



Catching quakes caused by energy exploration before they happen



Sandia scientists use 3D-printed rocks, machine learning to detect unexpected earthquakes

By **Mollie Rappe**

Sandia geoscientists used 3D-printed rocks and an advanced, large-scale computer model of past earthquakes to understand and prevent earthquakes triggered by energy exploration.

Injecting water underground after unconventional oil and gas extraction, or fracking, geothermal energy stimulation and carbon dioxide sequestration all can trigger earthquakes. Of course, energy companies do their due diligence to check for faults — breaks in the earth’s upper crust that are prone to earthquakes — but sometimes earthquakes, even swarms of earthquakes, strike unexpectedly.

UNDER PRESSURE — Sandia geoscientist Hongkyu Yoon holds a fractured 3D-printed rock. Hongkyu squeezed 3D-printed rocks until they cracked and listened to the sound of the rocks breaking to be able to identify early signs of earthquakes.

Photo by Rebecca Gustaf

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Search and rescue volunteers from Sandia respond to wilderness misadventures

By **Mollie Rappe**

By day, Craig Tenney is a Sandia chemical engineer. But sometimes as he readies for bed, he gets a call and instead finds himself on an icy trail, mere feet from a cliff high above the city in the Sandia Mountains rescuing a couple of hikers who thought they could make it to the top in tennis shoes and jeans.

Craig is one of a dozen Sandia volunteers who go off the beaten trail and give back to their community by participating in wilderness searches and rescues. As members of the Albuquerque Mountain Rescue Council, they use their technical expertise to solve the complex challenges involved in finding lost hikers and hoisting injured rock climbers to safety.



CITY LIGHTS, NIGHT WORK — Albuquerque Mountain Rescue Council members undertake a night rescue on the mountains overlooking Albuquerque.

Photo by Steve Larese, Albuquerque Mountain Rescue Council

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LABNEWS Notes

EDITOR'S NOTE: We've stopped printing the *Lab News*, but will continue to publish every two weeks. We want you to remain in our community of readers, so please send your comments and suggestions for stories or for improving the paper. *Lab News* welcomes guest columnists who wish to tell their own "Sandia story" or offer their observations on life at the Labs or on science and technology in the news. If you have a column (500-800 words) or an idea to submit, contact *Lab News* editor Jim Danneskiold at jjdanne@sandia.gov.

Small IT business wins Sandia's largest single subcontract

By **Manette Newbold Fisher**

Sandia awarded an information technology subcontract of potentially up to \$700 million dollars over a possible seven years to a New Mexico small business. This is the largest subcontract Sandia has issued to date.

"It's a big deal and a huge win for the small business community," said subcontract manager Ally Gronager. "I think this will open doors. It showcases that small businesses have the ability and the capability to bid on big projects."

Encantado Technical Solutions, LLC, will provide IT and telecommunications support to all Sandia sites under a



STREAMLINING SERVICES — Sandia awarded its largest subcontract to date — potentially up to \$700 million over a possible seven years — to a New Mexico small business, Encantado Technical Solutions, LLC. Several information technology subcontracts were consolidated into one. Sandia managers expect this will streamline IT services across the Labs. Former Sandian Anna Perez here looks over the Thunderbird computer. **Photo by Randy Montoya**

five-year deal with an option to renew for two more years.

The award replaces several subcontracts set to expire in April and continues with a similar scope of work. The agreement, signed in January, covers the support and provisioning of specific

telecommunications and IT services.

"We are thrilled to support Sandia National Laboratories with our scalable, flexible and comprehensive service-delivery model," said John Heneghan, Encantado partner. "We will leverage Encantado's Centers of Excellence

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Black engineer awards expand Sandia Labs spotlight

Ten problem solvers honored for scientific, community feats

By **Luke Frank**

Ten Sandia engineers received **Black Engineer of the Year Awards** for 2021, including Most Promising Scientist, Modern Technology Leaders and Science Spectrum Trailblazers.

Honorees include Sandia systems, chemical, computer, electrical, petroleum, manufacturing and mechanical engineers. All excel in their respective fields, and lead innovation that benefits U.S. national security.

The recipients, all with advanced engineering degrees, hold patents, have published extensively and received many professional and community awards. They perform several roles at Sandia and with research and academic partners across the country.

In addition to their professional pursuits, they are active with youth in their communities as local sports coaches, STEM student program and event mentors, computer camp counselors, Big Brothers Big Sisters volunteers, local tutors and ambassadors for Historically Black Colleges and Universities.

“Each of these award recipients demonstrates remarkable abilities to inspire procedures, productivity and people in their professional and personal lives,” said Esther Hernandez, Sandia’s chief diversity officer. “Sandia embraces the importance of supporting our professionals both in their careers and personal interests, which benefits our employees, enterprise and communities.”

BEYA is a program of the national Career Communications Group, an advocate for corporate diversity, and is part of its STEM achievement program. The awards annually recognize the nation’s best and brightest engineers, scientists and technology experts. The awards were announced at this year’s all-digital conference, held Feb. 11-13.

BEYA WINNERS

2021 Sandia Black Engineer of the Year awardees are:

Most Promising Scientist — Professional Award



LaRico J. Treadwell, chemical engineer

LaRico Treadwell is a chemist at Sandia’s Advanced Materials Laboratory. LaRico’s work covers the materials science spectrum, from basic materials discovery and characterization through applied materials reliability and device fabrication for a wide range of applications, including radiation, ultra-high-temperature systems, non-linear optics and thermo-electrics. His research advances science frontiers in chemistry, engineering, materials and component reliability.

Modern Day Technology Leader — Outstanding Achievement Award



Uzoma Onunkwo, electrical and computer engineer

Uzoma Onunkwo leads efforts in cutting-edge research and development spanning high-speed data analytics, streaming machine learning, large-scale wireless network simulation and quantum information science. His work in multithreaded coding, data structure and algorithms, queue management and compiler optimization accelerated new analytics on high-speed streaming data while protecting government computer networks. He has achieved notable success in the research and implementation of algorithms that enable large-scale wireless simulations at Sandia.



David Carter, electrical engineer

David Carter’s career path at Sandia has taken him from satellite electromagnetic compatibility and interference testing to physical security analysis to electronic device analysis and cybersecurity. David pioneered the use of an unconventional measurement system to augment traditional measurements techniques. He now works for Cyber Mission Alliances and is a liaison to the University of Texas at San Antonio and government entities in the San Antonio area.



Tonya Ross,
petroleum engineer

Tonya Ross creates and reviews two- and three-dimensional finite element meshes to support underground oil storage caverns built in salt domes for the Strategic Petroleum Reserve. Tonya led the effort to develop and implement a sitewide hazard analysis/qualitative risk-assessment-process supporting Sandia's work.



Elijah J. Finch,
computer engineer

Elijah Finch designed and implemented an information technology integration method that enables users to access each other's tools across the DOE complex, which allows for greater collaboration while maintaining data security and cybersecurity. Elijah's work enables analysts to dynamically execute and retrieve data in real time without constraints.

Science Spectrum Trailblazer — Outstanding Achievement Award



Quenton McKinnis,
systems engineer

Quenton McKinnis oversees electrical cables and connectors and production testers related to Sandia's national security mission. Over his 40-year career, Quenton has built numerous complex system and subsystem components and cable assemblies. As the lead integration and test engineer, he

oversees the functional activities of systems, system components and joint test assemblies. His attention to detail and drive for technical excellence are demonstrated in all facets of system engineering and cable design, ensuring system safety and reliability.



Jeffrey Robinson,
manufacturing engineer

Jeffrey Robinson leads a diverse team of engineers who provide research and development hardware and software surety engineering expertise of high-consequence systems throughout a product-realization lifecycle. Jeffrey delivers technical solutions for prevention,

early detection and mitigation of defects to protect against loss, damage and errors associated with national security technology. He develops or demonstrates new designs, testing concepts, materials, products, processes and systems.



Dennisa Thomas,
electrical engineer

Dennisa Thomas is an expert in product realization related to the development, qualification and production of national security systems' telemetry transmitters and modules. Her work has resulted in hundreds of design and manufacturing defects being identified and resolved before

qualification testing and production. Her expertise includes process improvement and defect prevention, product integration and testing, strategic planning and project management.



Tearie C. Buie,
electrical engineer

Tearie Buie designed, fabricated, qualified and implemented one of the first electrostatic discharge safe working areas for a major thermal battery supplier to the Labs, which ensured the safety and reliability of the manufactured product and personnel safety. She led a manufacturing team in

creating a technical onboarding training tool, the first of its kind, to allow new manufacturing employees to be trained and become competent in their new role within six months of employment.



Adam D. Williams, systems engineer

Adam Williams has made significant contributions incorporating systems-theoretic concepts, frameworks and analysis techniques into Sandia's national-security mission areas. Adam has applied his technological and policy aptitude to conduct high-consequence facility vulnerability assessments, design physical protection systems, analyze geopolitical implications of global energy development and support various global security engagement opportunities. He co-developed an analysis technique, Hazards and Consequence Analysis for Digital Systems methodology, that is advancing cybersecurity for U.S. interests.

Thin explosive films provide snapshot of how detonations start

By **Mollie Rappe**

Using thin films — no more than a few pieces of notebook paper thick — of a common explosive chemical, Sandia researchers are studying how small-scale explosions start and grow.

Sandia is the only lab in the U.S. that can make detonatable thin films like these for experiments that advance the fundamental knowledge of detonations. And the data improved a Sandia-developed [computer-modeling program](#) used by universities, private companies and the Department of Defense to simulate how large-scale detonations initiate and propagate.

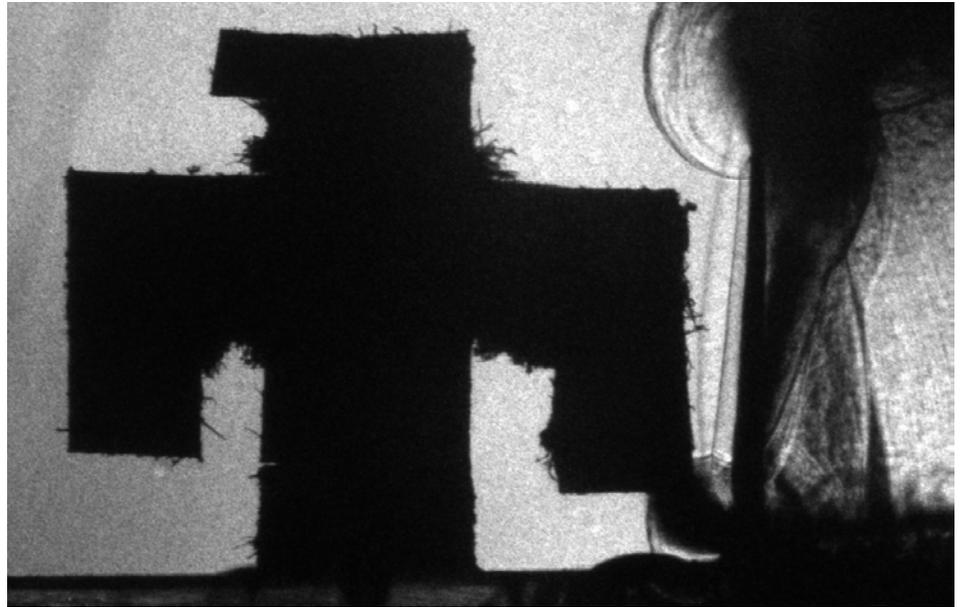
“It’s neat, we’re really pushing the limits on the scale at which you can detonate and what you can do with explosives in terms of changing various properties,” said Eric Forrest, lead researcher on the project. “Traditional explosives theory says that you shouldn’t be able to detonate at these length scales, but we’ve been able to demonstrate that, in fact, you can.”

Eric and the rest of the research team shared their work studying the characteristics of the thin films and the explosions they produce in two recently published papers in [ACS Applied Materials and Interfaces](#) and [Propellants, Explosives, Pyrotechnics](#).

For their studies, the team used PETN, also known as pentaerythritol tetranitrate, which is a bit more powerful than TNT, pound for pound. It is commonly used by the mining industry and by the military.

Typically, PETN is pressed into cylinders or pellets for use. The research team instead used a method called physical vapor deposition — also used to make second-generation solar panels and to coat some jewelry — to “grow” thin films of PETN.

Sandia is the only lab in the U.S. that has the skills and equipment to use this technique to make thin explosive films that can detonate, said Rob Knepper, a Sandia explosives expert involved in the project.



A LITTLE BANG — An image from a test detonation of a thin explosive film, about as thick as a few pieces of notebook paper, with a thunderbird-shaped barrier the size of the thunderbird on Sandia business cards. The “shimmering” lines to the right of the thunderbird are the shock waves from the explosion, detected by schlieren imaging, a technique that can detect differences in air density.

Photo courtesy of Eric Forrest

Growing and studying thin explosive films

Starting in late 2015, the team grew thin films of PETN on different types of surfaces to determine how that would affect the films’ characteristics. They started with pieces of silicon about the size of a pinkie nail and grew films that were about one-tenth the thickness of a piece of paper, too thin to explode. Some of the silicon pieces were very clean, some were moderately clean and some were straight-out-of-the-box and thus had a very thin layer of dirt — 50,000 times thinner than a sheet of paper.

On the very clean silicon surfaces, the PETN films formed what appeared under scanning-electron microscopy to be smooth plates, yet with tiny cracks in between plates, somewhat like dried mud on a dried lakebed. On the dirty silicon surfaces, the surface of the PETN films appeared more like even hills.

Using an X-ray-based technique, the researchers determined this is because the PETN molecules orient themselves differently on dirty surfaces compared to very

▶ Fast Shocks Video

A team of Sandia researchers led by Eric Forrest made thin explosive films to study how small-scale explosions start and grow. Using an ultra-fast camera that can take up to a billion frames a second, they watched the shock waves from the thin films’ detonations. By comparing the denotation of films with and without small gaps, they advanced basic understanding of denotations, which will improve the safety and reliability of explosives. For scale, the thunderbird in the last video is 3/8th of an inch tall.



clean surfaces, and thus the film grows differently, Eric said.

“This study in particular has shown that we can get not just novel, but very useful forms of traditional explosives that you would never be able to achieve via traditional means,” Eric said. “Finely controlling

the film properties enables us to investigate theories to better understand explosive initiation, which will allow us to better predict reliability, performance and safety of explosive systems through improved models.”

Rob, who served as Eric’s mentor on the project, agreed. “Developing a way that we can reproducibly control the microstructure of the films, just through the surface manipulation, is important. Right now, our focus is on using these films to further our understanding of explosive properties at small scales, such as the initiation and failure of explosives.”

Once the characteristics and properties of the thin films were better understood, the research team grew thicker films — this time about the thickness of two sheets of notebook paper — on very clean pieces of plastic about the size of a pinkie finger.

Then, with a bang, they detonated the explosive films inside a specially designed safety enclosure called a “boombox,” which was engineered to prevent a detonation from starting while the enclosure was open as well as contain any debris from the detonation. Using an ultra-high-speed camera that can take up to a billion frames a second, they watched the shock wave rise up as the explosion raced across the thin film.

In collaboration with [New Mexico Institute of Mining and Technology](#) in Socorro, the research team developed a specialized setup to see the shock wave despite the smoke and debris from the test explosions using schlieren imaging, a technique that can detect differences in air density similar to the shimmering over a hot highway.

Student refines explosives

A mechanical engineering master’s student from New Mexico Tech, Julio Peguero, used the data from these experiments to

refine Sandia’s explosives computer-modeling program. The program, called CTH, can be used for applications, such as to determine how to best shape explosive charges while drilling for oil, Rob said.

Julio plotted the velocity of the shock waves above the films with and without gaps and adapted the computer program to better match the experimental results on very thin films. The team engineered thin films with cracks in the middle of various sizes — ranging from one-third the width of a human hair to 1 1/3 the width of a hair — to better understand the reliability of thin films and how detonations can fail. The team found that gaps around the size of a hair could stop a detonation from continuing.

Eric was particularly interested in the gap studies because the first study found thin cracks between the very smooth plates of some of the films. Although these cracks were far smaller than even one-tenth a hair’s width, the data from the gap study provided insights into how these films would perform.

Julio, now a Sandia employee, started working on the project in January 2018, first as a student and then as a Sandia intern.

“In addition to the excitement of doing explosives research, I gained an appreciation for measurement uncertainty and risks,” Julio said. “That is especially important for national security work to ensure that our confidence in our measurements is well-understood.”

Rob agreed about the importance of the project. He said, “When you have experimental data at small scales, especially those that are relevant for the border between what can detonate and what can’t, those data can be really helpful in

calibrating computer models. Also, being able to have good characterization of the explosive microstructure to go into the models helps with having parameters that can successfully predict performance over a wider range of explosive behaviors.”

The research was funded by Sandia’s [Laboratory Directed Research and Development](#) program. [Michael Hargather](#), a professor at New Mexico Tech and a scientist at the Energetic Materials Research and Testing Center, worked on the project and mentored Julio. Numerous Sandia employees with expertise across a variety of fields also worked on the project. 



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Catching quakes

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Sandia geoscientists studied how pressure and stress from injecting water can transfer through pores in rocks down to fault lines, including previously hidden ones. They also crushed rocks with specially engineered weak points to hear the sound of different types of fault failures, which will aid in early detection of an induced earthquake.

3D printing reveals structural information

To study different types of fault failures and their warning signs, Sandia geoscientist Hongkyu Yoon needed a bunch of rocks that would fracture the same way each time he applied pressure — pressure not unlike the pressure caused by injecting water underground. Natural rocks collected from the same location can have vastly different mineral orientation and layering, causing different weak points and fracture types.

Several years ago, Hongkyu started using additive manufacturing, or 3D printing, to make rocks from a gypsum-based mineral under controlled conditions, believing that these rocks would be more uniform. To print the rocks, Hongkyu and his team sprayed gypsum in thin layers, forming 1-by-3-by-half inch rectangular blocks and cylinders.

However, as he studied the 3D-printed rocks, Hongkyu realized that the printing process also generated minute structural differences that affected how the rocks fractured.

This piqued his interest, leading him to study how the mineral texture in 3D-printed rocks influences how they fracture.

“It turns out we can use that variability of mechanical and seismic responses of a 3-D printed fracture to our advantage to help us understand the fundamental processes of fracturing and its impact on fluid flow in rocks,” Hongkyu said. This fluid flow and pore pressure can trigger earthquakes.

For these experiments, Hongkyu and collaborators at Purdue University, with which Sandia has a longstanding [partnership](#), made a mineral ink using calcium sulfate powder and water. The researchers, including Purdue professors Antonio Bobet and Laura Pyrak-Nolte, printed a layer of hydrated calcium sulfate about half as thick as a sheet of paper, and then applied a water-based binder to glue the next layer to the first. The binder recrystallized some of the calcium sulfate into gypsum, the same mineral used in construction drywall.

The researchers printed the same rectangular and cylindrical gypsum-based rocks. Some rocks had the gypsum mineral layers running horizontally, while others had vertical mineral layers. The researchers also varied the direction in which they sprayed the binder, to create more variation in mineral layering.

The research team squeezed the samples until they broke and then examined the fracture surfaces using lasers and an X-ray microscope. They noticed the fracture path depended on the direction of the mineral layers. Hongkyu and colleagues described this fundamental study in a paper published in the journal [Scientific Reports](#).

Classifying seismic events with sound

Working with his collaborators at Purdue, Hongkyu monitored acoustic waves coming from the printed samples as they fractured. These sound waves are signs of rapid microcracks. Then the team combined the sound data with machine-learning techniques, a type of advanced data analysis that can identify patterns in seemingly unrelated data, to detect signals of minute seismic events.

First, Hongkyu and his colleagues used a machine-learning technique known as a random forest algorithm to cluster the

microseismic events into groups that were caused by the same types of microstructures and identify about 25 important features in the microcrack sound data. They ranked these features by significance.

Using the significant features as a guide, they created a multilayered “deep” learning algorithm — like the algorithms that allow digital assistants to function — and applied it to archived data collected from real-world events. The deep-learning algorithm was able to identify signals of seismic events faster and more accurately than conventional monitoring systems.

Hongkyu said that within five years they hope to apply many different machine-learning algorithms, including those with imbedded geoscience principles, to detect induced earthquakes related to fossil fuel activities in oil or gas fields. The algorithms also can help detect hidden faults that might become unstable due to carbon sequestration or geothermal energy stimulation, he said.

“One of the nice things about machine learning is the scalability,” Hongkyu said. “We always try to apply certain concepts that were developed under laboratory conditions to large-scale problems — that’s why we do laboratory work. Once we proved those machine-learning concepts developed at the laboratory scale on archived data, it’s very easy to scale it up to large-scale problems, compared to traditional methods.”

Stress transfers through rock to deep faults

A hidden fault was the cause of a surprise earthquake at a geothermal stimulation site in Pohang, South Korea. In 2017, two months after the final geothermal stimulation experiment ended, a magnitude 5.5 earthquake shook the area, the second strongest quake there in recent history.

After the earthquake, geoscientists discovered a fault hidden deep between two injection wells. To understand how stresses from water injection traveled to the fault and caused the quake, K-Won Chang, a geoscientist at Sandia, realized he needed to consider more than the stress of water pressing on the rocks. In addition to that deformation stress, his complex computational model also needed to account for how that

stress transferred to the rock as the water flowed through pores in the rock itself.

K-Won and his colleagues described the stress transfer in a paper published in the journal [Scientific Reports](#).

However, understanding deformation stress and transfer of stress through rock pores is not enough to understand and predict some earthquakes induced by energy-exploration activities. The architecture of different faults also needs to be considered.

Using his model, K-Won analyzed a cube 6 miles long, 6 miles wide and 6 miles deep where a “swarm” of more than 500 earthquakes took place in Azle, Texas, from November 2013 to May 2014. The earthquakes occurred along two intersecting faults, one less than 2 miles beneath the surface and another longer and deeper. While the shallow fault was closer to the sites of wastewater injection, the first earthquakes occurred along the longer, deeper fault.

In his model, K-Won found that the water injections increased the pressure on the shallow fault. At the same time, injection-induced stress transferred through the rock down to the deep fault. Because the deep fault was under more stress initially, the earthquake swarm began there. He and Hongkyu shared the advanced computational model and their description of the Azle earthquakes in a paper recently published in the [Journal of Geophysical Research: Solid Earth](#).

“In general, we need multiphysics models that couple different forms of stress beyond just pore pressure and the deformation of rocks to understand induced earthquakes and correlate them with energy activities, such as hydraulic stimulation and wastewater injection,” K-Won said.

K-Won said he and Hongkyu are working together to apply and scale up machine-learning algorithms to detect previously hidden faults and identify signatures of geologic stress that could predict the magnitude of a triggered earthquake.

In the future, K-Won hopes to use those stress signatures to create a map of potential hazards for induced earthquakes around the United States.

His research effort, as well as Hongkyu’s initial work, were funded by Sandia’s Laboratory Directed Research and Development program. Hongkyu received funding from the DOE Office of Fossil Energy to continue his research. 

Small IT, big contract

CONTINUED FROM PAGE 2

and innovation labs focused on IT operations, cloud, cybersecurity, software modernization and artificial intelligence to maximize Sandia's investments and achieve the Labs' long-term IT strategy."

The scope of the agreement includes servicing about 25,000 telephones and 30,000 user devices; delivering conventional end-user service to 30,000 computing devices; and providing end-user support that includes managing servers.

The subcontract's infrastructure computing services include operating, maintaining and servicing the Labs' network, telephone, wired communications, wireless communications and mobile platforms, and desktop computing devices at Sandia's New Mexico, California, Washington, D.C., and Nevada sites.

Encantado has an office in Albuquerque and is registered as a New Mexico small business. The company also plans to form a New Mexico nonprofit, the Encantado Technical Solutions Sandia Foundation, to serve Albuquerque and Livermore, California.

"We are honored to be selected for this small business award," said Dave Yockman, Encantado partner. "We look forward to providing innovative and efficient IT service delivery to Sandia National Laboratories."

Single subcontract will merge efforts, improve processes

"There were a few main objectives we were trying to achieve by consolidating multiple subcontracts into one," said Thomas Montaño, a manager who served as a technical expert during the bidding process. "Working with one company to manage the subcontract will improve the services' quality through standardization, reduce the disruption of operations due to movement across subcontracts and increase the value IT provides to Sandia."

Additional values of a single award include increased operational efficiency and enhanced collaboration between Sandia and the subcontractors, said Sandia subcontract manager Alex Riebli. It will be easier to share information and innovations across centers once all IT-related projects operate

under the same company. In addition, managing a single subcontract will increase administrative efficiency and reduce costs within the Labs, Alex said.

Thomas said the subcontract transition already has begun and will be complete by the time the previous subcontracts expire.

Subcontract led to positive, overwhelming response

Companies were invited to bid on the subcontract in an external Sandia website posting in the summer of 2019, Ally said.

"We got an overwhelming response from the small business community during that time and that led us to be able to plan for a full, small-business set-aside, which means only registered small businesses could bid," she said.

Paul Sedillo, small business program manager, also emphasized the strong response, saying there was a solid group of competitors that put a lot of effort into the process.

Proposals were evaluated based on the technical criteria of relevant experience, technical solutions and transition plans, said Thomas.

"The source selection team was concerned with striking the most advantageous balance between technical features, price and identified risk, which the Encantado proposal did," said Alex.

Sandia also partnered with the Small Business Administration, which helped guide the labs through federal policy in awarding the subcontract, Paul said.

"I appreciate Sandia National Laboratories' effort to provide this kind of extraordinary opportunity

for small businesses in New Mexico and throughout the country," said John Garcia, director of the SBA New Mexico district office. "The final contract will benefit our economy in so many ways."

Paul said Sandia has long been committed to the small business community and continues to work with DOE and NNSA to increase spending in that area.

"This new subcontract is a key element in ensuring we are committed to small business at every level," Paul said. "This could open opportunities for small businesses at every cost level because this proves they can compete. This is big for the future, not just for Sandia, but for other sites that will see we were able to achieve this award, and others will most likely follow suit. Sandia is leading the way in awarding this major small-business, high-dollar, highly visible subcontract."

For more information on doing business with Sandia, visit the [Procurement website](#). 



Benjamin Balassi
ERA Winner 2020
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Mountain rescue

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The Albuquerque Mountain Rescue Council is a team of first responders that gets called in when people get lost or injured in the mountains and wilderness areas near Albuquerque, and across New Mexico. About 30% of the volunteers on the team work at Sandia, including the council's president, vice president and treasurer, and serve on the council in their off-hours.

"As far as what draws so many Sandia employees to Albuquerque Mountain Rescue, the technical expertise required to safely execute mountain rescue missions probably appeals to many of us," said Craig, who is the council's president. "The people who choose to work at Sandia are already predisposed to thinking about risk mitigation, systems engineering and solving complex, open-ended problems that have relatively high stakes. Plus, it's just nice to do good things for other people."

The Albuquerque Mountain Rescue Council is accredited by the New Mexico Search and Rescue Council. It is one of two search and rescue groups in the state that is also accredited by the national Mountain Rescue Association. Cibola Search and Rescue is another local research and rescue group; its members include six Sandia employees and two retired Sandia employees.

Memorable winter rescues, tragic searches

Craig joined the Albuquerque Mountain Rescue Council six years ago, and in February 2020, he led a rather memorable rescue. One night, two separate couples got stuck in the snow and ice about a quarter mile from the top of La Luz Trail. This spot is treacherous because the trail traverses steep terrain with significant cliffs, and the afternoon sun partly melts the snow, which freezes again into ice each night.

First Craig and his fellow rescuers — including three other Sandia employees, one of whom was a member of Cibola Search and Rescue — reached the two couples, checked them out and began getting



SETTING OUT — Bill Scherzinger, Karen Son and Shane Ruzinsky, left to right, load up their rescue gear and personal protective equipment, ready to tackle any wilderness search and rescue challenge.



ON THE TRAIL — Sandians, left to right, Shane, Karen and Bill volunteer with the Albuquerque Mountain Rescue Council to find lost hikers and rescue injured rock climbers near Albuquerque, and across New Mexico. **Photos by Randy Montoya**

them warmed up. Then he scouted around and decided the best course of action was to use ropes and crampons to hike straight up to the crest of the mountain and from there to the upper terminal of the Sandia Tramway, a gondola-like tram to the top of the Sandia Mountains. It took two hours to go up the 200 feet to the Crest Trail, working in four stages to protect the patients and rescuers, he said.

That same night, another group from the team, including three Sandia employees, was called in to rescue six people

who got into trouble about five miles up the La Luz Trail. Everyone involved in both rescues went home cold and tired, but safe and sound.

Bill Scherzinger, the council's treasurer and a mechanical engineer at Sandia, was introduced to the team in 1998 by Steve Attaway, another Sandia employee. One mission Scherzinger recalls vividly did not have a happy ending.

A young woman in her early 20s got lost during winter while hiking Mount Taylor, about 80 miles west of Albuquerque near

Grants. Bill and several other members of the team, including another Sandia employee, went on several searches to find her. When they came back from one search, Bill noticed the woman's parents staring at her preserved shoeprint.

"That really brought home what it is we do, when we're out there searching for people," he said. "Unfortunately, we didn't find her. Her body was found maybe six months later. Sometimes our missions don't turn out great. But seeing

her parents really drove home what we do out there, and how we're helping people whose whole world has been thrown upside down."

COVID-19 changes

Like almost every aspect of daily life, the COVID-19 pandemic has affected the team's search and rescue missions and training.

The council averages about 50 missions in a year. This year, there was an unusual spring spike. In the summer there was a sizable lull in rescue missions, despite

unusually packed trails and trailheads, Craig said. "Our rescues have stayed mostly on par with past years, even though there seems to be an increased number of people out there. Perhaps those who are going out are preparing or reading up ahead of time, or are being very conservative, and are staying out of trouble."

Before going out on a mission or taking part in a training exercise, each member takes a COVID-19 self-assessment. This includes a temperature check, reviewing other common COVID-19 symptoms and a contact-risk assessment. Of course, as a wilderness search and rescue team, all their missions take place outdoors, and the volunteers wear masks, wash their hands frequently and stay more than six feet apart whenever feasible.

In many cases, only one member approaches a patient or missing person, still keeping six feet away, Craig said. That rescuer provides the person with a mask — if they don't already have one — and assesses their COVID-19 risks before moving closer to provide aid, such as warmer clothes and a hot beverage or assessing and wrapping a twisted ankle.

In some situations, such as when the patient is so injured they need to be carried out on a litter, maintaining distance is not feasible. Team members also carry N95 masks, eye protection and hospital gowns they can use if they determine the patient is at a high risk of having COVID-19.

Training exercises that cannot take place online, such as practicing hoisting a patient off a ledge with ropes and pulleys, were scheduled for only five or fewer members at a time, said Shane Ruzinsky, the council's vice president and a mechanical designer at Sandia. He was first introduced to the team on a hike when he came across a group conducting a training session.

Early in the pandemic, when the virus was poorly understood, the training exercises were scheduled about two weeks apart to reduce the risk of spreading the novel virus among the team members.

The council's members, along with members of New Mexico's 40 or so other search and rescue organizations, have begun receiving the COVID-19 vaccine with other first responders, Shane said.



IN THE SUN — Karen Son, a Sandia computer scientist, volunteers with the Albuquerque Mountain Rescue Council.



AND THE SLEET — Bill Scherzinger is the council's treasurer and a mechanical engineer at Sandia.



ON THE ROCKS — Craig Tenney practices his technical rescue skills during an August training session. Craig is a Sandia chemical engineer and the president of the Albuquerque Mountain Rescue Council.

Photos courtesy Albuquerque Mountain Rescue Council.

Recruiting new members

COVID-19 has also disrupted the team’s recruitment of new members. Typically, they induct a new class of members each spring and provide three months of intense training to give them all the skills necessary to participate in rescues, Craig said.

But, because of COVID-19, they did not train a new class of members in the spring of 2020 and plans for 2021 are still in development, said Shane, who was part of the spring 2017 class.

When normalcy returns, the only prerequisite to join the team is a willingness to put in the time to learn, and the dedication to go out on missions at any time. Most

members also have a passion for outdoor adventure sports, such as rock climbing, hiking or backcountry skiing.

People interested in learning more about the Albuquerque Mountain Rescue Council can visit its [website](#). Once in-person gatherings resume, people interested in learning more — and possibly joining the team — are encouraged to attend at least one monthly meeting, now held virtually. Other Sandians on the team include Richard Borders, Walter Fazio, Ryan Flanagan, Jerry Inman, Jay Johnson, Kevin Long, Andrew Miller, Karen Son and Zak Wilson.

The team’s core training covers such technical rescue skills as using ropes and

pulleys, search and navigation skills, winter rescue skills, radio communications skills and basic first aid. Some team members are medical professionals and others take outside classes to become certified wilderness first responders or wilderness EMTs. Shane is a certified wilderness EMT.

“I’m very fortunate to be part of such a skilled and dedicated team,” Shane said. “Typically, we get called out in difficult conditions, usually in the middle of the night, and we’re in challenging terrain. I know I can always rely on my teammates. When we go out together and help somebody and bring them back to their family, that is unbeatable.” 

Mileposts



Mary Clare Stoddard 40



Dan Porter 35



Dan Sprauer 35



Daniel Barela 30



Michele Leshner 30



Jocelyn De Luche 25



George Bachand 20



Heather Brown 20



Matt Geuss 15



Uzoma Onunkwo 15



Chris Orendorff 15

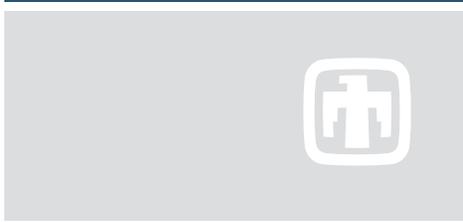


Karla Weaver 15



Cory Madsen 15

Recent Retirees



Perry Molley 36



Sharissa Young 31



Loren Riblett 30

Sandia teams receive DOE's highest awards

Secretary of Energy Honor Awards announced



CRUDE OIL — This fireball was created by igniting 400 gallons of superheated Bakken crude oil in a controlled release experiment. Data from infrared cameras were used to assess thermal hazards of crude oils tested at Sandia. **Photo courtesy of Michael M. Montoya**

By **Paul Rhien**

The U.S. Department of Energy recently recognized the achievements of six Sandia groups with the Secretary of Energy Honor Award. The awards celebrate the notable accomplishments of DOE employees and contractors and recognize their service and contributions to the department's mission and the nation.

"I want to thank all the recipients for their vital contributions to the Department and our country," said Dan Brouillette, outgoing DOE secretary. "I am truly honored to work alongside such brilliant, talented individuals who show unwavering commitment to public service. Congratulations on this well-deserved recognition."

Among Sandia recipients of the **DOE Secretary's Honor Awards** and COVID-19 Honor Awards were the following teams:

Crude Oil Characterization

In collaboration with DOE, Sandia led, coordinated, and delivered the Crude Oil Characterization study. By safely executing a series of large-scale tests in 2019, the team researched whether oils produced from some of the nation's richest shale formations possess combustion hazards in transportation and handling that are appreciably different from conventionally produced oil. The team designed, directed, and performed combustion and properties testing, including first-of-kind large-scale fireball tests, on various domestic crude oils.

Bringing together world-class expertise in geosciences, fire science, arming and firing, photometrics, and emergency operations, the team conducted the experimental study. The research answered key technical questions that directly impacts safe transportation of crude oil and directly informed policymakers and relevant stakeholders including the Department of Energy, the Department of Transportation, and Congress. The scientific study will also inform debate and improve industry best practices in crude oil sampling, sample analysis, hazardous material classification and emergency response for the large-scale transportation of crude oil in North America.

Flight Experiment 2 Design and Test

Sandia's Flight Experiment 2 Design and Test team was recognized for its national team leadership to design, build, test, field and launch the Conventional Prompt Strike Flight Experiment 2 Hypersonic Glide Body on a Sandia launch platform.

The results of the experiment expand the knowledge base of hypersonic flight regime for the vehicle and demonstrate the essential and innovative partnership between DOE and the Department of Defense in addressing the nation's highest priority defense needs.

Hypersonic platforms can deliver transformational, precision conventional warfighting capabilities that are in demand by Department of Defense planners and can provide robust policy options for future delivery systems while maintaining DOE-Sandia expertise for strategic re-entry systems.

National Labs' COVID-19 Testing

To protect mission-essential functions, keep the workforce safe, and help reduce the spread of COVID-19, DOE laboratories began offering testing for COVID-19 infection early in the pandemic.

COVID-19 clinical testing teams from Sandia, Lawrence Berkeley, Lawrence



EXPLOSION MONITORING — The Source Physics Experiment team prepares an explosive canister at the Nevada National Security Site prior to successful detonation.

Photo courtesy of Mission Support and Test Services



HYPERSONIC FLIGHT TEST — A common hypersonic glide body launches during a Defense Department flight experiment at the rocket launch range operated by Sandia in Kauai, Hawaii, in March 2020.

Photo courtesy of U.S. Navy



COVID-19 TESTING — Nurses perform COVID-19 testing at Sandia/California in May 2020.

Photo by Rosalind Turner

Livermore, Los Alamos, Oak Ridge and Pacific Northwest national laboratories received the secretary's special COVID-19 honor award for their work creating reliable tests, procedures, and capabilities to test more than 1,000 samples per day across the DOE complex.

Core teams of biological researchers, medical staff, safety experts and engineers performed extensive validation studies of the instruments, reagents and assays to prepare an Emergency Use Authorization application for submission to the Food and Drug Administration. Reliable testing has helped ensure the continuation of critical mission work by assuring the safety of the members of the DOE workforce.

Source Physics Experiment, Phase II, Dry Alluvium Geology

Concluding ten years of testing experiments (Phase I and II), members of the cross-lab Source Physics Experiment team were honored for advancing the science of nuclear explosion monitoring and for providing value to the nation's nuclear explosion monitoring mission.

Team members from Sandia, Los Alamos and Lawrence Livermore national laboratories, in partnership with Nevada National Security Site, the University of Nevada, Reno, and the Desert Research Institute safely and successfully executed a well-designed and extensively instrumented series of large chemical explosions at the Nevada National Security Site.

The experiments resulted in the first deployment of prototype seismic sources, maiden voyages of airborne infrasound systems, next-generation fiber-optic sensing, the first recording of dynamic explosion-induced ground motion using VideoSAR and improved high-performance physics modeling codes to make sense of the data. Using data produced by the experiments, the team developed one of the finest explosion-source phenomenology data sets in existence.

Additional Honors

Other Secretary of Energy Achievement Awards recognized Sandia contributions as members of broader working groups across the nuclear security enterprise. Some Sandians received awards this year for

work on projects that weren't principally the work of Sandia or its partners.

The Nuclear Security Enterprise Supplier Quality Working Group was honored for achieving new efficiency and cost avoidance by developing and implementing shared supplier assessments across sites. The group included representation from Sandia, Los Alamos, Y12 National Security Complex, Pantex, Savannah River Site, Livermore, Kansas City Nuclear Security Campus and Nevada National Security Site. In total, \$742,000 in cost avoidance was recorded for FY19 as a result of sharing supplier assessments, with an additional \$1 million projected by the end of FY21.

Sandia also participated in the Seattle Response and Recovery and Cs-137 Joint

Investigation Teams led by NNSA, recognized for their successful emergency response, recovery, stabilization and investigation of the breached radioactive source at the University of Washington's Harborview Research and Training Facility. The extensive investigative work performed by the team identified the underlying cause of the incident and will help prevent recurrence of similar incidents, as well as improve the efficiency and effectiveness of future radiological responses.

To learn more about the awards program, see the DOE news release about [award recipients](#), and visit the [DOE Secretary's Honor Awards](#) page for a listing of all awards for the past 12 years. 



Nathan Moore

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ERA Nomination Categories

LEADERSHIP	INNOVATION
TECHNICAL EXCELLENCE	COLLABORATION
INCLUSION & DIVERSITY	OPERATIONAL EXCELLENCE



SANDIA NATIONAL LABORATORIES
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