



## From Vietnam with love

If you, or a relative or friend, were a New Mexico Air National Guardsman stationed in Tuy Hoa, Vietnam, in 1968, Art Sena is looking for you. The reason goes back to a long-ago wish to make Christmas merrier for servicemen at war, and a long-lost box of film. Story, photos on page 12.

# Sandia LabNews

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# Making moly 99

## Sandia technology licensed to produce US supply of widely used, in-demand medical rad source

By Nancy Salem

An Albuquerque startup company has licensed a Sandia technology that offers a way to make molybdenum-99, a radioactive isotope needed for diagnostic imaging in nuclear medicine, in the United States. Known as moly 99 for short, it is currently made in aging, often unreliable nuclear reactors outside the country, raising concerns about future shortages.

Eden Radioisotopes LLC was founded last year and licensed the Sandia moly 99 reactor conceptual design in November. It hopes to build the first US reactor for the isotope and become a global supplier.

"One of the pressing reasons for starting this company is the moly 99 shortages that are imminent in the next few years," says Chris Wagner, Eden's chief operating officer and a 30-year veteran of the medical imaging industry. "We really feel this is a critical time period to enter the market and supply replacement capacity for what is going offline."

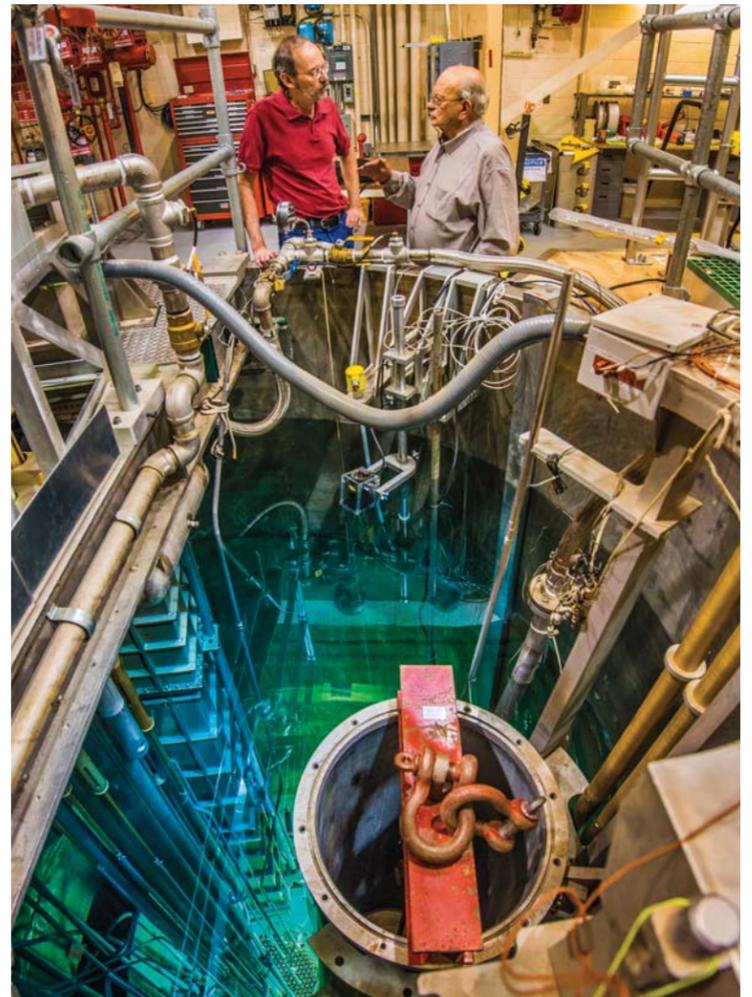
Moly 99 is the precursor for the radioactive isotope technetium-99m used extensively in medical

*"One of the pressing reasons for starting this company is the moly 99 shortages that are imminent in the next few years."*

— Chris Wagner, COO, Eden Radioisotopes

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DICK COATS, right, Eden Radioisotopes's chief technology officer and a retired Sandian, talks science with nuclear engineer John Ford (1381) at the Annular Core Research Reactor, where they helped develop a molybdenum-99 reactor concept in the 1990s. Eden recently licensed the technology with the goal of producing a US supply of moly 99 for use in nuclear medicine. (Photo by Randy Montoya)



## Engineered Safety

Sandia Quantum Information Science and Technology team members Ezra Bussmann and Rusty Gillen, now retired, came up with a novel solution to reduce risk to workers. Story on page 4.



## DOE Early Career Award

Stephanie Hansen has won a \$2.5 million, five-year Early Career Research Program award from DOE's Office of Science for her proposal to improve existing atomic-scale models for high-energy-density matter. Story on page 7.



## Electrolyte sensor

Soldiers on long missions could monitor their electrolytes with a wrist-worn diagnostic tool able to detect and remedy deficiencies, thanks to a prototype device that Sandia researchers are patenting. Story on page 7.

# IED detector developed at Sandia being transferred to Army to support combat troops

## Copperhead Synthetic Aperture Radar system detects IEDs day or night, in any weather

By Heather Clark

Detecting improvised explosive devices in Afghanistan requires constant, intensive monitoring using rugged equipment. When Sandia researchers first demonstrated a modified miniature synthetic aperture radar (MiniSAR) system to do just that, some experts didn't believe it.

But those early doubts are long gone. Sandia's Copperhead — a highly modified MiniSAR system mounted on unmanned aerial vehicles (UAVs) — has been uncovering IEDs in Afghanistan and Iraq since 2009. Now, Sandia is transferring the technology to the US Army to support combat military personnel, says Sandia senior manager Jim Hudgens (5340).

The technology was developed with the Defense Department's Joint Improvised Explosive Device Defeat Organization (JIEDDO), the US Army Engineer Research and Development Center/Cold Regions Research and Engineering Laboratory (CRREL), the Naval Air Systems Command (NAVAIR), Johns Hopkins University's Applied Physics Laboratory, the Naval Research Laboratory, and Florida-based force protection company AIRSCAN.

"JIEDDO tested a number of technologies and ours emerged as one that was viable," Jim says. "Today, we're acknowledged as the most successful airborne IED detection capability out there."

Department of Energy Secretary Ernest Moniz honored the team that developed Copperhead with an Achievement Award at a ceremony in Washington, D.C., this spring.

Copperhead detects disturbances in the earth, for example, those made when IEDs are buried. It can find them day or night and in many weather conditions, including fog and dust storms. Extremely fine-resolution images are processed onboard UAVs and transmitted in real-time to analysts on the ground. Those ana-



SANDIA'S HIGHLY MODIFIED miniature synthetic aperture radar system is being transferred to the US Army to support combat military personnel by uncovering improvised explosive devices, or IEDs.

lysts pass the information to soldiers charged with destroying IEDs.

Though fewer IED have detonated in Afghanistan since a peak of more than 2,000 in June 2012, IEDs account for 60 percent of US casualties, according to

(Continued on page 5)

## That's that

Is America facing a STEM crisis? That is, are there too few young people majoring in STEM (science, technology, engineering, and math)? Do we have too few students graduating with STEM degrees, particularly advanced degrees, to meet the rising demand for such skills in the 21st century? Is the STEM pipeline running dry? And if that's the case, what are the long-term implications for our economy and national security?

I thought I knew the answers to those questions. I had taken it as a given that the nation is facing a serious STEM challenge; it is received wisdom, something everyone "knows." But is this a case where what we "know" is wrong?

I didn't think there was any debate about the subject until I came across an article in a highly regarded engineering journal titled "The STEM Crisis is a Myth," with the subtitle: "Forget the dire predictions of a looming shortfall of scientists, technologists, engineers, and mathematicians."

The author of the article, published last August, says that contrary to conventional wisdom, the STEM situation in the US is not dire. In fact, he says, the STEM pipeline is actually clogged up, with thousands more STEM workers than there are jobs available. He also claims that STEM wages, in general, have been pretty much stagnant for more than a decade, which suggests that the supply of STEM workers exceeds demand. He says the STEM "crisis" has been around since the 1950s. Periodically since then, he says, we hear that if we don't get more competitive in STEM, we're toast.

I don't know what to make of the claim, but I can tell you that it has stirred up quite a firestorm, with the two camps — those who agree with the author and those who don't — firing broadsides back and forth on the Internet. As so often seems to be the case, depending on how you look at the data and how you define your terms, both sides can make a good argument for their perspective.

My own take is that we can never have too many top-tier STEM practitioners. Having a STEM degree and being able to perform at the level that Sandia (or Google, or Apple, or Microsoft) requires are two very different things. So, while there may not be a shortage in raw numbers, does anyone here think that we shouldn't be encouraging our smartest kids to pursue these very rewarding career options?

I think that's our biggest challenge: Keeping smart young people involved in science and engineering as they progress through their schooling. Lots of kids start out loving science and math, but as the disciplines get harder and more demanding, many fall by the wayside. With different motivations than those now in place, would some of these kids have stuck it out? Are we maybe doing a disservice by telling kids that science and math are "fun" when they're slogging through calculus? Maybe we ought to be telling them: "This is hard, this is going to require a total commitment, the journey is tough, but if you persevere, you'll be the best of the best and the rewards will be tremendous."

That's the real story. The problem, of course, is that most young people aren't very good at deferring gratification. I sure wasn't.

When I was a kid, up through about seventh grade if you had asked me what I planned to be when I grew up, my answer was a no-brainer: space program (astronaut!), aviation, astronomy — something along those lines.

So what happened to me that I ended up as a journalist (not that there's anything wrong with that!)? Well, I blame Paul McCartney . . . or more accurately, The Beatles. I'd been playing trumpet since the fourth grade, excelling in the hardest subjects in school, a model student, really. Then came the *Ed Sullivan* show in 1964, with all those kids — okay, girls — screaming for these four guys who were NOT playing trumpets. A week later my best friend and I had bought guitars and formed a band. (We actually ended up playing for pay for a couple of years.) I didn't give STEM another thought until it was too late.

Was I a lost opportunity? Were it not for The Beatles, might I have had an illustrious STEM career? Who knows? Not sure I'd have had the chops to rise to the first rank. But one way or the other, I did end up at Sandia, for which I am daily grateful.

As far as the STEM pipeline goes, there's a moral to my personal story: Mommas, don't let your babies grow up to be guitar players!

See you next time.

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

## Grey Ballard wins ACM Doctoral Dissertation Honorable Mention

By Patti Koning

Grey Ballard (8966) has received an honorable mention for the 2013 Doctoral Dissertation Award presented by the Association for Computing Machinery (ACM). Grey is a 2014 Sandia Truman Fellow.

Grey shares the award, which includes \$10,000 from Google, with Shayan Oveis Gharan, a postdoc at the University of California, Berkeley. ACM awarded its top prize for the 2013 Doctoral Dissertation Award to Sanjam Garg, a postdoc at the IBM T.J. Watson Research Center.

Grey's dissertation, "Avoiding communication in dense linear algebra," explores fundamental computations within dense linear algebra and investigates whether the current algorithms for these computations can be significantly improved. He received his BS and MA degrees from Wake Forest University and his PhD from the University of California, Berkeley.

"I'm interested in improving fundamental computations — those used by a wide range of computational scientists — so that they return accurate solutions more quickly, allowing scientists to work more interactively with their data, solve larger problems, and increase the quality of their simulations," he says. "I am especially excited about applying core ideas from my thesis work to problems important to Sandia. For example, we are improving the performance of algebraic multigrid within Trilinos by modeling and avoiding communication in the key underlying algorithms."



GREY BALLARD

## Maj. Gen. Sandra Finan, commander of AFNWC, visits Sandia/New Mexico

Maj. Gen. Sandra Finan, commander of the Air Force Nuclear Weapons Center (AFNWC), and Steven Amburgey, deputy of the Air Force Life Cycle Management Center, recently visited Sandia for a series of high-level briefings hosted by Deputy Labs Director Jerry McDowell, executive VP for National Security Programs, and Jim Handrock, director of New Mexico Weapon Systems Engineering.

During their visit, Finan and Amburgey were briefed on the status of numerous weapon programs, including the B61-12, Mk21 Arming and Fuzing Assembly, Long Range Stand-Off, and Interoperable Warhead 1.

The AFNWC includes a headquarters staff, one wing, and two wing-equivalent directorates: the 377th Air Base Wing and Nuclear Capabilities Directorate at Kirtland Air Force Base (AFB) and the Intercontinental Ballistic Missile Systems Directorate at Hill AFB, Utah. The AFNWC has more than 3,500 airmen at 11 locations in the US and Europe and is responsible for the entire scope of nuclear weapons sustainment functions.

Finan previously visited Sandia in early 2011 when she was a brigadier general serving as NNSA's principal assistant deputy administrator for Military Applications, Office of Defense Programs.



MAJ. GEN. SANDRA FINAN

## Sandia LabNews



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### Retiree deaths

Hugo Flores (age 90)	Mar. 20
Hilario Garcia (81)	Mar. 29
Irl M. Vance (71)	Apr. 3
George W. Elliott (95)	Apr. 5
Selma Savitt (95)	Apr. 6
Jacquelyn Hines (88)	Apr. 9
Charles T. Radigan (92)	Apr. 9
Albert William Snyder (88)	Apr. 9
Juanita M. Sanchez (65)	Apr. 19
Cornelius Visbeck (87)	Apr. 20
Verlan Gabrielson (81)	Apr. 23
Kenneth L. Goin (90)	Apr. 24
William F. Stamm (99)	Apr. 24
Larry D. Miller (83)	Apr. 29
William J. Brion (96)	Apr. 30
Mary M. Gonzales (89)	May 4
Lessie Lee (84)	May 4
Rudolph Walter (86)	May 5
Eulita Welch (93)	May 5

# Sandia chemist Mitch Anstey illuminates the Smithsonian's Future Is Here Festival



MITCH ANSTEY demonstrates photo luminescence with fluorescein and rhodamine glowing brightly. He explored the science behind this and other forms of luminescence in his talk, "Let's Make Light of the Situation," at the *Smithsonian Magazine's* Future is Here Festival. (Photo by Dino Vournas)

By Patti Koning

Chemist Mitch Anstey (8125) recently joined Patrick Stewart, George Takei, Brian Greene, Sara Seager, and other notable minds from the galaxy of science and science fiction at *Smithsonian Magazine's* The Future Is Here Festival on May 16-18 in Washington, D.C. Mitch's talk, "Let's Make Light of the Situation," explored different forms of luminescence, the principle of turning energy into light, with several glowing demonstrations.

Mitch first gave a version of his talk at Nerd Nite East Bay two years ago at the request of Sandia colleague Rick Karnesky (8252), a metallurgist and co-boss of Nerd Nite East Bay with Rebecca Cohen. Nerd Nite is a monthly series of fun-yet-informative cross-disciplinary lectures held in cities worldwide.

"I have a deep interest in science communications," says Rick. "Nerd Nite is relaxed and informal, but allows deeply informative and educational talks from some pretty amazing speakers."

Rick also co-hosts the biweekly *Spectrum* show on KALX (90.7 FM Berkeley). *Spectrum* explores scientific research and technology development through interviews with leading practitioners at the University of California, Berkeley, and throughout the San Francisco

Bay Area.

Last year, *Smithsonian Magazine* asked Nerd Nite to collaborate on its second annual The Future is Here Festival, a celebration and exploration of science, technology, culture, and the arts — all gathered around the exciting and elastic theme of "the future." When the call went out to the bosses of the regional Nerd Nites to nominate their favorite talks for the festival, Rick immediately thought of Mitch.

"Mitch's talk is a great mix of technical knowledge and experiential science," says Rick. "I knew it would really resonate with the theme of the future and science fiction."

At Sandia, Mitch's research focuses on molecular fundamental properties that give rise to luminescence and how these properties can be used for radiation detection and biomolecular tagging.

"The talk is somewhat related to what I do on a daily basis, but on a much broader level," Mitch says. "I really didn't want to talk about work and instead delved into other forms of luminescence that interest me and how they play into our daily lives. Think of LEDs, glow-in-the-dark T-shirts, whitening detergents, and even the X-Men character Cyclops, whose power is derived from bioluminescence."

## Sandia California News

# Renewables, other energy issues to be focus of enhanced Sandia, SINTEF collaboration

By Mike Janes

Under an expanded agreement, a decades-long partnership between Sandia and the Norwegian research organization SINTEF will now tackle energy challenges such as renewable energy integration, electric grid modernization, gas technologies, and algae-based biofuels.

SINTEF is the largest independent research organization in Scandinavia, with expertise in the natural sciences and technology, the environment, health, and social sciences. Its specific technical strengths include oil and gas, materials, maritime and biomarine technology, building research, and medical technology. The agreement includes close alignment with the Norwegian University of Science and Technology in Trondheim, the largest technical university in Norway.

Sandia has partnered with SINTEF since the 1980s, primarily in the field of combustion science at the Labs' Combustion Research Facility (CRF). A memorandum of understanding between the two organizations was signed in 2009.

Past joint research has included the use of laser diagnostics to study a new combustion technology that allows CO<sub>2</sub> to be captured from the combustion products, and advanced numerical simulations of the turbulent mixing and combustion of fuel jets in air. This collaboration led to publications reporting important insights into the consequences of replacing CO<sub>2</sub>-emitting fuels with environmentally friendly fuel in power generation.

Recently, research managers from SINTEF visited Sandia's California and New Mexico sites to plan the enhanced collaboration.

"Sandia and SINTEF are among the world's leading energy research institutions, and expanding the areas of collaboration is expected to bring new solutions to these difficult energy problems," says Bob Hwang, director of Transportation Energy Center 8300. "This partnership can make important strides toward our nation's goals in energy security."

The goal of the collaboration is to investigate various



INGE GRAN, president of SINTEF Energy Research, visited Sandia recently to discuss an enhancement to SINTEF's decades-long collaboration with the Labs. Under an expanded agreement, the two organizations will now tackle a variety of energy challenges. (Photo by Jeff McMillan)

technical areas from an international perspective. The agreement enables the organizations to undertake joint research, seek new funding opportunities, and establish multidisciplinary partnerships.

Both research organizations are known for groundbreaking work in energy research.

"Sandia offers a number of unique capabilities and significant test facilities, and we look forward to leveraging these resources in collaborating with SINTEF to advance our mutual goals," says Juan Torres (6120), senior manager of Sandia's renewable energy technologies group.

In addition to the CRF, Sandia's energy research facilities include the Photovoltaic Systems Evaluation Lab, the Distributed Energy Technologies Laboratory, and DOE's National Solar Thermal Test Facility.

"SINTEF is delighted to partner with Sandia to advance research in additional energy areas, along with our longstanding collaboration in combustion research," says Inge Gran, president of SINTEF Energy Research. "The expanded areas of collaboration recognize the relationship we have already had with Sandia for several decades, and it points to a strong collaborative future."

## Engineered Safety

# Using PH<sub>3</sub>: Defining unacceptable consequences

By Sue Major Holmes



Sandia Quantum Information Science and Technology team members Ezra Bussmann (1725) and Rusty Gillen, now retired, came up with a novel solution to reduce risk to workers, the public, and the environment when they studied the best way to implement a technique to make precise electronic components based on single atoms within a silicon chip.

The technique developed by Australia's University of New South Wales requires phosphine (PH<sub>3</sub>) gas, which is highly toxic if inhaled even in very dilute concentrations. Sandia Nanosciences Group researchers knew any failure while using the gas could be catastrophic.

PH<sub>3</sub> for industrial settings comes in cylinders that hold several pounds of gas under pressure. A cylinder failure could expose not only workers but also the public, and could shut down the facility where it's used for more than a month.

### Thinking through possible consequences

The Engineered Safety principle of thinking through the possible unacceptable consequences helped shape how researchers approached the project.

The facility where the research would be done

MITIGATING UNACCEPTABLE CONSEQUENCES — Among the Engineered Safety features for Sandia's use of PH<sub>3</sub> gas is this subatmospheric pressure phosphine gas cylinder and manifold developed by Sandia researchers Ezra Bussmann (1725), and Rusty Gillen and Roger Shrouf (both retired) in collaboration with SDC Inc. (Photo courtesy of Ezra Bussmann)

already had a cleanroom with the required gas containment cabinet.

Once the decision was made to use that cleanroom, researchers turned their attention to the gas container itself. Since Sandia didn't need as much gas as an industrial cylinder holds, they found a PH<sub>3</sub> source that offered a 40-gram (1.4-ounce) bottle, with the phosphine absorbed into porous carbon to prevent rapid release and in a vacuum rather than pressurized.

### A smaller, safer container

Still, Sandia modelers concluded even a release of that smaller amount could result in dangerous levels of gas more than 325 feet away.

Sandia worked out a way to receive PH<sub>3</sub> in a bottle holding only 10 grams, also in a vacuum, thus reducing the hazard zone to about 30 feet. It's enough gas for years of experiments, but the smaller, safer container and other measures in the facility ensure that no single-point failure can cause catastrophic exposure to the public. Two systems would have to crash simultaneously to endanger workers, and a toxic gas monitoring system would sound an evacuation alarm.

Manager Sean Hearne (6111) says thinking through the unacceptable consequences meant a thoughtful review of the project — and says he sleeps better at night because of that.

His advice for other groups who need to look at the consequences of a project before implementation: "Think carefully about what truly are these unacceptable outcomes — without focusing solely on risk or how likely it is for the event to occur. Then see what you can do in the design of the system to minimize or eliminate those potential outcomes."

## Sandia technology licensed to make medical grade moly 99

(Continued from page 1)

diagnostic tests because it emits a gamma ray that can be tracked in the body, letting physicians image the spread of a disease. And it decays quickly so patients are exposed to little radiation.

Moly 99 is made in commercial nuclear reactors using weapon-grade uranium and 50 to 100 megawatts of power. Neutrons bombard the uranium-235 target. The uranium fissions and produces a moly 99 atom about 6 percent of the time. Moly 99 is extracted from the reactor through a chemical process in a hot cell facility and used by radiopharmaceutical manufacturers worldwide to produce moly 99/technetium-99m generators. The moly 99, with a 66-hour half-life, decays to technetium-99m, with a six-hour half-life. The generators are then shipped to hospitals, clinics, and radiopharmacies, which make individual unit doses for a variety of patient imaging procedures.

"It's a \$4 billion a year market," Wagner says. "There are 30 million diagnostic procedures done worldwide each year and 80 percent use technetium-99m. More than 50 percent of the procedures are done in the United States, and 60 percent of those are cardiac related. This issue is very important to US health care because there is no domestic production supplier on US soil."

### Meeting the moly demand

The world's five primary moly 99 production reactors, in Canada, the Netherlands, South Africa, Belgium, and Australia, are often unpredictably closed for repairs, causing periodic shortages that can last months, Wagner says. Two of the largest, the Canadian and Dutch, could either stop producing moly 99 or be decommissioned in the next 10 years. "They represent more than 60 percent of the global supply," Wagner says. "There is a new reactor due in France, but at the end of the day, if the two go offline and new replacement capacity comes on, Eden still predicts a 20 to 30 percent global shortage to meet today's demand."

A search has been on for a number of years for a way to make moly 99 in the United States without using weapon-grade uranium. Several companies have explored new kinds of reactors and different methods to produce the isotope but are not yet in commercial production. "Eden would be the first reactor in the US specifically for medical isotope production," Wagner says. "We feel that science-wise, this has the most potential for success in the market."

Dick Coats, Eden's chief technology officer, is a retired Sandian who helped develop the moly 99 reactor concept at the Labs in the 1990s. "I've been involved in reactors my entire career," says Coats, who has a PhD in engineering sciences from the University of Oklahoma and worked at Sandia 35 years.

Based on technology developed in the DOE-funded Sandia medical isotope production program of the 1990s, the team created a reactor concept tailored to the business of producing moly 99. "This reactor is very small, less than 2 megawatts in power, about a foot-and-a-half in diameter and about the same height, but very efficient," Coats says.

The reactor sits in a pool of cooling water 28 to 30 feet deep. It has an all-target core of low-enriched uranium — less than 20 percent U-235 — fuel elements. "The targets are irradiated and every one can be pulled out and processed for moly 99. The entire core is available for moly 99 production," Coats says. "Every fission that occurs produces moly. The reactor's only purpose is medical isotope production. This is what is new and unique. Nobody thought about approaching it that way."

Ed Parma (1384), who was on the original Sandia team, says the world demand for

moly 99 can be met with a small, all-target reactor processed every week. He says larger reactors aren't cost effective because they use so much power to drive the targets. "They're using 150 megawatts to drive a 1 megawatt system," he says. "When you add in fuel costs, operations, and maintenance, it's hard to make money."

He says there has never been a reactor system designed just to make moly 99. "They all started as something else," he says. "Our design is scaled down to just the production of moly. The reactor is only the size you need. It's more efficient and economically viable."

### Completing a mission

The Eden reactor is based on a Sandia reactor concept that was envisioned but not designed. The Sandia team went on to other projects in the late 1990s. After he retired in 2011, Coats was asked to join Eden by company partners including CEO Bennett Lee, who learned of the technology while an intern in the Sandia licensing group.

"The reactor had been on my mind for many years," Coats says. "It's very exciting to be part of the effort to commercialize it. I don't view this so much as trying to produce a successful business venture as to complete a mission. There's more an emotional aspect than economic. It's something we can do for the country."

Eden is raising investment capital. The cost for initial funding through production is about \$75 million.

It hopes to be in production in about four years. During that time it will build the reactor and facilities and seek licensing from the Nuclear Regulatory Commission and approval of the manufacturing process from the Food and Drug Administration. Wagner says the preferred location is Hobbs, N.M., which has a workforce familiar with nuclear activities due to the nearby URENCO USA uranium enrichment facility. Eden would employ about 140 people.

"Our intent is not to make something just for the United States," Wagner says. "We will be US-based so US health care has domestic coverage. But our production capacity will be enough to meet the entire global demand."

### All the bases covered

On the business side, two companies provide 100 percent of US production and distribution of moly 99/technetium-99m generators: Mallinckrodt Pharmaceuticals in Missouri and Lantheus Medical Imaging in Massachusetts. Wagner is a former Mallinckrodt vice president and Eden advisory board member Peter Card is a former Lantheus VP. On the technical side, Coats is joined in the company by Milt Vernon, also a retired Sandian who worked on the technology. "We have all the bases covered to be successful," Wagner says.

Bob Westervelt (7932) says Sandia pursued an exclusive license for the technology. "We didn't want multiple people trying to build it," he says. "We wanted one company that could actually commercialize it."

The licensing department advertised it last summer, and interested parties had to demonstrate they had the financial resources and technical capabilities to build the reactor and get regulatory and environmental approvals.

"There were 10 responses and only one, Eden, came with a full package proposal," Bob says. Eden was given an exclusive license for the term of the patent, which is pending.

"It's very exciting to be part of a project that could be commercialized," Ed says. "I think this is the future. There's no doubt in my mind."

# Detecting IEDs



ENERGY SECRETARY ERNEST MONIZ honored the Copperhead team with an Achievement Award at a ceremony in Washington, D.C., this spring. More than 300 people each spent at least three

months on the project during development, including researchers and mission support staff, and another 200 Sandians worked to make the program successful since the technology was developed.

*(Continued from page 1)*

Department of Defense reports.

## MiniSAR legacy enables Copperhead's rapid development

Sandia is a world leader in the development of SAR systems, a history that grew out of Sandia's mission to develop radars for nuclear weapons. Recent SAR systems have vastly improved radar images from aircraft flying at great heights.

SAR and its descendent MiniSAR, the first system of its size to successfully transmit real-time images from UAVs in 2006, use small antennae that capture reflections of microwaves returned from objects on the ground, transmitting and receiving many radar pulses as the aircraft flies. The received pulses are integrated by signal processing techniques to synthesize a fine-resolution image, hence the name "synthetic aperture."

Jim and Sandia manager Bill Hensley say had it not been for Sandia's research and development process to reduce the size of the SAR that led to MiniSAR, Copperhead might never have been ready in time to help the Army.

"If we wouldn't have made that investment, we wouldn't have been in position to be ready. Otherwise it would have taken us years," Jim says. "So what we were able to focus on were the radar modes and the enhanced processing that we needed to do."

But MiniSAR was still limited when it came to the real-world problem of IEDs. As Americans heard more reports of soldiers killed or maimed by IEDs in Afghanistan and Iraq, Sandia researcher Bryan Burns (S300) wanted to help.

"People were getting blown up driving along the road and I said, 'We can help solve this problem,'" Bryan says.

A few different demonstrations and tests were conducted to demonstrate the fundamental capability. Though some experts expressed doubt that any coherent change-detection system could detect IEDs, in 2007, the Sandia team connected with Mark Moran, director of the special projects office at CRREL. Moran's team was running a series of scientific investigations to predict the operational ability of various technologies for JIEDDO. During one of those tests, the team showed the value of the MiniSAR technology.

JIEDDO then became interested in the technology and assigned Moran's team at CRREL as the developing and fielding program office. JIEDDO needed Copperhead developed in nine months, about half Sandia's normal development period, Bill says.

"Sandia does this advance research and development because there's a significant number of customers who come to us, they've exhausted their other possibilities, they need something and they need it now," he says. "If we haven't gotten out ahead of that with the technology, if we've got an 18-month technology development cycle out ahead of us, we can't help them."

## Focusing on mountaintops, valley floors simultaneously is solved

Just as cameras are limited by depth of field — where a near object is in focus but the background is blurry or vice versa — MiniSAR needed a way to keep the entire height of the terrain in an image in focus, for example, the top of a mountain and the valley floor.

So Bryan created advanced image-processing algorithms that focused the high and low terrain simultaneously while continuing to provide fine-resolution imagery. The new capability, which has been proven effective on slopes of more than 40 degrees, made Copperhead useful in the wide variety of terrain present in places like Afghanistan.

To make Copperhead a reality, more than 300 people each spent at least three months on the project during development, including researchers with diverse areas of expertise and Labs staff who helped with logistics, foreign travel, and contracting, Bill says.

"The team is awesome," he says.

Sandia and its partners had to quickly adapt and enhance the 30-pound MiniSAR so it could fly on NAVAIR's 17-foot Tiger Shark UAV and accomplish the mission JIEDDO had set.

Completing the modifications and getting them mature enough for operational use in nine months stressed Sandia's capabilities and the Copperhead team gave their best to meet an urgent mission need, Bill says.

"There were many late nights and long weekends. Key individuals spent months at Yuma Proving Ground," Bill says.

In the ensuing years, an additional 200 Sandians have applied their talents to make the program successful. "I wish we had room to list all their names," Bill says.

When the modifications were made Copperhead's MiniSAR technology weighed about 65 pounds and was about 1 foot wide, it could do all its image processing on board, and it was rugged enough for the environments it would face, Jim says.

Then the modified MiniSAR was integrated into the operational system known as Copperhead, which includes hardware and software tools to help radar analysts on the ground understand the data coming from the aircraft and a training program for them.

"We developed a flight planner and an exploitation tool that the analysts use in the ground station, and we had to develop all the concepts of operations to make it work and tactics, techniques, and protocols for utilizing the system," Jim says.

"While MiniSAR was a radar that we flew and used to collect data, Copperhead is an entire system, everything from communications to analyzing imagery to providing information useful to people who defeat IEDs."

## Wartime conditions test a success

In 2009, JIEDDO sponsored a 30-day evaluation of the technology in wartime conditions and — despite doubts raised that all the images could have such fine resolution — Copperhead has been fielded in Afghanistan ever since, Bill says.

Copperhead uses a technology called coherent change detection, which compares a pair of extremely detailed SAR images taken of the same scene but at different times. The process allows analysts to detect minute physical changes on the surface.

"There are other approaches to change detection out there, but this is the only one that's all-weather," Jim says.

An earlier version of coherent change detection developed at Sandia showed images of a lawn taken 20 minutes apart from an aircraft flying 10,000 feet up and three miles away. The images revealed the path of a lawn mower due to the bending of the blades of grass.

Bryan and the team are working with the Army to ensure that Copperhead continues to solve current problems. "We're helping them to use it in better and more effective ways, even when things change," he says. "The system is continuously adapting."

Sandia's transfer of the technology to the Army will take years to complete, but the Sandia team members say they are happy that they've provided the Army with a needed tool to detect IEDs.

Of the transfer to the Army, Bill says, "We're making a positive, measureable impact right now on the security of US people. This acknowledgement that it needs to be kept in the Army is very satisfying."

# Novel nanoparticle production method could lead to better lights, lenses, solar cells

By Sue Major Holmes

Sandia has come up with an inexpensive way to synthesize titanium dioxide nanoparticles, and is seeking partners who could demonstrate the process at industrial scale for use in everything from solar cells to light-emitting diodes (LEDs).

Titanium dioxide (TiO<sub>2</sub>) nanoparticles show great promise as fillers to tune the refractive index of anti-reflective coatings on signs and optical encapsulants for LEDs, solar cells, and other optical devices. Optical encapsulants are coverings or coatings, usually made of silicone, that protect a device.

Industry has largely shunned TiO<sub>2</sub> nanoparticles because they've been difficult and expensive to make, and current production methods produce particles that are too large.

Sandia became interested in TiO<sub>2</sub> for optical encapsulants because of its work in LED materials for solid-state lighting.

Current production methods for TiO<sub>2</sub> often require high-temperature processing and/or costly surfactants — molecules that bind to something to make it soluble in another material, like dish soap does with fat. Those methods produce less-than-ideal nanoparticles that are very expensive, can vary widely in size, and show significant particle clumping, called agglomeration.

Sandia's technique, on the other hand, uses readily available low-cost materials and results in nanoparticles that are small and roughly the same size with no agglomeration.

"We wanted something that was low cost and scalable, and that made particles that were very small," says researcher Todd Monson (1114), who along with principal investigator Dale Huber (1132) patented the process in mid-2011 (Patent 7,943,116, "High-yield synthesis of brookite TiO<sub>2</sub> nanoparticles").

## Technique produces small enough nanoparticles

Their method produces nanoparticles roughly 5 nanometers in diameter, approximately 100 times smaller than the wavelength of visible light, so there's little light scattering, Todd says.

"That's the advantage of nanoparticles — not just nanoparticles, but small nanoparticles," he says.

Scattering decreases the amount of light transmission. Less scattering also can help extract more light, as in the case of an LED, or capture more light, in the case of a solar cell.

TiO<sub>2</sub> can increase the refractive index of materials such as silicone in lenses or optical encapsulants. Refractive index is the ability of material to bend light. Eyeglass lenses, for example, have a high refractive index.

Practical nanoparticles must be able to handle different surfactants so they're soluble in a wide range of solvents. Different applications require different solvents for processing.

"As an example, different polymers are soluble in different solvents. If someone wants to use TiO<sub>2</sub> nanoparticles in a range of different polymers and applications, it's convenient to have your particles be suspension-stable in a wide range of solvents as well," Todd says. "Some biological applications may require stability in aqueous-based solvents, so it could be very useful to have surfactants available that can make the particles stable in water."

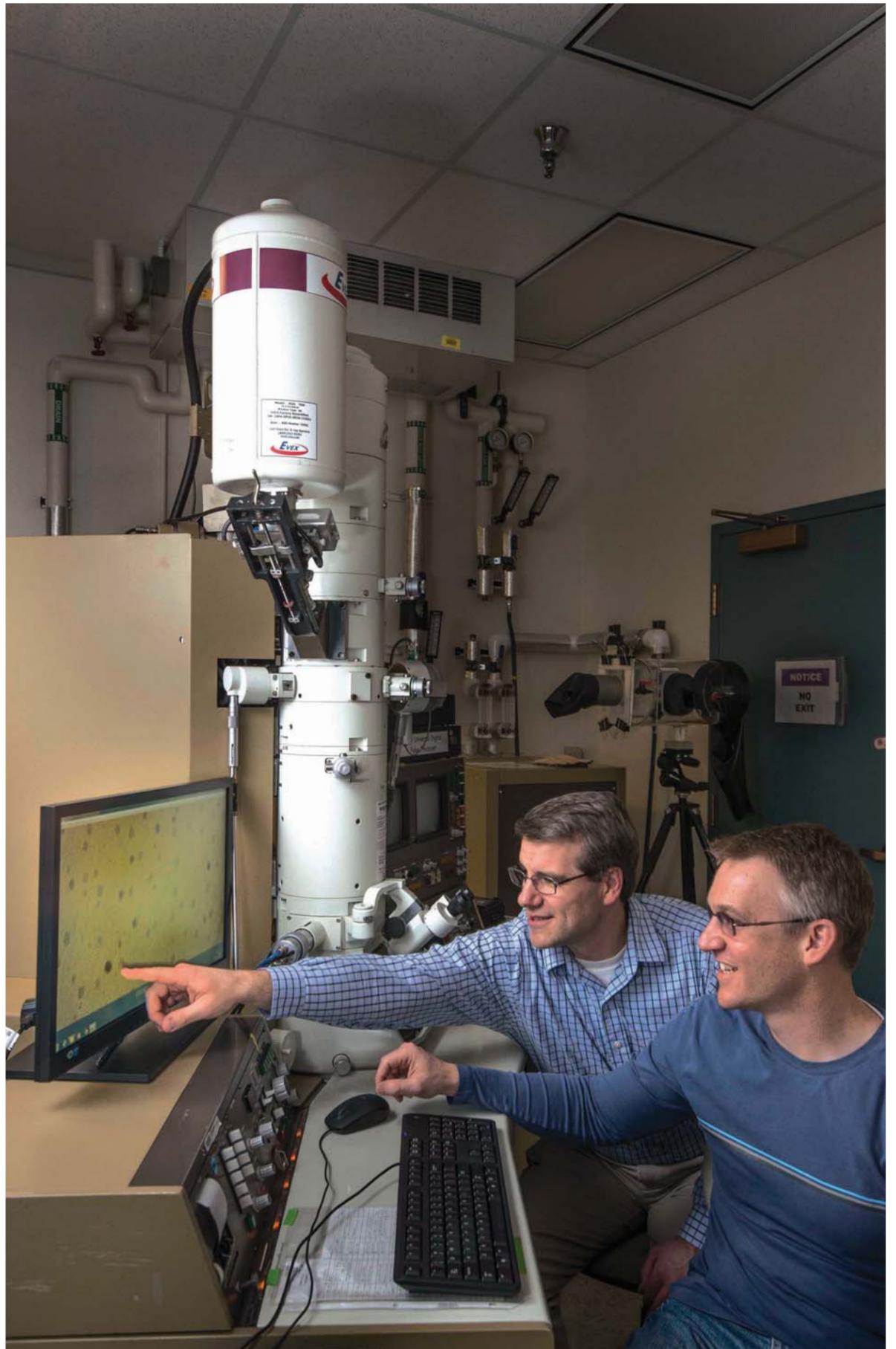
The researchers came up with their synthesis technique by pooling their backgrounds — Dale's expertise in nanoparticle synthesis and polymer chemistry and Todd's knowledge of materials physics. The work was done under a Laboratory Directed Research and Development project Dale began in 2005.

## Commercial applications were obvious

"The original project goals were to investigate the basic science of nanoparticle dispersions, but when this synthesis was developed near the end of the project, the commercial applications were obvious," Dale says. The researchers subsequently refined the process to make particles easier to manufacture.

Existing synthesis methods for TiO<sub>2</sub> particles were too costly and difficult to scale up production. In addition, chemical suppliers ship titanium dioxide nanoparticles dried and without surfactants, so particles clump together and are impossible to break up. "Then you no longer have the properties you want," Todd says.

The researchers tried various types of alcohol as an



SYNTHESIZING TiO<sub>2</sub> NANOPARTICLES — Dale Huber (1132), left, and Todd Monson (1114) have come up with an inexpensive way to synthesize titanium dioxide nanoparticles, which could be used in everything from solar cells to light-emitting diodes.

(Photo by Randy Montoya)

inexpensive solvent to see if they could get a common titanium source, titanium isopropoxide, to react with water and alcohol.

The biggest challenge, Todd says, was figuring out how to control the reaction, since adding water to titanium isopropoxide most often results in a fast reaction and large chunks of TiO<sub>2</sub>, rather than nanoparticles.

"So the trick was to control the reaction by controlling the addition of water to that reaction," he says.

Some textbooks dismissed the titanium isopropoxide-water-alcohol method as a way of making TiO<sub>2</sub> nanoparticles. Dale and Todd, however, persisted until they discovered how to add water very slowly by putting it into a dilute solution of alcohol. "As we tweaked the synthesis conditions, we were able to synthesize nanoparticles," Todd says.

The next step is to demonstrate synthesis at an industrial scale, which will require a commercial partner. Todd, who presented the work at Sandia's fall Science and Technology Showcase, says Sandia has had inquiries from companies interested in commercializing the technology.

"Here at Sandia we're not really set up to produce the particles on a commercial scale," he says. "We want them to pick it up and run with it and start producing these on a wide enough scale to sell to the end user."

Sandia would synthesize a small number of particles, then work with a company to form composites and evaluate them to see if they can be used as better encapsulants for LEDs, flexible high-index refraction composites for lenses, or solar concentrators. "I think it can meet quite a few needs," Todd says.

# Stephanie Hansen wins DOE Early Career award



STEPHANIE HANSEN

By Neal Singer

Sandia researcher Stephanie Hansen (1684) has won a \$2.5 million, five-year Early Career Research Program award for 2014 from DOE's Office of Science for her fundamental science proposal to improve existing atomic-scale models for high-energy-density matter.

"Understanding the properties of such extreme states of matter is where this

project is going," she says.

Thirty-five winners were chosen by peer review from approximately 750 proposals.

Stephanie's winning submission, "Non-Equilibrium Atomic Physics in High Energy Density Material," describes an approach to improve simulation tools used to design high-energy experiments in dense hot plasmas, as well as the diagnostic tools used to interpret data from them.

"I am interested in the states of matter created at a variety of advanced radiation facilities, because every time an experiment is run in a new regime, we are surprised by the results," Stephanie says. "Predictions of outcomes are relatively simple when effects occur in cold matter because its potential energy is greater than its kinetic energy. Or, in hot but not very dense plasma, kinetic is clearly greater than potential. But in hot dense matter you can't use those simplifying assumptions."

One of her interests is to produce high-accuracy predictions for the non-equilibrium X-ray emission of hot dense matter. "We use the X-ray emission from hot plas-

mas on Z, NIF, and elsewhere as diagnostics to infer something about the state of the material. For example, a hotter plasma might emit characteristic lines at a significant intensity, indicating one state of matter, while the emission from a cooler plasma will be dominated by slightly different lines, indicating a different state. So looking at the emission tells us something about why the target performed as it did." She wants her model to accurately predict either result.

Experiments that interest her at Sandia's Z machine include wire array and ICF experiments, both of which create plasmas in disequilibrium. But also, she says, "I am interested in experiments and conditions even beyond what we get on Z."

For example, she says, DOE supports "matter at extreme conditions" research at Stanford's Linear Coherent Light Source (LCLS). This free-electron laser provides "astoundingly intense X-ray radiation — so intense that you can hit, for example, a solid aluminum target with the X-ray beam, knock out one of the inner-shell electrons, and then knock out another before the ion has time to decay — and do this all before the ions have time to move."

Such experiments end up with exotic "hollow" ions in a dense lattice that perturbs the outer electronic orbitals. Meanwhile, the inner-shell holes modify the binding energies of the remaining outer shell electrons, and it all happens on femtosecond timescales.

Early Career Research Program awards support inves-



STEPHANIE HANSEN (1684), who has just been named a recipient of the DOE Early Career Research Program award, briefed Secretary of Defense Chuck Hagel about work at Sandia's Z machine during the secretary's January visit to the Labs.

(Photo by Randy Montoya)

tigations into advanced scientific computing research, basic energy sciences, biological and environmental research, fusion energy sciences, high energy physics, and nuclear physics. The DOE defines "early career" as a researcher who holds a doctorate issued within the last 10 years.

To date, there have been 204 university and 102 lab awardees from 38 states. Seventeen of the current year's winners work at 10 national labs.

"It has been an honor and joy to work with the exceptional scientists at the DOE Labs, whose work really set the foundation for this proposal," Stephanie says.

## Prototype electrolyte sensor provides immediate results

*Painless wearable device may reduce trips to doctors' offices*

By Neal Singer

Soldiers on long missions, encased in tactical armor, could monitor their electrolytes with a diagnostic tool worn on the wrist and immediately detect and remedy deficiencies, thanks to a prototype device that Sandia researchers are patenting.

Electrolyte levels are key to optimizing health, strength, and awareness, not only for soldiers but for anyone who subjects the body to extremes. The ability to predict and upgrade the performance of long-distance runners or competitors in other strenuous sports would improve significantly if coaches could learn what's happening physiologically while the athlete is exercising. The knowledge would help the self-aware athlete as well.

Electrolytes are crucial in carrying electrical impulses that tell the heart and other muscles when to contract or relax. Even non-athletes who feel poorly and try to navigate today's complex medical system with its costly laboratory analyses might prefer a pain-free home diagnostic device that can analyze and continuously record electrolyte levels.

The Sandia researchers used various miniaturization techniques to shrink laboratory-scale equipment that analyzes various electrolyte levels on the spot down to a model that can fit in a palm or be worn on a wrist. The device, when commercially available, could decrease the time patients must spend in emergency rooms, lab testing facilities, or doctors' offices.

### Painless, noninvasive, long-term use

The device is painless because it employs micro-needles so tiny they can't traumatize nerves when pressed into the skin, and samples only interstitial fluid (i.e. fluid between cells). Thus the device has the potential for long-term, noninvasive use.

"We're proposing a minimally invasive way to move away from centralized laboratory testing," says Ronen Polsky (1714), lead Sandia researcher on the project.

In a paper to be published as a cover feature in the June issue of *Advanced Healthcare Materials* (Wylie) and available online, Ronen, Sandia colleagues, and University of North Carolina/North Carolina State University graduate student Phil Miller describe using a fast-pulsed laser to create strong hollow microneedles that suck infinitesimal amounts of colorless fluid from

just beneath the skin's surface. The paper demonstrates that tiny amounts of potassium passed unhindered through the microneedle pores into a fluidic cartridge containing carbon electrodes. These measured the amount of this key electrolyte without being confused by the presence of other electrolytes in the fluid.

Miller says it's easy to change the selectivity of the carbon electrodes to detect and measure other such electrolytes as sodium or calcium in the same device. "We want to make the device wearable, non-invasive, and with real-time readout to constantly measure things a doctor might normally order for laboratory tests," he said.

University of New Mexico physician and researcher Justin Baca, who will lead human testing of the device, adds, "Development of this benchtop device into a handheld model for consumers and patients will be a true partnership between a clinician and an engineer."

Sometimes sensor technologies work well, but problems arise when they are adapted to living systems, Baca said. "We're trying to get at this problem from the beginning to develop the best needle geometry."

Baca, with a background in physical chemistry and a practice in emergency medicine, says he has initial approval from UNM's Human Research Protection Office review board to start tests. He's interested, he says, because "it's hard, using traditional methods, to take blood samples continuously." Using only interstitial fluids is another matter entirely, he said.



RONEN POLSKY holds a prototype of a microneedle fluidic chip device able to selectively detect and painlessly measure electrolytes in the interstitial fluids that bathe skin cells. The device features nine sampling needles, each just 800 millionths of a meter (microns) in height, and beneath them, a fluidic channel that can draw interstitial fluid over nine gold disk electrodes. Each disk can be tailored to detect a different analyte. The visible rectangular gold pads are contacts.

(Photo by Randy Montoya)

The initial sensor work was funded by Sandia's Laboratory Directed Research and Development program and the US Defense Threat Reduction Agency. Others working on the project include University of North Carolina/North Carolina State professor Roger Narayan.

"This is the future of personalized health care," says Ronen. "These wearable technologies are just starting to come out in different forms. It's inevitable that people will go there."

# TRUTHS AND CONSEQUENCES (FORMERLY ETHICS IN ACTION)

## DID YOU KNOW...

...that gifts and business courtesies are a frequent topic of questions fielded by Sandia's Ethics office? In the first half of FY14, nearly a third of all ethics consultations were related to this topic.

## ISSUE: CONFLICT OF INTEREST — GIFTS AND BUSINESS COURTESIES

Here are some guidelines to help you deal with these kinds of situations. The purpose of the guidelines is to help you avoid situations that create a conflict of interest; i.e., where the giving or receiving of gifts or business courtesies could be construed as an attempt to secure favorable treatment in a business relationship.

First, let's clarify what we mean by "business courtesy." Business courtesies include, but are not limited to, door prizes, meals, cash or cash equivalents (e.g., gift cards and gift certificates), entertainment and recreation (e.g., tickets to sporting, recreational, or other events), training, transportation, discounts, and promotional items.

### **Can Sandians accept gifts/business courtesies from business associates?**

Sandians are very lucky when it comes to winning door prizes at business-related conferences and workshops. Some of the prizes that have been offered include laptops, travel expenses, cash, gift cards, and tickets to local or national sporting events. Whether it's a door prize or a drawing or through some other business engagement, Sandians may only accept a gift or business courtesy if it is:

- Extended to a general audience.
- Infrequent, open, and transparent.
- Not in the form of cash or cash equivalent.
- Not in the form of expense-paid travel.
- Not greater than \$100 in value.

Anyone in a procurement role or procurement-like function (e.g., involved in evaluating and/or selecting vendors) may only accept a gift of nominal value (\$20 or less), such as a pen, key chain, water bottle, cup, or similar item displaying a company's logo.

### **Can Sandians give gifts/business courtesies to business associates?**

The cost of gifts/business courtesies is unallowable under the terms of Sandia's prime contract. However, if business courtesies meet certain requirements, including specific dollar limits, Lockheed Martin funds may be used, but this requires vice president approval before incurring any costs.

Gifts/business courtesies may be offered to nongovernment individuals in support of business activities if the gifts are:

- Consistent with laws and standards of conduct of the recipient's organization.
- Appropriate for the occasion.
- Not in the form of cash or cash equivalent.
- Not greater than \$100 in value.

Generally, gifts to federal employees are limited to \$20 per occasion and \$50 annually. Check with Ethics for further guidance about gifts/business courtesies to government officials and employees. Also, Sandia must comply with anti-corruption laws, including the Foreign Corrupt Practices Act (FCPA), which has strict guidelines for gifts (also referred to as "hospitalities") to foreign officials.

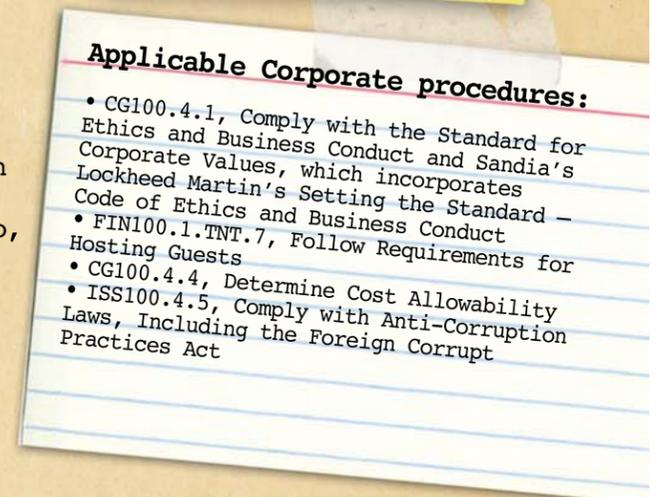
### **Remember:**

Each employee is personally responsible for ensuring that his/her offer or acceptance of a gift or business courtesy is appropriate and consistent with corporate procedures.

### **Got Questions?**

Call the Ethics Helpline at (505) 844-1744 or an Ethics Officer:

- Gwen Drake, 845-0335
- Diane Nakos, 844-9434





# HEARTBLEED HEROES

## Sandia responds to nasty cyber bug

By Phyllis Teague

On Monday evening, April 7, the world learned that the HTTPS online neighborhood — that gated community for safe transactions on the Internet — had become a dangerous place. The Heartbleed bug opened wide the gates to about 75 percent of the servers on which the Internet runs, and within hours, data thieves were terrorizing the neighborhood. User names, passwords, credit card information, and other sensitive information were up for the taking by those who knew how to snag them out of HTTPS Internet traffic.

### Sandia's cyber defenders go on alert

From the moment the vulnerability was disclosed, Sandia's cyber defenders were standing at the Laboratories' cyber doors, ready to take action. On Tuesday morning, Cyber Security's Rapid Response Security Team, the cyber equivalent of Sandia's Emergency Operations Center, convened subject matter experts from across multiple security and IT disciplines to evaluate Sandia's vulnerable systems and develop a plan of action.

Staff then immediately began working with dedicated vendors to apply emergency patches wherever a patch was available. Where servers couldn't be immediately patched, the action teams erected cyber fences to isolate those systems from attack and data loss.

The results: Within 30 minutes of the RRST meeting,

98 percent of Sandia's vulnerable infrastructure in New Mexico and California was patched, and the workforce wasn't affected by loss of service.

### Not quite the end of the story

By mid-day Tuesday, however, it became clear that remote access in New Mexico and California was still vulnerable because no patch was yet available. At that time, the cyber security organization, along with the CIO's office, made the difficult choice to block incoming VPN and remote connections and communicate the action and information about the vulnerability to the workforce. Staff worked throughout the night, testing and applying the patch that would make remote access safe. By mid-day Wednesday, remote access was restored, having been down only a little over 24 hours.

"It's always hard to take actions that affect the entire Labs," says John Zepper, director of Computing & Network Services. "But our cyber security and IT experts responded to this vulnerability with such surgical precision that Sandia didn't have to take more drastic measures like shutting down all Internet access."

### Labs develops its own website verifier tool

Even though Sandia's action team had patched vulnerable systems and restored services, the online world outside Sandia still posed a threat because so much of the Internet remained unpatched. Some media outlets published links to external sites where people could verify whether a particular site was safe, but accessing those sites from within Sandia posed a different kind of security concern. So Cyber Security developers quickly created the Sandia SSL Verifier, an internal tool for Sandia's workforce to check the safety of Internet sites.

At about 1 p.m. on Wednesday, April 9, CIO Mike

### More about Heartbleed

For more about the Heartbleed bug, its impact, remediations, and lessons learned, see the Wikipedia entry at <https://en.wikipedia.org/wiki/Heartbleed>.

Vahle announced that the tool would become available on TechWeb later that day. It seems that workforce members kept the site open and refreshed it throughout the day, because within 5 minutes of it going live — and at least 15 minutes before Sandia announced that the tool was now available — [ssl-verify.sandia.gov](https://ssl-verify.sandia.gov) had already seen more than 1,000 hits. Sandia also shared the SSL Verifier tool with its sister DOE sites across the country.

### Sandia's workforce responds positively

John reports receiving overwhelmingly positive feedback and enormous gratitude from Sandia workforce members, both for the information about Heartbleed and for the availability of the SSL Verifier tool. "Not only did we protect Sandia's assets," John says, "we also helped educate the workforce about how to protect their families and their personal computing resources from this very serious vulnerability."

Collaboration with DOE-HQ, sister NNSA sites, and Lockheed Martin was essential to the effort.

According to Phillip Cox (9317), a Cyber Security manager, Sandia's cyber security team collaborated with partners at DOE Headquarters, NNSA sites, and Lockheed Martin throughout the crisis to create a common understanding of this vulnerability. Ultimately, this helped all partners, including Sandia, respond to the vulnerability in a focused, consistent manner.

## Environmental Management System honors four with awards of excellence

By Katrina Wagner

Sandia honored members of the workforce who excel at conserving natural resources, recycling, and minimizing waste at Sandia during the Environmental Management System Excellence Awards ceremony on April 24. Sandia recognized 19 projects across the Labs and honored 10 with awards of excellence for their efforts in managing risks, reducing Sandia's environmental footprint, and being good stewards of the environment.

"This year, it was challenging to choose winners because all of our nominations were so impressive," says Michael Nagy (4143), EMS coordinator. "We received nominations from small departments that initiated reduction of paper use to corporate-wide computing improvement efforts that will save the Labs millions of dollars over the years."

David Blagg (1741) received the Greenie Award for his efforts in recycling Tyvek suits, plastic bottles, wafer boxes and boats, and metals that come from the fab operations in 858N and 858EF. He also started a recycling program for scratched and used safety glasses.

The group responsible for organizing and conducting SEC150, SEC303, and SEC310 won the Grass Roots award by fostering a reduce, reuse, recycle culture. The team reduced its use of paper, electricity, and toner and eliminated the use of plastic foam cups.

The Resource Conservation Award winner is the team that pioneered a sustainable solution to surplus Ozone Depleting Substances (ODS) refrigerant inventory. This team found a disposition pathway for surplus ODS refrigerant. In 2013, a contractor reclaimed 31 cylinders of surplus refrigerant, compensating Sandia \$7,975, which saved \$200,000 in internal disposal charges.

Division 3000 was given an Honorable Mention in the Resource Conservation category for going green electronically.

**Rolling out the New Digital Kiosks:** The Creative Services team designed and deployed four digital kiosks across the Labs to communicate new and time-sensitive customer information in a quiet yet compelling electronic format. The new kiosks help Sandia embrace a greener, cleaner way of doing business.

**International Training Course Learning App goes electronic:** This team created a Learning App for the iPad to move training materials from paper to electronic delivery as a means to increase efficiencies, minimize paper and printer use, and reduce costs.

**Creative Services Dashboard:** The Creative Services team and the IT Department developed an automated work request system that is all-electronic, saving paper and printing costs.

**Above and Beyond:** The Above and Beyond award recognizes the National Solar Thermal Test Facility for recycling Stirling engine dishes instead of disposing of them through solid waste, even though that would have been a far easier disposal path.

**The Sequoia award** is given to projects that impact the entire Labs and have a large reach. There was a tie in this category. The Phone Book Use/Disposal Reduction Team won for eliminating the receipt and delivery of paper phone books to the Labs. This effort eliminated 3,200 pounds of paper from Sandia's waste stream and 800 vehicle delivery stops annually.

The Network Revitalization Project won for converting unclassified users in Tech Areas 1, 3, and 4 in New Mexico to a new optical fiber unclassified network.

By going to fiber optic LAN, Sandia reduces the amount of space used for conventional copper wires, the number of distribution rooms, the amount of energy used for cooling, and the expense of maintenance while improving speed, reliability, and security. It is estimated that when fully realized, Sandia will have retired about 1 million KWh annually and diverted 7.2 tons from landfills/waste streams so far by trading in decommissioned equipment and recycling the copper as it is replaced.

**The Environmental Stewardship Award** is given to the group that exemplified the overarching EMS goals to minimize Sandia's environmental impact. The winner of this award is the team that created an engineered solution to remove R23 from operations and replace it with a cheaper, inert gas. This solution reduces releases of R23 ozone depleting gas to the atmosphere and saves Sandia about \$26,000 annually.



# Mileposts

New Mexico photos by Michelle Fleming  
California photos by Randy Wong & Dino Vournas



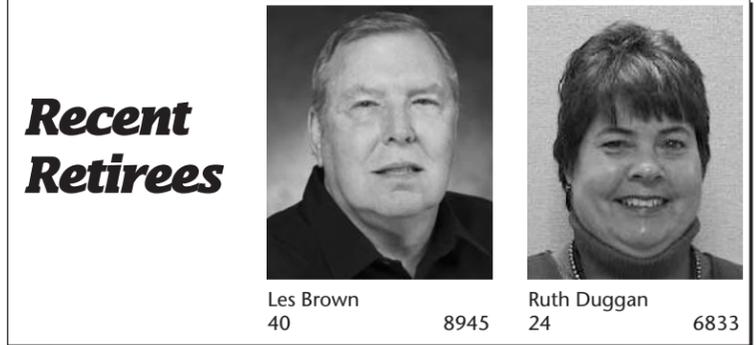
Joan Funkhouser  
35 8233



Glenn Russell  
35 2622



Bob Dankiewicz  
30 8234



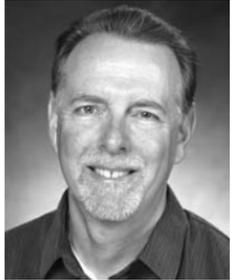
# Recent Retirees



Les Brown  
40 8945



Ruth Duggan  
24 6833



Howard Royer  
30 8512



Carl Skinrood  
30 8532



David Schultz  
30 2224



Martrice Endres  
25 2719



Joy Giron  
25 6612



Tracy Jones  
25 9542



Randy Lober  
25 5563



Robert McInteer  
25 3653



Vanessa Miles  
25 424



Patrick Ortiz  
25 4826



Sharissa Young  
25 241



Art Brito  
20 5781



Dahlon Chu  
20 5330



Thomas Laiche  
20 6631



Danny Maccallum  
20 1831



Norman Smith  
20 5644



Viola Baca  
15 9533



Hugh Bivens  
15 5945



Dennis Carlson  
15 6525



Jeff Crowell  
15 8259



Park Hays  
15 5792



Matt Hopkins  
15 1118



Karl Horak  
15 6832



Heather Pennington  
15 6631



Karen Ohlendorf Prinke  
15 4825



Joe Puskar  
15 1831



Jaideep Ray  
15 8954



Jesse Roberts  
15 6122



Amber Romero  
15 10656



Reynolds Salerno  
15 6820



Rich Schroepel  
15 5635



Steven Spinhirne  
15 2953



John Van Scyoc  
15 8237



Jimmie Wolf  
15 9336

# MANOS — Encouraging tomorrow's scientists



THE MANOS PROGRAM, now in its 23rd year, introduces science, technology, and engineering, and math (STEM) subjects to middle school students in a fresh and exciting way. The program is a cooperative effort of Sandia's Hispanic Leadership Outreach Committee, Community Involvement Dept. 3652, and Albuquerque Public Schools. Some 70 Sandians, including Laritza Saenz (9537), above, volunteered to make the 2014 program a success for 80 student participants. More than 3,000 middle students have gone through MANOS since it began in 1990. (Photo by Cheryl Garcia)

# Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads Sandia Classified Ads

## MISCELLANEOUS

SEWING MACHINE, antique, Westinghouse Deluxe Rotary, wooden cabinet, very good condition, can email/text photo, \$125 OBO. Mann, 401-0988.

COVERED TRAILER, 12-ft., never used, excellent condition, perfect for ATVs, \$2,800; red-ear sliders, need new home, currently in pond, \$30 OBO. Messex, 228-2569.

TO TRADE, for working VCR (or possibly give away), patterns (women's size 12-16, few men's), yarn, embroidery kit, queen bedspreads, photo frames, more. Joseph, 480-521-4989.

CRIB, white, wood, w/3 adjustable levels, mattress not included, excellent condition, \$45; 49-in. flat screen TV, Mitsubishi, works great, \$100. Moser, 980-2232.

PATIO UMBRELLA GRANITE BASES; 40-lb. \$40; 30-lb. \$30; trailer hitch w/ball sizes 1-7/8", 2" and 2-5/8", \$15 ea. Garcia, 280-5815.

SEWING/EMBROIDERY MACHINE, Bernina 730e, quilter's sewing table, w/15 hrs. training & many accessories, \$3,000. Chavez, 710-4519.

EXERCISE EQUIPMENT, high-end, elliptical & treadmill, \$300 ea. or \$500/both. Kallio, 507-2914.

ACOUSTIC STEEL-STRING GUITARS, 2, Pimental, both built in 1987, 6-string, rosewood, w/abalone accents, case, \$2,200; 12-string, mahogany, \$1,000; call for more detail. Dawson, 281-1235.

GOLF BAG, PGA-style, leather, blue & white, excellent condition, new \$150, asking \$80. Holmes, 873-5255.

SOFA, Pier 1 Abbie, berry red, 2 yrs. old, good condition, \$225. McCollum, 250-8475.

ICE MAKER, fits Kenmore/Whirlpool refrigerator, w/top freezer, \$20. Stevens, 293-5704.

PORTABLE AIR CONDITIONERS, 3: 10,000-BTU Sharp, \$300; 8,000-BTU Commercial Cool, \$250; 5,000-BTU, ElectroLux, \$250. Meinelt, 350-3255.

TONNEAU COVER, Leer 700, fiberglass, locking, fits '05-'14 Toyota Tacoma, 5-ft. bed, super white, excellent condition, \$600 OBO. Robertson, 505-553-0687.

SPARE TIRE COVER, '08 Toyota FJ Cruiser, \$45. Krapcha, 307-4956.

PIANO, Kawai/ES5, \$500 OBO; Mohaka mountain bike, 20.5-in. new tires, accessories, \$150 OBO. Kercheval, 505-266-5833.

PORTABLE BASKETBALL GOAL, free. Glover, 505-440-0823, ask for Cheryl.

PATIO SWING, 70-in. wide, new cushions, back & seat, \$100. Drebing, 293-3335.

TIMESHARE, Wyndham Pagosa, June 14-21, sleeps 8, \$1,100. Segovia, 892-8148.

VACATION, Branson MO, Stormy Point Resort, July 19-26, 2-king bdrs., 2 baths, sleeper sofa, kitchen, \$750. Fraser, 806-341-7252.

MOVIES/CDS, 2/\$5; table, glass top w/leather chairs, \$325; Verizon 4G LTE mobile hotspot, \$25; photos available. Chavez, 999-7929.

REFRIGERATOR, side-by-side, Kenmore, tan, ice & water in door, good condition, \$200; Kenmore dryer, white, 220-volt, \$75. Martinez, 414-9142.

ENGLISH SADDLE, fully equipped, Collegiate Equilibrium Apprentice, close-contact, 15-in. pads, rolled-leather headstall w/bit, split reins, \$1,000 OBO. Rivers, 218-3740.

GARAGE SALE, 10301 Toltec NE, household items, Saturday, May 31, 8 a.m.-noon. Dinge, 505-818-8933.

KITCHEN SINK & FAUCET, stainless steel, standard size, good condition, \$50 OBO. Schoenherr, 920-655-1577.

SCUBA EQUIPMENT, 2 full setups, 4 tanks, 1 pony, call for more details; refrigerator, side-by-side, black, \$200. Williams, 505-379-8994.

WIRE FEEDER, LN-25 Lincoln Port, semi auto, \$325 OBO; Victaulic Vic-easy VE-272F5 roll grooving tool, for PVC, copper, all pipe schedules, \$1,400 OBO. Green, 803-7228.

ANTIQUA BUFFET, w/marble slab, beveled glass cabinet doors, storage below; refrigerator, Mexican glassware, pottery, vases. Brown, 505-220-8823.

SEWING MACHINE, Lotus 100N, small, 11" x13" x 6", recently serviced, \$60; Schwinn Airdyne bike, \$175; call for info. Herrera, 833-5035.

### 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.

PIANO, free; entertainment center, \$25; bug zapper, \$20. Davis, 294-4614.

## TRANSPORTATION

'06 HONDA CRV SE, AWD, AT, all power, leather, loaded, white, dealer serviced, \$12,500 OBO. Mitchell, 379-8059.

'99 FORD EXPEDITION, 4x4, 5.4L V8, tow pkg., seats 5, 177K miles, excellent running condition, \$2,500. Glaser, 293-8110.

'06 LINCOLN TOWN CAR, Signature Limited, V8, fully loaded, leather, white, 58K miles, \$10,500 OBO. Dunham, 280-3817.

'94 BUICK ROADMASTER ESTATE WAGON, V8, 5.7L engine, white w/wood grain, leather, 160K miles, \$2,500. Wolf, 750-0080, ask for Mike.

'07 LEXUS LX470, 4WD, leather, moon roof, navigation, 3rd row, DVD, silver, 91.7K miles, KBB \$34,800, asking \$32,000. Moore, 220-8678.

'00 PORSCHE BOXTER-S, 6-spd., full leather, burr maple, hard top, 18-in. alloy wheels, silver, 43.7K miles, \$16,800. Foehse, 401-9491.

'01 TOYOTA TUNDRA, 4WD, access cab, all power, camper shell, tow pkg., 150K miles, mechanically perfect, \$10,500 OBO. Lyons, 291-0596.

'10 FORD MUSTANG GT, AT, leather seats, Kona blue, <22K miles, excellent condition, \$23,500. Floran, 264-5004.

'08 NISSAN VERSA, AT, 70K miles, very good condition, \$7,200. Anderson, 450-1101.

'02 TOYOTA TACOMA TRD, 6-cyl., 4x4, 158K miles. de la Fe, 903-0717.

## RECREATION

'94 FOUR WINNS BOAT, 17-ft., open bow, 3.0L engine, Bimini top, seats 7, great condition, \$5,500 OBO. Millard, 505-205-6090.

## REAL ESTATE

1.1 ACRES, mountain property, w/private lake, views of Santa Fe National Forest, water onsite, electricity 90-ft. away, \$26,500. Sandoval, 792-7883.

4-BDR. HOME, 2-1/2 baths, 2,318-sq. ft., 3-car garage, NE Heights, great schools, views, shopping, \$339,000 OBO. Delhotal, 659-1492.

4-BDR. HOME, 2-1/2 baths, 2-car garage, 1,702-sq. ft., new roof, paint, floors, Las Maravillas, MLS#813091, \$119,900. Romo, 453-5544.

TRAILER, beautiful, lots of upgrades, double pane windows, tile shower, new flooring, attached metal carport/shed, \$14,000 OBO. Kelsey, 710-4630.

1/2-ACRE, Angel Fire, within 1/4-mile of country club & golf course, corner lot, Pine Valley Drive & Broadmoor, \$30,000. Segura, 505-490-2756.

3-BDR. HOME, 1 bath, 1,091-sq. ft., updated kitchen/bath, 19' x 15' shed w/electricity, Menaul/Pennsylvania, \$135,000. Bemis, 235-0576.

PAAKO GOLF COURSE LOT, great view, utilities, best deal in Paako, \$94,900 w/plans. Sikorski, 505-573-1503.

## WANTED

GOOD HOME, Whippet/mix, house/crate trained, good with kids/cats/dogs, knows basic commands, high energy. Meyer, 449-8708.

GIRL'S TODDLER CLOTHES, looking for gently used 4T-5T jeans/pants, shirts, sweatshirts, etc., text or call. Ruiz, 575-650-2858.

ROOMMATE, UNM area, Ridgecrest, bike to UNM or SNL, \$300 mo., 1/2 utilities. Kelly, 263-0810.

SHORT TERM INVESTOR, to complete renovation of free-and-clear home, downtown Albuquerque, for flip/sale, terms TBD. Fosse, 917-886-3698.

## LOST AND FOUND

FOUND: set of keys w/Sandia Thunderbird silver medallion, call & describe to claim. Caskey, 505-227-3884.

FOUND, pedometer, in parking lot west of Bldg. 811, found on May 6, ~3 p.m.. Amann, 844-5847.



## Research Quality Standards case studies . . .

# Better to be 'murdered' in private



audience could use the information, and showing examples of how it worked or how it could be used in valuable ways. Papers and presentations with large amounts of math or that seemed more focused on "showing everyone how much you know" were usually not favored by attendees. They also noted that after the 20-minute conference talk ended, how the scientist responded to questions also had a big effect on whether they were well received.

With this data in hand the department manager set up a two-hour meeting whenever one of the staff was to present a paper. The manager was always in atten-

**A** Sandia research department decided to make it a goal to present the best possible papers at conferences. To achieve this goal the manager and senior staff in the department thought through what an effective strategy would be.

They had noticed that the best presentations were exceptionally good at three things. One of them was doing great science (obviously) but they noticed that was not enough. Exceptional talks also were extremely effective in how they presented the information both in terms of style and content. Leading papers tended to be presented and written with an emphasis on getting to the point, focusing on why the work was important, why the audience needed the information, how the

dance and expected the senior staff (and those interested in being senior staff someday) to attend. During the first 20 minutes the department members would listen and time the presentation, all the while taking notes on things that were not clear, that seemed contradictory, or were just wrong. If slides were hard to see or if the content raised obvious questions they made a note of it.

At the end of the presentation, the friendly group of department peers now became something else — the "Murder Board."\* They acted like the most hostile and critical of all possible audiences. Anything that could be improved was mentioned — nothing was off the table. The dialog that occurred during those 100 minutes was not always pleasant but it was effective. The Murder Board was helping their colleague make the best presentation possible for the department, and everyone knew that was the motivation. The result? This department consistently won either a Best Paper award or an Outstanding Paper award for every one out of three papers they presented. Given that a typical conference has 60 to 120 papers presented, with only one Best Paper and one Outstanding Paper, this was an impressive accomplishment.

### Moral of the story

Peer Reviews are an invaluable resource and should be used whenever possible. Be open to critique and seek it out. It is always better to get an honest critique from your friends when you can still make improvements rather than getting that feedback from members of the larger research community later. Actively seeking out candid appraisals of your work from your peers internally will have a major impact on how your research is received as well as your reputation as a researcher.

\* **Murder Board:** A committee of questioners set up to help someone prepare for a difficult oral examination. The term originated in the US military but is also used in academic and government appointment circles.

# From Vietnam with love

## Sandia retiree works to get wartime family greetings back home

By Nancy Salem

If you, or a relative or friend, were a New Mexico Air National Guardsman stationed in Tuy Hoa, Vietnam, in 1968, Art Sena is looking for you.

The reason goes back to a long-ago wish to make Christmas merrier for servicemen at war, and a long-lost box of film.

Art was one of those servicemen, a young Guardsman from Albuquerque who left his job at Sandia Labs to serve in Southeast Asia. Just before Christmas 1968 he was told to be at the first sergeant's office at a particular time. He showed up and was called into a small room.

The sergeant told Art to sit down, he wanted to show him a film. A projector came to life and an image lit up the screen. It was his mother. His grandparents were there, too, and his brother and girlfriend. They were talking to him.

"All these years later I can still remember how it felt. It was very emotional to see and hear them. The tears streamed down my face," Art says. "I had been in Vietnam seven months and mail was sporadic so I hadn't heard much from my family, and there they were. Everybody spoke. It was a wonderful thing. I only got to see it once then they said, 'OK, back to work.'"

Art, who returned from the war in 1969 to his Sandia job, never forgot the film and over the years wondered what happened to it. He learned hundreds of similar films were made and later stored in Sandia's film archive department. The archive was cleaned out in the late 1970s and the films sent to the Air National Guard in Albuquerque.

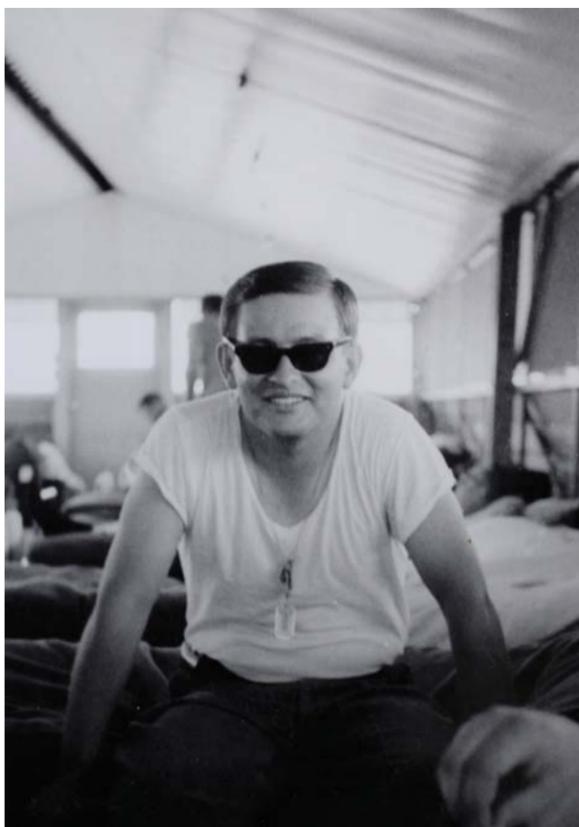
When Art retired from Sandia in December 2005 as a team supervisor, he thought again about the Vietnam films and mentioned them to a friend who had left the New Mexico Guard. "I told him those films had to be out there somewhere and he said he'd find them. I didn't think he was serious," Art says. "Two or three days later the phone rang and it was him saying he was at Guard headquarters looking at two boxes full of film."

Art got permission to take the 39 reels with 269 messages and tackle the huge project of digitizing the 16mm film. An even bigger project has been finding the veterans and their families and getting individual DVDs to them. About 90 have been contacted so far, and Art continues the search.

It has been a labor of love. "I still get emotional being able to see and hear my mom and grandparents," Art says. "My grandparents have passed, and I loved them dearly. I knew that other families would want the same thing. It would mean something to so many people."

### A round trip ticket to Vietnam

The film project began in 1968 with Ralph Looney,



ART SENA was photographed on his bunk in Vietnam in 1968. Art was with the New Mexico Air National Guard when he left his Sandia job to serve in Southeast Asia.



SANDIA RETIREE ART SENA looks at the original roll of film that holds the greeting his family sent while he was stationed in Vietnam in 1968. "It's a very emotional experience to watch it," he says. (Photo by Randy Montoya)



A FRAME from Art Sena's family film shows, from left, his brother, grandparents, girlfriend and mom. "Everybody spoke," Art says. "It was a wonderful thing."

an *Albuquerque Tribune* editor. Looney knew that about 500 New Mexico National Guardsmen — the 188th Fighter Squadron, part of the 150th Air National Guard — had been deployed to Vietnam and he wanted to film holiday messages from their families. He got help from the Guard, which provided contact information and a location at Kirtland Air Force Base, and Sandia, which offered the technical equipment and expertise to shoot and process the film.

"Ralph had the idea to get our families in there, make two-minute films, and he would hand-carry them to Vietnam," Art says. "He would spend a few days there while the films were played then bring them back to Albuquerque."

That's exactly what Looney did. "He brought them over and back," Art says.

Art's mother Jo Sena, at the time an executive secretary at Sandia, told her son she and the family waited in line for hours outside the Air National Guard office to do the film. "They all told me they missed me and loved me," Art says. "My mom was a single mom who had to work to support us, so I spent a lot of time with my grandparents. In the film my grandmother scolded me for not writing often."

Art was again overcome with emotion when he re-watched his film 40 years later. "When the image came on the screen I was awestruck at how beautiful my mom was," he says. "I was bawling like a baby."

### In search of the families

To digitize the film, he turned in 2012 to Rolling R Productions owner Rhoda Weill, a former radio broadcaster whose Albuquerque company offers voice talent and digital conversion and reproduction services. "My brother was killed in Vietnam so the project was certainly interesting to me," Weill says. "And I'm kind of geeky. I like looking at history."

It took Weill about four months to get the job done. She says she enjoyed the work and was happy to play a role in making the films available. "It was something I could give back," she says. "I watched every single film, and it was awesome. It was interesting to watch the emotion. The moms were trying to be strong for their boys but sometimes they broke down and the camera kept rolling."

Art began contacting families in the spring of 2013. Sheri Maloy of Albuquerque was 10 years old when she, her sister, and mother made a film for her father, Master Sgt. Don Day. Maloy's husband knows Art and heard about the film project. He surprised Maloy with her film on Christmas Day 2012.



A 45-YEAR-OLD BOX that holds 16mm films that went to Vietnam and back tells an amazing story. (Photo by Randy Montoya)

"We opened all the presents and my husband said he had one last thing for me," Maloy recalls. "I sat down and he put in the DVD and it was my mom and sister and me. I sat there and sobbed. It was just very emotional to see my mom speaking. My dad has passed away and she has Alzheimer's."

"I remember going out to the base and talking to my dad on camera, giving him holiday cheer. I occasionally pull out the DVD and watch it. I am very thankful to Art for finding those tapes. It means a lot to me. I love it."

In recognition of his work Art received the New Mexico Distinguished Service Medal and a Spirit of New Mexico Award. On Armed Forces Day May 17, Art received the Leo G. Marquez Veteran of the Year award.

"I've talked to so many veterans and their families," Art says. "I've had many calls from people thanking me. It has made the whole project worth it. I'm absolutely happy I took this on."

### Was your family filmed?

If you think your family might have been involved in the Vietnam film project, contact Art Sena at 505-873-1665.