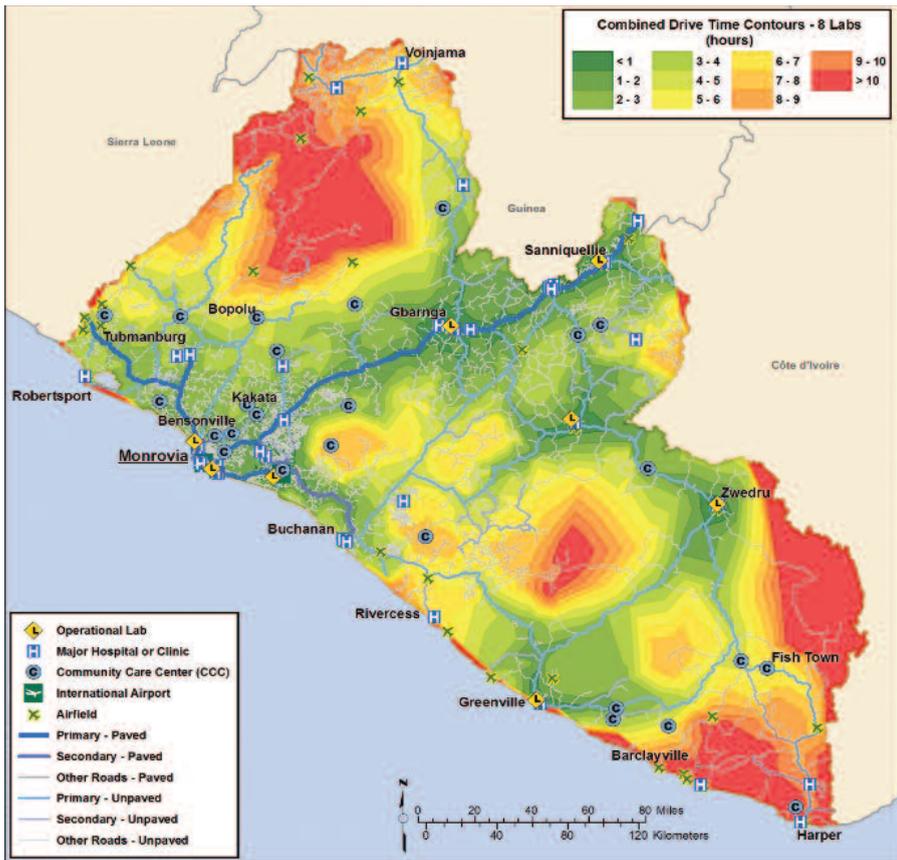


Fighting Ebola



Sandia models and improves Liberia's clinical sample transport system

Expertise could be useful in fighting disease outbreaks elsewhere

By Heather Clark

As Monear Makvandi (6825) climbed the rickety staircase to the top of a guard tower to view Island Clinic Ebola Treatment Unit in Monrovia, Liberia, the infectious disease epidemiologist hesitated momentarily about whether to grab the rail for safety or to avoid touching it, even though the scientist in her knew there was no chance she could be exposed to the deadly Ebola virus.

Emerging from the stairwell, Monear, project lead for a Defense Threat Reduction Agency and United States Strategic Command Center for Combating Weapons of Mass Destruction (DTRA/SCC-WMD)-sponsored project to model and assess the blood sample transport system in Liberia, looked down on a courtyard where three adults and two children sat listlessly in plastic lawn chairs waiting for word that they were free of the virus.

Later, outside the Ebola treatment unit's gate, Monear, manager Jen Gaudioso (6825)

(Continued on page 5)

SANDIA RESEARCHERS mapped Ebola treatment units, diagnostic labs, routes and drive times across Liberia to reduce the time it takes for patients' blood samples to reach labs for testing. The information in this map helped inform the analysis used to recommend a sample transport system so Liberia could more quickly diagnose patients. (Image courtesy of Sandia National Laboratories)

Anthrax detector takes home national tech transfer award

By Nancy Salem

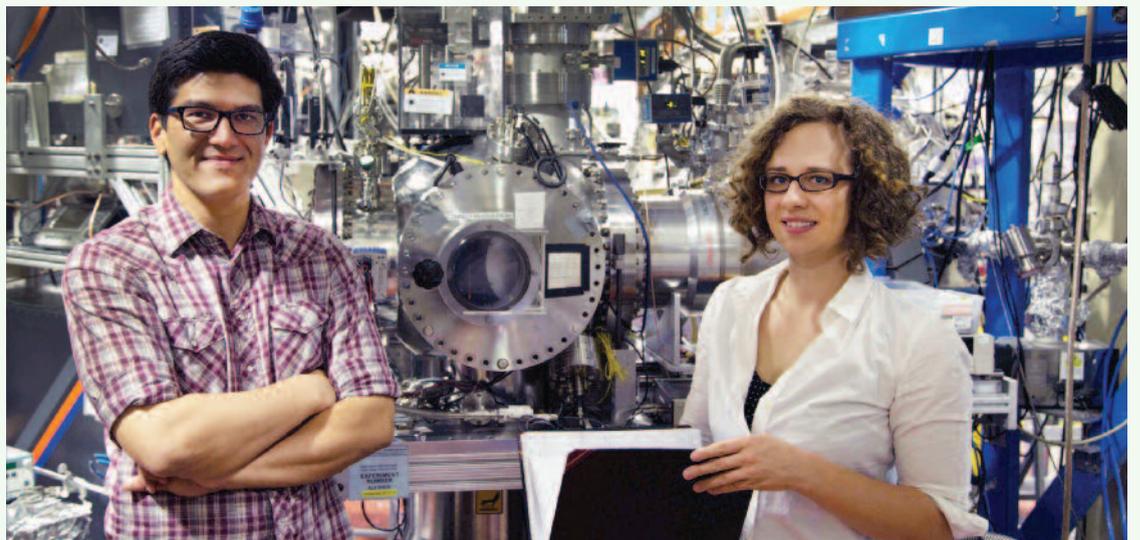
Sandia won the national Federal Laboratory Consortium's (FLC) 2015 Award for Excellence in Technology Transfer for a credit card-sized device that can detect bacteria that cause anthrax.

BaDx (Bacillus anthracis Diagnostics) works in places with no power, refrigerated storage, or laboratory equipment. It requires minimal or no training and makes anthrax testing safer, easier, faster, and cheaper.

The award recognizes employees of FLC member laboratories and non-laboratory staff who have accomplished outstanding work in the process of

(Continued on page 4)

Direct measurement of key molecule will increase accuracy of combustion models



COMBUSTION SLEUTHS — John Savee (8353), left, identified cycloheptadiene as the best fuel for creating a detectable QOOH, and Sandia computational expert Ewa Papajak (8353), right, and her adviser, Judit Zádor, used quantum chemistry to explain the mechanism of the reaction. John and Ewa appear in front of an instrument, the Multiplexed Photoionization Mass Spectrometer in the Advanced Light Source at Lawrence Berkeley National Laboratory, that took direct measurements. (Photo by David Osborn)

By Holley Larsen

Sandia researchers are the first to directly measure hydroperoxyalkyl radicals — a class of reactive molecules denoted as “QOOH” — that are key in the chain of reactions that controls the early stages of combustion. This breakthrough has generated data on QOOH reaction rates and

outcomes that will improve the fidelity of models used by engine manufacturers to create cleaner and more efficient cars and trucks.

A paper describing the work, performed by John Savee, Ewa Papajak, Brandon Rotavera, Haifeng Huang, Arkke Eskola, Leonid Sheps, Craig Taatjes Judit Zádor, and David Osborn (all 8353) and Oliver

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Sandia sisters show school kids that they, too, can be engineers

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How to be an effective principal investigator 9

Sandia marks Engineers Week 2015

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That's that

In the purest, technical sense – in a mechanical sense – it's probably not accurate to say that I write this column, if by "write" you mean take a pen in hand and scrawl words on paper. It's been a long time since I've written that way, except to take notes that I subsequently have to struggle to interpret.

And there are those who, observing my work habits, would argue that it's not even accurate to say that I type this column, if by "type" you mean placing your two hands on a keyboard and letting your 10 fingers fly seamlessly over the letters. No, the best description of how this column comes about is that I tap it out with two fingers. Not exactly elegant but I've become pretty proficient over the course of time. One of my early bosses at Sandia, in fact, once snuck up behind me and stood there looking over my shoulder while I worked. When I became aware of his presence, I glanced up and he said, "Didn't mean to interrupt; I'm just amazed at how fast you can do that . . . type with two fingers."

What brings up this subject is that I am now reduced to typing with one finger; my right arm is in a sling and will remain so for another month. I'm doing all my typing – and mousing, for that matter – with my left hand, which does get tiresome. And it's slow. But as I peck away, I can take some satisfaction in knowing that I'm in good company: In an interview conducted not all that long ago, George R.R. Martin, author of *The Game of Thrones* series, revealed that he types with one finger. And he's done pretty well, I'd say.

Regarding the sling, I had shoulder surgery to repair some damage that I should have addressed 20 years ago. My advice: If you're walking around with fixable injuries, don't put it off. If something can be fixed, fix it sooner rather than later, because sooner or later, the choice will be out of your hands.

In going through this process, I've been astonished by the technology and the technical competence that is brought to bear on medical challenges such as mine. From the diagnostic MRI, to the almost miraculous arthroscopic surgery – I had major work done through a couple of teeny little holes in my shoulder – to the skillsets of the practitioners who took care of me at the hospital – which is itself a system of systems – and the dedicated physical therapists who are helping me get my shoulder back in shape, I am really in awe of our medical infrastructure. A lot of people had to study awfully hard, sacrificing for years, to learn the skills they needed to help me get better. And that says nothing about the scientists and engineers who slogged away when the going got tough to conceive of and develop the underlying technologies. Can there be any other response but gratitude?

* * *

One more thing about this sling. I am fully aware that my disability, such as it is, is a temporary one, and in the grand scheme of things doesn't amount to a hill of beans. My shoulder will get better and in the wink of an eye I'll have full use of my arm again for the first time in I don't know how long. While I'm sort of making light of my situation, I know there are plenty of people, including not a few at Sandia, who deal with much more serious, long-term disabilities, and do so with a courage and grace that I'm not sure I possess. In the face of that, can there be any other response than humility?

* * *

Speaking of gratitude, I am coming up on a major career milestone. In early March I mark 20 years at Sandia. It's been an incredible and life-changing experience for me and my family. I don't mind saying that I consider it a privilege to be associated with this great institution. I know I've written about this before, but I often think of what NNSA DP head Don Cook said during a visit here a couple of years ago: "If Sandia fails, the deterrent fails." That's a sobering thought.

A couple of issues back, when writing about leadership changes here, I quoted the George Jones song, *Who's gonna fill their shoes?*, making the case that we have an abundant cohort of leaders ready to step up at any time. At the individual leadership level, that is absolutely true. But when it comes to Sandia itself, think about what Don Cook said: There isn't any alternative; we're it. And most of us, I'd wager, wouldn't want it any other way.

See you next time.

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

Sandia creates dedicated snack bag recycle process

By Stephanie Holinka

This year, for the first time, Sandia has begun collecting snack bags for recycle, opening up another waste stream to divert trash away from landfills.

In 2014, Sandia recycled about 4,619 snack bags, or around 49 pounds. Although it's a small amount, it's a type of waste that wasn't previously recyclable; a type of waste that would remain in a landfill essentially forever.

"Snack bags often contain plastic laminates or are metalized to proprietary standards that render them non-recyclable to common municipal recycle programs," says Samuel A. McCord, solid waste recycling planner in Waste Management & Pollution Prevention Dept. 4144.

As part of their sustainability program, Frito Lay and their partners sponsor the collection of their product containers for processing. To qualify for the program, recyclers must ensure the snack bags are empty prior to transport.

"Without sponsorship, it would not be economically feasible at this time otherwise," Sam says.

Bags were collected during several Sodexo-catered Zero Waste events where snack bag food was sold or provided, and also at the snack shop in Bldg. 898U, the Atomic Café in Bldg. 810, the hazardous waste facility office trailers, and in Bldgs. 861 and 960.

The bins are from a line of school-design recycle bins, repurposed from collecting paper to collecting snack bags. Look for them at an eating location near you.

Retiree deaths

Harvey Brewster (age 79)	Oct. 15
James Drake (96)	Oct. 19
Conrad Stayner (71)	Oct. 19
George Rodgers (94)	Oct. 21
Paul Benson (84)	Oct. 27
Robert Baker (83)	Oct. 28
Alphonse Rakoczy (91)	Oct. 31
Duane Carr (57)	Nov. 8
Carter Broyles (90)	Nov. 10
Alfred Switendick (83)	Nov. 10
C. Douglas Buck (72)	Nov. 12
Robert House (89)	Nov. 14
Paul Adams (92)	Nov. 16
Gertrude Piraino (96)	Nov. 16
Clifton Kinabrew (82)	Nov. 19
Richard Traeger (82)	Nov. 19
A. Carabajal (85)	Nov. 21
Robert Garcia (89)	Nov. 21
Wilbert Wood (82)	Nov. 21
Ruth Llamas (61)	Nov. 25
Ursula Rounds (74)	Nov. 27
Carl Hullinger (89)	Nov. 28
Benjamin Benjamin (92)	Nov. 30
Joseph Curzi (80)	Nov. 30
Helen Anderson (97)	Dec. 1
James Wright (77)	Dec. 2
Juan Perea (91)	Dec. 5
James Plimpton (84)	Dec. 7



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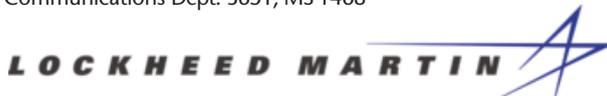
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Sandia's Reducing Global Nuclear Dangers Mission Area

Presents

Current State of Nuclear Weapons Development and Cooperation with Russia, China, and North Korea

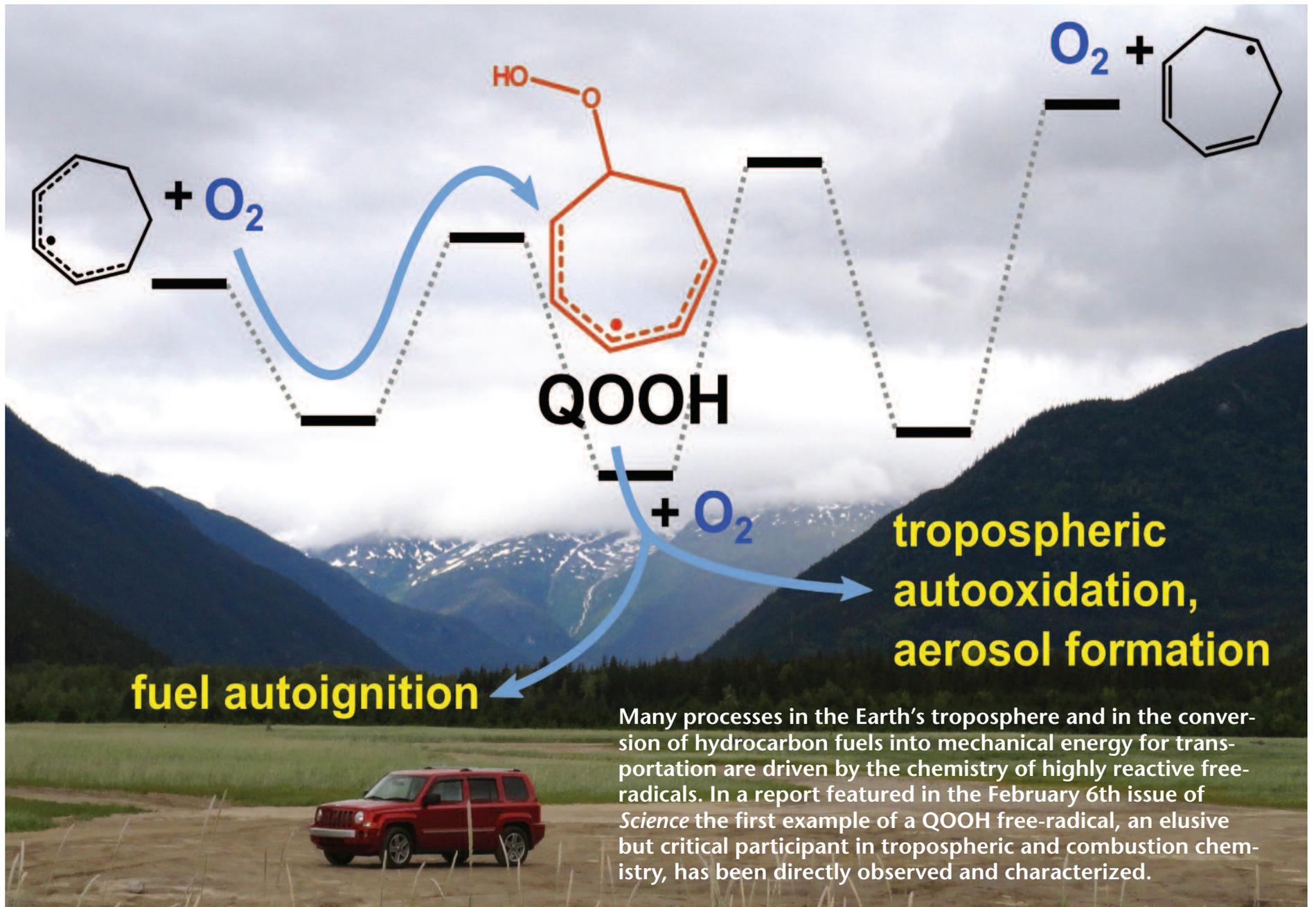
Guest speaker

Dr. Siegfried S. Hecker

Professor, Stanford University Department of Management Science and Engineering;
Senior Fellow, Freeman Spogli Institute for International Studies

9:15 am to 10:15 am, February 26, 2015
CNSAC Auditorium (Bldg. 810)

For more information, contact Gary Laughlin | 844-2787



Increasing accuracy of combustion models

(Continued from page 1)

Welz of the University of Duisburg-Essen (and former Sandia postdoc), at Sandia's Combustion Research Facility, is featured in the Feb. 6 edition of *Science*.

Thousands of chemical reactions are involved in the conversion of a fuel's chemical energy into mechanical work in an automobile engine. The fleeting molecules that initiate, sustain, and then increase combustion are radicals: short-lived molecules that readily react and form new chemical bonds. Although many aspects of combustion are well established, a veil still covers ignition, the early stage of this process, and the chemistry that determines whether a fuel-air mixture will ignite rapidly, react slowly, or extinguish.

Decades of research worldwide have shown that QOOH must be a central connection in the network of ignition reactions. Researchers learned this by studying the products of ignition chemistry, looking at this web of reactions from its perimeter and working inward, gradually deducing the nature of the "reactive intermediate" molecules that must lie at the center.

Unlocking combustion's secrets

Nearly 10 years ago, Sandia researchers designed a new instrument, the Multiplexed Photoionization Mass Spectrometer (MPIMS), to directly probe all kinds of intermediates, including the species that are at the center of important webs of reactions. In 2012, the Sandia team, together with colleagues from the University of Manchester and Bristol University in England used the MPIMS to directly measure reaction rates and products of the "Criegee intermediate," a crucial reactive molecule in the web of reactions that occur in atmospheric chemistry. (See the Jan. 27, 2012 issue of *Sandia Lab News*.)

"We not only measured the Criegee intermediates and provided fundamental knowledge about Criegee reactions," says Craig, manager of Sandia's combustion chemistry department. "We also disclosed to other researchers the process for generating and measuring the intermediates on their own. The impact has been enormous, as others have taken this knowledge and put it to work."

QOOH was next in line.

Sandia California News

But even with processes and tools in place, creative thinking was called for, says David, the chemist who headed the Sandia team. "We needed a specialized strategy to create enough QOOH radicals to detect, and we needed to determine the spectral fingerprint of a QOOH molecule, so that we would recognize it if we created it."

The path to QOOH

Chemist John Savee came up with that strategy. Putting his knowledge of combustion chemistry to work, John helped pinpoint the best fuel for producing a detectable QOOH. He chose cycloheptadiene, a molecule with seven carbon atoms arranged in a ring.

Initial experiments seemed to prove John's ideas were right, and the team turned to its computational experts, Ewa and Judit, who used quantum chemistry to predict what the experimentalists should have observed. Agreement between the two approaches would aid in confirming the discovery.

For the direct measurements, the team moved the MPIMS to the Advanced Light Source, a synchrotron user facility at Lawrence Berkeley National Laboratory. The intense tunable light created by the synchrotron allowed the team to measure spectral fingerprints of molecules, deducing the particular arrangement of atoms that gives a molecule its identity.

They confirmed that the spectrum of the radical they observed matched that predicted by Ewa and Judit, showing that it was in fact a QOOH molecule, rather than some other possible arrangement of the same atoms. Once again, the coupling of experimental results with computational verification gave the team confidence that they had detected and were measuring QOOH.

This teamwork was essential, says David. "Everyone on our team sits under one roof in the Combustion Research Facility. This means we can quickly marshal experts from different fields to attack a problem on multiple fronts, leveraging ideas and sparking creativity. When we confirmed we were seeing the center of the

early combustion web, and could measure how QOOH was created and consumed, that was a thrill."

The particular QOOH radical the team detected has a relatively long lifetime, reacting much more slowly with oxygen than any previous estimates. The impact of this class of QOOH radicals, which the team predicts will all have long lifetimes, is not yet clear, and their data will be incorporated into the latest combustion models to test its impact.

Interestingly, the same class of QOOH radicals has recently been proposed as a key intermediate that converts hydrocarbons in the atmosphere into small aerosol particles that impact health, visibility, and climate. Present models of atmospheric aerosol formation can't match the rate and size growth of these particles, and the QOOH intermediate may help bring observations and models into agreement.

Knowledge is growing

With work done at Sandia and elsewhere, knowledge is growing about the chemical pathways of hydrocarbon oxidation. "We've been working on this reaction network from all sides for many years," says Craig. "Now that we have directly measured reaction rates for a QOOH radical, we've filled in a large part of the picture."

The researchers acknowledged there is still much to do to create a complete and accurate model of ignition or atmospheric oxidation. For example, measurements of other, more reactive QOOH species will be important for predicting ignition and oxidation behavior of a range of fuels.

"We know from our experience with the Criegee intermediate that researchers around the world will make great use of this information," adds David. "And because these oxidation processes are important in many areas, including atmospheric studies, the impacts are likely to reach far beyond combustion."

This research was funded by the Office of Basic Energy Sciences in DOE's Office of Science.

Anthrax

(Continued from page 1)

transferring federally developed technology. A panel of experts from industry, state and local government, academia, and the federal laboratory system judge the nominations.

A Laboratory Directed Research and Development (LDRD) project in Sandia's International Biological Threat Reduction Program led to BaDx. While a large team helped develop the detector, the FLC award recognizes Thayne Edwards (1714), Melissa Finley (6825), and Jason Harper (8631). They will receive the award April 29 at the FLC national meeting in Denver, Colo.

The technology was licensed to Aquila, a New Mexico woman-owned small business that specializes in the design and manufacture of technologies and services for nuclear security and international safeguards.

"It has been a remarkable experience to not only work with a Sandia research team in developing cool technology, but also with dedicated business partners to transfer that technology to," Thayne says. "The awards that have recognized these efforts are another reminder to me of the great people I get to work with and the reward of solving difficult problems together."

Jackie Kerby Moore, manager of Technology and Economic Development Dept. 1933 and Sandia's representative to the FLC, says the competition for this year's award was especially tough. "Sandia's BaDx technology transfer recognition was one of only three selected across all of the Department of Energy laboratories for successful technology development and deployment," she says. "It is very satisfying to be recognized by our peers."

A deadly bacteria

Bacillus anthracis, the anthrax bacteria, is found in soils worldwide and can cause serious, often fatal, illness in humans and animals. It can survive in harsh conditions for decades. Humans can be exposed

through skin contact, inhalation of spores, or eating contaminated meat.

Currently, samples must be propagated in a laboratory that uses specialized tools requiring a consistent power supply not always available in the developing world, says Melissa, who helps veterinary labs in less-developed countries improve safety, security, and efficiency at diagnosing infectious diseases. "Working with dangerous samples like *B. anthracis* spores places laboratory staff at risk," she says. "Concentrating many positive test samples in a lab could also tempt someone to

B. anthracis spores. A field technician puts a sample swab into the amplification chamber, which contains selective growth media. The device then uses a lateral flow assay, similar to a common pregnancy test, to detect the *B. anthracis*. Magnetically operated valves allow the sample to advance from stage to stage to complete the testing process. A colored line appears on the device several hours later if the test is positive for the bacteria.

The technician can then initiate a chemical process that sterilizes the device, avoiding the risk of positive samples accumulating and falling into the wrong hands. "The device amplifies the *B. anthracis* so it can detect as few as 100 spores instead of the typical 1-10 million required for detection," Jason says.

Jason and Thayne developed the microfluidics platform with the patent-pending magnetic valves that move the sample through the testing process. Bioscientist Bryan Carson, with technologists Jackie Murton and Bryce Ricken (all 8631), developed the selective media, and worked on building and testing the device, as well as helping to develop the decontamination strategy. Nanotechnology researchers George Bachand (1132) and Amanda Carroll-Portillo (8631) are working on improved strips for the lateral flow assay. Bill Arndt (6825), a researcher in the International Biological Threat Reduction Program, who regularly works in the developing world, provided guidance on device design.

"This is a wonderful example of where very sophisticated technology

has enabled a practical solution to a very important problem" says Pete Atherton, senior manager of Industry Partnerships Dept. 1930. "Aquila has been a great partner for several years and their commercializing of this technology will help us fulfill our mission of serving the public good."

The FLC is a nationwide network of about 300 members that provides the forum to develop strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace.

The FLC Awards Program annually recognizes federal laboratories and their industry partners for outstanding technology transfer efforts and has become one of the most prestigious honors in technology transfer. Since its establishment in 1984, the FLC has presented awards to more than 200 federal laboratories.



SANDIA SCIENTISTS, from left, Jason Harper (8631), Melissa Finley (6825), and Thayne Edwards (1714) show a BaDx anthrax detector. The three were recognized by the Federal Laboratory Consortium for their work in commercializing the BaDx technology. The detector was licensed by a New Mexico company. (Photo by Randy Montoya)

steal positive anthrax samples for nefarious uses."

Another barrier is cost. "Farmers in many developing countries don't make a lot of money, so they don't pay for diagnostic testing often," Melissa says. "When they do, they can't afford to pay a lot for it."

The most common diagnostic test for anthrax costs around \$30, which is out of the reach of many farmers, perhaps discouraging them from testing animals they suspect as infected, Melissa says. The new device, which is like a pocket-sized laboratory, could cost around \$5-\$7 and does not require specialized tools.

Complex, sensitive, but simple to operate

BaDx needs no battery or electric power or special laboratory equipment. It's hardy against wide temperature variation and can detect very small numbers of

Sandia, University of Illinois sign research agreement

By Neal Singer

Sandia and the University of Illinois at Urbana-Champaign (UIUC) have signed an extensive five-year agreement to solve science and technology problems of national importance.

The partnership has three principal goals: solve big problems, sustain and engage human capital, and accelerate technology adoption.

The agreement is expected to augment connections between national research universities and federally funded research and development centers such as Sandia.

The project's goals include providing opportunities for students and faculty to experience research work at a national lab; joint recruiting of top graduate students, postdoctoral fellows and faculty; increasing transfer of technology from Sandia and the university to the private and federal sectors; and collaborating to address nationally significant problems.

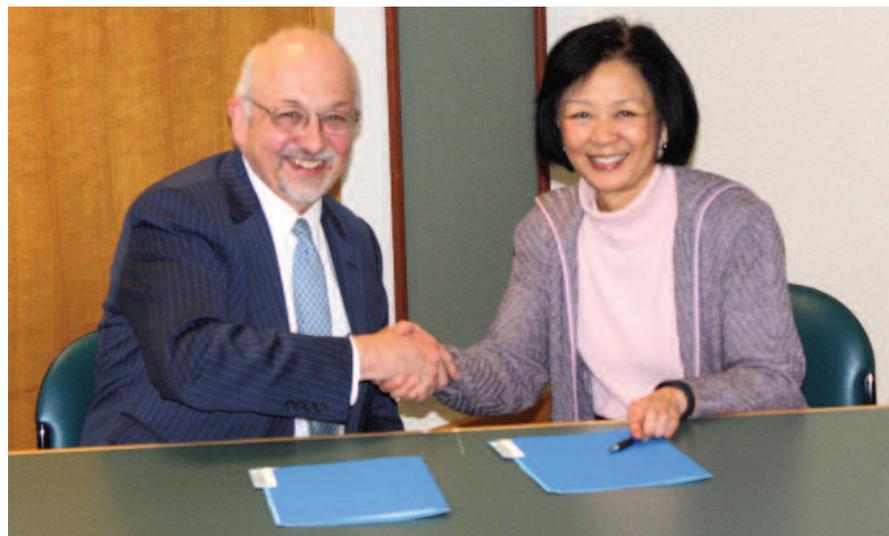
Said Sandia President and Labs Director Paul Hommert, "This agreement advances the long-standing partnership that we have with the University of Illinois to a more strategic level and will serve as a model for productive collaborations between Sandia and other national research universities."

UIUC Chancellor Phyllis Wise said, "We are excited by the potential this partnership presents. With a greater Sandia presence here in Champaign-Urbana and an Illinois presence at the Sandia campus, there will be a two-way street of innovation that fosters the development and actualization of radical new technologies that support future research relationships."

Said Russ Skocypec, Sandia's campus executive for UIUC, "As this relationship unfolds, the guiding ideology will be that of a culture of collaboration that propels this country's research agenda forward."

Jeffrey Binder, director of UIUC's Applied Research Institute, which will host Sandia at its facility in UIUC's Research Park, said, "This partnership will help the University of Illinois establish a firm foothold in emerging technical arenas such as digital manufacturing and data science, and it provides Sandia a clear conduit to the technical and human capabilities on this campus. We're enthusiastically setting a program in motion that will help improve national security and commercial opportunities over the coming years."

By fostering collaboration between a national lab and a prominent national



SANDIA PRESIDENT AND LABS DIRECTOR PAUL HORMMERT and University of Illinois Chancellor Phyllis Wise celebrate the signing of the MOU. (Photo courtesy UIUC)

research university, the partnership will take a multidisciplinary approach to solving big national problems and to introducing new technologies into the industrial and federal marketplace. A key goal is to engage early-career researchers at both institutions to work on complex problems of practical importance.

The partners plan to significantly increase interactions between the two campuses by spring. In the future, opportunities for joint faculty appointments and for research sabbaticals are expected to further intensify collaborations. To accommodate vital national needs, UIUC also expects to establish a classified research program in national security, energy and environmental technologies, and economic competitiveness.

Fighting Ebola

(Continued from page 1)



JEN GAUDIOSO (6825), manager of the International Biological and Chemical Threat program, washes her hands in bleach before entering a hotel for meetings with US aid organizations in Liberia. (Photo by Monear Makvandi)

and complexity scientist Tom Moore (6132), watched from an SUV as a survivor was discharged from the clinic. They were told the man's possessions were burned when he was admitted, so he was provided with clean hospital scrubs to wear, a week's worth of beans and rice, and \$10 for his journey home. No one was there to meet him. Due to lack of communications, his family likely did not know whether he was still alive.

Seeing the suffering, Monear hoped Sandia's assessment of how patients' blood samples are transported from Ebola clinics to diagnostic laboratories for testing would result in quicker reporting of diagnoses and shorter waits for patients.

In the project's first month, the Sandia team developed a set of performance requirements for a new nationwide sample delivery system that is being adopted by the Liberian Ministry of Health, says Jen, manager of Sandia's International Biological and Chemical Threat Reduction program.

"Prior to our analysis, samples were being transported from treatment units to labs on an ad-hoc basis. We developed a system and the country is implementing our system," she says.

Reducing wait time key in controlling Ebola

When Liberians suspect they have Ebola, they check into large, open waiting rooms, usually lined with beds, called Ebola treatment units (ETUs). Their blood is drawn and they wait, sometimes for days, to learn their fate. During that wait, patients afflicted with less serious diseases might mix with Ebola sufferers and contract the virus there, exacerbating the epidemic.

While Sandia's work is only one project among many that provide international assistance in Liberia, it's important to help control the epidemic because patients get the care they need faster. The sooner public health professionals can identify Ebola carriers, the sooner they can locate people outside the clinic who had contact with a carrier and might be infected, say Tom and Pat Finley (6131), who led the computer modeling effort.

The project also enhances US national security. "Fundamentally, there's the concern that Ebola will come to the US. The only way to prevent that from happening is to control the disease at the source," Jen says. "The other fundamental national security interest, in countries that are already challenged, is stability. If the disease continues to progress in an uncontrolled fashion, that will lead to further instability in these countries in areas where there are active terrorist groups seeking haven."

Fast, operational response to a dynamic situation

Monear, who has a cousin who was born in Liberia, was eager to put Sandia's resources to work to help control the Ebola outbreak.

"I made a conscientious choice to come work at a national lab and focus on biological threat reduction and global health security. With our national security mission, we're able to make a difference and identify small projects that contribute to the overall response effort," she says.

The request from DTRA/SCC-WMD came in October. Sandia had done sample transport modeling for DTRA/SCC-WMD and the State Department before, Jen says. "They knew we understood the realities of working in a country like Liberia, so that we could come up with a realistic system and not an idealized version," she says.

Jen quickly assembled the team (see box at right).

Typically, modeling efforts like this take six to 12 months, but the fight against Ebola was a race against time, so Sandia needed to figure out a solution for Liberia in a matter of weeks.

"We really had this tremendous cooperation, working across centers, different departments, and programs. When the chips were down, the Labs let go of a lot of the day-to-day stove-piping, and we were allowed to get in there and do what we needed to do," Pat says.

Pat's group had experience modeling disease and logistics in developing countries. They immediately decided that their normal serial approach would be too slow, so they had to work the four tasks simultaneously, he says.

Leo Bynum (6132), the geospatial analytics lead, and his team collected data and transformed it into maps, a task made more difficult by incomplete, anecdotal, and, at times, incorrect data.

Pat and Tom worked on creating a model and simulation of Ebola treatment in Liberia that aimed to reduce travel times of the samples from the ETUs to the labs for testing, thus decreasing the time patients with and without Ebola were together.

Operations research analyst Jared Gearhart (6131) and his team developed algorithms to determine the optimal locations for labs and the best transportation routes, while accounting for such obstacles as a national curfew, poor infrastructure, lab capacity, and other factors.

And Jen, Monear, and Tom travelled to Liberia in November to interview healthcare workers in the field, international agencies working in the country, and Ministry of Health representatives so they could supply Sandia's model with the latest data.



EBOLA SANITATION STATIONS like this one in the West Point District, Monrovia, were set up throughout the city. The public could use them to wash their hands and obtain information about the epidemic. (Photo by Monear Makvandi)

Culture changed by disease

The Sandians arrived for the six-day trip on a lone plane at the national airport in Monrovia and saw immediately how Ebola had changed Liberia. Before officially entering the country, Monear says they washed their hands in bleach on the tarmac outside the airport terminal and had their temperatures taken, a process repeated by guards outside buildings, restaurants, and hotels during their stay.

The team had no exposure to Ebola patients. All three say they felt safe the entire time they were in Liberia.

Sandia, which elevated the risk level for travel to Ebola-affected countries, including Liberia, extensively prepared the travelers on what precautions to take and provided a risk assessment based on a detailed itinerary of their trip. They also followed Centers for Disease Control and Prevention and state health department guidelines, which include a check at the US border for symptoms before re-entry and a requirement to monitor their temperatures and maintain daily contact with a public health worker for 21 days after their return.

"If you approached somebody with your hand extended, they would jump back," Tom says, adding that elbow bumps in the air are the equivalent of a handshake in Liberia now.

The peak of the epidemic had passed when they arrived; the markets had just reopened, but people were fearful of physical contact, Monear says.

They found that getting a lab test result that takes a day or even several hours in the US could take as many as four days from remote areas of a country the size of Tennessee.

Prior to Sandia's project, samples were taken to labs that were thought to be the closest or just because health care workers knew someone there, with little thought to lab capacity, travel difficulties, or other factors, Jen says. In one case, the team learned about sam-

A MULTI-DISCIPLINARY TEAM provided the expertise to make the Liberia project a success. They include: Pat Finley, Chris Frazier, Jared Gearhart, and Katherine Jones (all 6131); Leo Bynum, Bill Fogleman, John Hellier, and Tom Moore (all 6132); Lisa Gribble (6824); Ben Brodsky, Jen Gaudioso, and Monear Makvandi (all 6825); Robert Jeffers (6921); Janis Schubert (6923); and Walt Beyeler (6924).

ples carried on foot to a waterway, then brought by canoe to a bridge that connects with a "highway," which is similar to a US hiking trail.

Sandia's analysis helped influence where new diagnostic labs would be located, including one in Greenville in southeastern Liberia. "That's been the area where we've had the most impact by helping Liberian stakeholders become aware of and overcome the challenges of providing lab results quickly in the remote region," Jared says.

Motorcycles the vehicles of choice

Sandia's model also showed the fastest options for transporting blood samples from patients, many in remote jungles, to diagnostic labs. Motorcycles are the vehicles of choice because they can move through traffic in more populated areas and are more easily pulled out when stuck on muddy roads, Monear says.

The model is flexible, so that when an outbreak occurs in one area of the country, ETUs can quickly adjust where to send samples to avoid a backlog at one lab. The model considered the capacity of labs and recommended multiple daily deliveries of samples to maintain a constant workflow, rather than delivering samples an hour before the end of the work day, the team says.

Sandia was uniquely suited for the project due to its computer modeling capabilities combined with its decades of experience in global health security. While in Liberia, Sandia's team could reach back to the rest of the team to provide updated analyses, Jen says.

When Jen, Monear, and Tom attended meetings in Liberia, they would communicate any questions back to Pat, Jared, and others in New Mexico. The time difference worked in their favor. While the travelers slept, their colleagues answered the questions and incorporated changes into the model before work started in Liberia the next day.

With so many agencies involved in the response and the disease declining, it's difficult to say exactly how Sandia's sample transport system is affecting wait times in the ETUs, but Sandians say they were asked many times why they hadn't brought their capabilities sooner to West Africa.

"It was taking two days to get samples. Now the system being implemented can help get results back in the same day or overnight and that will reduce interaction time," Jen says.

Jen says Sandia's modeling can help with questions of where to station healthcare workers, how to resupply labs, how to administer clinical trials of vaccines in Ebola-stricken countries, and many other logistics challenges. Discussions are ongoing about how to provide this expertise.

And a second DTRA/SCC-WMD-funded project in which Sandia will serve as a lab coordinator for a diagnostic lab staffed by contractors in Sierra Leone is underway, Jen says. A Sandian will visit that country in early 2015 to integrate the lab into the Ebola response system under the leadership of Sierra Leone's Ministry of Health.



THESE BOOTS AND GOGGLES are personal protective equipment that have been cleaned and decontaminated before being dried outside the Island Clinic Ebola Treatment Unit. (Photo by Monear Makvandi)

SANDIA DOES ENGINEERS WEEK

DISCOVER ENGINEERS WEEK

FEBRUARY 22-28, 2015

Sandia's Engineering Week activities

Tuesday, Feb. 24

Glenn Miller, vice president F-35 Chief Engineer's Office, Lockheed Martin Aeronautics, will speak from 10:30-11:30 a.m. in the Steve Schiff Auditorium on "Systems Engineering of the F-35: Lessons Learned and Applied." He became vice president in July 2012, a position that makes him responsible for ensuring overall technical integrity for the F-35 program.

Wednesday, Feb. 25

Jeffrey Binder, director of the Illinois Applied Research Institute at the University of Illinois, will speak about the university's new partnership with Sandia, 9:30-11 a.m. in the Steve Schiff Auditorium. Binder, who earned his bachelor's and master's degrees and a doctorate from the university, worked at Oak Ridge and Argonne national laboratories before joining the research institute.

Sandia: Engineering solutions in the interest of national security

By Gary Sanders

Sandia Chief Weapons Engineer and VP, Weapons Engineering and Product Realization Div. 2000

Editor's note: Gary Sanders is VP for Weapons Engineering and Product Realization Div. 2000 and the chief engineer for nuclear weapons. He has held multiple Sandia leadership roles in nuclear weapon safety, weapon systems engineering, and facilities management and construction, and has served as weapons program director. He also has held positions at DOE headquarters in Washington, D.C., and with the Air Force Office of Nuclear and Counterproliferation in the Pentagon. Before becoming VP, Gary was deputy chief engineer for nuclear weapons and director of weapon systems engineering at Sandia/New Mexico. Prior to that, he served as the principal technical adviser for nuclear plans and policies to the secretary of the Air Force.



GARY SANDERS
SANDIA CHIEF WEAPONS ENGINEER

Two of Sandia's core attributes drew me to the Labs more than 34 years ago: Sandia's reputation as the national engineering lab where science is applied to engineering solutions, and knowing those solutions support important national security interests.

Over the years, I found that a person can spend a career at Sandia working on a vast array of projects from cutting-edge science, physics, materials, computing, testing, and many more, and see these directly integrated into applications in energy security, reductions in chemical/biological/nuclear threats, international treaty verification, transportation security, nuclear deterrence, missile defense, cybersecurity, and hundreds of other national security issues.

We approach every problem as an engineering challenge to fully understand the performance of systems in the broadest range of normal, accident, and hostile environments. Ensuring they respond safely and predictably is a core piece of our mission and our highest commitment to the nation. In an era of rapid change we embrace continuous improvement to ensure we achieve our strategic goal to always excel in the practice of engineering.

Sandians are fortunate to be able to apply their diverse talents in engineering and science to the needs of our nation and the further security of the world as the capabilities that underpin nuclear deterrence also support other national security missions.

Examples of the diversity of our work include analyzing threats to the US energy system, providing reliable, radiation-hardened space assets, or responding to a Fukushima or Deep Water Horizon-scale event.

Using engineering analysis to define, mitigate risks

When I joined Sandia, a major national security initiative was energy independence. Nuclear reactors were considered a prime solution, but after the 1979 Three Mile Island nuclear accident, concerns grew among the public and policymakers about the safety of nuclear power. In response to those concerns, Sandia drew from its expertise in assuring nuclear weapon safety to play a key role in analyzing US reactor designs to prevent accidents that could harm the public or environment.

To fulfill its core nuclear weapons mission, Sandia applied deep safety analysis and engineering expertise to the nation's nuclear weapons stockpile to analyze threats from lightning strikes, plane crashes, fires, and other accidents and to engineer solutions to make sure the probability of an accidental nuclear detonation would be unimaginably remote.

We used these same capabilities — engineering analysis, small-scale testing, computer simulation, and probabilistic risk analysis — to define and mitigate the nuclear reactor risks. Many of the same tools were also applied to analyze space shuttle flight risks, possible failure of solar collectors installed in schools, potential risks of plutonium radioisotopic thermal generators on the *Ulysses* and *Galileo* space probes, and the Chernobyl and Space Shuttle *Challenger* accidents in 1986.

Again and again over the past several decades Sandia's engineering approaches and evaluations to one area of national priority have been adapted and expanded to address new, evolving risks. I have been fortunate that my engineering background has allowed me to work on some of this spectrum of safety-critical issues.

Sandia is the leader in using its scientific depth to simulate, test, and evaluate complex engineering systems to ensure safety and security to prevent catastrophic consequences for the good of the nation and the world.

It was a short jump for me from evaluating nuclear reactor and weapon system responses in accidents to helping design improvements to the safety and security systems while also providing a credible nuclear deterrent for the president of the United States. Today, the nuclear weapons design community at Sandia is partnered with the broader science community to ensure that the weapon systems are reliable, credible, safe, and secure as long as they are needed — a promise that the laboratory director makes every year in a letter to the president.

That assessment is based upon annual comprehensive testing of each weapon type in both laboratory and flight environments, coupled with forensic material analysis and computer modeling not only to evaluate the current performance, but also to identify any aging trends and provide advanced warning of any degradation and need for a life extension program.

The nation puts its ultimate trust in us every single day. Our leaders know they can count on us, count on our excellence in engineering underpinned by a strong science foundation and uncompromising technical integrity, to solve the toughest national security challenges.

Engineering Principles



1. Commitments (A deal is a deal)

- We neither accept nor impose unilateral changes.
- We challenge requirements and guard against requirements creep.
- All commitments will specify what, who, and when.
- Delivery on commitments results in customer and national trust.

2. Accountability

- Commitments are made by managers.
- Individuals are accountable for commitments, not teams or committees.
- Commitments endure after the individuals who made them leave.

3. Program management rigor (Hope is not a plan)

- All commitments will have a credible, executable plan.
- All plans include management of performance, cost, schedule, and risk.
- Consider the life cycle support and assessment of our products.
- Know what the test results will mean before the test is conducted.
- Perform the computer simulation before the test.

4. Quality and process improvement

- A requirement is a requirement.
- Continually examine how to improve our development, qualification, and manufacturing processes.
- While working on current deliverables, always consider future threats.

5. Managed risk and contingency (Zero contingency is infinite risk)

- Risk management is a continuous process.
- We will always maintain and manage contingency in cost, performance, and schedule.

6. Communication (No surprises to customers or management)

- Communication is key to transparency and trust.
- Changes to milestones or commitments will be negotiated in good faith.

7. Customer respect

- We always treat customers with respect and integrity.
- When the decision is made, the debate ends.
- Relationships can trump technical interactions.

8. Workforce development

- We continuously develop capabilities and skills for the future.

9. Integrity

- Always operate with the highest integrity.

A bow to the past

Sandia AAEOY honorees credit family focus on education for career success

By Nancy Salem

Two Sandians thought back to their roots when they won Asian American Engineer of the Year (AAEOY) awards, Somuri Prasad to a village in India and Patrick Feng to a refuge in America.

Prasad's father helped found the first school in his native Pasumarru, in the Krishna District of southern India. Patrick's parents fled political and economic hardships in China and Yugoslavia for a better life in the United States.

"They were both a product of trying times," Patrick (8126) says of his parents. "They came to the same conclusion about the importance of education. It shaped our family's world view."

Prasad's (1851) father was influenced by the late Indian leaders Mahatma Ghandi and Jawaharlal Nehru, who promoted a free education for all. "When I was asked for input on my award nomination I said I should start with my roots and parents," Prasad says. "I belong to a generation of Asian Americans whose parents and forefathers lived under colonial rule with no easy access to post-elementary-school education. They worked so hard and made many sacrifices to make sure that people like me got a decent education. This award is a tribute to them."

Prasad and Patrick are the 15th and 16th Sandians honored with an AAEOY award, Prasad as Engineer of the Year and Patrick as Most Promising Engineer. The prestigious recognition program was started in 2001 by the Chinese Institute of Engineers-USA to honor outstanding Asian American professionals in science and engineering for their leadership, technical achievement, and public service. This year's 14th annual awards ceremony will be held Feb. 28 in Los Angeles as a finale to National Engineers Week.

Somuri Prasad: It takes a village

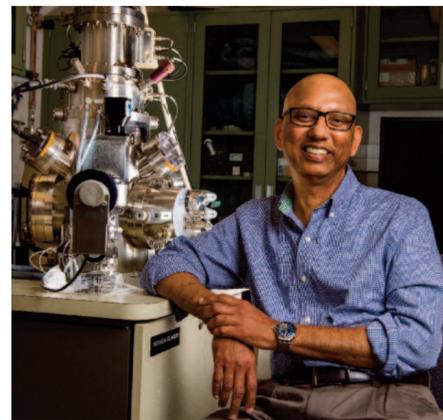
Prasad, as he prefers to be called, was a child in the 1950s when his father, a farmer, became mayor of his village as India won independence from Great Britain. "He immediately realized that children can't walk several miles on dirt and gravel roads in pursuit of a high school education," Prasad says. "He knew they wouldn't have a future without higher education."

He and other village elders founded a high school that paid rich dividends. Several graduates of the school went on to become physicians, scientists, and engineers.

Prasad graduated in metallurgical engineering from the National Institute of Technology, Warangal, and earned a master's degree, also in metallurgy, from the Indian Institute of Science, Bangalore. "There was just one major steel plant in the whole country when India became independent," Prasad says. "Unless we had steel and cement, there was no point in being independent. The

whole economy during that period revolved around steel production, and this is what inspired me to become a metallurgical engineer."

In 1977, he earned a PhD in materials science from the University of Sussex, England, mentored by the famed metallurgist Robert Cahn. Prasad returned to India and worked 12 years as a scientist and assistant director in the Indian Council of Scientific & Industrial Research Labs. "I was inspired by Robert to go back to my roots," Prasad says. "I didn't initially set my goals to pursue a career in the United States until I paid my dues to India." He won a senior fellowship award in 1989 from the National Academy of Sciences in



SOMURI PRASAD (1851) has been a leader and valuable team member at Sandia, says Duane Dimos, director of Pulsed Power Sciences Center 1600. "He has repeatedly broken new ground in our understanding of friction and wear in materials and made substantial contributions to national security programs," Duane says. "And he has made a significant commitment to mentoring young scientists and engineers." (Photo by Randy Montoya)



Washington, D.C., that let him pursue research at the Air Force Research Laboratory at Wright Patterson Air Force Base in Dayton, Ohio. He spent the next 10 years there.

In 1999, Sandia was looking for a technical staff member to work in tribology, the science of friction, wear, and lubrication. Prasad was ready for a change and accepted the job. "The beauty of Sandia is that it provides a unique environment not only to excel in the broader professional community but also to provide materials solutions to mission critical projects for national security and defense, based on fundamental science," he says.

Prasad takes pride in mentoring graduate students, postdoctoral associates, and early career staff. In his dual role as an adjunct professor at the University of Colorado, Boulder, Prasad mentored a Native American graduate student, Tsali Cross, and supported him through his PhD thesis defense. "In my sunset years I shall cherish this experience far more than any of my technical accomplishments" he says. "I am grateful to Sandia for giving me this opportunity to serve the community"

Patrick Feng: Early career thumbs-up

Patrick was raised in Hawaii, where his parents moved after meeting in Canada. His businessman father escaped China in the mid-1960s just before the Cultural Revolution while his mother came from the former Yugoslavia. "My parents had totally opposite upbringings. My father was from an educated, privileged family and my mother from poor farmers in the mountains," Patrick says. "But they shared a respect for education and diversity."

Patrick's parents encouraged him to choose his own direction, and he gravitated to science. He went to Colorado State University for a bachelor's degree and the University of California, San Diego, for a PhD, both in chemistry.

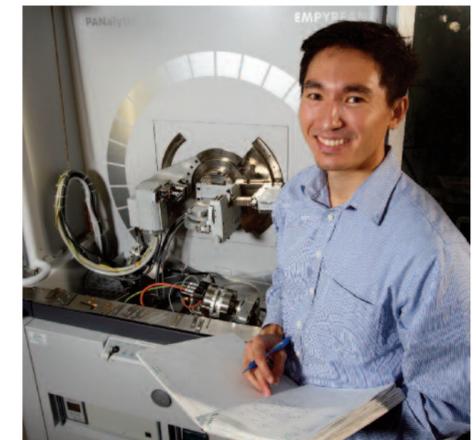
He graduated in 2009 and started as a postdoc at Sandia's California campus. A year later he joined the technical staff. His work is primarily focused on the luminescence properties of materials, or how light is emitted in response to various stimuli. "We study how to detect chemicals and how to use light to detect radiation," Patrick says. In several of his projects, Patrick and his team develop organic-based materials for the detection of fast neutrons, the signature for a variety of fissionable materials.

The technology could be used to detect and prevent the movement of fissionable materials through borders. It also could be used in high-energy physics applications and to validate the performance and benevolent operation of nuclear reactors. The work, which is moving toward product development, won an R&D 100 award last November for a group of six Sandians in California and New Mexico.

"I was fortunate to be paired up with mature scientists who have experience in basic as well as applied research. They invested time in me," Patrick says. "They taught me a lot." He gives back by mentoring underprivileged kids, some of them homeless, in science. He also plans to do science tutoring in high schools. "The biggest issue with science education is exposure," says Patrick, an avid outdoorsman who surfs, skis, and rock climbs. "Young people need to know about STEM. It feels good to spread the word."

Patrick's parents are his biggest advocates. "As much as I try to downplay my accomplishments, they build me up. They are very supportive and proud."

He says the AAEOY award, coming early in his career, gives him the confidence to move forward. "There are always insecurities when you're young and shaping your career," he says. "I can be my own worst critic. The award is really validating, and makes me feel my research is on the right track."



PATRICK FENG'S (8126) technical expertise, creativity, and focus on practical impact produce new approaches to solving significant problems in national security, says Duane Lindner, director of Homeland Security and Defense Systems Center 8100. "Patrick took a fresh look at how radiation interacts with materials and used his deep understanding of chemical physics to imagine a very novel approach to improved detection materials," Duane says. (Photo by Dino Vournas)

Future City: Middle schoolers engineer their vision of tomorrow

By Sue Major Holmes

Cities of the future won't look much like cities of today if middle school students have anything to say about it.

Thirty-nine teams of New Mexico and Colorado sixth- through eighth-graders entered the 2015 New Mexico Future City regional competition, which lets students act as engineers by identifying problems; brainstorming ideas; designing solutions; testing, retesting, and building; and presenting their results.

The competition is sponsored by Sandia /Lockheed Martin and Los Alamos National Laboratory/Los Alamos National Security LLC, the National Museum of Nuclear Science & History, University of New Mexico, New Mexico Science Teachers Association, the Association of Chinese-American Engineers & Scientists, and local community supporters.

Nos Deleitamos team from Deer Creek Middle School in Littleton, Colo., took top honors Jan. 24 in the regional competition, which drew 23 teams to the National Museum of Nuclear Science & History. The winners received an all-expenses-paid trip to the national finals Feb. 15-18 in Washington, D.C., to compete against teams from 36 other regions.

Last year was New Mexico's first year in Future City, started more than 20 years ago by DiscoverE. The contest requires students to use math and science on real issues; develop writing, public speaking, problem-solving, and time-management skills; work in teams; and learn how communities operate. Along the way, they explore engineering fields as possible careers.

Teams design virtual city, write about its key features

Each team designed a virtual city using SimCity software, taking into account such things as services, clean industries, and utilities. They wrote a 1,000-word essay detailing key features and designs and a separate 500-word narrative describing the city. Those were judged before the regional contest.

The regional event judged teams' physical model of a section of their city, assessing its effectiveness in terms of innovative solutions, advanced technologies, and how well it represented the design. Judges also evaluated students' brief oral presentations of their city's features.

"Building the physical model teaches kids about civil engineering, resource management, landscaping, and integrated planning. The competition offers opportunities to apply the basic analytical skills the students learn at schools," says Chui-Fan Cheng (2668), who along with Amy Sun (1814) is volunteer co-coordinator of the regional Future City that includes New Mexico and part of Colorado. "The presentation also requires that kids practice together, think through their vision, and articulate their plans so people will want to live there."

Models aren't exact replicas of the virtual designs, but rather 3-D creations illustrating the team's vision of its city, built with as much recycled material as possible and a budget limit of \$100.

Students at the regionals showed how inventive they could be with recyclables. Old CDs and ink cartridges became solar collectors; plastic Tic-Tac boxes, cut-up pieces of foam, and single-serving cereal boxes became buildings; popsicle sticks were converted to fences; pipe cleaners and dowels became vertical axis wind turbine blades; water bottles turned into water storage tanks; chess pawns were loudspeakers; poster tubes and paper towel holders became silos; laundry detergent caps and see-through take-out boxes were greenhouses. Students used ribbon, tubing, foil, jars, wire, small lightbulbs, a speaker grill, petri dishes — even candy dots and a hummingbird feeder.

2015 theme focused on sustainable agriculture

This year's theme, Feeding Future City, centered on sustainable agriculture and encompassed all aspects of project planning. "You have to do the math to build a model with the right scale. It's teamwork, which is important for this age. It's about the civil engineering, resource management, and governance. It has all those elements," Amy says.

And the elements have to line up. If a team imagines how a city would work on Mars, "your essay, your narrative, your physical model, your presentation have to be consistent, you have to talk about a city on Mars," she says.

This year's teams came from Albuquerque, Espanola, Las Cruces, Santa Fe, and Taos in New Mexico and Littleton in Colorado.

Public and private schools, home school groups, nonprofits such as Girl Scouts and Boy Scouts, or after-school programs like Girls and Boys Clubs can form teams. Each must have a mentor and a sponsoring teacher and at least three students. Larger teams must designate three students to present at the regionals. Although there is no limit on how many teams schools or organizations can form, they may send only three to regionals.

One of the biggest lessons from New Mexico's first year with Future City was the importance of volunteers and resources, Amy says. Sandia's Asian Leadership and Outreach Community has adopted Future City as its educational outreach activity. Amy says, "We have schools that need laptops, we need mentors who can help kids think about some of these issues that are real-life issues, how to be a mayor in a city, what kind of problems they face. Sandia and Los Alamos have provided us with great mentors and great volunteers. But we definitely need more resources."

FUTURE CITY COMPETITORS explain their models at the Jan. 28 regional competition at the National Museum of Nuclear Science & History. Sandia and Los Alamos national laboratories are among the sponsors of the competition, which lets students act as engineers. Some 23 teams from around New Mexico and Littleton, Colo., entered the regional competition. The winning team received an expense-paid trip to the national Future City competition in Washington, D.C., earlier this month. (Photos by Sue Major Holmes)



How to be an effective Principal Investigator, as reported by those who have done so

By Neal Singer

A desire in the lives of many Sandians is to lead projects of their own. Not far below that is the worry that something may go wrong.

To minimize missteps in the complicated process of becoming a successful Principal Investigator — writing proposals, understanding customers, motivating coworkers, setting realistic goals, and staying within budgets — who better to consult than those who have been to the well successfully many times?

And that is probably why the 2015 “Effective PI Workshop” filled its 92 slots in 90 minutes after its sign-up list was posted online, says Blythe Clark (1111), one of eight organizers of the event.

The sessions, which built on the success of a similarly sold-out workshop last year and Sandia/California’s “Life of a PI” workshop before that, offered unvarnished insights on how to plan for success and then run effective projects. The nuggets were delivered by nine panelists who had practiced what they preached, most of them for decades. Many of their insights were effectually summarized in a later presentation by Sandia Fellow Ed Cole (1000), whose manner — a lesson in itself — demonstrated how these approaches could be successfully intertwined and powerfully presented. An opening talk by Steve Castillo methodically broke down components of PI-hood, including the necessity to thoroughly understand customer requirements and problems, and the aptitude to effectively engage with a variety of personalities. A final overview by organizer Vipin Gupta (6124), fresh from his effort as a TEDx-ABQ speaker, rose above the plane of practical experience to provide an entertaining, high-level motivational overview.

Walk in your customer’s shoes

The format — casually dressed panel participants seated on what looked to be cafeteria chairs rather than tightly designed TV shows with focused décor and scripted arguments — did not exactly follow a plot line; the audience had to pick up insights where they dropped.

In the “Planning for Success” panel, these insights included Mike Hightower’s (6114) simple suggestion to look into Sandia education classes to learn leadership skills and accounting practices to augment a PI’s technical skills.

Eunice Young (5560) faulted PIs with too much ego. Those who lead with “This is what I want to deliver, without spending time walking in your customers shoes,” do not face a rosy future. Also, “It’s better to lay out a plan that everyone on the team buys into. Ask how they would approach it, and you’ll have a much richer option set.”

David Ingersoll (2500) said that he always picked “A-team members” for his projects, rather than B or Cs, because he wanted to be successful. “But interpersonal conflict of one A-team person can cause a mess. I don’t have time to deal with it, and don’t want it, so unless I’m backed into a corner, I don’t choose that person.” (Later, the point was made that B-team members couldn’t develop into A-team members unless given the chance to mature on the job.)

Paul Clem (1816) suggested providing intermediate deliverables in the first 90 days of a project to earn a sponsor’s trust. And, “if you can’t get something done, let them know early, to negotiate or provide alternatives.”

Tom Weber (6831) added that “the best program managers can help you structure intermediate milestones — ‘Why don’t you put this milestone over here, so you have something to show.’”

Other discussions involved the importance of timing in submitting ideas, canvassing managers to get proposal calls early rather than wait until word filters down — “Be proactive” — and don’t even wait for the call to socialize your idea: “The more you can talk with your possible team, playing devil’s advocate, the more prepared you’ll be when the call comes.”

Questions from the audience and responses from the panel included:

- How to handle more “agile” requests, which show

Resource Guide for Principal Investigators & Project Leads

Everything you need to know or wish you knew about being an effective Project Lead



Wouldn't it be nice if Principal Investigators (PI) at Sandia could phone a PI friend whenever they encountered a seemingly insurmountable obstacle? This PI Resource Guide may not be that actual friend, but it is a way for you to find the practical advice you are looking for quickly, connect with other PIs in the PI Forum blog (see below on the right), and reach out to Sandia proposal advisors, multimedia specialists, and financial analysts who are there to help you be the best PI you can be.

BE A BETTER PI — More information on being an effective PI is available on Sandia’s internal web at <http://tiny.sandia.gov/gtw0x>. Topics addressed include: How to Write a Winning Proposal; How to Estimate and Track Your Budget; How to Run a Project; How to Get Help With Making Your Project Look Good; and How to Develop Your Leadership Skills.

disconcertingly few specs — “Try to understand their mission and write the specs yourself in logical steps; that’s leadership.”

- How to break down “silos” — “Ever hear of the telephone? A couple of phone calls can make a difference, getting more personal interactions than email.”
- How do you avoid “kissing a lot of frogs to find the princess [or prince]” — that is, the project with a future? “Sandia provides services on where the issues are going to be, where most improvements are needed, and these services will show you if this is a \$25k or \$250k problem.”
- What is your strategy for selling yourself to the A-team? “Find a mentor who knows people around the Labs, and find people who are excited about the work you are doing.”

The second panel, “Running Effective Projects,” dealt with issues ongoing during the project.

Cliff Ho (6123) said it was important to have meetings, but a meeting needs to list an agenda and objective to make it meaningful. “That is, ‘This is why we’re here. This is what we’re tentatively planning to do. Is everyone OK with that?’ And then the leader facilitates the meeting discussion, wrapping up with next steps and action items.”

Schedule meetings well in advance

Brad Boyce (1851) felt that to minimize schedule conflicts, key meetings can be scheduled as much as four months in advance. “Explain ‘You have to be there, I need you there.’”

As for communicating science with outside researchers and reporters, Kristina Czuchlewski (5346) agrees that setting up a schematic of a paper to present at a conference works well to get people to fill it out. “I annotate the sections as to who I need help from,” she says. “Also, I make sure people know they’re going to get credit for presentations.”

Dealing with customers means understanding them, says Allen Roach (2735). “Do they want details or highlights? Positive or negative news? Maybe a customer wants someone in touch every day, or maybe not.”

• Advice on questions from the floor: When dealing with difficult partners who want to change goals midway through the project, “It’s a partnership. Communicate up front what you can and can’t do.” But, “Being diplomatic is helpful.”

• If you’ve inherited a project you didn’t originally plan: “The opportunity is, you can redirect the project to match your own vision; the pitfall is you can over-manage the project. You don’t want to derail it. A balance is necessary.” “Interview every technical member of the project as to where the project has been or is going.” “Find out, if it’s a negative situation, why the previous manager left. If so, team members will be happy to see change.”

- How do you stay technically engaged with your team as the programmatic gets bigger? “I try to carve out a [research] piece for myself.” Or, “I write a synthesis document that ties together the work of the team.”
- Are academic partners desirable? “The contract can

be a problem. More than \$30k, it’s worth it. Think about the pipeline; it’s a great way to bring in new students into the system.”

Ed Cole said much the same, but because it was a single, hour-long talk, he could put the fragments together. “Here’s some easy advice to take, and over 27 years, I’ve seen most of it ignored,” he began.

- Do great work, that’s why people come here.
- Know your customer and what the customer cares about.
- Your customer can be wrong. Tell them there’s a problem and offer a solution. This can happen at the outset. Do the right thing. You may lose the job but the customer will remember and come back. It will never come back to haunt you if you do the right thing.
- Use manager and mentor connections; build on existing relationships. Stop by brown bag lunches and make contacts.
- Socialize your proposed drafts with others. Listen. Team.

As for all the other interesting things that were said, Vipin advises you can still pick up more information at <http://tiny.sandia.gov/gtw0x>, which contains a “Resource Guide for Principal Investigators & Project Leads.”

Adds Blythe, “The workshop was video-recorded and those links will be posted to our wiki site once they’ve been reviewed and approved. So those interested can watch it at their convenience soon.” That address: <https://snl-wiki.sandia.gov/display/HTBEP>

Workshop series sponsors included:

- The Research Leadership Team (RLT)
- The AST Program (Advanced Strategic Training)
- ANGLE (Advancing the Next Generation of Leadership Excellence)

Workshop co-organizers:

- Matt Allen, staff, Phenomenology and Sensor Science, Org. 5785
- Laura Biedermann, staff, Electronic, Optical, and Nano, Org. 1816
- Blythe Clark, staff, Radiation-Solid Interactions, Org. 1111
- Rachel Colbert, staff, Electromechanical Systems II, Org. 2615
- Vipin Gupta, staff, Materials, Devices, and Energy Technologies, Org. 6124
- Michael Hibbs, staff, Materials, Devices, and Energy Technologies, Org. 1833
- Derek West, staff, ISR Systems Engineering and Decision Support, Org. 5346
- Amber Young, staff, Physics-Based Microsystems, Org. 1728

Operational Innovation honors excellence in efficiency and effectiveness efforts

At the Second Annual Operational Excellence Recognition Event, awards honored Sandians who have implemented their innovative ideas, saving the Labs money and improving the effectiveness of operations for Sandia's customers.

Awards were given in the categories of cost savings, cost avoidance, integration project, top contributor, leadership, sustainability, and inspirational individual.

Twenty-seven honorees were selected from 48 validated efficiencies entered into the Operational Innovation (OI) online tool in FY14. The tool is used to capture, quantify, and share cost-saving ideas generated across the Labs by individual and team contributors and as a result of Lean Six Sigma (LSS) and quality assurance activities.

In FY14, Corporate LSS, Innovation, and Policy Dept. 711 completed 436 such activities, including value stream analyses, Kaizen events, LSS projects, structured improvement activities, and parent company interactions — an 11 percent increase over FY13.

These activities resulted in \$93 million in validated savings for the fiscal year, far exceeding the goal of \$55 million. Pam McKeever, senior manager and program manager for OI, says, "Increased awareness of the program, along with a growing need to improve effectiveness and efficiency, is a contributing factor to exceeding our goal. Our goal for FY15 was increased to \$75 million, and thus far, we have validated efficiencies that will result in \$52 million by year end." Cost avoidances in FY14 totaled \$69 million, and cost savings accounted for \$24 million. Participation in OI by individual contributors rose 60 percent, and Sandians saved \$4 million more than the FY13 total by identifying new ways of saving money and working more efficiently. In FY14, 120 efficiency opportunities were submitted to the OI tool, which represents an 82 percent increase over FY13.

"Sandia strives for operational excellence, and every single person at Sandia is encouraged to contribute to this effort. Having this program allows people to put their information into the system, get recognized, and have it count for Sandia," says Pam.

Cost savings

The Operational Innovation program defines cost savings as "an intentional action that causes future spending to fall below the level of current spending for the same product or service. These cost reductions may be removed from budgets, reinvested, or redirected to other priorities." At the ceremony the following project teams were recognized for achieving significant cost savings and benefit to customers in FY14:



- Test Capabilities Revitalization Phase 2
- Silicon Fab Revitalization Tool Acquisition
- Network Revitalization Project
- Center 1100 Accelerator Acquisition
- Financial Business Operations Restructuring
- Center 1100 Dilution Fridge Acquisition
- Scandium Procurement Solution
- Personnel/Contract Clearances and Foreign Interactions Office Savings
- Radiological Material Reductions
- Technical Security Staff Efficiencies

Cost avoidances

According to the OI program, cost avoidances "result when there is an intentional action that causes future spending to fall, but not necessarily below the level of current spending. Avoided costs remove the need for an increase in staffing or costs, which would be necessary if present management practices continued." These projects realized notable FY14 cost avoidances and future benefit:

- Database Licensing Renegotiations
- W88 Program Alternate Design
- Energy Conservation Cost Avoidance
- Neutron Generator Product Cost Reduction
- Critical Skills Master's Program Tuition Savings
- 10650 Efficient Staff Consolidation
- Streamlining the Contract Closeout Process
- Sandia Library Information Discovery and Content
- Sandia Library Reports Request Process
- Automated Accrual for Contractor Cost Management

Integration Project team recognitions

"Integration of an innovative process benefits Sandia because one organization's self-directed activity or exercise results in a capability that can be replicated in another orga-

nization or across the entire enterprise," says Stephen Rudisell (711), OI project manager.

The following teams were recognized for integration potential:

- Risk and Opportunity Management for Nuclear Weapons Projects Division 2000 Strategic Initiative
- Product Acceptance Improvement Initiative
- Structured Improvement Activity for Communications Security Account Management

Top contributor

Joselyne Gallegos, director of Information Solutions Center 9500, was given the Top Contributor Award for submitting the largest number of newly validated opportunities in FY14. The center submitted and had six efficiency projects validated in FY14, increasing effectiveness across the Laboratories.

Leadership

Terri Lovato, senior manager of Security Mission Support Dept. 4240, received the Leadership Award for demonstrating an ongoing commitment to developing efficiencies throughout FY14. Terri sponsored several Lean Six Sigma events, and her staff has been the most active in creating and documenting efficiencies, having submitted approximately 20 new opportunities in FY14. Since the OI management system was created, Terri's organization has had 17 opportunities validated, which is the highest number at the Labs.

Sustainability

The Sustainability Award, given to the project team whose efficiency savings have the longest fixed savings period, was presented to Jane Farris, senior manager of Pension Fund and Savings Plan Management Dept. 10520. Her organization's pension savings project is estimated to produce gradually declining savings until approximately 2080, and the savings are a reduction in the required pension contributions as a result of the benefit formula change that began for the non-represented plan on Jan. 1, 2012.

Inspirational individual

The Inspirational Individual Award is given to an individual contributor who demonstrated significant initiative, ingenuity, and perseverance in the successful implementation of an efficiency savings. This year Steven Pope (3652-2) received the award for his corporate business card improvement project, which provides real-time review of business card orders, reduces cycle time for delivery, and improves quality (see story below).

Business card process improvement project results in more effective and efficient service

By Feleisha Mendez and Valerie Larkin

In a new "Innovative Thinking: The Sky's the Limit" series, the Lab News will periodically highlight projects selected from the Operational Innovation (OI) management system. The system is used to capture and analyze ongoing and completed projects that have resulted in significant cost savings or cost avoidances. This first installment describes how Steven Pope, a graphic designer in Creative Services Dept. 3652-2, improved the corporate business card process by reducing cycle time, improving quality, and saving money.

In 2013, Steven was in a meeting with his manager when he had the idea of improving the process through which Sandia business cards are ordered and printed.

"When I happened to be in a one-on-one with my manager and finding ways to save money for Sandia was brought up, I looked around to see what we could do differently. There it was, staring right at me: the corporate business cards," Steven says.

He noticed the text on his manager's business cards was askew, and he started thinking about how he could redesign the process to improve the print quality and also save money. During the meeting Steven volunteered to research and improve the current process.

He found that to order a box of 300 business cards, customers would complete a form and email or fax it to the vendor. Standard turnaround time was 10 days, and the cards were \$43 per box. With approximately 1,100 boxes ordered per year, Sandia was spending about \$43,700 on business cards annually. Additionally, customers did not have the option of previewing a proof of their cards prior to printing.

A new end-to-end approach

Over the course of a 14-month project, Steven collaborated with a diverse team — including procurement, information technology, the Center 3600 director and business administrator, and vendors — to redesign the process, which involved establishing a consistent design for the cards, placing a small-business contract in compliance with Government Printing Office requirements, implementing an online request system, and obtaining management approvals.

During the project, Steven and the procurement buyer identified a vendor that could provide the cards quickly and at a lower cost. By awarding a new contract,

the cost of business cards dropped to \$31 for a box of 300, and they are now delivered within three to five days. The new online ordering system also features a real-time proof of the card, so printing mistakes are minimized. As an added benefit, customers may now request any of the myriad of services offered by Creative Services through the online request form, and the system also tracks the department's metrics.

The result, Steven says, is a customer-oriented process, a standardized card design, and a product that reflects well on Sandia anytime a business card is handed out, all while saving time and money.

Closing the loop with OI

Stephen Rudisell (711), OI project manager, heard about the business card improvement project through Pam McKeever, senior manager of Operational Innovation Group 710, who had viewed a presentation of the new business card process at a Mission Support Team meeting. He encouraged Steven to enter his project into the OI database. Projects in the OI system are validated by the center business manager assigned to the organization from which the savings originate, and then shared across the Labs to encourage innovative thinking. Steven submitted his project, and as a result of his success was recognized at the Second Annual Operational Excellence Recognition Event with the Inspirational Individual Award.

"This project is important to the Operational Innovation program because it is a clear and repeatable example of our staff's ability to take a process and effectively innovate by asking the question 'How can we do this better for our customer?' Steven's initiative and follow-through is illustrative of the Operational Innovation program's message in action, which is to improve mission delivery by improving the way we do work across the Laboratory," says Stephen.



STEVEN POPE, a graphic designer in Creative Services Dept. 3652-2, was recently given the Inspirational Individual Award by Operational Innovation Group 710 for redesigning the corporate business card process and providing more value to customers. (Photo by Stephanie Blackwell)

Implementing new ideas

For employees like Steven who have innovative, cost-saving ideas, Mission Support and Corporate Governance Center 700 offers a number of resources to help them learn about process improvement and implement their ideas. The Center 700 website includes efficiency-skills-building courses; resources such as Lean Six Sigma classes and services, Innovation/Design Thinker classes, the Lockheed Martin Relations Program for reach-back opportunities — whereby Sandia employees "reach back" to the parent company for technical or operational assistance — and communities of practice eForums; and the Operational Innovation site to enter new ideas or to see examples of opportunities implemented at the Labs.

"It is important for all members of Sandia's workforce to seek out new ways of doing business, because the resulting increase in productivity, faster cycle times, and reductions in redundancy manifest into improved employee morale, product quality, and budget savings for more value-added purposes," Steven says.

Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads

MISCELLANEOUS

FIREPLACE TOOL SET, Uniflame pewter birdcage, 4-pc., \$60. Thompson, 292-2877.
 BIKE RACK, Hollywood, trunk mounted, holds 3 bikes, good condition, \$20. Dinge, 505-818-8933.
 MEDICAL EQUIPMENT, gently used: alternating pressure mattress; adjustable bed; wheelchair; small Visio TV; various items. Jennings, 610-1142.
 HOT TUB, Hot Springs Jetsetter, seats 2, good condition, \$500. Lorence, 237-1205.
 HOUSEBOAT TIMESHARE, 3 wks., Lake Powell, fall & spring, nice weather, fewer crowds. \$8,499. Barnard, 771-4620.
 COLOR CONSOLE TV, 60s vintage, beautiful piece of furniture, stereo & radio work, TV doesn't, \$100. Mozley, 884-3453.
 LEATHER JACKET, men's, Harley-Davidson Victory Lane, large, removable liner & chaps, \$740 value, asking \$540 OBO. Vigil, 414-4988, ask for Rita.
 CLASSICAL GUITAR, Samick LC-015G-1, w/hard case, \$55. Flores, 610-1474.
 INK CARTRIDGES, Canon, new set of 220 & 221, for PIXMA printer, \$10 OBO. Morosin, 298-0994, bmorosin@q.com.
 CRIB, w/mattress, 3-in-1, dark cherry, lime green bumpers, excellent condition, \$80. Tafoya, 220-7421.
 ANNUAL WILD LOVE FUNDRAISER, donate \$25 at fabulousfeelines.org to be entered into raffle for 2 prizes. Mundt, 505-412-3812.
 HEDGEHOG, female, 8 mos. old, mostly cream colored, w/cage, exercise wheel, water bottle, food bowls, bedding, \$240 OBO. Marchi, 220-0810.

REFRIGERATOR, Kenmore, black, bottom freezer, French doors, water/ice in door, 25-cu. ft., 35-3/4"W x 34-1/4"D x 69-3/4"H, excellent condition, \$950. Drebing, 350-6341.
 TIMESHARE, Marriott Grand Chateau, Las Vegas, MWC tournament, March 8-15, \$500. Urioste, 505-918-4054.
 DINING ROOM SET, natural wood, table, 6 chairs, 68"L x 44"W x 30"H, beautiful lighted buffet/hutch, \$400. Smith, 796-2558.
 TIRES, 4, Michelin LTX M/S, ~6K miles, 275/65/R18, almost new, retails \$220 ea., asking \$500/set. Weiland, 505-379-7473.
 MOWER, \$25; chainsaw, \$50; hedge trimmer, \$15; all electric drop spreader, \$10; wheelbarrow, \$5. Horton, 883-7504.
 REFRIGERATOR, Kenmore, 6 mos. old, like new, \$800; refrigerator, Kenmore, used, 30-in. wide, \$200; Kenmore washer & Whirlpool dryer, \$200 ea. Garcia, 280-5815.

TRANSPORTATION

'15 FIAT 500, w/sport pkg., ran w/wrong year in 1/23 Lab News, ~1,000 miles, brand new, perfect condition, premium sound system, \$13,500. Martin, 623-687-7673.
 '12 JEEP LIBERTY, 4x4, AWD, recently tinted windows, 44K miles, \$17,500 OBO. Spinello, 505-515-7809, call or text, jspinello32@gmail.com.
 '12 FORD F150 XLT, 4x4, V6, Ecoboost, camper shell, tow pkg., 18-24-mpg, 38.5K miles, \$32,500. Babb, 505-228-5225.

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.

'11 TOYOTA CAMRY LE, red, only 12K miles, excellent condition, multi-point inspection done on 1/5/15, \$16,900. FitzGerald, 505-857-0842.
 '81 CORVETTE STINGRAY, white-pearl, new alarm/stereo, miles not original, head-turner, gorgeous, fun, affordable, must sell, \$8,000. Santos, 269-3461.
 '07 BMW X5 3.0si, fully optioned, black, 20-in. stg. wheels, all maintenance complete, 71K miles, \$20,975. Solis, 331-8169.
 '03 CHEVY SILVERADO LS, 4-dr., bedliner, black, 96.8K miles, very good condition, \$7,500. Rosales, 463-4288.
 '02 SATURN SL-2, AT, AC, 113K miles, reliable, good condition, \$1,500. Graham, 271-1337.
 '12 DODGE JOURNEY, 3rd row seat, 1 owner, extended warranty to 100K, 40K miles, \$13,500. Pacheco, 505-550-4825, ask for Mike.
 '04 FORD CROWN VICTORIA LX, AT, V8, spruce green, leather, DVD, dealer-serviced, 73K miles, great condition, \$4,500. Desko, 514-6378.

5 ACRES, south of Moriarty, 34 mins. to Albuquerque, level, partially fenced, electricity, \$20,000 on REC. Mihalik, 281-1306.
 3-BDR. HOME, 2-1/2 baths, 1,410-sq. ft., all appliances, stair elevator, MLS#818070, \$144,000. Wright, 505-332-0773.
 2-BDR. HOME, both masters, 2 baths, 1,400-sq. ft., close to I-40 & Unser, \$123,000. Grady, 720-5364.
 4-BDR. HOME, 2 baths, 2-car garage, 2,093-sq. ft., newly constructed, tile, granite, fireplace, 98th & Ladera, \$249,000. Sanchez, 293-7246.

WANTED

ROOMMATE, large bdr., furnished or not, Copper & Juan Tabo, close to SNL, CNM Montoya campus & I-40, \$470/mo. includes utilities & Wi-Fi. McAllister, 730-0798, ask for Lynda.
 CERTIFIED TAI CHI INSTRUCTOR, for possible class at SNL or off-site instruction. Harger, 238-7879.

RECREATION

'05 KEYSTONE COUGAR 5TH WHEEL, 30-ft. long, inside good, outside fair, \$13,000. Riddle, 907-0277.

REAL ESTATE

5-BDR. HOME, 3 baths, 3-car garage, 3,933-sq. ft., 3 living areas, near Ventura & San Francisco, great schools, MLS#824799, \$399,800. Billau, 440-5374.

ROOMMATE, 11 mins. to base, \$750/mo., includes utilities, WiFi & covered parking. Wolfe, 505-235-3488.
 ROOMMATE, 7 mins. to SNL, no pets, \$400/mo., includes utilities & WiFi. Guillen, 505-385-8189.
 HONDA GENERATOR, 2000-W, great working condition. Moreno, 238-0494.
 MEAT, venison, beef, lamb, elk, organs, clear your freezer for the next hunt. Beggs, 414-2757.
 MOVING BOXES, packing material. Gabaldon, 480-2409.

Mileposts

New Mexico photos by Michelle Fleming



Jerry Adams 35 2996



Lydia Boye 35 5944



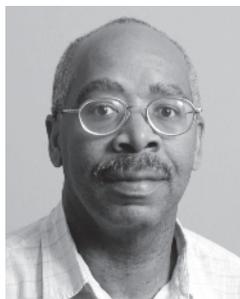
Michael Rouse 35 9542



Kurt Wessendorf 35 2635



John Zich 35 1800



Joe Perry 30 5353



Tad Ashlock 25 5337



Beth Dick 25 215



Duane Dimos 25 1600



Mark Harris 25 5563



Gregory Madrid 25 6614



Harry Moffat 25 1516



Stephen Evans 20 2727



Kyle Hayden 20 9342



Larry Kincaid 20 5963



David Robinson 20 1461



Andy Salinger 20 1442

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'She looks like me'

Sandia sisters show school kids that they, too, can be engineers



SISTER ACT — Shauna (422), left, and Imani (426) Adams have enjoyed white-water rafting, hiking, and geocaching in their little bit of time away from work and mentoring young people. "When we really want to relax, there's nothing like a good TV show," Imani says. (Photo by Randy Montoya)

By Nancy Salem

When twins Imani and Shauna Adams wrap up work as subsystem and components surety engineers at Sandia Labs, their day is hardly over. Most evenings — and weekends — they go from their jobs to their "kids," middle and high schoolers who need a nudge on the path to careers in science, technology, engineering, and mathematics (STEM).

"They see our faces a lot," says Shauna (422). "They think they can't do math, and we say, 'Why not? Here's a problem. Just try. There, you did math.' It's an awesome experience to see the light bulb come on, to see someone who thought they couldn't do math, who made all the excuses in the world, finally have a breakthrough. By the end of the day they accomplished something. They learned it's not really that hard if you just try."

Shauna and Imani (426) work with about 200 Albuquerque students a year through HMTech, sponsored by Sandia's Black Leadership Committee, competitions with the National Society of Black Engineers (NSBE), and other STEM outreach programs. HMTech exposes students to such subjects as anatomy, physics, fractals, robotics, coding, computer programming, and life skills including personal finance and resume-writing. NSBE sponsors national contests in science and math, robotics, and renewable energy.

Shauna and Imani, who are two of the advisers to the Greater Albuquerque junior chapter of NSBE, spend countless hours tutoring, organizing workshops, helping with contests, and mentoring students in engineering. They help them prep for the ACT and SAT college entrance exams. "We introduce our kids to career aspects and point out their options," Imani says. "We look at their class schedules and make sure they are on the right track. We show them where to find scholarships and push them to take advantage of summer opportunities through different STEM organizations."

In the process, they serve as powerful role models. "When they see you and hear you talk to their class, they say, 'She is an engineer. And guess what? She looks just like me,'" Shauna says. "Engineers look like all of us. When we go out and talk about engineering, it's good for students to see people who look like them and have similar backgrounds. They say, 'I can do this, too.'"

Gravitated to STEM

Shauna and Imani once stood in those shoes grow-

ing up in Hampton, Virginia, looking for a direction in life. They were latch-key kids — their father owned a business and their mother worked in community development and public housing — who came home to studies and science shows on TV like "Bill Nye the Science Guy" and "Zoom." They had been exposed to engineering by volunteers in the schools who worked at nearby research labs and companies such as Lockheed Martin Corp. and Boeing Co.

"Our parents weren't scientists, but we were always involved in science and math activities," Imani says. "You gravitate to what you're good at, and we were good at that."

In middle school, the twins were in gifted programs and part of the Cooperating Hampton Roads Organization for Minorities in Engineering, or CHROME, which supported STEM awareness and opportunities. "We hung around with like-minded people," Shauna says.

Their high school had an engineering focus, and they joined Project Lead the Way, a national nonprofit that offers resources and educational aid to K-12 students who want to enter STEM fields. Imani and Shauna took college-credit engineering courses through the program. They also did internships at NASA Langley through its Summer High School Apprenticeship Research Program, or SHARP, and attended the Hampton University Summer Transportation Institute focused on civil engineering.

"Our schools had many opportunities if you chose to take advantage of them," Shauna says. "We had a lot of positive role models."

In 11th grade, they had to decide whether to become math teachers, which they had in mind since childhood, or engineers. They didn't know which way to go. "When our pre-calculus teacher heard that he said, 'Why do you want to be a math teacher? Why not be an engineer?'" Imani says, "He said an engineer can always teach math, but a math teacher can't necessarily be an engineer. When he put it that way it made sense. Engineering allows you to do both."

Work and graduate school

The twins chose North Carolina Agricultural and Technical State University for college, majoring in mechanical engineering. North Carolina A&T is one of the country's Historically Black Colleges and Universities and a top engineering school. "We loved it," Shauna says. "It offered tremendous opportunities. It was an amazing experience."

Imani and Shauna were Thurgood Marshall and Intel Corp. scholars and attended national conferences in New York City and San Jose, California. They interned as systems engineers at Pratt & Whitney in Connecticut through the Tuskegee Airmen Golden Eagle Scholarship. One summer was spent apart, with Shauna at Proctor & Gamble in Ohio as a product engineer and Imani at Exxon Mobile in Louisiana as a technical engineer.

They heard about Sandia through their involvement with NSBE and the American Society of Mechanical Engineers, and from Labs recruiters who visited North Carolina A&T. They wanted to attend graduate school and learned of Sandia's Master's Fellowship Program, which allows people to be hired by the Labs, work summers, and attend graduate school during the academic year.

"We were introduced to the concept of working and going to school, and that sounded great," Shauna says. "You don't run across that kind of opportunity often."

They joined Sandia in 2011 and earned master's degrees in mechanical engineering two years later from Ohio State University.

Inspiring the next generation

Imani works in quality for batteries and power sources. "It allows me to understand the components and the requirements that go into the design," she says. "I work across components and weapon systems and get a good global aspect of the work at the Labs."

Shauna works on various subsystems for both the B61 and W88 programs. "We make sure that what we're building is being built according to requirements. Verification and validation methods are built into the design and testing," she says. "Surety engineers are involved every step of the process. We're one of the last signatures on the system."

They work on multiple projects and it's challenging, but they take the time to inspire the next generation, living by the NSBE code to excel academically, succeed professionally, and positively impact the community.

"I stand on the shoulders of a lot of other people," Shauna says. "They sacrificed and opened doors for me to get where I am today."

Imani says the opportunities she and her sister had growing up came from volunteers. "Someone was there to show us the way," she says. "It's our responsibility to do the same for someone else."