Full-scale test operations resume at the sled track

By Stephanie Holinka

Recently, Experimental Operations Dept. 1533, Mechanical Environments Dept. 1534, and Sensing & Imaging Technologies Dept. 1535, with Environmental Safety & Testing Dept. 6234, got the go-ahead to plan and execute the first full-scale sled track test since the suspension in 2008. The test series included an initial rocket sled track test, followed by a full-scale burn test that subjected the test object to temperatures similar to a catastrophic fire. The restart challenges were so formidable that some thought Sandia had performed its last sled track test.

Steven Samuels (1534), technical lead and test director, says the team overcame those challenges to meet the customer’s requirements, while incorporating engineered safety into the test design.

This test series was planned for a few years ago, but was delayed because of the...
That’s that

NOVA has always been one of the very best science programs on television. Its stories are thoughtful and thought-provoking, informative, balanced, and expertly presented. It’s no wonder that the program has survived in a very volatile business for almost 40 years now. Shannon hyperbole and sensationalism (for the most part) NOVA has built and retained a loyal following of viewers who wouldn’t miss it for anything.

My guess is that most NOVA productions are months in the making. But over the years the show has shown it can turn on a dime when the situation demands. In the latest example, NOVA had a production team on top of the Chelyabinsk meteor impact story within days of the Feb. 15 incident.

In an interview aired March 27, examined the meteor incident and the challenges such events pose for the safety of the planet. One of the “stars” of the show was Sandia’s own Mark Boulougou, one of the world’s experts in the field.

Watching Mark’s quite considerable contribution to the program, it’s easy to see why he has become a go-to guy for documentary video crews. He doesn’t just know his stuff; he’s terrific at conveying a sense of wonder about it. Here’s Mark from the NOVA program: Holding a small fragment of the Chelyabinsk meteor recovered by a Russian colleague, he says, “What’s amazing to me, when you think about it, this is part of an asteroid that has been floating through space, orbiting the sun for billions of years, and two weeks ago it exploded in the atmosphere, dropped to the ground, and here I am holding it in my hand. That’s amazing.”

You can see the NOVA program, “Meteor Strike,” on the PBS website. It’s worth checking out.

Staying on subject, the Chelyabinsk meteor, and the unrelated close encounter with asteroid 2012 DA14, which on Feb. 15 passed uncomfortably close to Earth on its huge elliptical orbit, ought to be a wake-up call for governments around the planet. These two episodes are a vivid reminder that asteroid impact is not just the stuff of Hollywood blockbusters. If Saks, which was discovered just a year ago, had hit the Earth, instead of passing a too-close 17,000 miles away, experts say it would have been energetic enough to flatten London. And here’s a scary thought: The Chelyabinsk meteor wasn’t charted at all. Scientists didn’t know anything about it until it slammed into the atmosphere at 33,000 mph.

Listening to retired astronaut Ed Lu, who spoke at Sandia/California a year ago. Lu is a board member of the nonprofit 8612 Foundation, whose goal is to have the nations of the earth establish a reliable asteroid early warning system and an asteroid defense capability. At that Sandia talk, Lu said, “Our fundamental belief is that humanity is worth protecting. Each and every day, we are putting 10,000 years of civilization on the line. If we don’t look for asteroids, then frankly what have we built all this space technology for if not to do this? Odds are we aren’t going to be hit by an asteroid tomorrow but long term I guarantee we will be hit unless we do something.” He’s right, plain and simple.

Saw an ad the other day for an upcoming tour stop here in Albuquerque by the Kingston Trio. Or should I say “Kingston Trio”? The original Kingston Trio, which emerged out of the coffee house scene in the Bay Area, was really hot stuff back in the mid-1950s, launching a folk music revival that set the stage for such original artists as Bob Dylan and Joan Baez, who opened the way, in turn, for a new generation of folk-tinged performers who would become known as the folk rock. From Bob Dylan to van Morrison to the Byrds to Buffalo Springfield, Jefferson Airplane, and Zappa, this is beginning to sound like a lecture from Jack Black in School of Rock. The point is, the Kingston Trio was big. Really big. And they’re still on the road. Or should I say “they’re” still on the road. I use the quotation marks because the original members of the Trio have long since departed. As the group’s own website puts it, “Over the years, the trio has welcomed fresh faces to the act as others move on. Nevertheless, the revolving lineup maintains the spirit and excellence that enabled the original lineup to achieve world fame.” So they aren’t really the Kingston Trio. Or are they? This is a very metaphysical. More of which remains of Grandpa’s ax . . . We’ve changed the handle eight times and the head four times, but we wouldn’t part with it for anything. Because Grandpa cleared the whole back 40 with it.

See you next year.

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

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Long-distance microscopy

By Patti Koning

Just over a year has passed since the day that Doug Medlin and Josh Sugar (both 8656) held their breath as they demonstrated remote operation of Sandia’s new aberration-corrected scanning transmission electron microscope (AC-STEM) during the Materials Science & Technology external review panel’s visit to Sandia-Livermore. Doug and Josh did their demonstration from an office in building 916 on the California site; the AC-STEM is located in building 897 in New Mexico, more than 1,000 miles across the three states away.

“We were pretty nervous with that first demonstration, but it worked beautifully,” says Doug.

Since that first day, the remote operation system has transformed the way that the two scientists work. “Sitting here, we see exactly the same thing that someone in New Mexico sees, working just a few feet away from the microscope,” says Josh. “The only difference is we have to rely on them to physically load our samples.”

The idea for operating the AC-STEM remotely came from Livermore and working within Sandia’s network that connects the two sites. The network solutions architect Rich Gay says network solutions architect Rich Gay (8656). “But the reality of traveling to Albuquerque from Livermore is a pretty big barrier to regular use, so we were eager to create a remote solution.”

“The microscope has really exceeded our expectations and is an absolute joy to work with.” — Doug Medlin

The challenges to implementing the remote operation system were ensuring fast, real-time access to electronic images from Livermore and working within Sandia’s stringent network security requirements. But we were afraid the experience would be like a bad video game. My fear was that if our researchers were unable to make real-time adjustments to the instrument, it would be extremely frustrating to use and possibly unworkable,” says Sarah. The researchers need to make fine corrections to the lens optics and position miniscule samples with nanometer scale accuracy to image atomic-scale dimensions.

The solution was to employ a video compression system to enable a data transfer rate fast enough for the researchers in California to see their minute adjustments to the AC-STEM in real time. Without the video compression, says Doug, the lag between data control and visual response would make it nearly impossible to do even routine operations, let alone operate the instrument to its full capabilities.

Implementing the remote access required close cooperation between the information technology departments in New Mexico, California, and the vendor. “We had to get the right group of people together, and then it went very smoothly,” says network solutions architect Rich Gay (8656). “This project really brings the sites together, which is our goal with the network.”

Doug and his New Mexico counterparts designed a “bubble-net” within the larger network that connects the two sites. The bubble-net allows access only to the microscope and only by a few Sandians.

Reduced travel, increased collaboration

The most obvious benefit to the remote access is that it minimizes travel for Doug and Josh. They have to send their prepared samples to the New Mexico site and arrange for a colleague there to load the samples into the AC-STEM. Otherwise, they work just like their counterparts in New Mexico — scheduling time on the instrument and spending a day or two at a time using it.

The trend of working together as a team across sites has continued from the initial installation of the remote operation to the ongoing experimental work with the AC-STEM. “The teamwork involved between microscopists extends far beyond just loading samples. We are working together to push the limits of what the microscope can do. This is a theme that will continue as we take advantage of this unique capability,” says Josh.

The remote access also allows for more collaboration with their colleagues at the California site because they can be present and see the immediate results of the analysis. The remote access is located in the same building that houses the offices and labs of other materials scientists. “This is a benefit we didn’t anticipate during the planning,” says Sarah. “Doug and Josh can pull me, Norm Bartelt (8656), or Francis Leonard (8656) into the remote access lab to look at something. This leads to very rich conversations and inspires ideas for changes, follow-on experiments, and new work.”

The AC-STEM is at the state-of-the-art of electron microscopes. In an article in the June 1, 2012, issue of Sandia Lab News, Paul Kotula (1822) described the instrument as “like a Lamborghini with James Bond features.”

A tremendous benefit of the new instrument, says Doug and Josh, is the increased speed in collecting spatially resolved compositional data. What used to take several hours can now be accomplished in a matter of minutes or even seconds. These capabilities are now being applied to numerous projects at Sandia including work on component performance and reliability, energy conversion and storage technologies, such as thermoelectrics and battery materials; and fundamental materials science questions relating to interfacial structure, composition, and stability.

For instance, in one project, Josh is studying porous palladium particles with a rhodium skin. “Palladium is good at absorbing hydrogen, but the pores collapse at elevated temperatures,” he says. “To address this, we can coat the particles with rhodium, which has a higher melting temperature and stabilizes the pore structure. But we need to know that the rhodium is where we want it to be.”

The rhodium skin is so thin that with previous instruments Josh was unable to differentiate it from the particle. The aberration correction on the AC-STEM allowed Josh to see the skin clearly.

“The microscope has really exceeded our expectations and is an absolute joy to work with,” says Doug. “This is an experiment on how to share capital equipment across all of Sandia.”

Josh adds that “the success of the remote operation capability demonstrates that access to high end instrumentation is no longer limited by physical location.”
H

ydrogen fuel cells may be heading out to sea in
the not-too-distant future. Hydrogen fuel cells
are being used in a variety of ways to provide
clean, efficient, pollution-free power — mobile lighting sys-
tems, forklifts, emergency backup systems, and light
duty trucks, to name a few. Providing auxiliary power
to ships in berth may be added to that list soon.

Joe Pratt (8366) and Aaron Harris (8367) recently
completed a study for DOE’s Office of Energy Efficiency
and Renewable Energy that found hydrogen fuel cells
may be both technically feasible and commercially
attractive as a strategy for providing power to ships at
berth and replacing on-board diesel generators.

Auxiliary power to stationary ships in port, usually
provided by on-board diesel engines, is a significant
contributor to greenhouse gas emissions and air pollu-
tion, accounting for one-third to one-half of the in-port
emissions attributed to ocean-going vessels. For a busy
place like the Port of Los Angeles, those average daily
emissions could exceed that of nearly 200,000 vehicles,
according to the paper “Harboring Pollution — Strate-
gies for Clean Up U.S. Ports,” by D. Bailey, T. Plenys, G.

According to this paper, grid-based cold-ironing is
complex and costly to implement, as most ports lack the necessary infra-
structure to meet the power needs of multiple ships at berth. Those costs can run to $5-$10 million or
more per berth. The Port of Oakland is installing 11
berths on six terminals at an estimated cost of about
$70 million.

In addition, switching to grid-based power doesn’t
eliminate emissions. Instead, this approach shifts the
emissions to the source of electricity. Depending on the
electricity source, the overall reduction in emissions
can be quite small.

The hydrogen fuel cell barge bypasses the need for
electrical infrastructure. The barge also has the poten-
tial for higher usage because it can be moved from
berth to berth as needed and to anchorage points to
berth. Those of power vessels waiting for berths.

“While Sandia has previously examined the poten-
tial for hydrogen and fuel cells in aircraft, construction
equipment, electrical generators, telecom backup, man-
portable power, and mobile lighting systems, this is the
first study of a maritime environment,” he says. “Dur-
ing the course of this study I learned what complex and
amazing places ports are, with so much activity and so
much variety between the individual ports.”

An alternative to auxiliary diesel engines is a practice
called “cold-ironing,” in which a vessel at berth con-
nects to a source of electricity on the shore. The engine,
made of steel or iron, literally becomes cold, hence the
name. Electricity supplied by a hydrogen fuel cell
may be another form of cold-ironing.

Grid-based cold-ironing

The Navy has been employing grid-based cold-iron-
ing for many years to save fuel. California is now turn-
ing to the practice to meet the state’s tough environ-
mental regulations. While only a few berths have grid-
based cold-ironing, infrastructure is being installed at
ports across the state to meet California Air Resources
Board regulations that take effect in 2014.

“Fuel cost is only part of the total economic picture,
but discovering that the cost-effective hydrogen price
matches that which is expected to be available is an
important finding,” says Joe. He is now developing a detailed plan for the Hawai-
ian inter-island transport barge application. “A success-
ful deployment of the containerized fuel cell on a
floating platform in a typical marine environment will
be useful not only in this particular service, but also
because it validates the concept for the larger, con-
tainer-ship sized application,” he says. “It’s challenging
on many levels, but technically feasible with potential
commercial and worldwide impact.”
Crash and burn: Full-scale test operations resume at the burn site

I magine having to design and perform a large-scale fire test for objects that subjects an object to intense heat, when you weren’t sure what condition the object would be in by the time it arrived at your door. That was the challenge facing members of the Fire & Aerosol Sciences Dept. 1532 team as they prepared for their role in a recent test series of an engineering prototype designed by engineers in Environmental Safety & Testing Dept. 6234.

Large, potentially energetic fire tests can’t be done at Sandia’s indoor Thermal Test Complex, so the test was done at the Labs’ outdoor burn site, which hadn’t performed a full-scale energetic test in several years. The series called for a sequential accident. First, crash the object on the sled track, then subject it to a catastrophic burn that focused the flames on the most vulnerable part of the crashed test object, which could react violently if the prototype failed. Despite the delay that resulted from a sled track accident in 2008 and its lengthy restart process, the customer chose Sandia because it could perform both tests in one place, a unique capability.

There were uncertainties going into the burn test. “This is the first crash and burn series where we didn’t know what we were mounting until after the sled test,” says manager Randy Watkins (1532).

Technical co-lead Sylvia Gomez-Vasquez (1532) says the team has done smaller fires at the outdoor burn site in the past few years, but had to revitalize the site for this test since it had been battered for years by New Mexico’s high winds and harsh sunlight. Cables and instrumentation needed to be re-run and tested, in addition to other changes needed to support the test’s larger scale.

**Electrical power a concern**

Technical co-lead Shane Adee (1532) says the energetic hazards of the fire meant that equipment the team could get normally was unavailable because of a thousand-foot hazard zone. Many systems had to be automated and plans had to include redundancies in case systems inside survived the sequence of events. The documentation lives on past the experts. “The documentation lives on past the experts. If there are no data or images the test is a failure,” says technical co-lead Mike Mortensen.

Despite that, Doug says, the prototype performed well. “The team spent five days validating that the materials survived the sequence of events. The materials survived, and the customer went away very happy that this concept will work for them,” Doug says.

Walt says Sandia considered closing the outdoor burn site a few years ago. “Because many types of fire tests can be done using models or inside the Thermal Test Complex, there was little attention paid to the outdoor site for the past few years, but it looks like we may be using it more during the next decade because we have customers calling for it,” Walt says.

Randy says the site definitely will host more testing over the next few years, including possible crash and burn tests of car batteries.

**Sled track restart (Continued from page 1)**

SLED TRACK TESTING is performed in an extreme environment. There’s been a lot of outside attention on the energetic, but there are many other hazards that require the same level of attention when working in these environments.

Richard says that through an exhaustive hazard analysis, complete electrical design safety checks, and rocket motor inventory and selection practices, most potential risks “can be eliminated or mitigated.”

“An internal goal of ours was to incorporate engineered safety practices into our operations, creating a more catastrophic approach to safety,” says sled track and facility director Michael Viggil (1533). “We looked at everything, with documentation to ensure that safety was repeatable and sustainable.”

Michael, who was involved in the readiness reviews leading up to the restart, says the restart activities concluded that Sandia’s technical activities were expert-based, and were run by exceptional people who were very good at what they did, but that safety practices weren’t rigorously documented.

“If you don’t document what you’re doing,” Michael says, “how are you going to pass on what you know and what you did to the next generation? We’ve learned from the experts who helped us figure out our approaches, but we then documented that information, so we don’t have to go back to the expert again. The documentation lives on past the expert.”

In addition to the technical evaluation, the team also paid close attention to human factors. For example, to ensure that fatigue wouldn’t impair safety, the test plan implemented a 14-hour time limit for operations.

“We are now consciously accepting risk, when in the past we were unconsciously accepting risk. Because we understand the trade-offs more thoroughly, we can better mitigate those risks,” Steve says.

Applying this rigor across the board had unexpected benefits. “We documented hazards and the technical basis of both new equipment and legacy equipment,” says instrumentation lead Quentin Kramer (1535).

The team discovered flaws in the safety basis for some equipment, which led to manufacturers issuing safety warnings and updates to their customers, Quentin says. “We don’t think of instrumentation and photometrics as being engineered, but they are,” Quentin continues.

Steve says the test data will be used to ensure the customer’s model is correct or to help redesign it. This test needed to capture data such as the object’s impact velocity, impact angle of the test unit, accelerations of the test unit, and object velocities as it travelled down the track.

“The cameras and instrumentation need to survive and capture the information. If there are no data or images the test is a failure,” says photometrics lead Mark Nissen.

**More rigorous documentation**

Steve says the work has also resulted in plans for updates to Sandia’s explosives safety manual, so future test designers can design against this more detailed information.

More rigorous documentation is especially crucial because half the team had never seen a sled track experiment at Sandia.

Though he’s done a few small tests since starting at Sandia a few years ago, console operator Luke Lebow (1534) says he came to Sandia anticipating large-scale tests such as this one. “Those of us who have never done a large-scale test wanted to do what we came here to do. This test is the coolest thing I’ve ever done,” Luke says.

Michael says the team has trained a lot of new people such as Luke, but cross-trained experienced team members as well, using the revised documentation as the foundation for ongoing training.

Steve says some people thought that “we were putting systems into place that didn’t bring any value. But the value those systems provide goes beyond a single test.”

“Over time, we will forget that these things are requirements. Soon, they will just be how we do business every day.”
Experiments, modeling work together

Sandia researchers Lisa Deibler and Arthur Brown had a ready-made problem for their computer modeling work when they partnered with NNSA's Kansas City Plant to improve stainless steel tubing that was too hard for nuclear weapon requirements.

When steel is too hard it becomes brittle, so the plant ended up getting new tubing. However, Lisa says KCP needed a backup in case it couldn’t find replacements in time to meet deadlines.

Sandia’s modeling, coupled with experiments, allowed the rapid design of an annealing process to soften the metal's ductility. The model predicted how the microstructure would be affected by variations in the process, which improved researchers’ confidence that the heat treatment would produce parts that met specifications.

Arthur (8259), a modeler at Sandia/California, says he worked on the model as a natural extension of a larger project, supported by Sandia’s Nuclear Weapon program, called Predicting Performance Margins. Under that program, numerous Sandia researchers are studying the way microstructure affects properties of material in various alloys. Arthur became involved in the project as a member of a team that developed a thermal-mechanical modeling tool to predict how microstructure and properties change during forging. That led to his collaboration with Lisa and her technical adviser, Joe Puskár (1831), on thermal profiles for welds.

When the need arose to address the tubing issue, Arthur says Joe contacted him to see if Arthur could work with Lisa to help optimize a heat treatment.

Experiments, modeling work together

Lisa, a post-doc in Sandia/New Mexico’s Materials Characterization and Performance Department, provided experimental data that Arthur fed into his model of recrystallization in stainless steel. Recrystallization, in which grains in deformed microstructures are replaced by strain-free grains, occurs during annealing — the process of heating metal to dissipate energy built up while the metal is compressed, twisted, or otherwise worked. Heat makes the metal softer and more ductile. Lisa and Arthur were able to solve the plant’s real-life problem since recrystallization is part of the annealing process. And they were able to do it quickly because the model already existed.

Lisa’s experiments indicated it was important to model two softening mechanisms, recovery and recrystallization. Recovery occurs first within a microstructure when material is heated to soften it. By measuring the hardness and the amount of recrystallization after each heat treatment, Arthur and Lisa identified how much softening was due to recovery.

“It was important to model both softening mechanisms because we were seeing microstructures that contained no new recrystallized grains, but which had changed properties from the initial deformed material,” Lisa says. “By failing to include the effects of recovery, our model couldn’t predict why the properties weren’t the same as the initial deformed material. Adding to recovery allowed us to account for the changed properties in microstructures with no recrystallization.”

She described the work in a poster, “Design of a Heat Treatment to Soften Stainless Steel Tubing,” presented at Sandia’s winter 2012 Post-Doctoral Technical Showcase.

Solution required baseline for model

The team first developed a baseline for the model. Lisa performed heat experiments on the steel tubing since she didn’t know the conditions under which it was manufactured. That effort required “a lot of ship-
Sandians kick off Manos program for Hispanic youth

Story by Stephanie Hobby • Photos by Randy Montoya

Last week, more than 140 Hispanic middle school students embarked on a four-week-long academic adventure designed to encourage students’ interest in math, science, and engineering concepts. The Manos program was launched by Sandia’s Hispanic Leadership Outreach Committee and Community Involvement Dept. 3652 in partnership with Albuquerque Public Schools. Manos is now in its 23rd year.

Twice a week, after school, students from several area middle schools board buses and head to Rio Grande High School for two-hour workshops. Students select one of seven workshops focused on physics, chemistry, electronics, computer design, robotics, finances, and introduction to engineering. Activities include building and flying rockets, learning what causes fireworks to have different colors and what makes bread rise, circuitry and controlling the flow of electricity, building web pages, building and programming LEGO robots, making money “grow,” and building cars and bridges.

Miquelita Carrion (10657) leads the coordination of Manos, and all of the teachers are Sandia employees who volunteer their time. The participating middle schools are Ernie Pyle, Polk, Harrison, Truman, John Adams, and Jimmy Carter.

“We really want to increase the pool of Hispanic students who pursue STEM university degrees by showing students the possibilities and highlighting the accomplishments made by Hispanic professionals,” says Javier Ruiz (10657), who helps coordinate the Manos program. “One of our goals is to increase and promote academic excellence for students at the precollege level. We provide hands-on learning experiences to help inspire these young minds, and to see them succeed is very rewarding.”
Stories by Nancy Salem

Sandia being considered for the 2013 Secretary of Defense Employer Support Freedom Award, the highest recognition given by the US government to employers for outstanding support of employees serving in the Guard and Reserve. Each year, Guard and Reserve employees, or a family member acting on their behalf, can nominate their employer for the Freedom Award.

Sandia named a Patriotic Employer

Joshua Konetzni, team lead for Grounds & Roads Dept. 4843, has received a Patriot Award from the New Mexico Employer Support of Guard and Reserve (ESGR) for his encouragement of a staff member’s military duty.

With other employers outside Sandia it was very difficult. Not everybody is helpful when it comes to military leave,” says Roy Cain (4843S), who nominated his supervisor Joshua for the award. “With Sandia and Joshua, the support is there. When I get military orders I give them to him and everything is taken care of.

Roy, a heavy-equipment operator in the facilities group, spent eight years in the US Navy and two in the Army. He came to Sandia in March 2012 and about six months later joined the Air National Guard’s 210th Red Horse unit. Red Horse squadrons provide the Air Force heavy repair capability and construction support.

“The unit was just forming in New Mexico and they needed experienced heavy-equipment operators,” Roy says. “I helped start a training program and get the unit up and running.”

Roy was on leave four months, returning in February. He recently began a short assignment at Kirtland Air Force Base. “The response was surprising to me,” Roy says. “I used to be scared to take my orders to my boss. I didn’t know if I’d have a job or not. But with Joshua there was no problem whatsoever. He makes sure there is a smooth transition when I come back.”

Roy had heard about the Patriot Award, which recognizes supervisors nominated by a Guardman or Reservist employee for support provided directly to the nominator.

“I had never had an employer worth nominating,” Roy says. “I think very highly of Joshua. And Sandia’s support of the military makes it possible.”

Joshua says the award was unexpected and means a lot to him. “I had never heard of it. It was one of those good things that happen when you’re a supervisor,” he says. “My grandfather was in the service and I always looked up to him as a role model. Hearing the stories of what he did and how it impacted the country gave me a great appreciation for what service men and women do to make our lives what they are.

I wish I could do more for the military. Supporting someone like Roy is my way of saying thank you to the people who keep us safe and keep our country going.”

Supervisor made military leave a breeze

A helping hand when duty calls

Norman, Okla. students headed to National Science Bowl after reigning in Albuquerque

BY STEPHANIE HOBBY

A team of five students from Norman, Okla., took the top prize at the third Annual Intertribal Middle School Science Bowl, held in conjunction with the National American Indian Science and Engineering Fair (NAISEF) in Albuquerque.

Twenty teams of middle school students took part in the fast-paced regional competition, which included questions about math, chemistry, physics, and biology. The winning team is now headed to Washington, D.C. to compete in the National Science Bowl on April 25-29.

The NAISEF and EXPO, now in its 26th year, is hosted by AISES, the American Indian Science and Engineering Society. AISES was founded in 1977 to identify and remove barriers to academic success for American Indian students, and substantially increase the representation of American Indians and Alaska Natives in science, technology, engineering, and math fields. The program works with students, professionals, mentors, and leaders and provides a “full cycle of support” model, with emphasis on professional development, mentoring, networking, community service, and initiative awards programs that start with pre-college programs and continue through retirement. More than 300 tribal nations are represented within AISES, which has the support and partnership of corporate, government, academic, and tribal decision makers.

“AIOC is the mission of AIOC is to stimulate the increase and success of American Indian employees at Sandia and to help young American Indian students explore the pathways of higher education that will lead to rewarding careers at Sandia. AIOC uses various means to accomplish its goals, providing opportunities, mentoring, and support that employees and students need to grow and advance. AIOC members are instrumental to the success of the NAISEF and EXPO, providing volunteers to serve as judges and moderators. “Our mission is to stimulate and increase the success of Native American students,” says Cindy Burnett (35543), an AIOC member who helps coordinate Sandia’s participation in the annual event. “AIOC members really care about helping other people, and this event allows us to reach out to students and encourage them to explore pathways to higher education.”
**Brilliant, gifted Carlos Cox lived by his convictions**

Carlos Cox, an avid and accomplished mountaineer and member since 2009 of the elite Albuquerque Mountain Rescue team, fell to his death during a climb in the Sandia mountains last Friday. (Photo by Ben Goddard, Albuquerque Mountain Rescue)

Carlos, 35, joined the Labs’ technical staff as a mechanical engineer in 2010, had worked previously as a Sandia contractor. At the time of his death, Carlos was supporting several Z machine-related projects in Tech Area 4.

Collaborations: Dan Heidley (1678), part of the team that originally brought Carlos on board as a contractor, says, “My friendship with him grew over time,” involved mostly around lunchtime, hallway, office, and dinner conversations. “We deeply enjoyed talking about the deepest things. We spent a great deal of time discussing family, mountain, nature and whatever else we stumbled upon. Carlos refused to take a quick answer always challenged me to think through my beliefs and I am grateful to God for the time I spent with him. He was my beloved friend and I miss him.”

Carlos’ manager, Finis Long (1678), recalls his colleague as a critical member of the Dept. 1678 team. “Carlos wasn’t just a great thinker and also extremely creative and his designs are a testament to his engineering abilities. He took on assignments with great enthusiasm and always saw a chance to engineer safer, more efficient processes.”

“It was always a pleasure to stop and talk to Carlos about work or about his hobbies. His outlook was always to do his best at whatever he did. Losing Carlos is a huge loss to the Labs, as well as a loss to Sandia in whom he served.”

While his professional accomplishments were significant and his technical insights invaluable, it was the way Carlos touched people at the simplest human level that will be remembered among his colleagues. Says Joanne Wintor, “Carlos was a wonderful person to be around, always very upbeat and enthusiastic. He liked to bake bread; we were always sharing recipes. I will miss him terribly.”

Carlos collaborated frequently with Kurt Tomlinson designing Z machine targets. Kurt, a General Atomics engineer working as a DOE contractor assigned to Sandia’s pulsed power program, says, “Typically, Carlos would attempt to come up with a target design that fulfilled the physics requirements while being as simple and inexpensive as possible. He was always very upbeat and enthusiastic. I liked his sense of humor, too. His death is definitely a great loss to the world. Carlos was a great human being.”

No-bomb fertilizer

(Continued from page 1)

denier since I was 8. We had five acres in Las Cruces with the problems of calcareous soils that are very similar to those in the Middle East. I know something about commercial farming.”

He also knew the chemistry of IEDs from years of training soldiers how to deal with them.

Ammonium nitrate has an Achilles heel from a terrorist’s perspective. The ammonium ion is weakly attached to calcium, and when mixed with a fuel, the right chemical reaction can easily pull them apart. Kevin reasoned you could separate the ions by adding a compound that would react with calcium and get rid of the reaction. “It would change into something else at the molecular level,” Kevin says.

He tried several materials including iron sulfate, a readily available compound that steel foundries throw out daily. When mixed with ammonium nitrate, the iron ion “grabs” the nitrate and the ammonium ion takes the sulfate ion. Iron sulfate becomes iron nitrate and ammonium nitrate becomes ammonium sulfate. This reaction occurs if people attempt to alter the fertilizer to make it detonable when mixed with a fuel.

“The ions would rather be with different partners,” Kevin says. “The iron looks at the ammonium nitrate and says, ‘Can I have your nitrate rather than my sulfate?’ and the ammonium nitrate says, ‘I like sulfate, so I’ll trade you.’”

Ammonium sulfate and iron nitrate are not detonable, even when mixed with a fuel. “It’s a different compound,” Kevin says. “We worked on the formula in late 2012. At the chemical level it’s a great fertilizer but does not detonate.”

Chemical engineer Vicki Chavez (6633) ran a small-scale proof-of-concept of the reaction, and validated it. “We were able to prove that there was little to no ammonium nitrate left in the resulting process,” she says. “It was very cool.” We looked at pure ammonium nitrate and pure ammonium sulfate. The resulting sample looked more like ammonium sulfate.

Kevin says iron sulfate in fertilizer adds iron and acidities soil. “It does good things for soil health. It takes alkaline soil and makes it more neutral, closer to an ideal pH level,” he says. “The closer you get a neutral pH, the more crops grow. Crop yield would improve significantly.”

And iron-containing fertilizer added to the soil would be taken up in crops and help light stress and other iron deficiencies in people who eat them.”

The soil in Afghanistan is alkaline with a high pH, and would benefit from an ammonium nitrate/iron sulfate fertilizer, Kevin says. “What they use now, ammonium sulfate with calcium carbonate—which makes soil more alkaline doesn’t make sense,” he says.

Danger to soldiers

Sandia could have patented the formula but opted to waive ownership rights for humanitarian reasons. “One of Sandia’s priorities is deploying the technology that resulted from our research for the public good,” says Pete Atherton, senior manager of Industry Technologies that result from our research for the public good.”

Kevin says his sense of urgency in tackling the issue came from looking into the eyes of hundreds of soldiers he trained in anti-IED tactics. “Explosive Ordinance Disposal techs see a lot of IEDs, and about one third of them will die, be maimed, or injured by IEDs before getting through their tours, and most from ammonium nitrate-based explosives,” he says.

At a meeting last year in Crystal City, VA, Kevin sat next to an ex-Marine who had lost both legs trying to find IEDs. “He had a metal detector, but some bombs are chemically initiated with no metal parts. He stepped on a remote trigger and set off a blast that took off both legs. He became a double amputee in millisecond. So when I sit next to him and see the aftermath of this tragedy I have to ask myself if I can do it in a way possible to keep stuff like this from happening.”

“It does good things for soil health. It takes alkaline soil and makes it more neutral, closer to an ideal pH level. The closer you get a neutral pH, the more crops grow. Crop yield would improve significantly.”

— Researcher Kevin Fleming
Sandia's safety journey

"When I reflect on our performance, I'm reminded that we have had quite a few recent injuries at Sandia during normal, planned work. We have also experienced some incidents that had the potential for serious injury. Yet we were fortunate; nobody was injured. However, one thing is certain: We cannot rely on luck when it comes to safety. The Halon and lithium incidents stand out in that regard. The first led to the suspension of activities, failure analyses, and supplemental causal analyses. The second led to detailed safety assessments, and both events led to many lessons learned. Furthermore, in some respects, we have plateaued in our safety performance. Some may consider this situation adequate. However, I do not."

Excerpts from video by Paul Hommet, Sandia President, and Laboratories Director and Chief Safety Officer, December, 2012

“A marathon, not a sprint”

“Sandia’s safety culture — its progress — is a journey,” says Mike Hazen, VP of Infrastructure Operations Div. 4000. “Most folks think it’s something you can change overnight. It is not. It’s a marathon, not a sprint.”

Mike became the Div. 4000 VP in the fall of 2007. The following year a rocket sled motor ignited prematurely and an employee was hurt, suffering a broken foot and severe burns.

“Looking back, the sled track accident was a low point in our safety journey. It was a watershed, a wake-up call for us on safety. At the same time we’ve worked hard at the evolution of our safety culture because of it,” Mike says. “Our culture is maturing rapidly and now with the implementation of Engineered Safety with truly engaged leadership, we are seeing results.”

“When leadership does the right thing and makes the tough decision, even if it might impact schedule or cost in the short run, then the safety culture will improve.”

— Sid Gutierrez, Chief of Safety

After a two-year suspension due to the accident, Sandia re-started operations of the sled track and recently conducted a successful, full-scale test — the first of its kind since the 2008 accident (see related article on page 1).

“But what if post-accident the sled track had been permanently shut down? Mike asks. “Or what about the possibility that you or a co-worker might not go home in the same safe condition in which you arrived at work? What are you willing to do about it?”

That is Paul Hommet’s tough, bottom-line message about the importance of Engineered Safety as Sandia’s critical new step in its safety journey.

Engineered Safety, in Paul’s words, “uses a principle-based approach for designing safe operational systems by identifying what could go wrong and planning in advance to prevent them or by mitigating consequences when failures do occur.”

Its interconnected elements include people, processes, facilities, equipment, and the hazards inherent in them and the work to which they are applied. Engineered Safety values technical understanding, critical thinking, and due diligence by viewing safety as a system engineering context, appropriate for an R&D laboratory: a system where safety is part of the design intent.

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“Engineered Safety is about determining what the hazards are that could impact a project, determining the consequences of those hazards, and then determining how those consequences are acceptable before proceeding on that project,” says Mike.

“Engineered Safety is an improvement in our safety journey and something the line developed and owns,” says Mike.

Leading by example

Under Paul’s direction as Sandia’s safety leader, the Labs has made a practice of examining lessons learned, understanding feedback others have provided, and combining these with new approaches that place a higher value on safety. Mike says.

Mike says a key message is that Sandia’s safety culture is only as good as the activities leaders deliver and model by word and deed through working relationships with people first and demonstrating safety values.

“Safety is now part of mission success — it’s how we define success beyond delivering the product. Safety is becoming an institutional part of our daily Sandia culture,” he says.

Sandia’s character as a learning organization means that workers and managers think through what might go wrong, what the consequences might be if something goes wrong, what they can do about it to make such outcomes less likely, or design systems that may eliminate them entirely.

Case studies of successes in the two-year Engineered Safety pilot program, written or recorded on video, are part of this learning behavior as Sandia implements, including on an online repository of design documentation and other resources, along with contact information for mentors who have successfully implemented Engineered Safety activities.

Mike says he already has seen a change in safety attitude among one team.

“We’re more productive if we’re safer. People are engaging others about safety — whether it’s about activity-level work or speaking with someone about biking across campus without a helmet. People are responding by saying ‘thank you’ rather than feeling they’re being challenged,” adds Mike.

Sid Gutierrez, director and Chief of Safety (4100), and co-lead of the Engineered Safety Implementation Team with Charles Barbour, director, Research & Development Science & Engineering (1000), points to a number of daily safety enhancements that demonstrate this workforce shift. They include use of the LiveSafe website, the slips and falls awareness program, the new training simulator for slippery conditions, and a new focus on reducing stress and over-exertion.

“But the most important change involves leadership expectations and actions. The staff is looking for things such as making it easier for them to do the right thing, and making the tough decision, even if it might impact schedule or cost in the short run, then the safety culture will improve.”

Moving away from a ‘hero culture’

He says leadership needs to move away from Sandia’s hero culture of ‘deliver no matter what’ as the measure of success. “We are only successful in completing the mission if we do so without injury to personnel and without breaking equipment.” Sid says.

Mike and Sid emphasize that Sandia workers must consistently implement three key behaviors at all levels:

1. Take personal responsibility and commit to “Do the Right Thing” at all times. Decision-making must be risk-informed and thoughtful, with “Safety Always.”

2. Be unrelenting safety advocates, constantly challenging assumptions and externally vigilant, seeking to identify and eliminate or mitigate all hazards. Always questioning. Constantly learning. Always trying to get better.

3. Treat failures that result from human error as learning opportunities, but address intentional at-risk behaviors and reckless behaviors with discipline. The consequences must be proportionate to the at-risk behavior and the outcome of the event. We must create a “Just Culture.”

Sandia can be proud of how far it has come, but it still has a ways to go, says Mike.

“We have a lab full of people who want to do the right thing. We have to make it as easy as possible for them to do it.”

— Div. 4000 VP Mike Hazen
Michelle Racicot was a high school grad itching to leave home when she enlisted in the military in 1997. She served for 13 years later, transformed into an Army nurse who saved lives on the battlefields of Iraq and Afghanistan.

Today, Michelle (3331) is a family nurse practitioner at Sandia with strong ties to her first career. She’s vice executive director of American Women Veterans (AWV), a national organization that advocates on behalf of serviceveterans, women, and their families. She’s also vice chairwoman of Cuidando Los Niños, an Albuquerque nonprofit committed to ending child homelessness. She educates legislators and community members on homelessness, post-traumatic stress disorder (PTSD), women in combat, and health disparities.

“My plate is probably too full,” she laughs. “But I love everything I do. It’s just who I am.”

Michelle was one of 14 women recognized on March 19 by first lady Michelle Obama as Champions of Change. The event, which took place at the White House during Women’s History Month, honored women veterans who have made a major impact on the nation’s communities, businesses, and schools. Hundreds were nominated for the award.

The first lady spoke to the group on behalf of her joining Forces initiative, which helps veterans and military families receive benefits, support, and respect.

“You are the leaders in our businesses and schools in our communities,” she told the honorees. “You’re volunteers in your neighborhoods, on the PTA, mothers raising your kids with that same sense of responsibility.”

Michelle grew up in Tijeras and graduated in 1997 from Manzano High School in Albuquerque. “I wanted to get away so I joined the Army,” she says. Through Army training she became a medic and a licensed practical nurse while stationed in Fort Lewis, Wash. The Army awarded Michelle a Greens-to-Gold Scholarship that sent her to college to become an officer. She earned a bachelor’s degree in nursing from Pacific Lutheran University. “I became a registered nurse and an Army officer,” she says.

Michelle was stationed in Germany on a hospital surgical floor taking care of wounded soldiers from Operation Iraqi Freedom and Operation Enduring Freedom. Hurricane Katrina brought her to New Orleans in 2005 and deployment with the Army’s 21st Combat Support Hospital (21st CSH). She returned to Germany briefly then was deployed with the 21st CSH to Iraq for 12 months in 2006-2007.

“I worked in Logar Province doing trauma care, then set up another Forward Surgical Team in the Ghazni Province,” she says. “I enjoy teaching, so instructing medics on how to evaluate trauma patients and triage was easy. Army medics are the most amazing people you could ever work with.”

Michelle worked through rocket and mortar attacks, often sleeping in the trauma bay with a radio in hand. “There are times when you are scared, but the crazy thing is you’re more scared for your patients,” she says.

“You’re more anxious to save patients’ lives. That’s the most important thing.”

She did dismounted ground patrols, not routine for a nurse, meeting Afghan citizens and helping out in orphanages. “I loved what I was doing but knew I needed to get a master’s degree,” she says. “I left the Army in April 2010.”

Thirteen years after saying good-bye to her family, Michelle returned to Albuquerque to get a master’s at the University of New Mexico (UNM) and become a nurse practitioner. “I missed a lot being away from my family, things like my sister’s graduation,” she says. “I wanted to spend time with them.”

She graduated from UNM in May and joined Sandia as a contractor in January. “This has been the best two months ever,” she says. “I work in urgent care and health maintenance. Sandia has great programs and is very progressive on health issues. I can learn so much from the physicians here, and the patients are great. It’s a perfect match.”

Michelle’s manager, AnnaMarie DeCoste (3331), says Michelle is enthusiastic about patient care and eager to learn more as a healthcare provider. “She not only cares about patients but equally cares about her community,” says AnnaMarie, who nominated Michelle for the Champions of Change honor. “Michelle is a young woman who wants to make a difference and she is definitely making a difference in our community. I’m very proud to have her as part of our staff.”

Michelle says community service brings her many rewards. “You can always give to your community,” she says. “At the end of the day you’re changing people’s lives.”

Michelle says one of the best moments of her life came during the first AWV parade. “A woman came up to me and said, ‘I’m a veteran, too.’ And I thought that’s who we need to do this. We’re veterans not just one day, but every day of the year.”