Sandia LabNews

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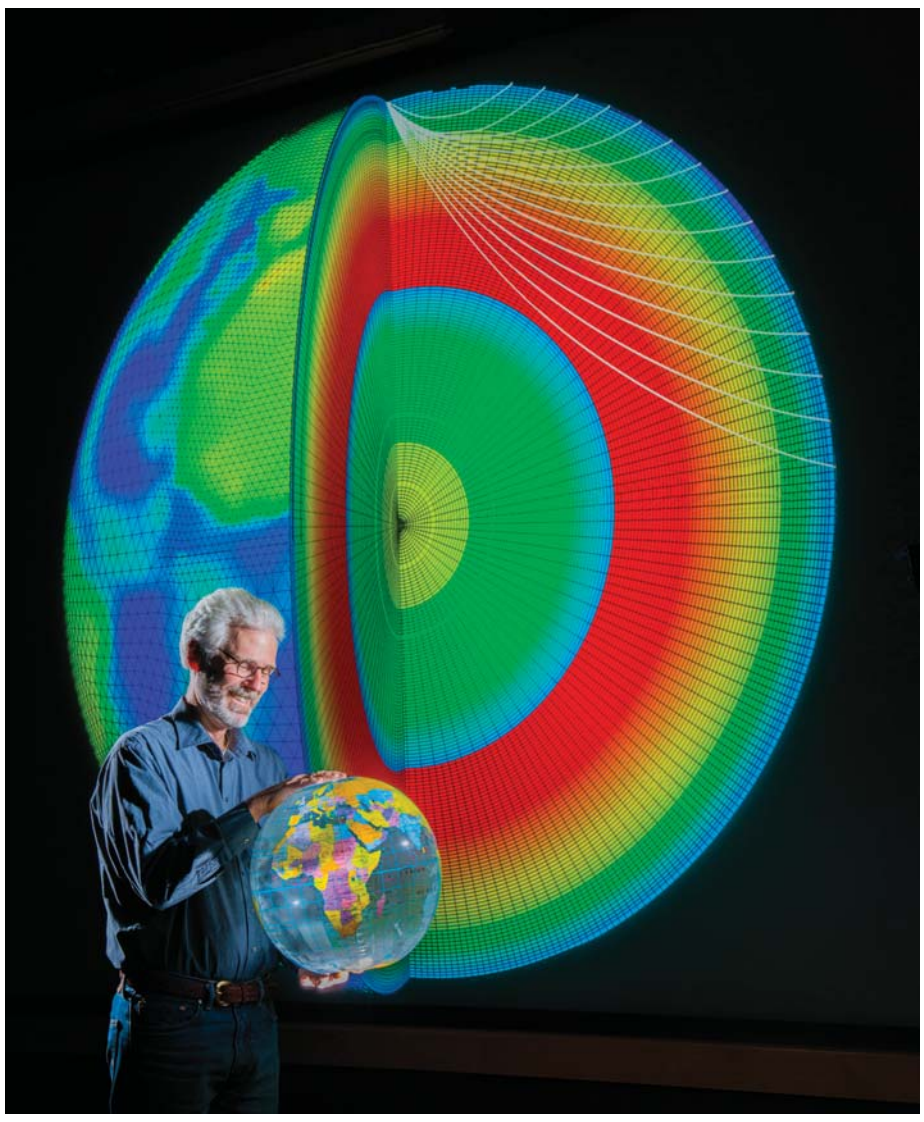
Sandia National Laboratories

Power to the teachers!

Middle school science teacher Krystal Irby shares her experience of a visit to Sandia as part of a summer training workshop. See story and photos on **page 6.**



SANDIA RESEARCHER Sandy Ballard and colleagues from Sandia and Los Alamos National Laboratory have developed SALSA3D, a 3-D model of the Earth's mantle and crust designed to help pinpoint the location of all types of explosions. (Photo by Randy Montoya)

3-D model more accurately pinpoints source of earthquakes, explosions

Sandia offers free, standardized GeoTess software to public

By Heather Clark

During the Cold War, US and international monitoring agencies could spot nuclear tests and focused on measuring their sizes. Today, they're looking around the globe to pinpoint much smaller explosives tests.

Under the sponsorship of the NNSA's Office of Defense Nuclear Nonproliferation R&D, Sandia and Los Alamos National Laboratory have partnered to develop a 3-D model of the Earth's mantle and crust called SALSA3D, or Sandia-Los Alamos 3D. The purpose of this model is to assist the US Air Force and the international Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna, Austria, more accurately locate all types of explosions.

The model uses a scalable triangular tessellation and seismic tomography to map the Earth's "compressional wave seismic velocity," a property of the rocks and other materials inside the Earth that indicates how quickly compressional waves travel through them and is one way to accurately locate seismic events, Sandia geophysicist Sandy Ballard (5736) says. Compressional waves — measured first after seismic events — move the particles in rocks and other materials minute distances backward and forward between the location of the event and the station detecting it.

SALSA3D also reduces the uncertainty in its predictions, an important feature for decision-makers who must take action when suspicious activity is detected, he adds.

"When you have an earthquake or nuclear explosion, not only do you need to know where it happened, but also how well you know that. That's a difficult problem for these big 3-D models. It's mainly a computational problem," Sandy says. "The math is not so tough, just getting it done is hard, and we've accomplished that."

A Sandia team has been writing and refining code for the model since 2007 and is now demonstrating SALSA3D is more accurate than current models. The team members include Andre Encarnacao, Jim Hipp, Brian Kraus, Ben Lawry, and Chris Young (all 5563), Eric Chael (5736), and Mike Begnaud at Los Alamos lab.

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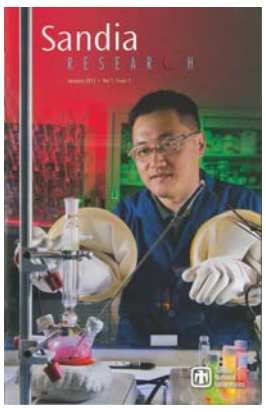
THIS IS AN EXERCISE

Sandia Emergency Response capability put through its paces . . . page 7

New magazine spotlights Sandia's scientific work



Sandia is publishing a quarterly research magazine targeted to a national audience of industry, academia, and government readers.

The magazine, *Sandia Research*, is a window into the cutting-edge science and engineering that form the basis of the Labs' national security mission. It also introduces some of the talented scientists and engineers behind the work.

"The magazine will chronicle Sandia's technical impact across the national security arena and its underlying fundamental science and engineering research," VP Steve Rottler wrote in the inaugural issue. "That research spans a spectrum of disciplines including chemistry, physics, materials science, biology, geoscience, nanoscience, computer science . . . the list goes on."

The first issue, published in March, focused on Sandia's seven research foundations: Bioscience, Computing and Information Sciences, Engineering Sciences, Geoscience, Materials Science, Nanodevices and Microsystems, and Radiation Effects and High Energy Density Science.

Each of the following seven issues will look in-depth at work being done in one of the foundations. The second issue featured Computing and Information Sciences and its critical role in science, engineering, and national security.

Magazine readers will learn why Sandia's research matters. Concerns like the effects of climate change, domestic and international terrorism, clean and affordable energy, and the safety, security, and reliability of the nuclear deterrent are important to US quality of life. The innovations and breakthroughs developed at Sandia tackle these and other matters.

The ability to apply multiple research and development disciplines to solve complex national security problems is a defining feature of Sandia and will form the substance of *Sandia Research*. Sandians can read the magazine at www.sandia.gov under "News" and then "Publications." It's also available on Sandia's iPad app with enhanced visuals and added video.

— Nancy Salem

IP fast track

Ready-to-sign licenses make tech transfer a breeze

By Nancy Salem

Sandia is building a portfolio of intellectual property (IP) that can be licensed by businesses in as little as an hour.

"This is the simplest process possible," says business development specialist Bob Westervelt (7932), who helped put together the ready-to-sign licensing program, which can be accessed by businesses on the Sandia website. "The language is clear and easy to understand. We can say, 'Here's the license, here are the terms. Once you and Sandia have signed it, you can start using the intellectual property.'"

The goal is to get more Sandia IP into the hands of small businesses and entrepreneurs. Sandia has about 1,300 patents available for licensing. Bob says the Licensing group, which works with companies of all sizes, noticed that smaller ones often find the number of patents to search through and the complexity of licensing daunting.

About a year ago the group came up with the idea of creating a standard license for certain IP they identify as being desirable. "We look through the IP for technologies we're surprised aren't being used, that need more visibility, and that still have a lot of time left on the patent," Bob says.

Small businesses might not have the time or manpower to sift through 1,300 patents to see if Sandia has something that might help them be more successful.

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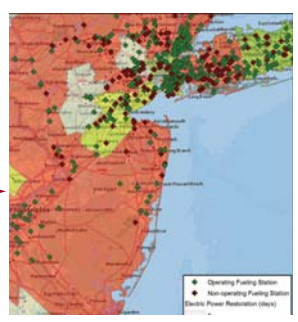
Inside . . .



That's that

The rain in Spain stays mainly on the plain. By contrast, the rain in New Mexico stays mainly somewhere else. Like Illinois. It sure doesn't rain on our plains. Or our mountains, valleys, mesas, or arroyos, either.

T.S. Eliot wrote that "April is the cruelest month," representing as it does (at least according to some critics) a time of unfulfilled hopes, of promises not kept. With all due respect to the eminent poet and Nobel laureate, I'm beginning to think the "cruelest month" is June. How many times over the past few weeks have we been led on by the promise of rain only to be let down? You could look it up, as American philosopher Casey Stengel used to say: Practically every day this month, the WeatherBug "forecast" has said "Chance of rain." Two chances, in fact: fat and slim.

How many times this month have my wife and I dashed out of our house, tantalized by the sound of thunder, seduced by the flash of lightning, the rising chorus of the wind, to think that maybe — maybe! — this time we'll get rain? Well, I'll tell you: too many times.

How many times have we tried to convince each other that, yes, yes, the sky is definitely getting darker over there? But always "over there." Somewhere else. Not here.

How many times have we seen the streaking virga trying to find its way from cloud to ground, only to disappear in a gossamer wisp somewhere in between? And then even that is gone. Like the pot of gold at the end of the rainbow, the rain has become something you can't quite get to. It's always one more county away.

It's not only dry; it's scary dry. You know what I mean? The farmers are wondering how they're going to get by. Their plants are withering, their prospects for the year shriveling into a little ball that's about to get blown away by a cruel, dark wind. The forests are burning — the Gila, the Pecos, the Jemez: We're a land on fire. The animals out there, the wild and the tame, are confused. Something is not right in their world.

Or ours either: We love the desert in New Mexico. We either chose to move here from somewhere else or — if this was already our home — chose to stay. But we *need* the green. Exactly because we are a desert the little bit of green we *do* get means more to us than a riot of green means to someone from Mississippi or Maryland or Minnesota. They take it for granted. We don't. We need the rain, the green, to quench and soothe our parched spirits.

So, like those stateless persons in *Casablanca*, we wait. And wait. And wait. But it will come, the rain. And when it does, when we do get that rain, that real rain and not the little tease of a drop or two here and there, when we do get that big gully washer, that fence-lifter, hat drencher, toad-floater, lake-filler, when we *do* get that inevitable drought-busting mother of all monsoon downpours, I'll be out there in it up to my shins stomping around in the puddles like Gene Kelly, with a smile on my face, dancin' and singin', not caring a whit how silly I might look.

* * *

I got a note the other day from a colleague, Margaret Lovell, a tech writer in 5500 who's come to my rescue on more than a few occasions when I needed a story for the *Lab News*. Margaret was writing to say she was going to be retiring soon and wanted to get the announcement in the paper. She attached a photo. I thanked her for all her help over the years and wished her the best. And oh, by the way, I wrote, how many years have you been at Sandia? We need to include that info with the photo. She wrote back: "4 years as a Sandian. Going to look pretty puny, isn't it? . . . Too bad we can't say: 'She worked for 45 years — here and there.' That would make it sound more like a real retirement."

Well, Margaret, we *can* say it; at least, I can say it here: Congratulations, my friend, on 45 excellent years!

And how many of us, after all, don't have some "here-and-theres" in our lives? I know I do: carpenter, welder, ranch hand, fry cook, custodian . . . . I could go on. My own here-and theres ended here and, like almost every single Sandian I've met over the past 18-plus years, I'm glad it did. It makes a difference to me, a big difference, to know that I'm part, even if just a small part, of something *here* that makes such a difference *there* — that is, in the community, the nation, the world.

See you next time.

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

Basil Hassan Elected Fellow in American Institute of Aeronautics and Astronautics

Basil Hassan, manager of the Aerospace Systems Analysis Dept. 5422, has been named a Fellow in the American Institute of Aeronautics and Astronautics (AIAA). AIAA is the professional society that represents the aeronautics and space community, with more than 27,000 professional members. Basil was introduced with the 2013 AIAA Fellow class on May 7-8 in Washington, D.C., at the annual AIAA Fellows Dinner and Spotlight Awards Gala.

BASIL HASSAN (5422), right, is pictured with his father, Prof. H. A. Hassan from North Carolina State University, left, at the AIAA Fellows Dinner on May 7, 2013 in Washington, DC. Basil's father was selected as an AIAA fellow in 2006. They are the fourth father-son Fellow combination in AIAA.

The distinction of Fellow is conferred on AIAA members who have made notable and valuable contributions to the arts, sciences, or technology of aeronautics and astronautics. Only one-tenth of 1 percent of the eligible professional membership is selected for this honor each year. Basil has been a long-time member of and contributor to AIAA since 1984, when he joined as a student member at North Carolina State University. He currently serves on AIAA's board of directors as the vice president of technical activities, having oversight over all AIAA conferences and technical/program committees. Prior to his term as VP, he served on AIAA's board as director-technical for engineering and technology management.

Basil joins current Sandian Steve Rottler, VP California Laboratory, and retired Sandians Fred Blottner, Bill Oberkampf, Carl Peterson, and Jerry Yonas as AIAA Fellows from Sandia. Additionally, Basil and his father, Professor H. A. Hassan from North Carolina State University, are the fourth father-son Fellow combination in the institute.

Basil joined Sandia in 1993 as a postdoctoral researcher in Aerosciences Dept. 1515 (then called Aerodynamics Dept. 1554) in the Engineering Sciences Center 1500 after completing his PhD in aerospace engineering at NCSU. Basil spent nine years as a staff member in departments 1515 and 1541, as well as serving as manager of both the departments from 2002 to 2010, including seven months as acting senior manager for 1510. In 2010, he spent six months working in the office of the chief of staff for former Labs Director Tom Hunter and current Labs Director Paul Hommert, including serving as Paul's acting chief of staff. Basil has been in his current position in the Integrated Systems Development Center since 2010.

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Coronado Thunderbirds

Coronado Thunderbirds is a club for persons 50 years or older who have retired from Sandia, DOE/NNSA, other federal agencies, or the military. Spouses and surviving spouses can also join. Thunderbirds is a social club offering monthly programs plus activities such as bridge and travel.

Coronado Thunderbirds monthly meetings are held at the Mountain View Club (formerly the Officer's Club East) on Kirtland Air Force Base on the second Tuesday of each month. Meetings begin at noon with 30 minutes of business before the program, which lasts about an hour. Many members come for lunch at 11 a.m., ordering from a menu of soup, salads, and sandwiches. It's a great time to get to know each other.

Dues are $10 per person, $20 per couple annually. Dues checks should be made out to Coronado Thunderbirds and mailed to the membership chairman Vicky Clark, 6618 Mossman Place NE, Albuquerque, N.M., 87110.

All Coronado Thunderbirds members are required to be members of the Mountain View Club (MVC). The MVC does not charge the Thunderbirds for use of the facility for meetings and the Thunderbirds are active in the monthly MVC events. Membership in the MVC is $7 per month for federal retirees; military retirees are charged according to salary level. The MVC membership card is an Officer's Club Card issued as a CHASE credit card. Applications for the MVC may be picked up at the club or from Vicky Clark (address above).

Base Access: All Coronado Thunderbirds members must have a DBIDS pass or a military ID to have access to KAFB. If you need a DBIDS pass, contact Vicky Clark at 881-3625 for an application form, which includes a background check. You must complete the form as instructed and return it to Vicky, who will get it to the proper authority on base. This process takes about two weeks.

For further information call Vicky Clark, membership chairman at 881-3625, or visit the club's website at: http://home.comcast.net/~the_coronado_thunderbirds/site/.

Hydrogen paves the way for collaboration with Thai university

By Patti Koning

Natchapol Poonyayant and Natee Angboonpong, students from Thailand's Mahidol University, are spending their summer immersed in hydrogen storage research at Sandia. This international exchange came about through a connection between Lennie Klebanoff (8367) and Pasit Pakawatpanurut of the Chemistry faculty at Mahidol.

In 2010, Pakawatpanurut sent Poonyayant, an undergraduate at the time, to Sandia for a three-month internship. Studying abroad for international experience and personal growth is a common practice for Mahidol students. This was the first trip out of Thailand for Poonyayant, who goes by the nickname "Golf."

"If you think about what he did — traveling abroad for the first time in his life, interfacing with a national lab and all of our rules, regulations, and bureaucracy, and all in a second language — it's pretty impressive," says Lennie. "I'm not sure if I would have been up to those challenges when I was 19 years old."

For Golf, those initial three months at Sandia were a transformative experience. "It was my first time doing research outside of my country. The big differences were the intensive cyber and information security training as well as thorough safety training," he says.

The training had the added benefit of bolstering his English skills. "At first, I had to watch the training videos with a dictionary and stop to look up words, but then it became easier," says Golf.

> *Energy is universal – everyone needs it, no matter where they live."*
>
> **— Natchapol Poonyayant**

He returned to Mahidol University with a desire to continue working on hydrogen storage. Golf graduated with a degree in chemistry and, with the support of Pakawatpanurut, began a hydrogen storage research project — the first of its kind at the university and among the very first hydrogen storage projects in Thailand. "Lennie was a huge help," says Golf. "I stayed in contact with him and he answered a lot of questions for me."

Golf was awarded a grant to return to Sandia this summer from Mahidol University on behalf of the Development and Promotion of Science and Technology Talents Project through the university honors program. He is joined by Angboonpong, an undergraduate who goes by the nickname "Game."

In Thailand, proper names tend to be long and complex, so families traditionally give their children short, fun nicknames. So, long before the two Thai students ever met, their families had decided on remarkably compatible nicknames.

Game's experience coming to Sandia was quite different than Golf's. "I was very interested in the hydrogen storage project started by Golf and became part of the research team," he says. "I'm grateful to Golf — he's a true pioneer and created this opportunity for me."

Golf and Game are supported by a Cooperative Research and Development Agreement with Boeing to study complex metal hydrides as potential hydrogen storage materials. Their work is directed by Lennie and Vitalie Stavila (8367).

"There are many types of complex metal hydrides that can store hydrogen, but the thermodynamics and kinetics are not optimized, so it's an inefficient storage method," explains Vitalie. "On this project, we are identifying promising materials and working to fine-tune the thermodynamics and kinetics."

In their time at Sandia this summer, Golf and Game are synthesizing complex metal hydrides and characterizing the physical, chemical, thermodynamic, and kinetic properties of those materials. Lennie expects to publish a paper on their research later this year.

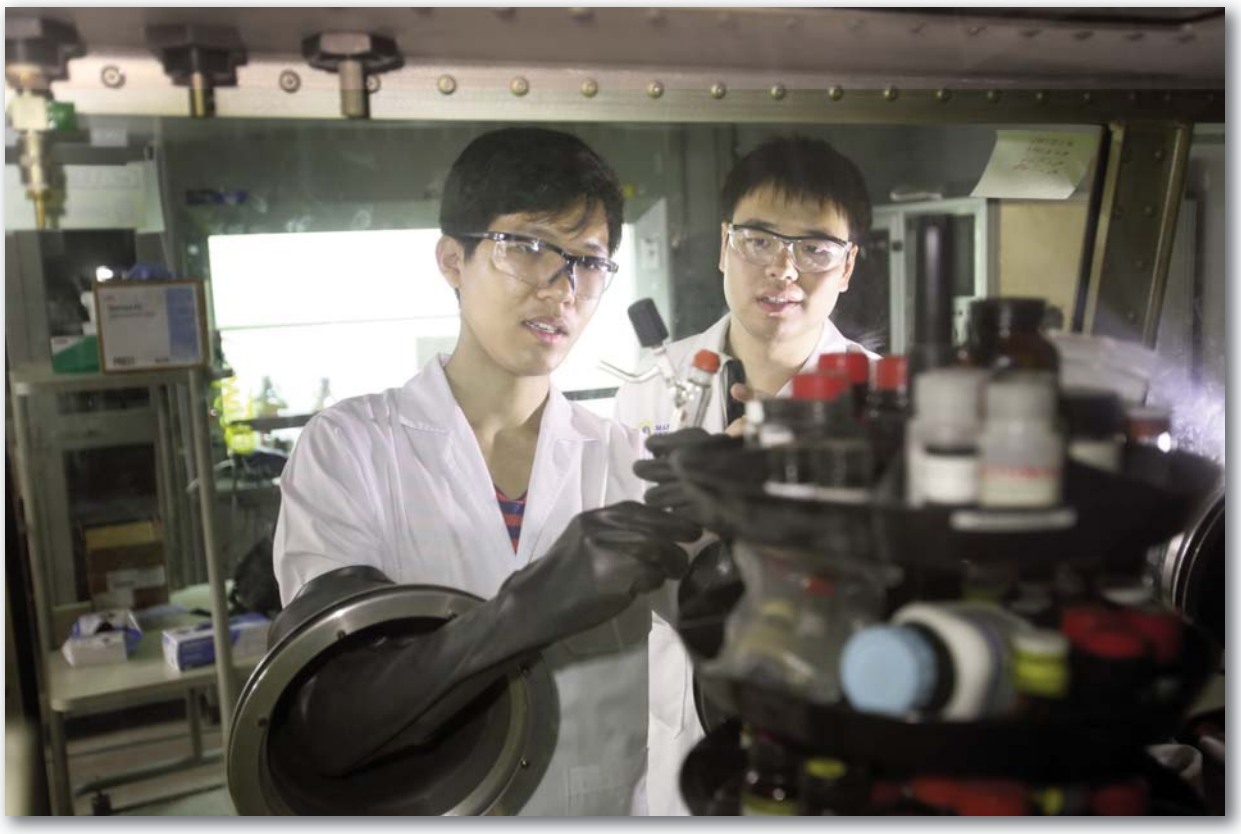
"They are great students," says Vitalie. "They are very enthusiastic, persistent, and motivated to get the most out of their stay here."

The two students have enjoyed their time in Livermore and appreciate the differences from their hometown of Bangkok, like cooler weather and less crowded streets. "People here are very kind and friendly. I love the way it is so easy to start a conversation with someone you don't know, like if you are waiting at the bus stop," Game says. "That just doesn't happen in Thailand."

They also miss their families and home. "Thailand is a very beautiful country with forests, beaches, and lots of natural scenery. As a Buddhist country, there are many beautiful temples," says Golf.

Game will return to Thailand in August and Golf will return in October. Both students intend to continue studying hydrogen storage at Mahidol University. Next year, Golf plans to apply to graduate programs in the United States, specifically Stanford and the University of California, Berkeley. He hopes the collaboration with Sandia will continue.

"I want to pass on the knowledge of what I have learned at Sandia to the people of my country," says Golf. "I want to further energy research in Thailand, to continue down this path that Lennie put us on. Energy is universal — everyone needs it, no matter where they live."



VISITING THAI STUDENTS Game (on left) and Golf (on right) work in the glove box on a hydrogen storage research project. (Photo by Dino Vournas)

Sandia CaliforniaNews

Fuel Cell Mobile Light illuminates $2 billion highway construction project

By Patti Koning

The Fuel Cell Mobile Light has been field-tested in a number of interesting locations — highway shoulder work for Caltrans; airfield maintenance operations at San Francisco International Airport; at Hollywood awards ceremonies like the Academy Awards, Golden Globes, and Grammys; and the final Space Shuttle launch in 2011.

The Connecticut Department of Transportation (CT DOT) is now using a Fuel Cell Mobile Light unit to quietly and cleanly illuminate a major interchange construction project, the I-95 New Haven Harbor Crossing Corridor Improvement Program. The construction aims are threefold: 1) to reconstruct the I-95/I-91 interchange to improve transportation operations and safety for the 140,000 vehicles a day that transit the location; 2) to construct a new Pearl Harbor Memorial Bridge on I-95; and 3) to construct new I-95 off ramps to the New Haven Long Wharf area.

LENNIE KLEBANOFF, left, with members of the Connecticut Department of Transportation and the fuel cell mobile light unit they are using to illuminate a highway construction project.

The Fuel Cell Mobile Light is being deployed to reduce emissions and noise in the work zone, allow CT DOT to gain experience with fuel cells, foster hydrogen refueling in the area, and display applications of fuel cells in transportation.

"This is the first time the Fuel Cell Mobile Light has been used in a major construction project," says Lennie Klebanoff (8367). "This is the largest federal Interstate construction project in the country, so the Fuel Cell Mobile Light is in the construction big leagues now."

The concept for the Fuel Cell Mobile Light was developed through a Cooperative Research and Development Agreement with Boeing, and later supported by the DOE Energy Efficiency & Renewable Energy Fuel Cell Market Transformation activity. The project grew into a consortium that includes technology experts, mass-manufacturers, and end users. The consortium recently received a patent for the Fuel Cell Mobile Light. Last year, it was the winner of the Federal Laboratory Consortium's Award for Excellence in Technology Transfer. Commercialization of the unit by Multiquip Inc. is planned for early 2014.

Defense Science Study Group delegation visits Labs

Photos by Randy Montoya

Selected professors from universities nationwide recently visited Sandia as part of the Defense Science Study Group, sponsored by the Defense Advanced Research Projects Agency and administered by the Institute for Defense Analyses. By participating in the DSSG program, Sandia hopes to inform the attendees about the Labs' capabilities and get them thinking about incorporating solutions to national security challenges in their research. During the two-day visit, Sandia presenters encouraged collaboration and partnerships with faculty interested in Sandia's research. In addition to the Z machine tour pictured here, the attendees during their visit learned about the Labs from their host, Sandia President and Labs Director Paul Hommert, Defense Systems & Assessments VP Jeff Isaacson (the group's technical host), Executive VP and Deputy Labs Director Jerry McDowell, and VPs Duane Dimos, Jill Hruby, Julia Phillips, and Steve Rottler.

SALSA3D

(Continued from page 1)

In recent tests, SALSA3D was able to predict the source of seismic events over a geographical area 26 percent smaller than the traditional one-dimensional model and 9 percent smaller than a recently developed Regional Seismic Travel Time (RSTT) model used in combination with the one-dimensional model.

GeoTess software release

Sandia recently released SALSA3D's framework — or GeoTess, the triangular tessellated grid on which the model is built — to other Earth scientists, seismologists, and the public. By standardizing the framework, the seismological research community can more easily share models of the Earth's structure and global monitoring agencies can better test different models. Both activities are hampered by the plethora of models available today, Sandy says (see box at right).

"GeoTess makes models compatible and standardizes everything," he says. "This would really facilitate sharing of different models, if everyone agreed on it."

When an explosion goes off, the energy travels through the Earth as waves that are picked up by seismometers at US and international ground monitoring stations associated with nuclear explosion monitoring organizations. Scientists use these signals to determine the location.

They first predict the time it takes for the waves to travel from their source through the Earth to each station. To calculate that, they have to know the seismic velocity of the Earth's materials from the crust to the inner core, Sandy says.

"If you have material that has very high seismic velocity, the waves travel very quickly, but the energy travels less quickly through other kinds of materials, so it takes the signals longer to travel from the source to the receiver," he says.

For the past 100 years, seismologists have predicted the travel time of seismic energy from source to receiver using one-dimensional models. These models, which are still widely used today, account only for radial variations in seismic velocity and ignore variations in geographic directions. They yield seismic event locations that are reasonably accurate, but not nearly as precise as locations calculated with high fidelity 3-D models.

Modern 3-D models of the Earth, like SALSA3D, account for distortions of the seismic wavefronts caused by minor lateral differences in the properties of rocks and other materials.

For example, waves are distorted when they move through a geological feature called a subduction zone, such as the one beneath the west coast of South America where one tectonic plate under the Pacific Ocean is diving underneath the Andes Mountains. This happens at about the rate at which fingernails grow, but, geologically speaking, that's fast, Sandy says.

One-dimensional models, like the widely used ak135 developed in the 1990s, are good at predicting the travel time of waves when the distance from the source to the receiver is large because these waves spend most of their time traveling through the deepest, most homogenous parts of the Earth. They don't do so well at predicting travel time to nearby events where the waves spend most of their time in the Earth's crust or the shallowest parts of the mantle, both of which contain a larger variety of materials than the lower mantle and the Earth's core.

RSTT, a previous model developed jointly by Sandia, Los Alamos, and Lawrence Livermore national laboratories, tried to solve that problem and works best at ranges of about 60-1,200 miles (100-2,000 kilometers).

Still, "the biggest errors we get are close to the surface of the Earth. That's where the most variability in materials is," Sandy says.

Seismic tomography gives SALSA3D accuracy

Today, Earth scientists are mapping three dimensions: the radius, latitude, and longitude.

Anyone who's studied a globe or world atlas knows that the traditional grid of longitudinal and latitudinal lines work all right the closer you are to the equator, but at the poles, the lines are too close together. For nuclear explosion monitoring, Earth models must accurately characterize polar regions even though they are remote because seismic waves travel under them, Sandy says.

Triangular tessellation solves that with nodes, or intersections of triangles, that can be accurately modeled even at the poles. The triangles can be smaller where more detail is needed and larger in areas that require less detail, like the oceans. Plus the model extends into the Earth like columns of stacked pieces of pie without the rounded crust edges.

The way Sandia calculates the seismic velocities uses the same math used to detect a tumor in an MRI, except on a global, rather than a human, scale.

Sandia uses historical data from 118,000 earthquakes and 13,000 current and former monitoring stations worldwide collected by Los Alamos lab's Ground Truth catalog.

"We apply a process called seismic tomography where we take millions of observed travel times and invert them for the seismic velocities that would create that data set. It's mathematically similar to doing linear regression, but on steroids," Sandy says.

SEISMOLOGISTS AND RESEARCHERS WORLDWIDE can now download GeoTess, which provides a common model parameterization for multidimensional Earth models and a software support system that addresses the construction, population, storage and interrogation of data stored in the model. GeoTess is not specific to any particular data, so users have considerable flexibility in how they store information in the model. The free package, including source code, is being released under the very liberal BSD Open Source License. The code is available in Java and C++, with interfaces to the C++ version written in C and Fortran90. GeoTess has been tested on multiple platforms, including Linux, SunOS, MacOSX, and Windows. GeoTess is available at www.sandia.gov/geotess.

Linear regression is a simple mathematical way to model the relationship between a known variable and one or more unknown variables. Because the Sandia team models hundreds of thousands of unknown variables, they apply a mathematical method called least squares to minimize the discrepancies between the data from previous seismic events and the predictions.

With 10 million data points, Sandia uses a distributed computing network with about 400 core processors to characterize the seismic velocity at every node.

Monitoring agencies could use SALSA3D to precompute the travel time from each station in their network to every point on Earth. When it comes time to compute the location of a new seismic event in real-time, source-to-receiver travel times can be computed in a millisecond and pinpoint the energy's source in about a second, he says.

Uncertainty modeling a SALSA3D feature

But no model is perfect, so Sandia has developed a way to measure the uncertainty in each prediction SALSA3D makes, based on uncertainty in the velocity at each node and how that uncertainty affects the travel time prediction of each wave from a seismic event to each monitoring station.

SALSA3D estimates for the users at monitoring stations the most likely location of a seismic event and the amount of uncertainty in the answer to help inform their decisions.

International test ban treaties require that on-site inspections can only occur within a 1,000-square-kilometer (385-square-mile) area surrounding a suspected nuclear test site. Today, 3-D Earth models like SALSA3D are helping to meet and often significantly exceed this threshold in most parts of the world.

"It's extremely difficult to do because the problem is so large," Sandy says. "But we've got to know it within 1,000 square kilometers or they might search in the wrong place."

Sandia's headlights

Research foundations lead beyond the known and into tomorrow

By Nancy Salem

NOTE: This article from the first issue of Sandia Research *magazine (see page 1) describes the origins of Sandia's focus on fundamental research.*

Physicist Dick Claassen could not have imagined the magnitude of exploration he would set in motion when he penned a memo to his Sandia colleagues on May 31, 1957. World War II was history, the Cold War was reality, and Sandia was in transition, its nuclear weapons mission shifting from production engineering and assembly to systems and product design.

Claassen envisioned a broader, more complex mission that called for deep roots in the fundamentals of science and engineering. His memo to Sandia leadership set out the characteristics and guidelines of a research organization at the Labs.

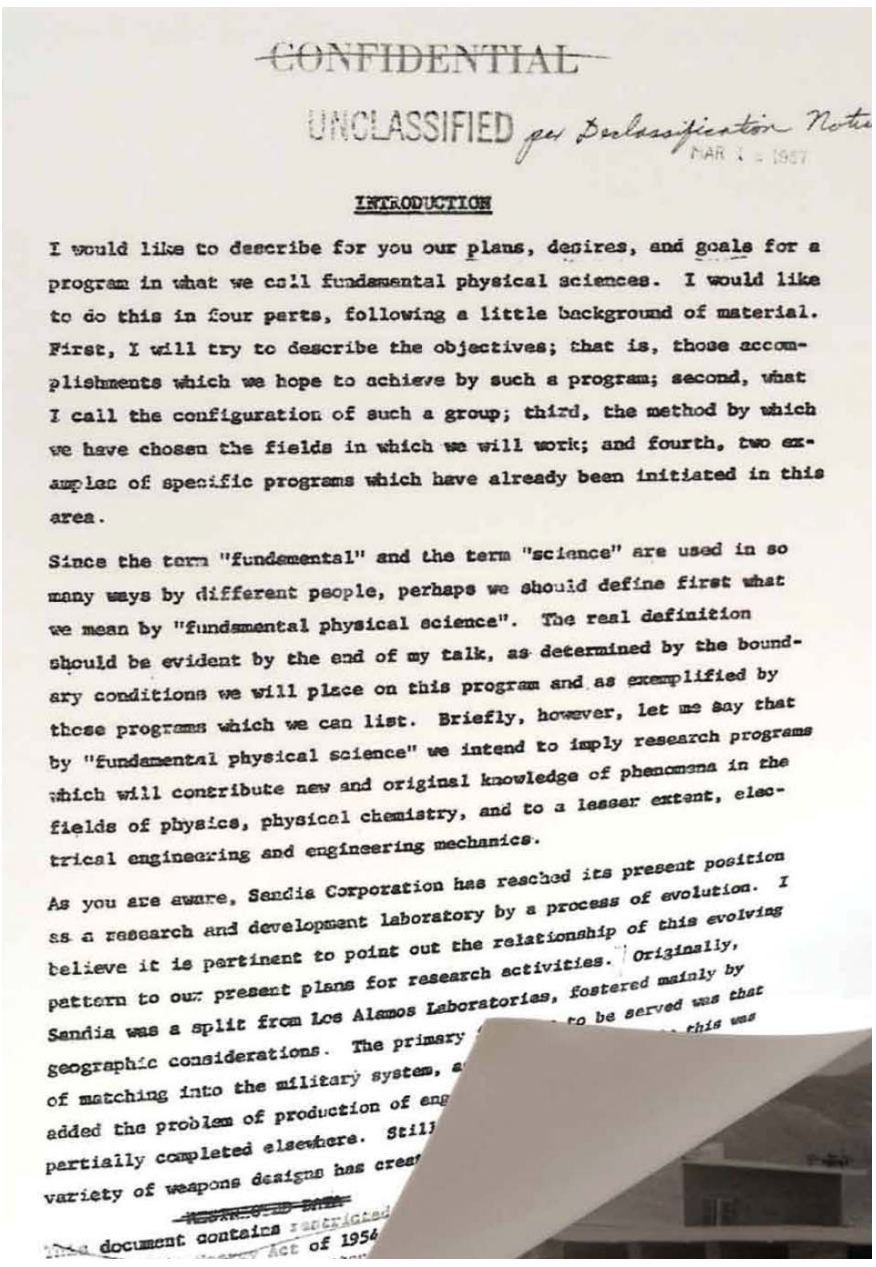
"I would like to describe for you our plans, desires, and goals for a program in what we call fundamental physical sciences," the memo opened. Claassen wrote that Sandia's research efforts were a result of the development of nuclear weapons components. "In a mature organization, the research effort should be expended in advance of the development programs," he continued. "We are in an international weapons race. To obtain and maintain a superiority in this race, we must find a way to form a very close coupling between advances in fundamental knowledge and engineering designs of new weapons."

Claassen proposed research into electronics ("Semiconductors are of high interest in many places in the country"), radiation effects, combustion, hydro-magnetics, theoretical mechanics, thermal shock, and geophysics. He wrote that the choice of fields was crucial, "for if they are wrong, then even the best of research individuals cannot make effective contributions."

"These are a set of fields or disciplines or sciences which are the underlying basis for the solution of many practical development problems," he wrote.

Claassen got a thumbs-up from Sandia leadership and the job of establishing and leading the research organization. He was promoted in 1960 to director of physical research, the first to hold that post.

Fast forward a half century to a Sandia Labs where fundamental research is at the heart of the Labs' national security mission and identity. The work takes place in seven research foundations, each focused on a specific scientific discipline and overseen by the Office of the Chief Technology Officer and the Research Leadership Team. "Research is the headlights of the Laboratory," says Div. 8000 VP Steve Rottler. "We can look broadly across the scientific and engineering community and ask, 'What are the new and emerging areas of research that could have a beneficial impact on the nation?'"



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INTRODUCTION

I would like to describe for you our plans, desires, and goals for a program in what we call fundamental physical sciences. I would like to do this in four parts, following a little background of material. First, I will try to describe the objectives; that is, those accomplishments which we hope to achieve by such a program; second, what I call the configuration of such a group; third, the method by which we have chosen the fields in which we will work; and fourth, two examples of specific programs which have already been initiated in this area.

Since the term "fundamental" and the term "science" are used in so many ways by different people, perhaps we should define first what we mean by "fundamental physical science". The real definition should be evident by the end of my talk, as determined by the boundary conditions we will place on this program and as exemplified by those programs which we can list. Briefly, however, let me say that by "fundamental physical science" we intend to imply research programs which will contribute new and original knowledge of phenomena in the fields of physics, physical chemistry, and to a lesser extent, electrical engineering and engineering mechanics.

As you are aware, Sandia Corporation has reached its present position as a research and development laboratory by a process of evolution. I believe it is pertinent to point out the relationship of this evolving pattern to our present plans for research activities. Originally, Sandia was a split from Los Alamos Laboratories, fostered mainly by geographic considerations. The primary [illegible] to be served was that of matching into the military system, a[illegible] this was added the problem of production of eng[illegible] partially completed elsewhere. Still[illegible] variety of weapons designs has creat[illegible]

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WITH THIS MEMO from 1957, Sandia physicist Dick Claassen set out the characteristics and guidelines of a research organization at the Labs. (Image from Sandia archives)

A search for core competencies

The foundations had roots in Claassen's organization but didn't take shape as entities until the early 1990s when then-Labs Director Al Narath wanted to deepen the Labs' commitment to a vibrant research community in support of the mission. He asked a committee to identify Sandia's strengths based on the seminal *Harvard Business Review* article on core competencies by C.K. Prahalad and Gary Hamel.

The panel agreed on five core competencies: engineering science, materials science, pulsed power, microelectronics and photonics, and computing. The first research foundations were built around those disciplines. Over time the original foundations evolved, names changed, and new core competencies emerged, resulting in the current seven foundations: Bioscience, Computing and Information Sciences, Engineering Sciences, Geoscience, Materials Science, Nanodevices and Microsystems, and Radiation Effects and High Energy Density Science.

"The foundations exist to enable the mission and advance the frontiers of knowledge in science and engineering," says Julia Phillips, Div. 7000 VP and Chief Technology Officer. "With high beams on we can see things that haven't been articulated yet."

Research supports national security in important ways, Phillips says. "It provides the opportunity to explore concepts that are farther out," she says. "The time horizon is longer. There's time to think about how to do something as opposed to being schedule-driven."

Rottler says program work in a national laboratory is typically driven by near-term considerations. "You think in the lifespan of a program," he says. "In the research community you have the luxury of being able to look out well beyond programs that are in place today, perhaps even envisioned. We can look into new and emerging areas that, if mastered by an adversary, could be used to the disadvantage of us and our allies. We can position ourselves to counter a threat if it becomes a reality."

Rottler says both near- and long-term research are motivated by and vital to the Laboratory mission. "As an institution we become more appreciative of the lifecycle of research and the varying temporal scales," he says. "Each of them is important to the future of the Laboratory."

Research for the public good

Much of the funding for research in the foundations comes from Laboratory Directed Research & Development (LDRD), a $165 million-a-year program that invests in staff-generated, high-risk, high-potential ideas that advance Sandia's missions and scientific frontiers. Rottler calls LDRD a precious resource and the engine of research at Sandia.

"The reason it is so precious is we have considerable discretion over what we fund, with oversight from the National Nuclear Security Administration," he says. "If we need a new capability to support our mission or we want to start something new and expand our impact from a national service perspective, this funding makes that possible. Some of the biggest programs at the Lab today had their start in LDRD."

LDRD and research in each foundation have helped Sandia attract and keep exceptional scientists. "One reason the Laboratory is what it is today is the people we hire. You can't state it strongly enough," Rottler says. "We attract professionals who are among the smartest people on the face of the planet, who are not afraid of challenging problems, and who believe national service is worthy of a career commitment."

Their work impacts the larger scientific, academic and business communities and, ultimately, people on the street through partnerships that produce invention, innovation, entrepreneurship, and economic development. "We want to ensure that the results of publicly funded research and development are deployed for the public good," Phillips says.

Research results are published in peer-reviewed journals and contribute to the broad body of science and engineering knowledge, helping other researchers and stimulating creative thinking that builds on Sandia's work. And a considerable body of research becomes intellectual property in the form of patents or copyrights available for licensing by industrial partners. IP with commercial potential moves from the Labs into the private sector and the hands of the public. IP with national security implications is developed by industry for use by the government.

Ingredients of innovation

When Dick Claassen wrote about the importance of electronics and semiconductors back in the 1950s he might well have been peering into a crystal ball. His vision embodies why Sandia's research foundations exist: to look ahead.

Claassen saw a future where tiny devices could change lives, and Sandia ran with it. Rottler says discoveries and innovations in microelectronics, microsystems, and nanondevices are among the Labs' greatest achievements.

The Microsystems and Engineering Sciences Applications, or MESA, complex supports research and development programs throughout the Laboratories and is at the forefront of international advancement in the field. "I really believe that over the past 15 years this is something that has gone from being important to the Labs to being a cornerstone of the Labs," Rottler says. "It's incredible what comes out of that foundation every year in terms of advancement.

"This is an example of the outstanding things that can happen at a place like Sandia with sustained customer and leadership commitment over a long period of time. You assemble a critical mass of people and develop world-class facilities and you create a work environment in which truly innovative things can happen. They can't happen any other way."

Albuquerque middle school teachers get the POWER

Photos by Colin DeGroot
Rio Rancho Public Schools

Note: *McKinley Middle School science teacher Krystal Irby was part of a delegation of local teachers that visited Sandia recently to learn more about science and technology at a national laboratory. Their visit was coordinated by Sandia's Community Involvement Dept. 3652. Krystal wrote this first-person account at the request of the* Lab News.

By Krystal Irby, middle school teacher

"POWER On to Water and Energy Resources" is a summer program sponsored by Sandia and Lockheed Martin in which teachers from Rio Rancho to Los Lunas are studying ways to infuse their curriculum with content related to water and energy. During this year's POWER workshop, we had the unique opportunity to tour Sandia's nuclear reactor facilities. It was so exciting to get a behind-the-scenes look at such powerful and sometimes ominous technology. From the Gamma Irradiation Facility (GIF) to the Sandia Critical Experiments (SCX) facility to the Annular Core Research Reactor (ACRR), we were able to really see nuclear energy in action.

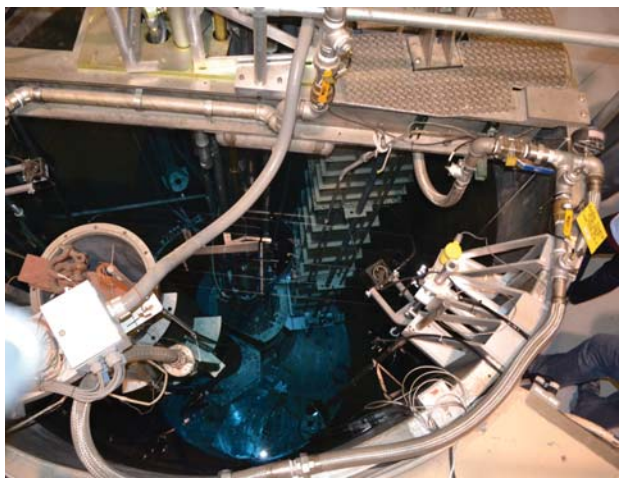
KRYSTAL IRBY

At the GIF, the Sandia staff was very informative and promptly invited us into a small cell with thick concrete walls. We discussed testing methods and identified signs of radiation effects within the cell. Once outside, the staff did a demonstration using a board covered with calcium fluoride chips. Radioactive cobalt-60 sources were raised into the cell from an underlying water pool and in just a few moments we were able to see the Sandia logo glowing inside the chamber! I was surprised to learn that the cell could be entered almost immediately after the test. Visiting another cell — this one large enough to hold an Abrams battle tank — was impressive because it seemed like an engineering feat to bring it into existence. When they opened the 200-ton door with a cushion of air at 50 psi and a 1.5 HP motor, I was convinced.

We were also able to get up close and personal with the SCX. Inside its domed abode of the former Sandia Pulse Reactor, you would have found us crowded around the small reactor discussing fuel rod formations with the operator, as well as how they control reactions and test the specifications for making future reactors "go critical."

However, my personal favorite experience was standing over the ACRR for a pulse. Seeing the flash, hearing the pop, and then being frisked for possible contamination, was quite an experience! It was incredible to learn that the power of the pulse, though lasting only a fraction of a second, was greater than that of the Palo Verde nuclear power plants in Arizona (see for yourself at http://tinyurl.com/ouglfyl). The staff was able to answer all of our questions and really made this experience palpable for our group of teachers.

I am so thankful for this opportunity to gain real-world experience and knowledge to bring back to my classroom. In addition to the tour, the information we gleaned from the Sandia staff about their job responsibilities, day-to-day operations, and the amount and type of schooling needed was paramount. Presenting as many aspects of this future career as we can to our students will hopefully help us inspire and encourage them to continue to pursue STEM education and STEM careers.



THIS IS AN EXERCISE

• Photos by Randy Montoya •

Continuous improvement — that was the focus and goal for the Sandia Full Scale Exercise completed by Emergency Management. After a year of planning, the 2013 exercise was held June 12 simulating an emergency involving radiological waste material with potential onsite and off-site impacts. Participating were more than 125 individuals and seven different local and federal entities including Sandia Emergency Responders, Security, Emergency Management (EM) Consequence Assessment Team, EM 911 Communications, Emergency Operations Center, Media Relations & Communications, Community Involvement, Government Relations, Medical, and Radiation Protection. Also participating were the NNSA Sandia Field Office, Federal Radiation Assistance Program (RAP), and Kirtland Air Force Base's Fire Department, Bio Environmental Dept., 911 Dispatch, and Law Enforcement. "Teams demonstrated an effective response in a real-time, stressful environment that replicated an actual emergency situation," says Eugene McPeek, manager of Emergency Operations Dept. 4236. He continues, "This was a complex scenario that required critical thinking, rapid problem solving, decision making, and teamwork. We thank all who participated, and those who may have been impacted by the exercise. The exercise was a success, and we will work together as we continue our ongoing improvement journey." — *Cathy Ann Connelly*

Team gears up for hurricane season

By Sue Major Holmes

A Sandia team is gearing up for hurricane season, readying analyses to help people in the eye of a storm.

The Department of Homeland Security's National Infrastructure Simulation and Analysis Center (NISAC), jointly housed at Sandia and Los Alamos national laboratories, studies the interdependency and vulnerability of critical infrastructure and the consequences of having systems disrupted by disasters, including hurricanes.

Hurricane season began June 1 and runs through Nov. 30. It generally peaks in August and September, notwithstanding Superstorm Sandy's appearance late last October.

NISAC has two jobs relating to hurricanes: conducting annual "hurricane swath" analyses of probable impacts on the Gulf Coast and East Coast and providing quick analyses of crisis response in the face of an imminent hurricane threat to the United States.

NISAC TEAM — A NISAC team of infrastructure modelers and analysts works on providing a crisis response to the Department of Homeland Security. When NISAC is activated, such teams provide quick analyses to DHS for national events such as hurricanes. (Photo courtesy of NISAC)

Analyses allow preliminary look at storm

A swath analysis looks at how a hurricane might interrupt electricity or water service and at impacts specific to an area, such as petroleum and petrochemical industries in Houston or financial services in New York City. It also looks at such things as the economic impact of the storm or how it could upset food deliveries.

Federal officials pull swath analyses off the shelf when a hurricane seems likely to hit a particular place. They used the New Orleans report a few days before Hurricane Isaac headed toward that city last August.

"While it was too far out for us to do our analysis, they could use the report as a first cut," says Dan Pless (6924), NISAC program lead at Sandia.

NISAC's portfolio includes a dozen swath analyses updated every few years, two cities at a time. A team coordinated by Mark Pepple (6632), NISAC fast response lead, this year updated reports for Houston and Corpus Christi, Texas; last year the work focused on Miami and Tampa. Updates keep information from becoming too stale, Dan says.

NISAC decided what to put into the original analyses, but is working on updates with state and local officials and Department of Homeland Security (DHS) agencies, including the Federal Emergency Management Agency (FEMA).

Reports analyze 'reasonable bad scenario'

Each report uses a "reasonable bad scenario" that would be possible in the particular area, with local officials deciding what scenario would be most useful for disaster planning, say Dan and Mark. For example, a Category 5 hurricane isn't likely in New York City because colder waters dampen hurricane strength, but a Category 3 is within reason.

"These storms form in the Caribbean, they form in the Gulf. They can get quite strong down there," Dan says. "They don't form in the North Atlantic. They have to travel there."

The analyses — also useful in other natural disasters — consider impacts to the infrastructure, the population, and the economy, Dan says.

"We look at where power outages are likely," he says. "For Houston, it would examine the possible national impact on petroleum supplies and whether we should worry about that."

They look at so-called food deserts: urban areas where food deliveries might be interrupted, he says.

NISAC also has found that some local officials want more demographic information. Officials in Florida, with its high retiree population, want to know where the elderly are concentrated, Dan says.

The most difficult part of an analysis is defining a scenario because every place is different and a wide range of agencies must reach consensus, he says.

Team activated for big hurricanes

Once NISAC is activated, the team focuses on exactly what's in the storm's projected path.

"Anytime a hurricane is going to make landfall in the US we're busy at some level. If it's going to be a Category 3 or higher you can pretty much figure we're going to go to full activation," Dan says. The decision whether to activate and to what degree comes from NISAC's program manager at the DHS, the Homeland Infrastructure Threat and Risk Analysis Center, known as HITRAC, part of the Office of Infrastructure Protection.

Mark helps lead NISAC's crisis response. When federal officials activate a team, he coordinates with HITRAC and Sandia's partners at Los Alamos, which has its own team doing analyses. The labs collaborate. For example, Los Alamos models and analyzes the impacts to electricity and metropolitan water systems, and Sandia uses those results to look at impacts to energy such as petroleum and natural gas or sectors such as transportation and banking.

He's also responsible for getting Sandia's team together, not just pulling in people, but identifying what expertise or simulation tools are needed. While a crisis response team always needs at least one economist to assess economic impact, a hurricane in Houston would require more analyses of the petrochemical sector than a hurricane in North Carolina, where agriculture could be a larger concern.

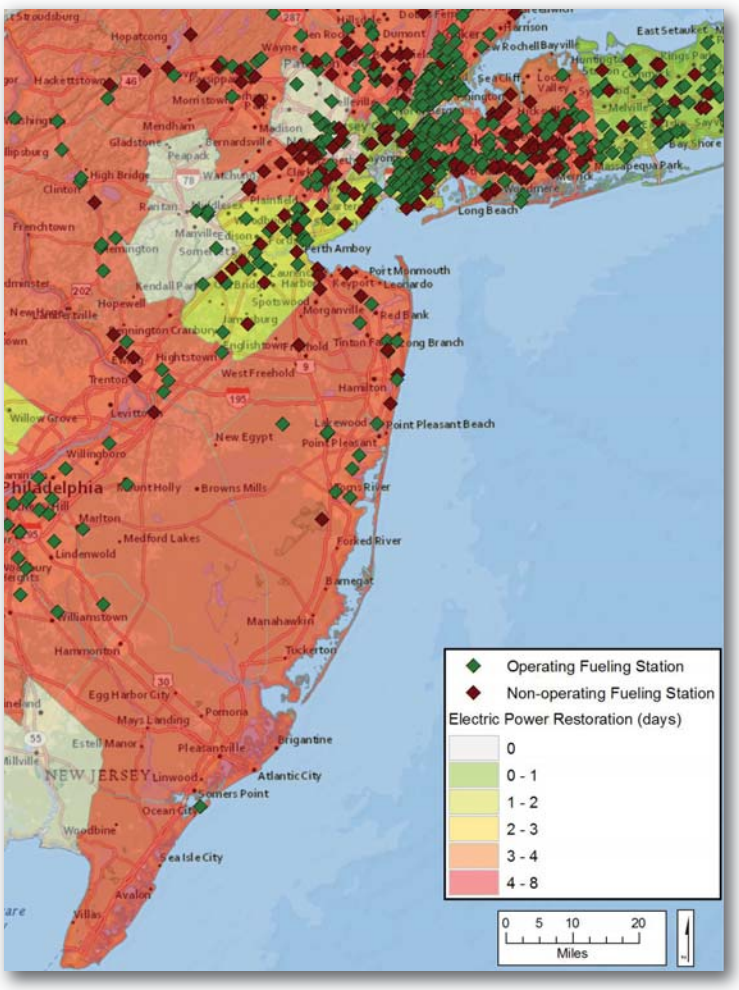
NISAC and HITRAC collaborate on how much time the team has before it locks in a prediction of the hurricane's track toward land. The National Oceanic and Atmospheric Administration issues regular landfall projections. At some point, NISAC has to lock in a storm track, or prediction, on which to base its analyses.

Dan says the amount of time for analysis is shrinking. NISAC had 48 hours for Hurricane Gustav, which hit the South in late August and early September 2008.

"They said that's too much time, the track can change too much in that time," Dan says.

The team had 24 hours to do its analysis for Hurricane Ike, which hit the Texas, Louisiana, and Mississippi coasts in September 2008. By the time Irene hit the East Coast in August 2011, the deadline had dropped to 12 hours. "We're roughly around 10 to 11 hours at this point," Dan says.

The team provides similar information as for a swath analysis, with less detail but using the hurricane's strength and what's in its path. While the report generally focuses on the projected track, sometimes the team adds a caveat that damage could be worse if the storm changes path.



HURRICANE PREPARATIONS — NISAC helped emergency response officials decide where to restore fuel supplies to gas stations during Superstorm Sandy last year. NISAC, or the National Infrastructure Simulation and Analysis Center, is jointly housed at Sandia and Los Alamos national laboratories and studies the interdependency and vulnerability of critical infrastructure and the consequences of having systems disrupted by disasters, including hurricanes. (Graphic courtesy of NISAC)

Questions spike when hurricane hits

The team also responds to a flurry of questions from DHS just before landfall. For Ike, Dan says, officials wanted to know which large Houston-area water treatment plants were most likely to lose power and could use one of three available FEMA generators.

For Sandy, NISAC's report identified subways in the storm surge zone and did some power outage modeling.

Questions usually spike after a hurricane hits. That was particularly true for Sandy.

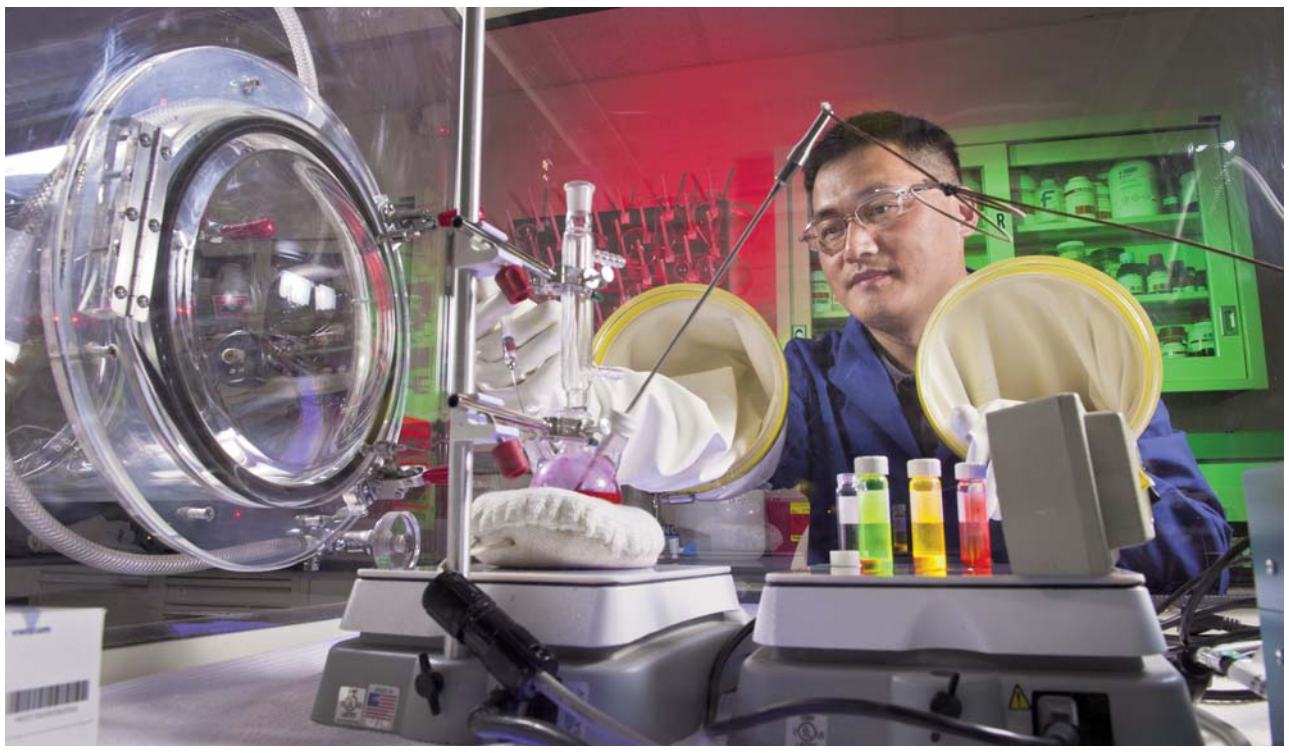
"You had this massive power outage and they were wondering, 'OK, we have these cell towers and a lot of them have diesel generators for backup. Those last 48 to 72 hours and the power isn't coming back in 48 to 72 hours. How do we prioritize that? Few of the gas stations have fuel, what's going on? Is it that they don't have power or because eight of the nine fuel delivery terminals in New Jersey were down?'" Dan recalls.

Sandy reversed the normal workload.

"Usually we have a lot heavier workload going into the hurricane before landfall and generally have tired people and a lighter workload afterward. On Sandy, we worked the opposite. We had a relatively light workload going in and then it got really busy," Dan says. "That was because it was that weird perfect storm."

Already 'outstanding poster' selected for international exhibit

By Neal Singer



SANDIA RESEARCHER Hongyou Fan was presented an "outstanding poster" award at the spring meeting of the Materials Research Society. His poster was judged "superior in technical content, appearance, graphic excellence, and presentation quality." (Photo by Randy Montoya)

Sandia researcher Hongyou Fan (1815) was presented an "outstanding poster" award at the 2013 Spring Meeting of the Materials Research Society (MRS).

Twelve posters received that honor out of 2,147 on display at the conference.

The certificate, presented by the meeting chairs, states that the work was "judged superior in technical content, appearance, graphic excellence, and presentation quality."

Further, the Sandia poster then was chosen as one of three — the best of the best — to represent the MRS in Cancun from Aug. 11-15 at the 22nd annual International Materials Research Congress. The invitation came with travel expenses paid, and Hongyou says he plans to attend. The other two posters emerged from Stanford and Drexel universities.

Emailed MRS program coordinator Paula Mahar, who notified Hongyou of both the national and international honors, "The poster sessions are a highlight of the MRS meetings and are one of the best-attended events. So, not only is the award something of distinction, it's also a very public honor."

The Sandia poster, titled "Solution-Based Nano-engineering of Multifunctional Coatings through Self-Assembly Techniques," reported progress in the self-assemblage of nanoparticles into ordered, three-dimensional films with uniform optical properties. The coatings, developed for near-infrared reflectors, bypass the harsh conditions imposed by conventional processing (chemical vapor deposition, sputtering, etc.), and so achieve improved functionality. The method also permits development of anti-reflective optical coatings through phase separation of light.

Collaborating with Hongyou on the work was Sandia fellow and University of New Mexico (UNM) professor Jeff Brinker (1002), Bruce Burckel (1712), former UNM postdoctoral fellow Zaicheng Sun, former Sandia post-doctoral fellow Huimeng Wu, and UNM graduate student Raid Haddad.

The work is supported in part by DOE Basic Energy Sciences and Sandia's Laboratory Directed Research and Development (LDRD) program.

A similar "outstanding" commendation was received at the Spring 2012 MRS meeting by Sandia postdoctoral student Binsong Li, a member of research group. Binsong presented a poster titled "Pressure-Directed Folding and Unfolding Self-Assembly of New Classes of Multi-Dimensional Nanostructures."

Ready to sign

(Continued from page 1)

"If we give them a shorter list and simplify the process good opportunities are more likely to be noticed," Bob says.

The ready-to-sign license is uncomplicated, with simplified language and pared-down terms, conditions, and reporting requirements. And it's lower cost. "We are offering relatively small up-front fees, in the $3,000 range, and low-percentage royalties," Bob says. "We don't want to impose a financial burden on a small business that needs cash flow."

BOB WESTERVELT

So far eight patents fall under the program, from a drive system for industrial applications that require high torque and low rpm to a compact spectrometer that can detect trace amounts of gases such as carbon monoxide and methane to a vehicle barrier that holds up to a powerful impact. More ready-to-sign licenses are in the pipeline and Bob says the group hopes to assemble a portfolio of about 50.

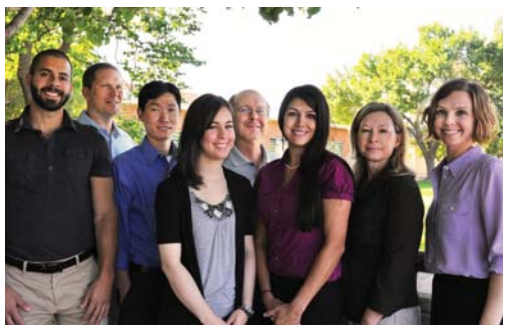
"We want a manageable number that can have the most impact," he says. "These are all technologies that no one has licensed in areas where small businesses might be able to get a foothold. A small company could take any of these licenses and run with it."

The licenses are non-exclusive, so any number of companies can make use of a technology. "It's not first-come first-served for the IP," Bob says. "If five companies are interested in a technology, all five can license it."

One has been signed so far. Advance Plumbing of Albuquerque licensed the Labs' Hedgehog water-purification technology (see below). Company President Vincent Sanchez says he signed on because of the simplicity of the licensing process.

"This was really easy to get into," he says. "I would not have looked at it if finding the technology and doing the agreement was a big process requiring certification and lots of financials and other reporting. I'm not in a position to do all that. If it's easy, I can say, 'Why not? Let's take a look.'"

Pete Atherton, senior manager of Industry Partnerships Dept. 7930, says Sandia is always looking for better ways to transfer technology for the public good. "The ready-to-sign program is a new component of our initiative to make licensing Sandia's technology easier and faster," he says.



SIGN HERE — Some of the Sandia/New Mexico team members who worked on the ready-to-sign licensing program are, from left, John Pavlakos (7932), David Wick (7932), Michael Beckett (11500), Jean Leger (7932), Chief Intellectual Property Counsel Kerry Kampschmidt (11500), Christina Vallejos (7932), Dept. 7932 Manager Mary Monson, and Brooke Garcia (7932). They came up with the idea of creating a standard intellectual property license with simplified language and pared-down terms, conditions, and reporting requirements.

Ready-to-sign licenses are listed on the Intellectual Property website at https://ip.sandia.gov/readyToSignLicenses.xhtml. A business owner can click on a technology to get information and download a PDF file with the paperwork. "You click on one link and it downloads everything you need," Bob says.

He says the Licensing group is looking for IP that would fit the ready-to-sign program. "We would like Sandians to suggest ideas," he says. "You might know of a patented technology that would have broader uses. There is so much good IP out there."

What's a Hedgehog?

By Nancy Salem

The Hedgehog water purification system was developed at Sandia after the US Environmental Protection Agency in 2006 lowered the allowable amount of arsenic in drinking water from 50 parts per billion to 10. New Mexico has about 100 communities with arsenic contamination in ground water.

"It wasn't a problem until the standard was revised, then all of a sudden a bunch of communities by law did have a problem," says Pat Brady (6910), lead researcher on the Hedgehog, the first Sandia technology to be licensed under the new ready-to-sign licensing program. "A lot of them were at around 15 parts per billion, just within sight of being in the clear."

Pat says a city the size of Albuquerque can afford the infrastructure and manpower to remove arsenic from water, which can cost into the hundreds of thousands of dollars. So Sandia focused on how small communities that get their water from the ground can affordably reduce arsenic. "We did an analysis that found the big costs are the infrastructure — building filter galleries — and operators," he says. "The Hedgehog is an attempt to solve the arsenic problem with no infrastructure and no people."

THE HEDGEHOG is a submersible recirculation pump with an attached filter that sits in the bottom of a water tower.

Hedgehog is a submersible recirculation pump with an attached filter bed that sits in the bottom of a water tower. It runs continuously, grabbing arsenic and other organic and inorganic contaminants as water runs through the filter. The Sandia-designed filter is replaced every few months.

"It's a simple idea," Pat says. "What made it cool for small communities is that most of them pump water from a well into a tower and add chlorine. The water flows by gravity into pipes, so the only infrastructure to work with is a well or water tower. By putting Hedgehog into the tower there's no need to build big filter galleries that have to be watched all the time. It works with what they have."

Pat says the Hedgehog, licensed by Advance Plumbing of Albuquerque, was designed specifically for small communities with arsenic-contaminated water. "This is the least expensive way to fix it," he says. "It gets the count down to 10 parts per billion and gets the towns out of trouble."

National Security Speaker Series

Stories by Sue Major Holmes • Photos by Lloyd Wilson

Adm. McRaven outlines future of Special Operations Forces

ADMIRAL WILLIAM McRAVEN

The commander of US Special Operations Command, Adm. William McRaven, says that while the nation will always need the military forces wearing the black balaclavas or flying the Black Hawks, most of what US Special Operations Forces do centers on helping other countries solve their own problems.

McRaven spoke during a June 18 National Security Speaker Series on "Special Operations Forces 2020," outlining his vision for the Special Operations Command and Special Operations Forces (SOF) in the future. He told a packed crowd at the Steve Schiff Auditorium that he expects the vision to be realized well before 2020. His talk was videoconferenced to Sandia/California.

McRaven, displaying a slide that read, "You can't surge trust," said SOF is building relationships around the world. They can't be built overnight, but relationships forming now among young officers moving up the ranks of the military in countries around the world will help solve global problems in the future, he said.

His talk focused on building networks, partnerships, and trust to avoid sending US forces to solve a problem. He said he wants "a good guy network overlaid on a bad guy network."

"There's no such thing as a local problem," he said. "People that think in this world today you can ignore what happens in Mali, or you can ignore what happens in Bahrain, or you can ignore what happens in the Pacific and that problem won't manifest itself later, they're just flat mistaken."

McRaven outlined ways the command is building collaboration between allies; between SOF and US agencies, national laboratories such as Sandia, academia, think tanks, and industry; and among US forces under separate commands worldwide. SOF operates in about 80 countries, and the Special Operations Command has 96 nation partners, he said. He has a dozen Special Operations Liaison Officers (SOLOs) assigned to SOF headquarters in partner nations and said he plans to have 40 such liaisons eventually.

Despite the far-flung network, he said he cannot issue orders directly to Navy Seals or any other team. "I don't command and control anything," McRaven said. Rather, he said, in contrast to what's portrayed in the movies, he works through military commanders in the various geographic theaters and through US ambassadors.

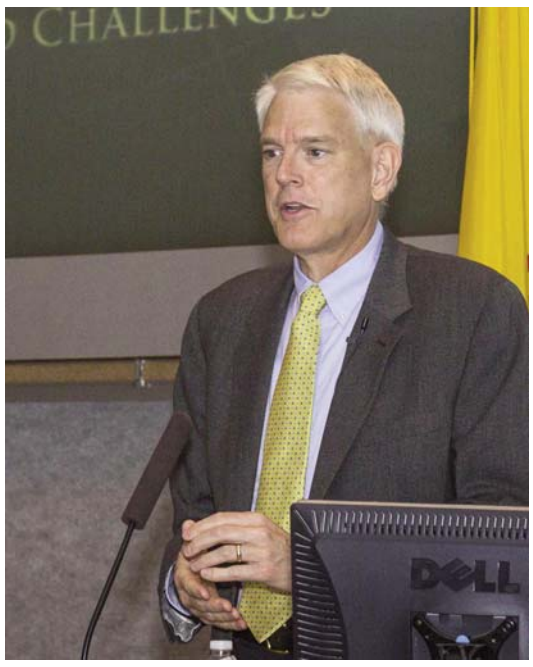
Building networks means being able to move information and people when needed, McRaven said. It also means getting people together to solve problems. To that end, he said he "energizes the network," regularly pulling together theater Special Operations and component commanders, liaison officers, and others for web-based talks involving 40 to 60 nodes online with 10 to 100 people at each node. He asks questions and if someone raises a problem, someone else on the network can help solve it, he said.

"That's the power of the network," he said.

McRaven also gave a picture of the average SOF operator: The average enlisted member is 29 and the average officer is 34. They average eight years' experience, are likely to have a college degree so they know how to think critically, they're married with two kids, and a large percentage enjoy problem-solving games such as chess.

Brookings Institution senior fellow discusses US-Russia arms reduction

Steven Pifer, director of the Arms Control Initiative and a senior fellow in the foreign policy program at The Brookings Institution, told a Sandia audience there's an opportunity for further arms reduction talks between the United States and Russia even before the New Strategic Arms Reduction Treaty (New START) takes full effect in 2018.



AMBASSADOR STEVEN PIFER

Pifer spoke during a June 18 National Security Speaker Series on prospects and challenges in arms reductions by the two superpowers, which control most of the nuclear weapons in the world. His talk to an overflow audience at the CNSAC auditorium was videoconferenced to Sandia/California.

Pifer, a former ambassador to Ukraine, listed challenges to getting arms reductions beyond New START. Further reductions would involve complicated verification, "requiring both the US and Russia to go beyond their comfort zone of the last two decades," Pifer said. And, he said, the US would have to figure out non-nuclear ways to provide assurance of the US security commitment to European allies. Central European and Baltic nations have an interest in reducing the Russian advantage in tactical nuclear weapons but want a continued US nuclear presence in Europe, he said.

"There are important opportunities out there," but also big obstacles in the way of those opportunities, Pifer said. Still, he said, it could be worth the effort.

Currently, there's a rough balance between the stockpiles of the two nations. A US-Russia agreement on further arms reductions could be done either through a single treaty covering everything but retired nuclear weapons or through reducing weapons systems on separate, parallel tracks, Pifer said.

Negotiations on a single, large treaty could encompass reducing the total number of both deployed and non-deployed warheads, setting additional reductions on deployed strategic warheads, and further limiting deployment of strategic delivery vehicles, Pifer said. Such a treaty could provide a tradeoff between Russia's numerical advantage in non-strategic weapons and America's numerical advantage in reserve strategic weapons, he said.

Even after those reductions, there would be "a clear distinction between the two world nuclear superpowers and the rest of the world," Pifer said.

However, since completion and ratification of such a wide-ranging treaty likely would extend beyond President Barack Obama's term, some have raised the idea of two parallel tracks for weapons reductions, he said.

The first track, which Pifer suggested could be accomplished in relatively short negotiations, would amend New START to solely reduce deployed strategic weapons. The second, which would require longer negotiations, would encompass reserve strategic and nonstrategic weapons, he said. It could be done in phases, starting with confidence-building measures and transparency on weapon numbers and types, moving perhaps to consolidating weapons at declared storage sites, and finally setting limits. But Pifer said some in the Senate might link their support for the treaty amendments to what Russia would do with its advantage in nonstrategic weapons.

Resolving differences between Russia and the US also might require a cooperative NATO-Russia missile defense arrangement for Europe, Pifer said. Such an agreement would require transparency, joint exercises and two independent but interacting missile defense systems to satisfy security concerns of all countries involved, he said.

CHECKING OUT RIFLESCOPE — Adm. William McRaven looks through the RAZAR, a US-SOCOM-funded adaptive optics zoom riflescope that uses variable focal length polymer lenses. Brett Bagwell (5331), a former Army Special Forces officer, is the optical engineer who led the development of the lenses and the riflescope design. RAZAR stands for Rapid Adaptive Zoom for Automatic Rifles.

STEVEN PIFER (left), director of the Arms Control Initiative and a senior fellow in the foreign policy program at The Brookings Institution, talks with Sandia President and Laboratories Director Paul Hommert and Jerry McDowell, deputy Labs director and Executive VP for National Security Programs. Pifer, as part of Sandia's National Security Speaker Series, spoke June 18 about prospects and challenges in arms reductions by the US and Russia.

Medical ordeal reveals caring from co-workers for new Sandia employee far from home

By Heather Clark

Cheryl Perich works in Lethality & Threat Dept. 5417, but her group's name belies the character of those who work there. She recently underwent a medical emergency that showed her their true nature.

Cheryl, a recent Cornell University graduate, had only been at Sandia a few months when she accidentally chopped off the pad of her left middle finger while cooking at home.

"I just froze and started screaming," she says.

The accident, surgery, and months of rehab were a nightmare for Cheryl, who was working her first full-time job in a new city and far away from family. But Cheryl also found she had a new "family," among her Sandia co-workers and friends.

After the accident, Cheryl — her friends say she was amazingly calm — called her co-worker Jeromy Hollenshead (5417) to ask for directions to an urgent care center. Cheryl's friend, Rachel Colbert (2615), immediately called her own mother, a physician's assistant, for advice and then drove Cheryl to an emergency room.

Rachel stayed with her friend, holding Cheryl's uninjured hand for eight hours while doctors sewed the pad of her finger back on and dressed the wound.

The next day, Cheryl says her finger was throbbing and numb, so she returned to the emergency room where doctors gave her antibiotics to treat an infection and sent her home, but a day later, a Saturday, Cheryl was awakened by pain shooting up her arm and discovered her finger was swollen to nearly four times its normal size.

Cheryl called another friend, Lia Kashdan (2615), who drove her to the hospital where, following a 10-hour wait, Cheryl was told she needed surgery to treat infection.

Cheryl's family members wanted to jump on the first plane headed West from their home in Chicago, but Cheryl asked them to stay home because of the support she had. While Cheryl was in surgery, Rachel says she, Lia, and Tiffany Mayfield (2990) coordinated their schedules to make sure someone was with Cheryl at the hospital, especially when she awakened.

For three days, Cheryl's friends and co-workers visited her at the hospital, but their kindness didn't end there. Cheryl's co-workers Jeromy, Ray Dukart, and Arne Gullerud (all 5417) cooked meals or provided food. Books and cards arrived. Her manager, Gene Hertel (5417), and others made daily phone calls to make sure Cheryl was recovering.

Jeromy says the group values mentorship, a culture started by his "work dad," Ray. Jeromy thinks of himself as Cheryl's "work dad."

"I have a daughter who's 19 years old and I would want somebody to be there for her," Jeromy says.

THAT'S WHAT FRIENDS ARE FOR — Arne Gullerud, left, and Jeromy Hollenshead, right, (both 5417) were two of the co-workers who supported Cheryl Perich (5417), seated, during a recent medical ordeal by giving her advice, helping provide her meals, moving her office equipment, and helping her meet her work deadlines. (Photo by Bob Clancy)

"When you're by yourself in a new town and it's before you know anyone, something could happen and no one would know."

While she was recovering at home, back at work Cheryl's office had to be moved, so her co-workers packed up her entire office for her.

When Cheryl returned to work, co-workers were shocked to see her arm in a full cast. Two hours a day of intravenous antibiotics left her pale and weak, and multiple appointments with her surgeon and wound care were needed.

"I would come back to work and still be in a lot of pain," Cheryl recalls, but through it all Gene insisted she take care of herself and take the time off she needed to recover.

As her project deadlines neared, Cheryl says Jeromy and her co-worker Arne ran computer simulations that modeled impact or shock wave propagations for her while she provided the code input.

Cheryl was so grateful for her co-workers' support that she emailed David Keese, director of Integrated Military Systems (5400), to let him know.

"I think it's really important to understand that Sandia's not just a place that you work and they aren't just your co-workers, they're your friends and your family," Cheryl says. "I really feel that way. I've never been in an environment before where I felt so comfortable and felt that people cared about me as a person and not just as an employee."

David agrees with Cheryl's assessment. He writes: "I have often thought of our team as family (and spoken of them as such to others). Stories like yours reinforce that belief. I am convinced that we work with some truly great people, not just intellectually but from a kind and caring perspective as well."

Cheryl's physical therapy for her hand ended in May and save for a small incision scar at the base of her finger, you'd never know she had been so badly hurt. Should anything happen to one of her co-workers — and she hopes nothing will — Cheryl says she'll be first in line to pay it forward.

Fixing and fortifying the grid

Sandia deploys Energy Surety Design Methodology to assist on civilian grids

By Stephanie Holinka

Sandia will help eastern communities devastated by Hurricane Sandy boost the resiliency of their electric grid so they can be better prepared to deal with natural disasters.

Sandia's Energy Surety Design Methodology (ESDM) is a quantitative, risk-based assessment approach that has been applied at more than 25 sites nationwide, primarily military facilities, in cooperation with more than 20 local and regional utilities.

The first civilian project is planned for New Jersey, where DOE and the city of Hoboken Public Service Electric & Gas Company (PSE&G) entered into an agreement under which Sandia will deliver a conceptual design of an energy-resilient "smart grid" for Hoboken to help the city rebuild and upgrade its electricity infrastructure damaged by Sandy. The project is scheduled for completion in October.

Mike Hightower (6114), Sandia project lead, says the evaluation teams will look at unlikely but high-impact events that have long outage durations, potentially a week or longer. These include events like hurricanes and flooding and other natural disasters.

Mike says the work seeks cost-effective ways to improve the resiliency of the electric grid to ensure that basic services can be maintained for such essential customers as hospitals, critical government services, emergency response and critical infrastructures.

"Most utilities design for normal operations and to withstand high-probability, low-consequence events. Utilities do not analyze low-probability, high-consequence events because it's difficult to recover costs for that planning," Mike says.

Sandia also will provide help for two grid projects being developed in New York — one in Manhattan's financial district, and one on the Rockaways Peninsula in Long Island.

Sandia senior manager Bob Hwang of Grid Modernization and Military Energy Systems group 6110 says past projects have demonstrated that the ESDM approach enhances reliability, makes the energy system more resilient, and improves renewable and distributed-energy use, while allowing the configuration to operate efficiently in both grid-tied and islanded configurations.

The project is in response to the increased intensity and frequency of natural disasters — attributed to a hotter, wetter atmosphere that triggers increased weather activity — which cause the bulk of power outages. According to NOAA, prolonged electrical outages, largely because of storms, have been steadily increasing in frequency since 1995.

Recovering from big events

Researchers will look for ways to shore up the Hoboken power grid so it can adapt to and recover from large-scale disruptive events. This will minimize the catastrophic consequences that affect quality of life, economic activity, national security, and critical-infrastructure operations, Bob says.

"At the end, the tradeoffs for all the projects are cost vs. performance. If you design an energy infrastructure to withstand a 200-mph wind, it would be very expensive, and you might never see a storm that big. In many cases, ensuring you can maintain critical services is a worthy goal. We can generally quantify system performance vs. cost for the big events. This is useful for utilities and the communities they serve," Mike says.

Abe Ellis (6112), project lead for Sandia's planned work in New York's financial district, says ESDM includes using modern communication and energy-management and control technologies to enable distribution system feeders to operate both when tied to the grid and when cut off. In this way, the feeders are able to use renewable and distributed generation, as well as storage and demand response that improve efficiency when grid-tied, and can enhance local energy reliability and resiliency when separated from the grid.

Dave Robinson (1464), Sandia's technical project lead for the Rockaways project, says Rockaways, which suffered large-scale damage during Sandy, is different from other systems Sandia is evaluating.

"Projects in other locations focus on identifying weak points and isolating vital services. But Rockaways' vulnerability to storms means that the approach used in that location could look quite different from solutions for communities further inland and on higher ground," Dave says.

"We're expecting to focus the framework on a solution that can bring the power systems up quickly, by strategically placing localized power sources such as generators, solar systems, and storage and networked control devices, while hardening the system against power failure as much as possible," he says.

The work is funding by DOE's Office of Electricity Delivery and Energy Reliability (OE).