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Underground tests dig into how heat affects salt-bed repository behavior



CRYSTAL CLEAR — Kris Kuhlman, right, a Sandia geoscientist, and Melissa Mills, a Sandia geochemist, peer through a salt sample from their Waste Isolation Pilot Plant experimental site. They have just begun the third phase of a yearslong basic science experiment to understand how salt and very salty water behave near hot nuclear waste containers in a salt-bed repository.

Photo by Randy Montoya

Study to refine computer models, inform policymakers for future spent nuclear fuel disposal

By Mollie Rappe

Scientists from Sandia, Los Alamos and Lawrence Berkeley national laboratories have just begun the third phase of a yearslong experiment to understand how salt and very salty water behave near hot nuclear waste containers in a salt-bed repository.

Salt's unique physical properties can be used to provide safe disposal of radioactive waste, said Kristopher Kuhlman, a Sandia geoscientist and technical lead for the project. Salt beds remain stable for hundreds of millions of years. Salt heals its own cracks and any openings will slowly creep shut.

— CONTINUED ON PAGE 11

1 day. 3 rockets. 23 experiments.

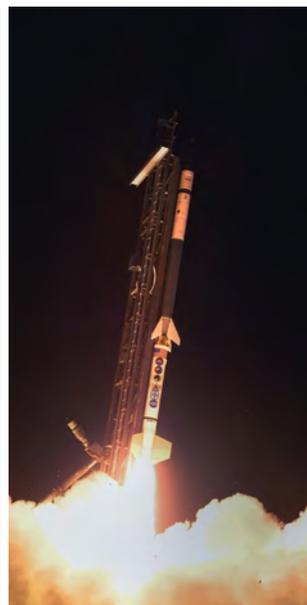
Sandia conducts hypersonic weapons research at blistering pace

By Troy Rummler

One year to design, build and test three rockets. Six weeks to unpack, assemble and test them at the flight range. One day to launch them.

Sandia launched three sounding rockets in succession for DoD on Oct. 20. The triple launch was conducted at NASA's launch range at Wallops Flight Facility in Virginia to hasten development of 23 technologies for the nation's hypersonic modernization priority, including the Navy's Conventional

— CONTINUED ON PAGE 7



1... 2... 3... BLAST OFF — Sandia conducted three sounding rocket launches for DoD on Oct. 20. The launches supported research for hypersonic weapons programs.

Photos by Mike Bejarano and Rana Weaver

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LAB NEWS Notes

Lab News may contain photos shot prior to current COVID-19 policies. Individuals in photos followed all social distancing and masking guidelines that were in place when photos were taken.

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 Katherine Beherec at kgbeher@sandia.gov.

Sandia-operated Arctic measurement facility moved, research to continue

Atmospheric studies and more to continue at fixed Arctic observatory

Story by **Mollie Rappe**

After eight great years of observations and research, a Sandia-operated atmospheric measurement facility moved from Oliktok Point, on the North Slope of Alaska, this summer. The mobile facility will be relocating to the southeastern United States; the exact location is still being decided.

The DOE Office of Science's **Atmospheric Radiation Measurement** mobile facilities collect important data



UP, UP AND AWAY — A weather balloon launches automatically from Atmospheric Radiation Measurement's fixed observatory in Utqiagvik, formerly known as Barrow. **Photos by Brent Peterson**



SEARING SNOW — Blowing snow at the Atmospheric Radiation Measurement mobile facility in Oliktok Point.

Photos by Brent Peterson

on atmospheric, aerosol and cloud dynamics to refine climate and weather models. The third mobile facility was originally intended to stay in northern Alaska for only five years but has been collecting and processing data at Oliktok Point since 2013.

Over the years at Oliktok, Sandia scientists and researchers from across the country have also conducted experiments on [cloud dynamics](#), [distributed acoustic sensing](#), [unmanned aircraft systems](#), [tethered balloons](#) and more. Critical Arctic observations and scientific studies will continue at Atmospheric Radiation Measurement's fixed observatory 165 miles away at Utqiagvik, formerly known as Barrow. The fixed observatory in Utqiagvik has been [collecting data for almost 25 years](#).

"The DOE's commitment to Arctic atmospheric observations and researcher-driven studies in Utqiagvik is not changing at all," said Lori Parrott, recently retired manager of Sandia's atmospheric and Arctic sciences group. "The mobile facility at Oliktok Point offered a powerful extension of that facility, as it was on the Beaufort Sea instead of the Chukchi Sea with regional variation. We're grateful that DOE is going to continue its mission of collecting unique atmospheric measurements to support

the climate modeling community with its move of the mobile facility to the southeastern U.S."

Arctic observations, research to continue

Arctic observations and DOE Office of Science experiments will continue at the Utqiagvik observatory, which has been operating since the summer of 1997. Some specialized instruments, like snow measurement sensors, will move from the Oliktok Point facility to the Utqiagvik facility, said Joe Hardesty, who leads the Sandia team that manages DOE Alaska Atmospheric Radiation Measurement facilities. "We look forward to maintaining that long record of Arctic data and observations to serve the modeling community."

One notable example of how Sandia researchers were able to use the Oliktok location to conduct other research projects is Dari Dexheimer and her [tethered balloons](#). She has regularly flown 13-foot-tall, sensor-laden tethered balloons at Oliktok since 2015. The balloons have collected important information about the temperature and [supercooled liquid water content of Arctic clouds](#), which were then fed into climate models to fine-tune them.

"Being up at the mobile facility on Oliktok Point gave us an unparalleled opportunity to test and refine our expertise

flying tethered balloons," Lori said. "Being able to insert instruments in a cloud from top to bottom, using our restricted airspace and stay in there to collect data over a long time, provided some unique datasets. It also gave our tethered balloon team great experience in improving our technology, strengthening the tethers, so that they could handle extreme conditions. Now we're using that skill for other studies in Oklahoma, Texas and Colorado."

Another experiment that will continue at Oliktok Point is Rob Abbott's three-year [distributed acoustic sensing interrogator](#) project. His team uses fiber optic cable to capture data on the seafloor of the Arctic, including sounds from ice quakes and transportation activities. "They're doing first-time-ever measurements up there," said Mark Ivey, Sandia senior engineer and science liaison of Atmospheric Radiation Measurement facilities at Utqiagvik and Oliktok.

Special-use airspace will remain

One aspect of Oliktok Point that allowed for the testing and usage of the tethered balloons was the presence of special-use airspace, including a [700-mile-long, 40-mile-wide](#) international warning area and a 4-mile-diameter restricted area. These enabled tethered balloon flights



LOOKING AT CLOUDS — Dari Dexheimer and her team prepare to launch a 13-foot-tall tethered balloon, also known as a helikite, from Atmospheric Radiation Measurement’s Oliktok facility. **Photos by Brent Peterson**

under protected conditions to prevent small aircraft from running into a tethered balloon hanging invisibly in a low cloud, Joe said. Sandia manages both the restricted airspace and the warning area for DOE.

Sandia’s Arctic team is working with DOE on transferring management of Oliktok’s special-use airspace from the DOE’s Office of Science to **DOE Arctic Energy Office**. This will allow DOE and Sandia to continue managing that resource for researchers across the nation to be able to use, said Joe.

The special-use airspace has allowed for the testing of **unmanned aircraft systems**, colloquially known as drones, in extreme conditions. One collaboration with the Coast Guard allowed them to test search-and-rescue response in high latitudes to include surveillance, detection and communications. Communication equipment doesn’t always work the same way at high latitudes as it does in the mid-latitudes, said Lori. She added that this is due to special polar atmospheric physics that can cause interference.

“It’s still unknown, but the transfer could lead to more significant research

for Sandia, DOE and other agencies,” Joe said. “We have retained some facilities and equipment at Oliktok and will use these to collaborate with other agencies. Going forward, we will want to use these, and the special-use airspace, to continue and expand our research at Oliktok. There will definitely be opportunities to continue conducting Arctic studies at our long-term facility in Utqiagvik.”

Moving from clouds and drones to pollen and dust

The primary goal of Atmospheric Radiation Measurement, which is a national scientific user facility operated by nine DOE national labs, is to collect data to refine climate models and address inconsistencies between models in the realm of atmospheric processes, Mark said.

After consulting the scientific community in 2018, the DOE decided to move the mobile facility to somewhere in the southeastern corner of the country to allow the collection of new, important data on how the land, forests and aerosol properties impact atmospheric processes in that part of the nation, he added. The new location will be

finalized this fall. The core facility should be up and running by **the end of 2023**.

The Oliktok mobile facility was packed up and shipped to Albuquerque this past summer, which the team accomplished ahead of schedule and under budget, Mark said.

“There’s new atmospheric science to do in the southeastern U.S.,” added Mark, who has been involved with Atmospheric Radiation Measurement for almost 30 years, with a focus on the Arctic since 2004. “There’s a lot more interactions between aerosols like dust, smoke and pollen blowing around in that part of the world. We need to know more about the impact these particles have on how much sunlight comes down through the sky and bounces up through the sky.”

Important partnerships will continue

Some of the things that allowed for continuous operation of Atmospheric Radiation Measurement facilities in the remote and harsh North Slope communities were the very close working relationships Sandia formed with service providers, oil companies, the Air Force, other federal agencies and Native

Alaskan corporations, such as the **Utqiagvik Inupiat Corporation**, Parrott said.

“You may think that when you’re going from an Alaskan Native village like Utqiagvik to Oliktok Point on Prudhoe Bay, you’ll see very large differences,” Lori said. “But there are some human qualities that persist across them, such as depending upon and taking care of your neighbors.”

Joe agreed and pointed out the importance of Atmospheric Radiation Measurement’s close partnership with the National Oceanic and Atmospheric

Administration observatory next door to the Utqiagvik observatory and a great relationship with the University of Alaska Fairbanks. Atmospheric Radiation Measurement’s Utqiagvik facility will also continue to launch weather balloons for the National Weather Service.

Mark added that the 611th Civil Engineer Squadron at the Air Force’s **Joint Base Elmendorf-Richardson** in Anchorage, Alaska is another particularly important relationship for continuing to do scientific research in the Arctic.

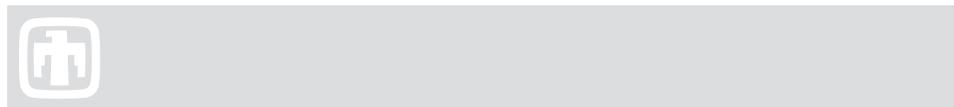
“Since we’ll be managing the airspace, and we have these strong relationships, I expect that we will be able to connect with other researchers who will have strong interest in understanding the changes that are occurring in the Arctic for both science and national security purposes,” Joe said. “I believe Sandia will play a growing role in that.”

All Atmospheric Radiation Measurement facilities are supported by DOE’s Office of Science Biological and Environmental Research program. 



FROM ALASKA, WITH CARE — Fred Helsel, right, a Sandia systems engineer, points out a feature of a shelter that had been stationed in Oliktok Point, Alaska to Mark Ivey, a senior engineer who has been involved in the Atmospheric Radiation Measurement user facility for nearly three decades. After eight great years of observations and research, a Sandia-operated atmospheric measurement facility moved from Oliktok Point. **Photo by Randy Montoya**

Mileposts



John Garcia

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Esther Hernandez

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Tania Carson

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Mary Abt

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Mike Rector

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Lynette Rocheleau

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Providing resilient power

A partnership between Sandia, Emera Technologies and Kirtland Air Force Base demonstrates DC microgrid technology for resilient power to homes and installations



POWER PARTNERS — Emera Technologies and Sandia formed a Cooperative Research and Development Agreement to collaborate on direct-current microgrid technology. The option to use locally produced power provides reliable insurance when power from a central grid is not available. **Photo by Randy Montoya**

By **Mattie Hensley**

As illustrated this summer, extreme-weather events and wildfires can put power grids under pressure and threaten their ability to produce reliable power.

For decades, consumers have relied on electricity delivered across long distances from large, centralized power plants. But what if a neighborhood, military installation or hospital complex could safely disconnect and run on locally produced power when power from the central grid was not available?

A microgrid demonstration project, launched by Emera Technologies and Sandia, is in its second year of successful operation and data collection. Since the project [ribbon-cutting ceremony in 2019](#), researchers have been evaluating the microgrid's stability and how to maximize its reliability while minimizing costs, among other measures.

Housed on Kirtland Air Force Base, the project integrates solar power, batteries and other local energy sources to power a community center and temporary housing located on the base. Each building has solar panels, and the energy storage is located at a separate node. Kirtland leadership envisions the project as a new model for resilient power.

“Our leadership at Kirtland Air Force Base has established a vision for an updated, resilient infrastructure that can provide mission-critical services for generations to come,” said Joseph Pellish, 377th Mission Support Group deputy commander. “Working with Sandia and Emera as partners has provided us the opportunity to showcase advanced technologies in real settings that meet current energy needs while also promising resilient solutions for our energy system of the future. This has the potential to serve as a model for other DoD installations,” Pellish added.

Sandia has led research for advanced microgrid controls, security and integration for over a decade. The Labs' location

on an Air Force base has offered a unique opportunity to demonstrate Kirtland leadership's vision with this new technology: a research, development and demonstration partnership that addresses the need for greater resilience. “As threats continue to evolve — related to climate challenges as well as other threats — this demonstration and what we're learning from it serve as a great example of a new paradigm for resilience through distributed and interconnected microgrids,” said Charles Hanley, Sandia's grid modernization program manager.

As the name implies, **microgrids** are localized power grids. They have control capability, meaning they can connect or disconnect from the traditional grid and even operate autonomously. Microgrids can supply primary power or backup power in case of emergencies, along with other advantages thanks to their flexibility.

A novel demonstration

The Kirtland demonstration project is novel in several ways. The main power bus

is based on direct current rather than traditional alternating current. Additionally, it is a hierarchical microgrid, meaning that control and integration occur at multiple levels and enhance the ability to provide resilient power under a variety of circumstances. This hierarchical nature means parts of the installation can run independently, in combination with each other, or in connection with the traditional power grid. This project also ties into the central grid, which uses alternating current, making it a hybrid direct-current grid. Sandia is studying this hybrid direct-current structure to better understand the advantages, optimize the design and seek out cost savings. This makes the system more resilient than even a traditional microgrid, investigator Jack Flicker said. The functionality is enabled by power electronic interfaces, an [area of research](#) for Sandia.

“Since we started operations in December 2019, we’ve been concentrating on evaluating microgrid operations in three areas,” said Jack. “The first area concerned operations that all microgrids can do, such as provide power to all nodes and island when needed. We then moved on to operations that are more difficult for traditional microgrids to do, such as black start and maintaining full operations through fault events.”

Black start is the process of restoring power after an outage. “We’re now looking at

operations that typical microgrids cannot do, such as — in resilience events — being able to arbitrarily route power to critical nodes that are dynamic in both space and time as the situation evolves,” Jack said. Coupled with the Distributed Energy Technologies Laboratory, the installation allows researchers to simulate varied scenarios and observe how well the microgrid performs.

While much of the power transported and delivered across the U.S. is alternating-current power, recent advances and changes to the composition of the grid have revived interest in direct-current grid installations. According to a 2015 study that [examined the potential benefits of direct-current microgrids](#) relative to an alternating-current microgrid, it was noted that direct-current microgrids might have cost, reliability and efficiency advantages for certain applications. Seven national laboratories, including Sandia, participated in the study. The study identified potential areas of imminent and future study to verify and better understand any potential advantages.

The connection between the direct-current microgrid and Distributed Energy Technologies Laboratory provides researchers with information about the microgrid’s performance. Meanwhile, the demonstration project contributes renewable energy to the base facilities’ footprint. Increased use of renewable energy, which emits no

greenhouse gas emissions, will be a key part of achieving the nation’s ambitious goals to tackle climate change, a [DOE priority](#).

Strengthened grid stems from strong partnership

“The project is, for me, the embodiment of all the things that microgrids have promised to deliver, especially the modularity and resilience,” said Gerro Prinsloo, project manager with Emera Technologies for the demonstration. “We have been able to integrate new technologies and test rapidly, doing so with little additional engineering effort post-commissioning. The rate at which it was done would have been difficult to achieve had it not been for the flexible nature of this microgrid architecture and the excellent resources Sandia brought to the table.”

Emera Technologies and Sandia [formed a Cooperative Research and Development Agreement](#) after Emera Technologies approached Sandia to work together on making clean, community-scale direct-current microgrids mainstream. Sandia researchers had already been studying the control and stability of direct-current microgrids for military applications, aiming to optimize design and performance at a lower cost.

Adding local control to energy distribution systems through microgrids can mean added resilience to the nation’s existing energy infrastructure. [📄](#)

Rocket launches

[CONTINUED FROM PAGE 1](#)

Prompt Strike and the Army’s Long-Range Hypersonic Weapon programs.

This was the first mission for the High Operational Tempo for Hypersonics rocket program, funded by DoD. Experiments were supplied by Sandia, entities within DoD and partner institutions. Other collaborators included Oak Ridge National Laboratory, the Applied Physics Laboratory at Johns Hopkins University and several defense contractors.

“Hypersonic vehicles include components and materials from a wide array of cutting-edge technologies,” Sandia program manager Ben English said. “And because all those components come from a broad number

of sources, all of them presumably can benefit from a reduced-cost, high operational tempo, flight-testing environment.”

A sounding rocket carries instruments that collect scientific data high up in Earth’s atmosphere. The rockets launched on Oct. 20 measured how experimental materials, sensors and communications devices contained inside the rockets — developed for hypersonic missiles — fared during launch and reentry.

Sounding rockets gather more accurate data than ground-based, mechanical flight simulators, and they can be launched more frequently and at a lower cost than fully fledged hypersonic vehicles, speeding up development of hypersonic technologies, Ben said.

“Our purpose is to generate a rapid

testbed tempo at reduced cost to the taxpayer for future hypersonic weapons systems development and upgrades,” Ben said. “We are the technological steppingstone between ground-based lab testing and simulations, and a full weapons test. Sandia does both, currently, and this program is the middle ground between the two of them.”

While hypersonic vehicles like the Sandia-developed common hypersonic glide body, by definition, cruise for long distances at speeds of Mach 5 and above, the rockets that were launched on Oct. 20 experienced these speeds for a comparatively brief time during their 260-mile ascent and subsequent reentry. Sandia is planning another launch in 2022 that will increase the amount of time payloads spend in hypersonic flight conditions. [📄](#)



HELP US HELP THE COMMUNITY THIS SEASON

Multiple agencies will receive the turkeys including Roadrunner Food Bank, Bethel Storehouse, Rio Grande Food Project & St. Felix Food Pantry

COLLECTION BINS LOCATED AT

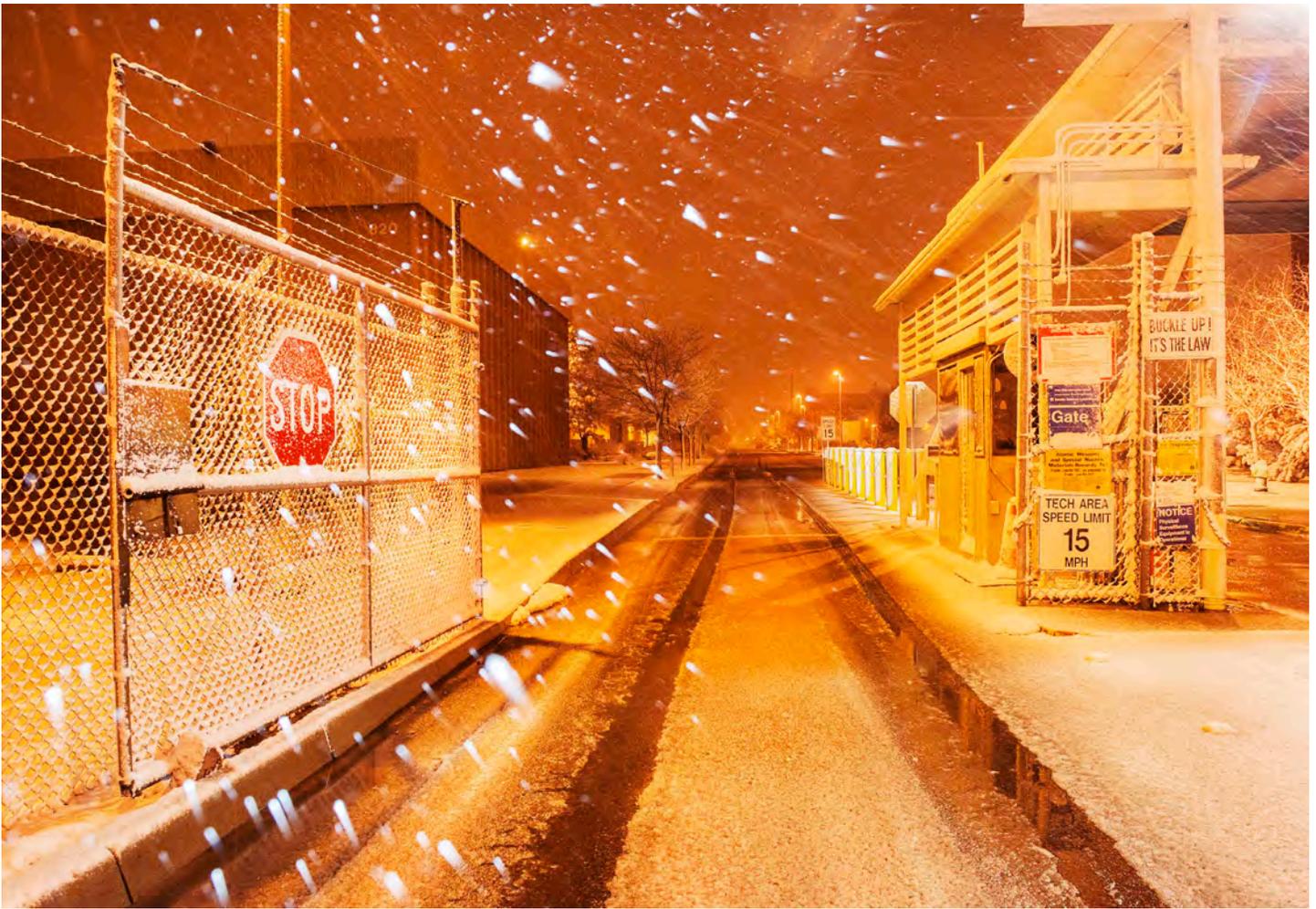
BLDG. 825, SSA (SOUTH PARKING LOT) 7 – 9 A.M.

BLDG. 800 7 – 9 A.M.

VARIOUS SANDIA LABORATORY FEDERAL CREDIT UNION LOCATIONS IN ALBUQUERQUE, EDGEWOOD, LOS LUNAS & RIO RANCHO 11 A.M. – 1 P.M.

CHECK THE COMMUNITY INVOLVEMENT WEBSITE FOR CREDIT UNION DROP OFF LOCATIONS

GO DIGITAL IN LIEU OF A TURKEY, YOU CAN MAKE A FINANCIAL CONTRIBUTION TO ROADRUNNER FOOD BANK [HERE](#)
QUESTIONS TO KATRINA WAGNER



SNOW HAPPENS — Sandia has refined its inclement weather notification process to better guide employees during significant weather events.

Photo by Randy Montoya

Demystifying inclement weather notifications

By **Luke Frank**

While most of us were enjoying a warm New Mexico spring and summer, Sandia Environment, Safety and Health, Emergency Management, Facilities and other stakeholders have been busy preparing for the weather vagaries of fall and winter to keep the workforce safe and informed.

Workforce messaging for weather events has been refined, as has the procedure of notifying employees about closures, delayed openings and early releases due to

inclement weather.

“Sandia bases its early release, closure or delayed start decisions on weather conditions on site at the Labs, not where employees reside,” said David Stuhan, acting director of Environment, Safety and Health. “At the core of every decision is the safety of our employees. Please use personal judgment in your decisions about getting to and from the Labs due to weather conditions. If you feel weather or road conditions are unsafe, contact your manager.” If you already are a telecommuter, you are expected to work from home regardless of weather conditions.

The day of a significant weather event, an early release will be communicated as quickly as possible to the workforce via text and email. For overnight weather events that prompt a closure or delayed opening, every effort will be made to communicate changes to the workforce by 5 a.m.

If weather or road conditions are questionable but the Sandia site is determined to be safe, a notification may be sent via text and email that Sandia is open for business. However, if employees haven’t received an early release, closure or delayed opening notification, it is business as usual at the Labs. “If you have not been

notified by Sandia of a change in operations, you are expected to follow your normal work schedule,” said Emergency Operations Manager Jim Breen. “We won’t normally broadcast workforce messages indicating Sandia is open for business.”

Sounds simple, right? A decision is made, and a Labswide text and email notification follow. Staff might be surprised, however, at what it takes to deliver accurate, timely weather-related workforce messages and prepare Sandia’s New Mexico site for the safe departure or arrival of its employees.

Assessing the weather

Making the decision to close Sandia due to inclement weather is a major undertaking requiring layers of assessments, briefings, reviews and approvals.

For Sandia’s purposes, inclement weather is any existing or forecast weather event that might impact Sandia facilities and the health and safety of employees. That could include snow, sleet, ice, flash flooding and fog. Other elements that might trigger a workforce message could include lightning, extreme temperatures or high winds.

Weather monitoring at Sandia Labs is unrelenting. Existing or forecast storms are continually assessed for their timing, potency, duration and impact. Duty officers in Sandia’s 24/7 Emergency Management Communications Center are on the front-line evaluating and reporting these events and their effect on Sandia employees, facilities and operations.

Sources like the National Weather Service, local media outlets and even interstate freeway cameras are scanned to determine when action might need to be taken. For on-site conditions, duty officers are in contact with Sandia Facilities’ grounds and roads teams to determine existing conditions and mitigation plans in preparation for workforce arrival at 6 a.m. or early release when the weather event occurs during working hours.

Duty officers also track closure activities at Kirtland Air Force Base, local and state government offices, public schools and other large employers in the area.

If further assessment is needed, the duty officer checks in with Sandia’s Emergency

Management agency representative, who deploys to the field and gathers additional information on onsite road conditions, along with the status of turnstiles, parking lots and walking surfaces.

Message timing

For dicey weather conditions or forecasts, a virtual meeting is called that includes Sandia Emergency Management leadership, Communications, Sandia grounds and roads leadership and telecommunicators.

Once convened, briefings are shared regarding current and forecast weather, road conditions and any changes in work schedules by other large employers in the area. Sandia Facilities then provides a briefing on grounds and road conditions.

If there’s an overnight weather event, the early morning briefing includes efforts to prepare the site for safe access and operations, and projections of completing site preparation for a workforce arrival of 6 a.m.

Based on all the above inputs, recommendations regarding Sandia operations come from the duty officer, Sandia Agency Representative, facilities, grounds and roads team lead, and the Emergency Management operations manager. Ultimately, the Emergency Management senior manager makes the determination to escalate the issue to an executive meeting for a conclusive decision.

If a Sandia executive meeting is called for an existing or pending weather event, the associate lab director for infrastructure operations, ES&H director, Sandia Field Office, ProForce and R&D Science & Engineering senior managers join the group for a full briefing and discussion. If an executive meeting is called for a possible early morning closure or delayed opening decision, the group convenes by 4:15 a.m.

When a decision is made to close the Labs or delay its opening, it is broadcast via text and email to the workforce by 5 a.m. to advise the workforce prior to the 6 a.m. start time. The dynamic nature of a weather event might affect this self-imposed deadline, but all efforts will be made to advise employees by 5 a.m. If the executive group elects to keep the Labs open, no message will be sent.

Inclement weather message types

To expedite the communications process, seven inclement weather messages have been prepared for broadcast to the workforce via text and email.

Winter storm advisory —

This provides information regarding a potential for closure or delayed opening the next day.

Sandia Labs closure —

Do not come to work unless absolutely necessary.

Sandia Labs early release —

Inclement weather has prompted an early release of the workforce for the day.

Delayed start for Sandia Labs —

Sandia’s New Mexico site will open for business at a specific time of day.

Additional delayed start for Sandia Labs —

Due to site conditions, Sandia will further delay opening to a specific time.

Personal safety or individual choice for reporting to Sandia Labs —

Employees’ concerns about personal safety due to inclement weather should be weighed in consultation with their manager in their decision to report to the site.

Caution — Proceed with caution arriving to Sandia’s New Mexico site due to potentially icy, slippery surfaces.

Message content

Inclement weather notifications from Emergency Management will provide clear language on any protective action for the workforce, including a closure or specific times for early release or delayed opening. This information also will be posted to Sandia’s [Facebook](#) and [Twitter](#) feeds and its internal and external websites. Sandia media relations will provide closure or delayed opening information to the local television stations.

Workforce notifications also will include additional sources for local weather conditions or forecasts; local road conditions; contacts for reporting hazardous site conditions; and directions on time charging.

“With these procedures, we’ll provide even clearer, more timely and decisive messaging to the workforce on how to proceed for an existing or looming inclement weather event,” said Jillian Konst, acting senior manager for Emergency Management. “We will continue refining this process to help keep Sandia employees safe and informed.” 

Salt-bed repository

CONTINUED FROM PAGE 1

For example, the salt at the **Waste Isolation Pilot Plant** outside Carlsbad, New Mexico — where some of the nation's Cold War-era nuclear waste is interred — closes on the storage rooms at a rate of a few inches a year, protecting the environment from the waste. However, unlike spent nuclear fuel, the waste interred at the Waste Isolation Pilot Plant does not produce heat.

The **DOE Office of Nuclear Energy's** Spent Fuel and Waste Disposition initiative seeks to provide a sound technical basis for multiple viable disposal options in the U.S., and specifically how heat changes the way liquids and gases move through and interact with salt, Kris said. The understanding gained from this fundamental research will be used to refine conceptual and computer models, eventually informing policymakers about the benefits of disposing of spent nuclear fuel in salt beds. Sandia is the lead laboratory on the project.

“Salt is a viable option for nuclear waste storage because far away from the excavation any openings are healed up,” Kris said. “However, there's this halo of damaged rock near the excavation. In the past, people have avoided predicting the complex interactions within the damaged salt because 30 feet away the salt is a perfect, impermeable barrier. Now, we want to deepen our understanding of the early complexities next to the waste. The more we understand, the more long-term confidence we have in salt repositories.”

Trial and error in the first experiment

To understand the behavior of damaged salt when heated, Kris and colleagues have been conducting experiments 2,150 feet underground at the Waste Isolation Pilot Plant in an experimental area more than 3,200 feet away from ongoing disposal activity. They also monitor the distribution and behavior of brine, which is salt water found within the salt bed left over from an evaporated 250-million-year-old sea. The little brine that is found in the Waste Isolation Pilot Plant is 10 times saltier than seawater.

“Salt behaves much differently when it's hot. If you heat up a piece of granite, it isn't



MINE WORK — Kris, front, and Thom Rahn, a Los Alamos National Laboratory scientist on the team, carefully extract a sample of brine from one of the boreholes.

Photo courtesy of Sandia



SALT CORE — Melissa Mills, left, a Sandia geochemist, and Kristopher Kuhlman a Sandia geoscientist, display salt samples from their Waste Isolation Pilot Plant experimental site. Photo by Randy Montoya

that different,” Kris said. “Hot salt creeps much faster, and if it gets hot enough, the water in brine could boil off leaving a crust of salt on the waste container. Then that steam could move away until it gets cool enough to return to liquid and dissolve salt, possibly forming a complex feedback loop.”

In other words, the scientists are looking at whether the heat from spent nuclear fuel could actually help enclose waste

containers, and even protect them from the corrosion that salty water can cause.

Planning for the experiment's first phase began in 2017, using existing horizontal holes at the Waste Isolation Pilot Plant. During this “shakedown” phase, researchers learned what equipment to use in subsequent experiments. For example, the first heater, which worked like a toaster, did not get the nearby salt hot enough to boil brine,

said Phil Stauffer, a geoscientist with an expertise in combining computer models and real-world experiments who is leading Los Alamos National Laboratory's contributions. However, the second heater the team tried, an infrared model, was effective; it worked more like the sun.

"When we put the first radiative heater into the first borehole, as part of the shake-down phase, it turns out the air didn't allow the heat to efficiently move into the rock," Stauffer said. "Then we switched to an infrared heater, and the heat moved through the air with little energy loss. In the early numerical simulations, naively we just put in heat; we didn't worry about how the heat got from the heater into the rock."

How brine and gases move through salt

During the experiment's second phase, the team drilled two sets of 14 horizontal holes into the side of a hall and inserted more than 100 different sensors into the holes around the central horizontal hole containing the heater. These sensors monitored the sounds, strains, humidity and temperatures as the salt was heated and cooled.

Melissa Mills, a Sandia geochemist, made a special salt-concrete seal for testing the interactions between cement and brine.

Among the sensors used were almost 100 temperature sensors, like those found in home thermostats, so researchers could measure temperature through time at locations around the heater. Yuxin Wu, a geoscientist from Lawrence Berkeley National Laboratory, also installed fiber-optic temperature sensors, strain gauges and electrical resistivity imaging.

Charles Choens, a Sandia geoscientist, used special microphones, called acoustic-emissions sensors, to listen to the "pop" of salt crystals as they expand while heated and contract while cooling, Kris said. The team used these microphones to triangulate the location of the popping salt crystals.

"Those pops are evidence of the transient permeability of the salt bed — the cracks between the salt crystals, which brine can percolate through," Kris said. "When you heat it up, it closes those little cracks. When the salt is hot, the permeability goes down, but when it cools down, the cracks temporarily open up and the permeability increases."

To test the flow of gases through the damaged salt, the researchers injected small amounts of rare gases, such as krypton and sulfur hexafluoride, into one borehole and monitored their emergence in another, Kris said. "When the salt was hot, the gases didn't go anywhere. When we turned the heat off, the gases permeated the salt and came out in another borehole."

Similarly, the team injected lab-made brine into one borehole with a small amount of the element rhenium and blue fluorescent dye as "tracers." The team is monitoring for the emergence of the liquid in other boreholes, which will be sampled at the end of the test.

"The goal with the fluorescent dye — once we drill out post-test samples — is to map where the tracer went," Melissa said. "Obviously, we'll be able to say that it went from one borehole to the other, if we detect a rhenium signal, but we won't know the path it took. Also, brine will interact with minerals in the salt, like clay. The fluorescent dye is a visible way to identify where the liquid tracer actually went in the field."

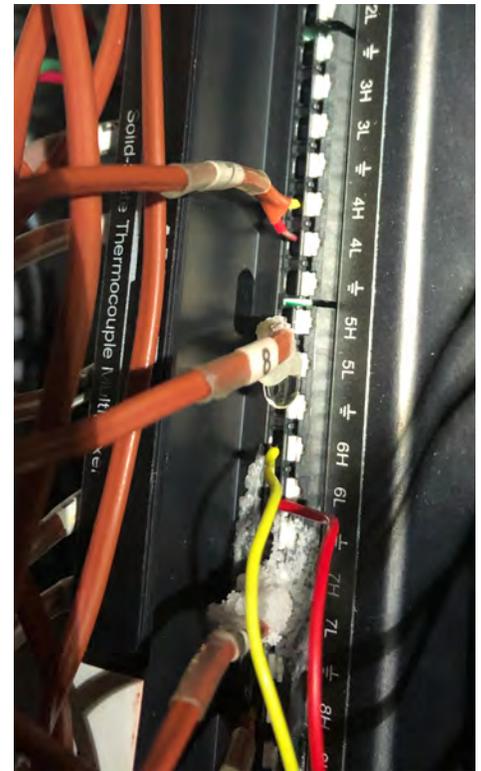
In the third phase, which began in mid-October, the team will be drilling a new array of nine heated boreholes, building on what they learned in the prior phases of the experiments.

Working in challenging conditions underground

The team has learned a lot from the first two phases of the experiment, including the best heater type, when to drill the boreholes and just how corrosive the brine is, Stauffer and Melissa said.

"The first two phases involved a lot of equipment testing; some has failed, and some was sent back to the manufacturer," Melissa said. "We've also learned to keep backup equipment on hand because salt dust and brine destroys equipment. We need to double-seal things because the brine can seep down insulated wire and then equipment dies. It's been a process to learn how to work in the salt environment."

Kris agreed. "Many things can go wrong when you take sensitive lab equipment and put it in a salt mine. We went back and read the reports from the WIPP experiments in the '80s. We want to learn from



A SALTY PROBLEM — An example of corroded electronic equipment from brine seeping down an insulated wire. **Photo courtesy of Sandia**

the past, but sometimes we have had to make our own mistakes."

The researchers are **collaborating with international partners** to use the data from this project to improve computer models of the complex chemical, temperature, water-based and physical interactions that take place underground. This will improve future modeling of nuclear waste repositories globally.

Ultimately, the team would like to scale up to larger and longer experiments to obtain data relevant to future salt repositories, said Kris and Stauffer. These data, supplementing already collected data, would inform repository designers and policymakers about the safety of permanently disposing heat-generating nuclear waste in salt repositories.

"It's been really intriguing and interesting, for me, to work on a project that is so hands-on," Melissa said. "Getting to design and build the systems and going underground into WIPP has been really rewarding. Doing research in an active mine environment can be a challenge, but I've been proud to work down there and implement our ideas." 

One year, many successes

Mentor-Protégé Program finishes inaugural year helping small businesses

By **Michael J. Baker**

Sandia's Mentor-Protégé Program wrapped up its first year this October of working with small businesses, already making an impact with a new subcontract awarded to one participating company and several initiatives aimed at helping all three protégés thrive.

"We have been extremely successful, not only providing exceptional development assistance for our small-business protégés but also leveraging the knowledge and skills of Sandia mentors to support program initiatives," said Royina Lopez, the Mentor-Protégé Program lead. "It is great working with such a diverse group of people, who have a passion and desire to collaboratively work toward increasing small-business participation at Sandia."

Such participation increased in July when the first protégé was awarded a non-competitive contract as allowed by federal regulations meant to bolster developmental assistance to protégés. CeLeen LLC, a small disadvantaged business based in Perryville, Missouri, with an operating location in Belleville, Illinois, was awarded a subcontract to complete data governance work at Sandia.

"The Mentor-Protégé Program is supporting us in strengthening our core operations as well as expanding our client base and vertical market solution offerings," said Charles Hickey, vice president of client services for CeLeen. "We are truly thankful to the Mentor-Protégé Program core team, the leadership team and the many people at Sandia that have offered their time and support as mentors to CeLeen."

CeLeen also received a subcontract purchase agreement that will allow Sandia to mentor the professional and information technology service provider while completing individual orders with defined scopes, Royina said. Sandia is also working on subcontract purchase agreements



WORKSHOP SUCCESS — Representatives from small-business protégés and Sandia mentors take part in a continuous improvement workshop as part of the Labs' Mentor-Protégé Program. Since the beginning of the program, protégés have participated in 15 virtual workshops, covering areas such as additive manufacturing and 3D printing, accounting, safety and security, cybersecurity, leadership and financial management.

Photo by Zach Mikelson

for the other two small-business protégés in the program, Albuquerque-based Pluma LLC and Strategic Industry Inc., based in Kingsburg, California. Both companies are service-disabled, veteran-owned small businesses specializing in construction.

Since the beginning of the Mentor-Protégé Program, the businesses have participated virtually in nearly three dozen one-on-one sessions and 15 workshops, covering areas such as additive manufacturing and 3D printing, accounting, continuous improvement, safety and security, cybersecurity, technical leadership and financial management. Sixty-seven mentors from all Sandia divisions have assisted with the workshops. The three protégés have at least one more year in the program with the option of a third.

"It was truly an honor to be able to help small businesses and to represent Sandia," said Elsa Bonano, a system engineer and presenting mentor. "I am looking forward to continuing to work with CeLeen and Strategic and with future small businesses."

With Sandia's current program objectives focusing on mentoring protégés from construction and IT industries, the next opportunity will focus on Sandia's mission area needs. Sandia is looking for businesses with a focus in cables and connectors, said Paul Sedillo, Sandia's small-business program manager.

"I am looking forward to our next round of the Mentor-Protégé Program," Paul said. "We are working closely with our nuclear deterrence mission area to find protégés that will help grow our supplier base in this critical area. This opportunity will allow Sandia to award up to three agreements. It is a great thing that the supplier diversity team and the small-business community can help in a meaningful way with this effort."

Sandia's fall 2021 mentor-protégé opportunity was recently posted on the Labs' [Business Opportunities website](#) and received an overwhelmingly positive response from small businesses across the country, Paul said. 

The rise of rudeness

How do we manage an increase in workplace incivility?

By Lynn Moore

Have you ever let a rude remark from a stranger or colleague ruin your day? On a recent visit to the airport, I picked up lunch before I boarded my flight. As I was paying, I asked the woman who wrapped my sandwich, “Could I please get some extra dressing?” She looked at me with an irritated expression, and it caught me off guard. She tossed the sandwich across the counter, flung the packet of dressing, then turned to look at the person behind me with a put-on smile.

I stood there for a minute, unsure of how to respond or feel. My face felt hot. I picked up the bag and said, “Have a nice day.” As I walked back to my gate, the exchange replayed in my mind. I was deeply bothered by her random and unwarranted rudeness. Why does rude behavior affect us this way?

A [Portland State University study](#) in August indicates that incivility is on the rise, particularly in the workplace, and a [Psychology Today article](#) posits that social media is partially to blame for making us ruder. The author suggests that between Twitter feuds and Facebook rants, the “anonymity factor” of online interactions — most specifically lack of eye contact — has created a free breeding ground for insults, verbal attacks and generally bad behavior. And all that virtual trolling and hating, she observes, can take a toll on mental and physical health.

Over the past two years, pandemic-driven isolation seems to have taken its toll on staff, even though Sandia offers a very positive, respectful workplace culture. People are more stressed and less connected, resulting in an increase in concerning behaviors among our workforce. Sandia’s Security Review Board, which reviews security-related employee issues, was convened 37% more times in FY21 than in the previous three fiscal years. The [Employee Assistance Program](#) has seen an increase

in calls for counseling services, and more individuals are reaching out for help with alcohol abuse and domestic violence.

“We’ve definitely seen a rise in hostile interactions and verbal conflicts between colleagues; people are just dealing with a lot of stress. Many Sandians report that they are asked to do more with less, repeatedly, and I wonder if it has become easier to allow ourselves to push and be pushed when we are not in the face-to-face work situation on a regular basis,” said Ben Klein, Sandia’s lead clinical psychologist.

To combat the kind of stress that breeds conflict, Ben suggests learning to be kind to ourselves and caring for our physical and mental health. Employees may be able to take vacation time or simply maximize time away from work to rest and recharge doing activities that bring them joy. When possible, returning to on-site work, even in a part-time or hybrid capacity, can improve work-life balance and increase quality interactions with peers. Employees can contact the Employee Assistance Program to find a counselor who provides professional services. They can also take advantage of a new Health Action Plan,



VIRTUAL KINDNESS — Ben Klein, Sandia’s lead clinical psychologist, said he has seen “a rise in hostile interactions and verbal conflicts between colleagues,” which may be related to an increase in virtual work. **Photo courtesy of Ben Klein**

Thriving — Becoming Your Best Self, to focus on developing healthy lifestyle habits, producing positivity, managing negativity and enriching personal connections.

The bottom line is that rudeness and hostility are contagious, but so are kindness and empathy. Mental health issues can be serious and require focused attention, but by practicing the simple common courtesies taught from childhood, Sandians could flatten the curve of negativity and maybe change their colleagues’ outlook for the better. 



BECOME YOUR BEST SELF — Studies have shown an increase in workplace incivility this year. Sandia offers counseling through the Employee Assistance Program that can help employees manage stress during difficult times at home and work.

Photo courtesy of Getty Images

NNSA principal deputy administrator visits Sandia



NUCLEAR LEADERS — Associate labs director Susan Seestrom, center, and other Sandia leaders welcomed NNSA leadership including, from left, associate administrator for information management [James Wolff](#); Sandia Field Office manager [Daryl Hauck](#); principal deputy administrator [Frank Rose](#); and Jill Zubarev, special assistant to Frank Rose, on Oct. 26. **Photos by Bret Latter**



SITE TOUR — NNSA principal deputy administrator [Frank Rose](#), center, visited Sandia on Oct. 26 to learn more about the critical national security work being performed at the Labs in support of NNSA's mission. In his new role, Rose will lead cybersecurity, workforce development, staffing and international outreach.