tables; other pieces, call for more detail. Roesch, 281-9751.

**STOCK RIMS**, 4, from '14 Subaru Forester, free. Aragon, 235-3043, call or text.

**DINING TABLE**, wood, light color, w/cloth chairs, \$50 OBO. Romero, 505-307-9389.

**ELECTRIC LAWN MOWER**, not battery, 19-in., Black & Decker, \$20. Woods, 299-6928, woodsr@asme.org.

**DESK**, hand-made, cherry-stained pine, w/right-hand L extension, perfect shape, \$450. Clark, 505-228-3181.

**CABINET SPEAKERS**, 2, Cerwin-Vega D-3, 10-in., 3-way, 28" x 16" x 11", hickory, scuff-resistant finish, excellent condition, \$175 OBO. Martinez, 505-292-1494.

**FAN EXERCISE BIKE**, Marcy AIR 1, exercises arms & legs, tracks speed, time, distance, calories, like new, \$250 on Amazon, asking \$50. van Berkel, 505-899-2738.

**TELESCOPE**, classic Criterion Dynascope, F8, 48-in. focal length, clock drive, 4 eye pcs., perfect for student, free. Seltzer, 299-0284.

**MOVING SALE**; NordicTrack, \$450; 2 vintage bikes, \$250; dining table & chairs, \$250; bedroom set, \$250; headboard & frame, \$100; grill, \$100. Homan, 505-553-5001.

**HORSE TRAILER**, '07 Exiss ES20, cherry condition, new tires, only used 2 seasons, see Craigslist photos, \$8,500. Smith, 505-221-6821.

**ELECTRIC PIANO**, DGX-620, portable grand, 88-key weighted graded hammer, stand & bench, \$400. Hietala, 610-1252.

**CAMPING SCREEN ROOM**, 10' x 12', w/closable sides, very sturdy frame, \$50; Porta Potty, never used, \$25. Eichel, 292-5795.

**WASHER & GAS DRYER**, Maytag, white, great working condition, you pick up, \$350/pair. Bigney, 505-235-9243.

**SILVER TRUMPET**, Getzen, excellent condition, \$500; 55-gal. tank/stand, complete set up, \$150; REI backpack, \$50. Ohlhausen, 505-301-0963.

**HYDRAULIC RAM CENTRAL MACHINERY**, new, paid \$650, asking \$350 OBO; new central machinery, yellow engine stand, 360 degree rotation, paid \$65, asking \$50 OBO. Lynch, 573-2036.

**MATTRESS**, king, pillow top, \$100; custom oak bow-front aquarium stand, \$100; roll-top desk, \$100; exercise pedals, \$25. Crawford, 401-6886.

**SCREEN DOORS**, 2, 82" x 32", w/all hardware, pneumatic door closers, new screens, \$100. Sansone, 505-296-7945.

**WATER SKIS**, men's, O'Brien Celebrity, 67-in., used once \$100; Christmas lights & décor for stairs, \$40. Drebing, 293-3335.

**GRASS HAY**, this year's, clean, barn-stored, horse-quality, \$9/bale, \$8.50/bale for 100 or more. Rivers, 505-720-4701.

**ROADMASTER TOWING**; Even-Brake, \$500; Sterling tow bar, \$300; front arm brackets, \$100; Guardian, \$100; Tow Defender, \$100. Gehrke, 263-7327.

**CHILD'S TRAIN**, battery operated, Geotrax, 8 engines, many cars, bridges, structures, tracks, etc. \$150 OBO. Hibray, 821-3455.

**TIRES**, 4, Sumitomo Touring LST, 185/60R15, 2 at 9/32, 2 at 6/32, of 11/32. \$80/all. Beer, 505-350-3455.

### How to submit classified ads

**DEADLINE:** Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- EMAIL: Michelle Fleming (classads@sandia.gov)
- FAX: 844-0645
- MAIL: MS 1468 (Dept. 3651)
- INTERNAL WEB: On internal web homepage, click on News Center, then on Lab News link, and then on the very top of Lab News homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902.

Because of space constraints, ads will be printed on a first-come basis.

### Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

**REEL-TO-REEL TAPE RECORDER**, Teac 200 X700R, works, needs adjustment, \$200; entertainment unit, holds 32-in. TV, hand-made, solid wood, \$400. Alexander, 264-5432.

## TRANSPORTATION

'73 DODGE CHALLENGER 451 STROKER, 3-spd. AT, 3:55 rear ratio, 10:6:1 compression, \$15,000. Plut, 366-4114.

'66 FORD F-100, radio, power steering, power brakes, AC, AT, new strong Windsor engine, great condition, \$7,000. Howard, 296-6056.

'78 CUTLASS SALON, 112,123 original miles, new tires & battery, 1 owner, good condition, \$3,500. Kelsey, 710-4630.

'07 HONDA ACCORD, V6, fully loaded, leather, spoiler, etc., 85K miles, \$9,800. Soto, 505-856-6081, ask for Rick.

'05 FORD ESCAPE XLT, Sport AWD, V6, moonroof, leather seats, 140K miles, excellent condition, \$4,800. Case, 286-2090.

## RECREATION

**MOUNTAIN BIKE**, 14-in., Giant, women's, purple, \$100; Nirve 7000 BMX bike, green, \$100; oversized training wheels, \$40. Ohlhausen, 505-301-0963.

## REAL ESTATE

**VACANT LAND**, Tome, NM, near UNM extension, 1.90 acres, \$55,000/acre. Ramos, 304-593-3425.

**7-BDR. HOME**, 4,992-sq. ft., ranch-style, walk-out basement, 2 acres, East Mountains, 24 mins. to Sandia, open house Aug. 1, MLS#842530, \$424,900. Weaver, 505-480-9951.

**3-BDR. HOME**, 2 baths, 1,850-sq. ft., fully updated, over-sized cul-de-sac lot, MLS#844378, \$220,000. Hughes, 806-676-3584.

**4-BDR. HOME**, 3 baths, 2,301-sq. ft., hardwood, courtyard, city/mountain views, RV pad, MLS#830658, \$249,900. Brown, 505-980-8660.

**3-BDR. HOME**, 2 baths, 2,600-sq. ft., guest suite (1-bdr., 1 bath), garage, scenic deck, Cedar Crest, \$298,000. Barnett, 505-573-9779.

**2 ACRES W/CUSTOM HOME**, 22 mins. to Eubank gate, get more for your money, MLS# 844274, \$269,000. Meadows, 505-301-1090.

**4-BDR. HOME**, wonderful Colorado log home, Southern Colorado, Conejos River, year-round access, 2,000-sq. ft., \$285,000. Green, 505-858-3051.

## WANTED

**WOOD LATHE**, 1/2 or 3/4-hp motor, 40-in., to turn baseball bats, 120-volt power. Lowe, 884-0994.

**GOOD HOME**, attractive, pit mix, 3 yrs. old, loves affection & play, excellent watchdog. Chary, 573-9019.

**HOME TO RENT**, NM 14, East Mountains, fenced, dogs OK, 3-bdr., 2 baths, woodstove, immediate move-in for veteran. Hellwege, 808-321-2465.

**MALE ROOMMATE**, quiet, non-smoker, for updated, newer, 3-bdr. home, on Kirtland Air Force Base, \$550/mo. Bonner, 925-324-6995.

**CAMPER SHELL**, 7-ft., white, for '06 Ford 250. Moquino, 505-280-5947.

**MOUNTAIN BIKE**, men's, full suspension, for college student, in good condition. Babilonia, 505-554-4420.

**TWO TICKETS**, Denver Broncos vs. Green Bay Packers, at Denver, Nov. 1. Brandhuber, 504-6371.

**TOYOTA**, extended cab pickup, from ~'90-'02. Aranda, 697-8219.



**Mileposts**

New Mexico photos by Michelle Fleming

 Sylvan Benjamin 35 9516	 Charlie Craft 35 5943	 Cathy Ottinger Farnum 35 6231	 Karen Current 30 9012	 Mary Carroll 30 10262		
 John Herzer 30 9537	 Art Salazar 30 4021	 Roger Showalter 30 4022	 Rob Leland 25 1000	 Vicki Porter 25 1542	 Loren Riblett Jr. 25 5965	 Kim Haulenbeck 20 1558
 Suzanne Dove 15 9543	 Rhonda Fraser 15 2953	 Robert Hohlfelder 15 1674	 Rush Inlow 15 6511	 Sonya Jackson 15 10659	 Paula Jernigan 15 9548	 Coralee Marie Sisk 15 4842

**Recent Retiree**

Mary Carroll  
30 10262

# Clean-tech hub

## Sandia will lead pilot offering help to small energy companies



SANDIA'S NATIONAL SOLAR TEST FACILITY could be used for collaborative research through the Small Business Voucher Pilot.

(Photo by Randy Montoya)

### By Nancy Salem

DOE has chosen Sandia as one of five leads in a pilot that will give small, clean-energy companies access to national laboratory expertise and resources. Sandia will receive \$2.75 million of DOE's \$20 million investment to launch the voucher pilot for small business assistance and collaborative research.

"Our pilot, which we've named Tech Assist Green (TAG), unites the three NNSA labs — Sandia, Los Alamos, and Lawrence Livermore — to provide a broad array of unique assets from the national lab system," says Jackie Kerby Moore, TAG team lead and manager of Technology & Economic Development Dept. 1933.

The Office of Energy Efficiency & Renewable Energy's (EERE) Small Business Voucher (SBV) Pilot is part of DOE's National Laboratory Impact Initiative, which seeks to significantly increase the industrial impact of national labs on the US clean energy sector. Sandia was awarded the pilot in the sectors of solar energy, wind, and geothermal technologies.

Starting in early fall, companies with fewer than 500 employees will be able to apply to Sandia for \$50,000 to \$300,000 in vouchers that can be used for a variety of technical assistance. The best business proposals will be selected in a competitive process. Successful applications will require the companies to provide a 20 percent cost share.

"There are several examples of how a company can access the labs through this new SBV Pilot," Jackie says. "They could apply to do collaborative research with a particular scientist, request technical assistance from an engineer, or use facilities such as the National Solar Thermal Test Facility at Sandia, Center for Integrated Nanotechnologies at Los Alamos and Sandia, and High Performance Computing Innovation Center at Livermore."

Sandia/California was named one of three partners, along with the Lawrence Berkeley and Lawrence Livermore national laboratories, in an SBV Pilot for battery, fuel cell, and geothermal technologies, and advanced manufacturing. Lawrence Berkeley is the lead lab.

EERE says the technical needs of US clean-tech small businesses include engineering design, modeling and analysis, unique materials, prototyping, scale-up of samples and processes, and technology testing and evaluation. The vouchers will increase small business access to cutting-edge lab research and help labs and the private sector work together to bring the next generation of clean-energy technologies to market.

"Sandia and Los Alamos have jointly run a highly successful New Mexico Small Business Assistance (NMSBA) program within the state," says Pete Atherton, senior manager of Industry Partnerships Dept. 1930. "Now we are taking the best practices from that program and applying them to the SBV Pilot."

SBV is the latest element in a technology transfer strategy that seeks to deploy the results of Sandia's publicly funded research and development for the US public good. Sandia

tech transfer efforts include NMSBA, Entrepreneurial Separation to Transfer Technology, the Sandia Science & Technology Park, collaborative research, intellectual property licensing,

and the Center for Collaboration and Commercialization, or C3, which will offer programming and services to strengthen partnerships, technology transfer, and ties to the community.

## Sandia, UNM ink pact to promote research, recruiting

### By Jim Danneskiold

The nation's largest national laboratory and New Mexico's flagship university have expanded their commitment to work together to help redefine the future of science and engineering for national security, partner on research, and jointly recruit top scientists and engineers.

Then-Sandia President and Laboratories Director Paul Hommert and University of New Mexico Provost Chaouki Abdallah signed the Memorandum of Understanding (MOU) on July 13 for a Strategic Alliance at UNM's Centennial Engineering Center.

"With this MOU, Sandia and UNM commit to a deeper relationship to strengthen both organizations by exchanging personnel, developing innovative joint research programs, and educating the next generation of national security leaders," Paul said.

Said UNM President Robert G. Frank, "In research, as in real estate, location is key. Not many research universities have a national lab as their neighbor, but we do. This agreement with Sandia Labs strengthens that close working partnership and pools our intellectual resources."

The MOU aims to:

- explore strategies enabling the future of engineering for national security;
- seek innovative facility partnerships that enable collaborative research; and
- jointly recruit and hire nationally prominent researchers for UNM faculty and Sandia technical staff.

Collaborative research will focus initially on quantum computing and information science, nanoscience and microsystems engineering, nuclear engineering, high energy density science, energy, water, cybersecurity, and bioscience for national security.

The MOU makes UNM part of a larger academic alliance that Sandia has formed over the past year to bring together the Labs' technical status as a Federally Funded Research and Development Center and the know-how of major national research universities. The alliance has three principal goals: solve big problems, sustain and engage human capital, and accelerate technology commercialization.

About 2,400 UNM graduates work at Sandia, many in technical areas vital to national security. The MOU will encourage exchanges and integration of researchers, fac-

ulty, and students, sharing of offices and facilities, and an overall increased presence on each other's campuses. At this time, more than 400 current UNM students are working at the Labs.

Sandia and UNM will build on their historic interactions and create more strategic relationship between the institutions, said Rob Leland (1000), Sandia's VP for Science and Technology and Chief Technology Officer.

"We wanted to establish a deeper collaborative relationship between Sandia and UNM as part of our new academic alliance with universities that are performing mutually beneficial research focused on science and technology relevant to national security," Rob said.

In recent years, joint research involving UNM and Sandia led to the development of inorganic nanospheres that act as carriers for cancer-killing chemicals, collaborative work on quantum computing featured in several journals, and other innovations across a broad spectrum of science and engineering fields. Overall, Sandia and UNM have undertaken more than 300 joint research projects since 1997.

They share the Advanced Materials Laboratory in UNM's Science and Technology Park, which supports collaboration among Sandia, UNM, and industry in materials research, development, and transfer to private companies for commercialization. The 45,000-square-foot facility south of UNM's main campus houses about 90 staff from the university, Sandia, and private companies in a single, integrated research laboratory. Since it was established 13 years ago, research at the lab has produced 10 R&D 100 awards, the so-called "Oscars of Invention."

Sandia and UNM also work together through an Inter-Institutional Visitor Agreement, which allows direct collaborations without formal agreements or the need for UNM to use a project-specific research contract to have Sandia staff run experiments at the Labs.

Joint UNM faculty/Sandia technical staff appointments include Fernando Garzon, a recognized expert in materials science and engineering and the first professor recruited together by Sandia and UNM. Sandia researchers Jeff Brinker and Rick Kemp also work for UNM as professors through joint appointments, and Rob notes the MOU explicitly calls for more such hires.

Sandia also has formed academic alliances in the past year with the University of Illinois at Urbana-Champaign, Purdue University, and the Georgia Institute of Technology.