



Restoring power to the grid

Researchers create model to improve 'black starts'

By Mollie Rappe

Sandia computer scientists have been working on an innovative computer model to help grid operators quickly restore power to the electric grid after a complete disruption, a process called a black start.

Their model combines a restoration-optimization model with a computer model of how grid operators would make decisions when they don't have complete knowledge of every generator and distribution line. The model also includes a physics-based understanding of how the individual power generators,



POWER PEOPLE — Sandia computer scientists Casey Doyle, left, and Kevin Stamber stand in front of an electrical switching station. Their team has developed a computer model to determine the optimal order to restore power to the substations and infrastructure of a grid after a total disruption, a process called a black start. Photo by Craig Fritz

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Economic impact: Sandia Labs tops \$4.2B in spending for first time, added 480 jobs in FY 22



IMPACTFUL SPENDING — Summit Construction contractor Ramon Silva applies sealant to pits that support a new cooling tower by Building 823. The new towers use less power to operate. Sandia awarded \$1.5 billion to subcontractors like Summit Construction during fiscal year 2022.

Photo by Craig Fritz

Labs' purchasing power benefits regional, national economies

By Troy Rummler

For the first time, Sandia's contributions to the economy have topped \$4.2 billion in a fiscal year, supporting individuals, families and businesses at an unprecedented level. Total spending in fiscal year 2022, which ended Sept. 30, was \$312 million more than the previous fiscal year. The spending includes labor, subcontracts, purchases and other expenditures.

Sandia also created 480 jobs in fiscal year 2022.

"Sandia has seen steady and significant growth over the last several years, and the numbers show how our communities are growing with us," said Associate Labs Director Scott Aeilts about

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LABNEWS Notes

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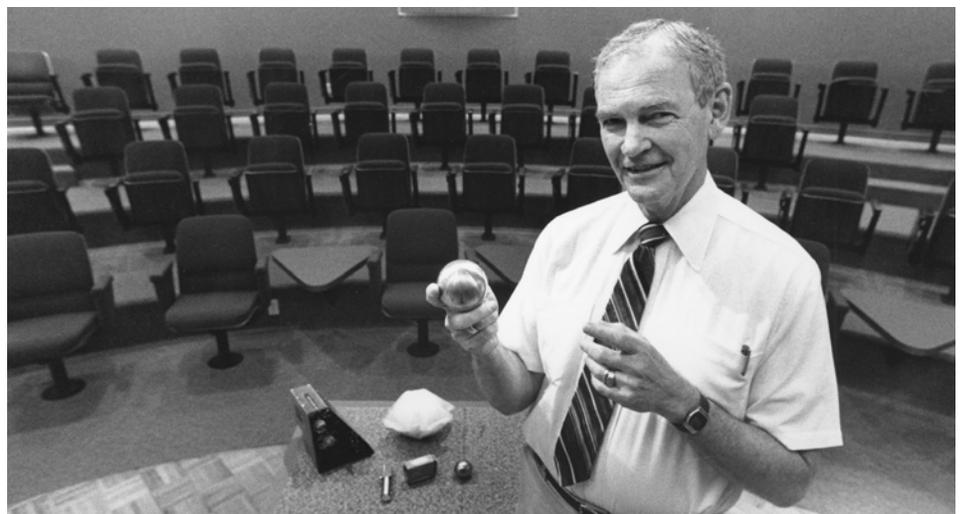
Military Liaison anniversary

Sandia's oldest department celebrates 75 years

By **Stephanie Holinka**

Recently, Sandia's Military Liaison Department celebrated its 75th anniversary with an event that brought together past and current engineers and technical writers along with military partners from DOE, the Defense Threat Reduction Agency, the Air Force and the Navy.

"From the beginning to today, Military Liaison serves as the lead operational interface agent for NNSA's nuclear security enterprise and military services with operational responsibility for future and enduring nuclear weapons," said



KNOWLEDGE TRANSFER — Trainer Dick Brodie in a classroom.

Photo courtesy of the Sandia corporate archives

Bill Beenau, current manager and former Air Force nuclear weapons maintenance manager.

The group provides field engineering, technical publications that detail the technical procedures to operate and maintain each weapon system and first-generation training, where the field engineer provides hands-on training to DOD technicians.

“To be able to teach the DOD how nuclear weapons work and how it interfaces with their weapon systems for 75 years is a great testimony for this department and the Air Force Nuclear Weapons Center,” Bill said. “Strategic Air Command’s motto was ‘Peace is our Profession.’ Military Liaison can say with confidence that it helps make that possible.”

Before there was a Sandia, there was a Military Liaison department

The group started unofficially in late 1945. By 1946, Los Alamos personnel were giving informal technical assistance to the military assemblers, and thus performing core military liaison tasks.

Military Liaison was formerly established in 1947 by Los Alamos National Laboratory’s Z Division to promote communication and understanding between LANL and military

services who had operational responsibility for nuclear weapons. Many of the original Military Liaison personnel were directly from the Manhattan Project and quite a few had worked for Los Alamos.

“I always thought of Military Liaison as where the rubber meets the road. The weapons designers needed someone to help create an interface between the military services and the engineering components,” said retired systems engineer and Air Force nuclear weapons manager Mac Stringer.

When Sandia Laboratory was formed in 1949, the group became a Sandia function. The addition of the California Laboratory in 1979 made it Sandia National Laboratories.

“This important mission will be functioning 25 years from now. I would like an invitation to come back to the 100th to talk about the good old days of 2022,” said John Hogan, a former Military Liaison trainer and cofounder of the Weapon Intern Program. “Please have it again on Dec. 8, when I will be 100 years and one day old.”

See the 75th anniversary [video](#) that discusses the group’s history and evolution or check out Sandia’s [history](#) webpage for more on the Labs annals. 

MLK Day celebration



BLACK RESILIENCE — Inclusion, Diversity, EEO & AA and the Black Leadership Committee hosted an Martin Luther King Jr. Day celebration on Jan. 17, featuring guest speaker La Vonda Bowens-Woodard, director of operations of the New Mexico Office of the Medical Investigator. Bowens-Woodard spoke about the resilience of the Black community. “Positive dreams come when you give yourself permission to be amazing. With this permission, you are proclaiming that you are a resilient dreamer,” she said.

Photo by Craig Fritz

Restoring power

CONTINUED FROM PAGE 1

distribution substations and power lines would react during the process of restoring power to the grid.

“We’ve spent a lot of time thinking about how we go beyond simply looking at this as a multilayered optimization problem,” said project lead Kevin Stamber. “When we start to discuss disruptions to the electric grid, being able to act on the available information and provide a response is critical. The operator still has to work that restoration solution against the grid and see whether or not they are getting the types of reactions from the system that they expect to see.”

The overarching model also can simulate black starts triggered by human-caused disruptions, such as a successful cyberattack.

Optimizing power restoration

The optimization portion of the model assesses the grid and its components to determine how to restore power as quickly as possible, said Bryan Arguello, a Sandia computer scientist who worked on this section of the model.

For example, the optimal approach might be to start with generator 1 to power up substation A. Once substation A is energized, generators 2-4 can safely power up, which in turn will provide power to substations B, C and D, as well as some critical infrastructures such as a water purification plant or an area hospital. Once substation D is energized, power plants 5-8 can power up, and so on until power is restored to the entire grid.

Once the power-restoration schedule is developed, the algorithm compares it against physical limitations to determine if the schedule is feasible, Bryan said. “The challenge here is bringing in just the right amount of information so that the model can make wise decisions, without bogging it down in too much detail.”

The restoration optimization portion is based off a similar model created by researchers at Lawrence Livermore National Laboratory and the University of California, Berkeley, which strategically adds more details to the model as the algorithm progresses, Bryan said.

This model can also accurately approximate alternating current power flow, which is computationally more complex than direct current and is a more accurate representation of the grid during severe disruptions such as black start conditions, said Richard Garrett, a Sandia computer scientist who led this portion of the project.

Recently the team began validating the restoration schedules generated by their code against ones created by industry-standard optimization software to ensure that Sandia’s model recommends plans that can be realistically executed, Kevin said.



WEATHER OR NOT — Fog rises from an electrical substation in Albuquerque. Sandia computer scientists have created a computer algorithm to determine the best way to restore power to a grid after a disruption, such as a complete blackout caused by extreme weather. **Photo by Craig Fritz**

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Modeling operator decision-making

The fulcrum of the overall model lies with the operator decision-making code, Kevin said. This algorithm takes the results from the optimization code and enacts it on a third code, which is a physics-based simulation of the grid and how it dynamically responds to the operator’s actions. Walt Beyeler led the development of the third portion.

The operator decision-making model is based on a research-based cognitive model created by scientists at Carnegie Mellon University, said Casey Doyle, a systems analyst who is leading this portion of the model. This well-established model was adapted for power restoration by coding in expert knowledge about the subtasks necessary to complete main tasks such as the steps required to start a generator and then connect it to the nearest substation. They also added in safeguards so the cognitive model wouldn’t freeze if the grid behaved unexpectedly, Casey said.

“We’re trying to create a cognitively sound agent that can read in a restoration plan that’s created by the optimization model and then try to implement it on a simulation of the power system,” Casey said. “It goes through step-by-step and reads what the schedule says has to happen and it tries to implement it. It does all the decision processes in between, including making sure that the frequencies match before lines are connected.”

The operator model interacts with the model of the grid through a simulated console and is limited to the knowledge presented by the console, rather than presuming the grid operator knows everything, which is typically assumed in power-restoration models.

In fact, the operator model can assess whether the network model’s behavior matches up with what it is expecting based on the results of the optimization algorithm, Kevin said. The simulated console can also allow the team to swap in actual feeds of information from the grid for the network dynamic model, if a partner provides the information, he added.

“Black starts are really rare, extreme events, but when one happens it’s really bad,” Casey said. “Even in partial blackouts, like what happened in Texas in 2021, people died because they didn’t have power, they didn’t have heat. If you have a complete blackout, it’s likely that it would be caused by a hurricane or earthquake and operators are trying to restore power to whole communities. Delays in power restoration could cause even more damage or loss of life. It’s hugely impactful to understand how to bring the power back as quickly as possible.”

The three-year project was funded by Sandia’s [Laboratory Directed Research and Development](#) program. The researchers are currently looking for sponsors to continue and expand the project. [i](#)

Economic impact

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the 2022 Sandia [Economic Impact brochure](#). “Partnering with businesses, particularly small businesses, helps us accomplish our national security mission and helps communities thrive.”

Of all subcontract-related payments,

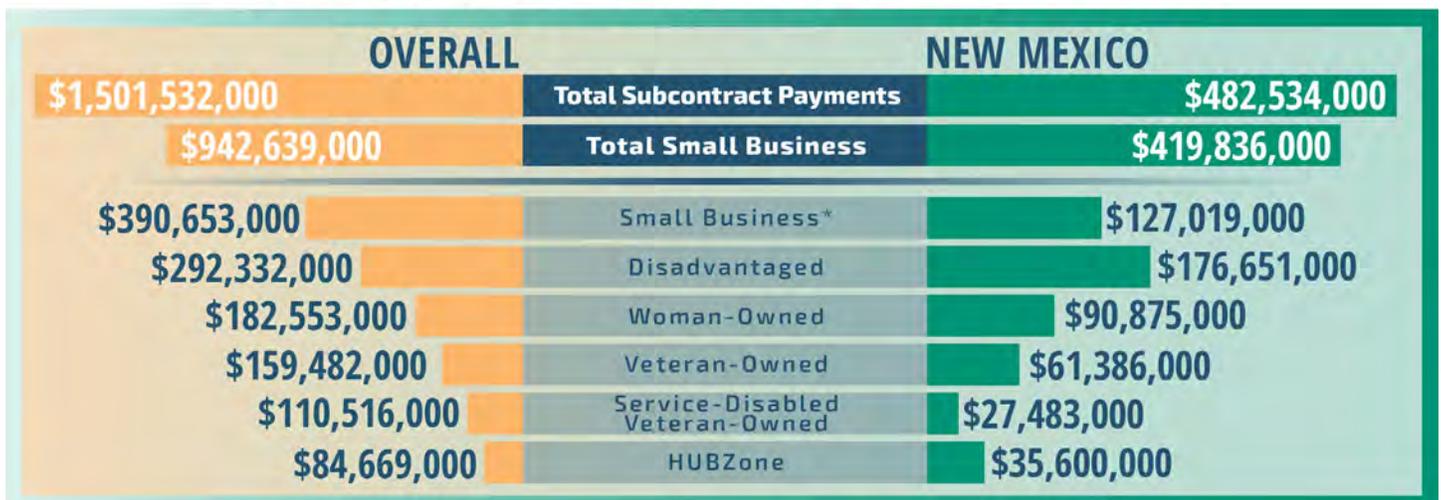
totaling more than \$1.5 billion, nearly \$943 million — or about 63% — went to small businesses. Total subcontract-related payments increased \$132 million more than the previous fiscal year, with 79% of the increase going to small businesses.

More than 32% of all subcontract-related payments in fiscal year 2022

benefited New Mexico companies. Sandia also paid the state of New Mexico nearly \$112 million in gross receipts tax, up more than \$4.8 million from the previous fiscal year.

Sandia spent about \$491 million with New Mexico businesses in fiscal year 2022. That includes nearly \$8.9 million in procurement purchases and more than

SUBCONTRACT-RELATED PAYMENTS



SMALL BUSINESS COMMITMENT — Sandia spent more than \$1.5 billion on subcontracts in fiscal year 2022 with nearly \$943 million going to small businesses. Total subcontract-related payments increased \$132 million over fiscal year 2021. **Graphic by Lloyd Wilson**

\$482 million in subcontracts within the state. Of the New Mexico subcontracts, nearly \$420 million — or 87% — benefited small businesses.

“Strong partnerships with diverse suppliers have been a key to our mission success,” Labs Director James Peery said. “Small businesses promote innovation and help us bring to the marketplace technologies that improve peoples’ lives. Sandia is committed to partnering with and building relationships with highly qualified small businesses to spur economic growth in New Mexico and across the country.”

In addition to spending, Labs employment increased by 610 over fiscal year 2021, including 480 new nonstudent jobs and 130 more student interns, and more than \$2.5 billion was spent on labor and non-subcontract related payments. Sandia’s total employment across all sites is 15,500, with the largest Labs’ site, located in Albuquerque, employing nearly 12,600.

Technology commercialization initiative extended for five more years

In 2022, New Mexico Gov. Michelle Lujan Grisham signed into law legislation extending the Technology Readiness Gross Receipts Initiative for five years. Sandia is a key player in the technology maturation initiative that helps address a critical stage between technology development and commercialization when many companies need additional funding to ready products and services for the marketplace.

The program enabled Sandia to work with 10 companies on 12 projects in 2022, including one that helped IR Dynamics mature a nanoparticle film that could make windows more energy-efficient, using technology invented at Sandia.

Companies acquired 10 licenses for Sandia technologies in fiscal year 2022, and two companies engaged in [Cooperative Research and Development Agreements](#).

Sandia manages several economic development programs that leverage the

people, innovations and facilities of the Labs to deploy technology in support of Sandia’s mission and job creation.

During calendar year 2022, Sandia provided \$2.4 million in technical assistance to 130 small companies through the [New Mexico Small Businesses Assistance program](#).

In the last fiscal year, 104 new patents were issued for Sandia technologies. Sandia additionally filed 223 patent applications and maintained 567 active commercial licenses.

Mentor-Protégé Program expands with addition of two more companies

Sandia grew its small-business [Mentor-Protégé Program](#) in January from three participating companies to five. Dynamic Structure and Materials LLC, based in Tennessee, and Pennsylvania-based Compunetics Inc. joined the program designed to help small businesses develop their ability to compete for federal and industry opportunities.



HIGH IMPACT — Sandia’s spending for fiscal year 2022 hit an all-time high.

Graphic by Lloyd Wilson

“We are excited to have our program grow and will continue to look for ways to maximize opportunities for our small-business protégés to work with Sandia Labs and the Department of Energy,” said Royina Lopez, Mentor-Protégé Program lead.

Both companies provide products and services critical to Sandia mission areas. Dynamic Structure and Materials provides precision motion systems and related electronics along with design and manufacturing services. Compunetics manufactures and assembles rigid and flexible printed circuit boards and provides advanced interconnect solutions.

“We value this new relationship as a means to develop as a Department of Energy contractor and intend to harness the resources available through the Mentor-Protégé Program to deliver innovation and an excellent customer experience to Sandia National Labs,” said Dynamic Structure and Materials President Jim Bickmore.

John Gralewski, director of sales at Compunetics, said, “We believe the partnership developed under this program will enhance our growth as a company while also providing a quality supply partner for flex, and rigid-flex printed circuit boards and assemblies to Sandia National Labs.”

Sandia philanthropy supports local families, organizations

Sandia continued to support K-12 educational success and family stability programs throughout Albuquerque and Livermore, California. In calendar year 2022, National Technology and Engineering Solutions of Sandia contributed **\$1.4 million** on behalf of Sandia to the local communities, including \$175,000 in the Livermore area.

Sandia employees committed \$4.6 million through the United Way of Central New Mexico to nonprofits throughout Albuquerque, Livermore and the nation during the Labs’ annual Sandia Gives campaign. Employees donated an additional **\$103,000**, with Sandia providing a \$25,000 match donation, to help victims of the historic 2022 New Mexico wildfires, and more than **4,200 retired Sandia computers** were donated to New Mexico schools.

Sandia provided STEM programs, including **Family Math Night**, **Department of Energy Regional Science Bowls**, **Summer Physics Camp for Young Women**, and the **New Mexico Electric Car Challenge**. **STEM in the Sun** provided outdoor science, technology, engineering and math activities for children attending Albuquerque community center programs.

Sandia exceeds small-business goals

Sandia has met and exceeded small-business goals for six consecutive years. The Labs focus on working with small businesses that fit the federal categories of small disadvantaged, women-owned, veteran-owned, service-disabled veteran owned and historically underutilized business zone, also called HUBZone.

“Sandia is motivated to partner with small businesses with a variety of skills and expertise to promote innovation in support

of our mission. We have teams dedicated to helping interested suppliers navigate the rewarding but sometimes unfamiliar path of working with a national laboratory,” said Laura Lovato, Sandia’s manager of supplier diversity and supply chain risk management.

Through various efforts in fiscal year 2022, Sandia worked with 500 small businesses that had not previously supported the Labs.

For more information on doing business with Sandia, visit the procurement [website](#) or email supplier@sandia.gov with questions. 



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LIKE NEW — What remains of a military aircraft, an F-4 Phantom, is now one of the few objects on what used to be a cluttered concrete pad in Tech Area III.

Photo by Craig Fritz

Guided by ‘a responsibility to act,’ team tidies up Tech Area III

Team has removed more than 3,700 tons of leftover materials from large-scale tests

By **Troy Rummler**

“What you’ll see way off here in the distance is nothing,” Sandia manager Dann Jernigan tells me from the driver’s seat of a dusty Chevy Tahoe SUV. He motions toward a small, manmade hill in the remote scrubland known as Tech Area III, south of Sandia’s main campus. For decades, 10-foot-tall reinforced concrete blocks had laid just beyond the hill, built to receive the full impact of a fighter jet rocketing down Sandia’s 2,000-foot [sled track](#). When the test was finished, some of the targets were left behind.

Similar scenes have dotted the Sandia testing area landscape. Vehicles, tools, scrap materials and temporary structures, some dating back to the 1960s, have stood as monuments to the Labs’ legacy of large-scale testing.

Today, however, the ground behind the hill is clear. The blocks were removed in 2020 as part of a reclamation campaign that since 2018 has hauled away than 3,700 tons of materials throughout the tech area.

It’s summer, and I’m Dann’s passenger on a tour of these project sites. He points out lots of nothing on our drive: a gravel lot with nothing but a few metal storage containers — half of what used to be there; a building with nothing piled around it but a single row of neatly stacked scrap metal; a paved paddock 50 feet wide and four times as long, now empty except for a pair of dilapidated jets.

The paddock used to be packed full of rail cars and test equipment, Dann said. “You could not drive a car through there.”

Dann manages the reclamation campaign, although he’s quick to point out most of the planning and coordination is done by a rotating team of three other people: a member of his organization who acts as the project manager; an Environment, Safety and Health coordinator; and a demolition foreman. A

loose confederation that includes Dann, ES&H experts, director champions and a contracted demolition crew supports this core team. The housekeeping is nobody's primary job, Dann said, but it fits in nicely with his day-to-day role maintaining sites at Sandia's **Validation and Qualification Sciences Experimental Complex**.

Each year this team identifies sites, coordinates evaluations to identify potential hazards, navigates any applicable requirements and oversees the work.

We ease through a dirt road, muddy today from monsoon rains. A red-tailed hawk in our path takes flight, a reminder that Tech Area III is shared land.

In need of housekeeping

The leftover materials came from many sources over the years, Dann tells me. Sometimes, Sandia teams had planned to pack up test articles but ran out of time or funding.

Other times, Sandians intentionally have held onto articles for future tests.

That culture is now changing, as Sandians are planning more for what will be left over, and in some cases have "engineered out" scrap materials, redesigning an experiment so there will be less need for housekeeping afterwards.

Tom Faturios, the campaign's first project manager, would later tell me about what they found when he first started bringing the primary subcontractor, Engineering Constructors, Inc., and its sub-subcontractors out to job sites. "There were a few things that we encountered that were sort of nasty. Just piles of junk, old rotting storage containers that were full of mice and dead rodents. I mean, this wasn't pretty. But the contractor would go out and spray with bleach and get it to the point that it's safe to use, wear respirators and really just did a yeoman's job."

Dann tells me that the storage containers came from an earlier attempt to mitigate the mess.

'A responsibility to act'

In June 2016, Randy Watkins, a now-retired Sandian who had just started the same managerial post Dann now holds, gathered his team.

It was time to step things up.

He shared his vision of removing unused test articles over the following years to improve on "a lasting legacy of environmental stewardship."

For the rest of 2016 and 2017, Randy and his crew circulated their vision throughout Sandia, gathering support for what Randy told his team was "a responsibility to act."

"We got together with our test engineers and our test directors, and we would walk down all of the sites before we did anything to make sure that we didn't get rid of something that they thought was valuable," Tom said.

They also took steps to manage the material responsibly. Most of the metal has been recycled. Concrete and asphalt are "rubble-ized" and taken by subcontractors for recycled construction material. Some of the material, after evaluations, stayed at Sandia.

"This wasn't trivial. There was a lot of junk out there, but it wasn't a case of just getting the loader and putting it in a roll-off dumpster. Each article was reviewed, particularly at the 10,000-foot rocket sled track where we retained several old sleds and other items to understand how tests were done in the past. The engineers wanted to retain them, and we did," Tom said.



RUBBLE RUBBLE — Concrete debris gathering around the 2,000-foot sled track was removed in 2019 as part of the Tech Area III reclamation campaign. **Photo by Janise Baldo**

Janise Baldo, in addition to serving as the original ES&H and security coordinator, has served as the technical lead and the Reapplication liaison. She also has documented the campaign, reported on progress and accomplishments, and trained subcontractors. Since retiring in 2018, she has continued to support the campaign as a subcontractor.

"She is mostly responsible for the success of the reclamation campaign, having trained a succession of project managers and the subcontractor and its lower tier subcontractors on what to do and how to do it safely," Tom said. "She deserves the lion's share of the credit for the success of the project."

Campaign tackles major test fixture

In 2009, Sandia conducted the largest liquefied natural gas pool fire experiments ever performed to address safety concerns regarding marine vessels. Teams created a controlled fire 56 meters (183.7 feet) in diameter and 146 meters (479 feet) tall, said Anay Luketa, a researcher in the Fire Science and Technology department who worked on the project.

The tests required a major construction in the tech area.

“To carry out the experiments, teams erected a massive, domed storage reservoir to spill and ignite 52,000 gallons of LNG onto a constructed 2-meter deep, 120-meter diameter lake,” Anay said. “The results from the experiments along with previous risk-based studies performed in 2004 and 2008 by Sandia have been incorporated into regulations by the United States Coast Guard and provide the foundation for their approach to LNG safety.”

By the time Dann and I drove past the site, the lining at the bottom of the pool had been removed, the pit filled in. Pipes had been exhumed; infrastructure torn down. A bulldozer was driving back and forth atop an enormous pile of dirt, slowly pushing down the mound that had formed the bottom half of the dome.

For a moment, a blaze-orange, flame skimmer dragonfly hovered near the car. Further off, a helicopter maneuvered through the skies.

Dann and I drive back to his office with a fresh layer of mud caked to the side of our Chevy. The dirt roads and spread-out buildings give the impression of a small, rural town compared to the denser tech areas to the north.

Back in his office, Dann sits among

posters of environmental tests, including one of an **F-4 Phantom jet** screaming down the sled track toward a concrete target.

“I think we need to be responsible for the environment and try to return sites to the condition we found them in,” Dann said. 



TAKE ONE DOWN — Contracted crews demolished a major test fixture, the liquefied natural gas pool fire facility, in 2022. A massive dome was built on top of an earth-berm reservoir dirt hill, pictured here, to hold 52,000 gallons of LNG. **Photo by Janise Baldo**



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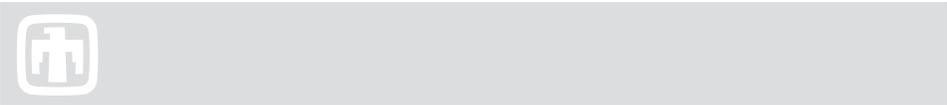
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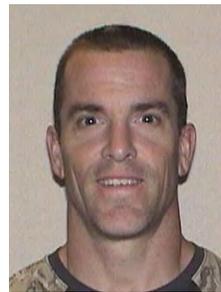
Norm Schwers 30



Joel Stevenson 30



Elizabeth Taylor 30



Clint Hobart 25



Bob Knowlton 25



Corey Reitz 25



Pat Ball 20



Wes Crownover 20



Johnny Ethridge 20



Todd Houchens 20



Brian McMurtrey 20



Michael Ross 15



Adam Williams 15



NATO visits the Labs

Recent Retirees



Dorothy Saucedo 20

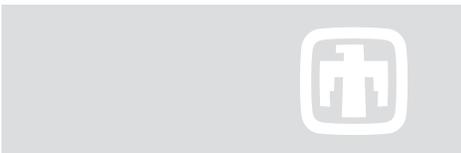


Gerald Creager 12



SITE TOUR — On Jan. 16, NNSA and Labs leadership hosted the NATO Nuclear Planning Group Staff Group and shared how Sandia ensures the U.S. nuclear deterrent is always ready when it needs to be and never when not intended. Throughout the tour, the visitors learned about science and technology’s role in sustaining and modernizing the stockpile. In this photo, Dominika Kolesarova, center, from Slovakia and part of the NATO group, tours the Superfuge facility.

Photo by Craig Fritz



Bringing STEM to the UNM Children's Hospital

By **Ariana Stern**

Executive Director for Information Engineering and Chief Information Officer John Zepper demonstrated the similarities between the human body and computers at a recent visit to the University of New Mexico Children's Hospital.

"It was such a great opportunity to be able to teach the kids something about STEM, but most importantly, to see their excitement and take their minds off of why they're there in the first place," John said.

The Sandia Women's Action Network's Outreach team and the hospital's Child Life Program, which helps support normal childhood development and routines while managing a health condition, organized the Jan. 13 event.

John visited individually with the children receiving treatments and spoke with them about how specific computer parts correspond to a function of the human body. The children saw the inside of a computer and could see the components as John explained each part.

A computer's central processing unit operates like your brain by processing information and allowing you to complete tasks, John said to the kids. The hard drive is part of the computer where information is stored and retrieved, just like your memory.

John showed how the mouse and keyboard are like your hands, receiving input and sending information into and out of the computer. Electricity supplies power, like blood provides energy and nutrients for the body to function properly. John ended the demonstration by showing the motherboard, the main structure of a computer and the glue holding everything together, much like a skeleton.

"Working with the kids at the infusion center was truly a gift, SWAN Outreach lead Kara Komula said. "Seeing the children light up was magical as they learned

how their bodies relate to a computer. I'm also very grateful that Sandia was able to bring the joy of STEM to the children's bedside."

SWAN Outreach strives to hold at least one event per month and is looking forward

to expanding its partnership with UNM Children's Hospital to provide opportunities to continue to engage children in STEM, Kara said. Sandia employees wanting more information on SWAN Outreach event can contact Kara. [@](#)



LIFTED SPIRITS — Executive Labs Director and Chief Information Officer John Zepper demonstrates how various computer parts relate to the human body during his visit to UNM Children's Hospital.

Photo by Craig Fritz



STEM DEMO — Executive Labs Director and Chief Information Officer John Zepper shows a computer chip to Robert Rossiter at the UNM Children's Hospital Infusion Clinic.

Photo by Craig Fritz

Mechanical engineer harnesses power of the sun to fight climate change

By **Sarah Jewel Johnson**

Mechanical engineer Evan Bush is passionate about unlocking longer-term energy storage technologies that can positively affect the energy grid's reliability and stability. Every person has something to contribute to the fight against climate change, he said, adding that the catalyst of change lies in clear communication and inclusion.

Evan began his career as an undergraduate intern in Sandia's concentrating solar group in spring 2011. He received his bachelor's degree in mechanical engineering in 2014 from the University of Louisville, then obtained his master's in 2017 and doctorate in 2019, both from Georgia Tech and in mechanical engineering.

After receiving his degrees, Evan

returned to the concentrating solar group as a postdoc in June 2019 and became a staff member in January 2022.

In an interview with Lab News, Evan explains his definition of climate security, how his work helps fight the climate crisis and how he hopes to recruit new generations of climate activists.

LN: Why are you passionate about climate change?

EB: I think it would be really irrational for anyone to not be passionate about climate change. Whether it's a concern for yourself, loved ones, other living things or future generations of people and animals, we all have plenty of reasons to want a stable and healthy environment. You can't really say anyone is a bystander on this challenge, even if we may act like it. The challenge is daunting, so being pessimistic or avoidant is certainly something I can

sympathize with. Still, there are certain aspects of climate change that provoke optimism and motivation. Since we all have a stake in solving climate change, the solutions can be ones which unite us and help us move past old divisions, distrusts and prejudices.

LN: What does "climate security" mean to you?

EB: To me, climate security means climate stability, which means climate change mitigation. Human civilization has flourished in part due to a remarkably stable climate. The many risks of climate change — including resource access, geopolitical instability, extreme weather events — are threats because, as a society and as individuals, we cannot react and adapt instantly and perfectly harmoniously to changes in our environment. If our strategy is just to react and adapt, we aren't really promoting climate



SOLAR STAR — Evan Bush explores using concentrating solar power-generated heat to produce ammonia. In this photo, he places thermocouples inside the receiver cavity of a solar reduction reactor.

Photo by Craig Fritz

security. A rapidly changing climate creates a world where the costs — both literal and figurative — of adaptation compound the longer we wait and the less we focus on mitigation. We can't have a reliable climate security strategy without mitigation taking a front-and-center position, and that means rapidly transforming how we generate and use energy.

LN: What climate-related challenge are you most excited to work on?

EB: Industrial decarbonization. There has been tremendous technological progress in making clean, renewable energy and transportation economically viable and widely available. While there's still a lot of work to be done there, it's some of the other parts of our energy map that make me the most excited as a researcher. Finding ways to power high-temperature industrial processes, which currently require the combustion of fossil fuels, is a big challenge, but also one which concentrating solar power is situated to address. There are many vital industries today for which there is no alternative, or at least no commercially mature alternative, to carbon-intensive methods. Solar heating, solar thermochemical processes and industrial waste heat utilization provide lots of opportunity for innovation.

LN: How does your work at Sandia advance climate security?

EB: I work in the concentrating solar thermal technologies group, specifically on high-temperature energy storage and using concentrating solar radiation to drive chemical processes. I analyze materials that harness and carry the energy, and I design solar receivers and reactors that run the processes and reactions for these technologies. This work helps promote climate security by unlocking longer-term energy storage and the ability to use solar energy even when the sun isn't shining. These technologies can play a role in enhancing the reliability and stability of the energy grid as it takes on larger shares of intermittent renewable energy technologies. They also can help us lower our dependence on fossil fuels and nondomestic energy sources by modifying industrial processes to no longer rely on fuel combustion.

LN: What perspective or capabilities does Sandia bring to addressing the climate crisis?

EB: I think Sandia's credibility in the area of national security can be leveraged to make the case that ambitious climate action is necessary. The interconnections between geopolitics, national security and the effects of climate change should be emphasized more strongly when we make the case for climate change mitigation, and Sandia is an entity which can do that with credibility.

Sandia's large network of experts and infrastructure also gives us the opportunity to play a role in addressing climate change. Facilities like the [National Solar Thermal Test Facility](#) allow us to develop and test technologies at larger scales than are possible elsewhere. Scale-up is a very big challenge in developing alternative energy technologies and is a bridge from the lab to private industry. The solar test

facility has decades of experience in this area and in working with private industry to deploy concentrating solar technologies. Through our own research projects and by working with others, we can help to ensure that good ideas make their way from the lab scale to the commercial scale.

LN: What does the nation or world look like in the future if we are successful in addressing climate change?

EB: At this point, some degree of climate impact is already locked in, so even if we are successful in curtailing greenhouse gas emissions like we need to, success still includes adapting to some significant climate impacts. But successfully addressing climate change will also lead to some very good secondary effects beyond minimizing the degree to which we have to adapt to changes in regional climate and extreme weather events. It will mean a more stable energy grid, which is more resilient to localized outages and variation in electricity production. In a world where energy generation is focused on harnessing distributed, renewable energy rather than localized resource extraction, we can undercut the ability of bad actors to leverage control of energy resources to do harm.

We also can diminish the degree to which certain regions and groups of people are disproportionately impacted by the externalities — climate change and otherwise — of energy production. But, to achieve this, we need to take care that we don't recreate the same problems we currently see with

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traditional resource extraction when it comes to manufacturing and supply chains for renewable energy technologies.

LN: What's your vision for integrating energy equity and environmental justice into Sandia's climate security efforts?

EB: I grew up in eastern Kentucky, which is in the Appalachian region. Appalachia played a central role in the country's energy economy and has experienced disproportionate impacts of energy extraction. Appalachian coal production drove incredible industrial advancement in this country. But much of eastern Kentucky's history is an example of what doing it wrong looks like in energy resources management and how the costs and benefits of technology aren't often proportionally experienced by the people producing it and using it to make our lives better. In a bit of poetic injustice, after bearing the brunt of the negative sides of our traditional energy production, Appalachia will be one of the hardest hit areas by

transitioning away from those energy technologies.

So, I think it's very important that, when we develop new energy technologies, we try to minimize the chance that we create similar situations. We should ensure that new technologies benefit the people who will have them in their backyards. We also should ensure that the impacts on those who depended on old technologies for their livelihoods and were most negatively impacted by those technologies are considered as well.

I think Sandia can help work toward this goal by incorporating the local and regional challenges into our techno-economic analyses. Rather than just studying new energy systems in terms of which regions are most suited to implementing them, we can do work to understand how the most vulnerable groups and regions will be impacted by our work. We also can involve stakeholders through collaboration and hiring to ensure that the people most impacted by a solution have a say in how it is developed.

LN: If you were trying to recruit somebody to work on the problem of climate change what would you say to them?

EB: I would say this is a problem that we all have a stake in solving, and we can all make an impact. We need smart people, but we need much more than that. Scientists, engineers, investors and policymakers often speak different languages and have different perspectives. The challenge may seem intimidating at times, and people new to the field may think "where do I even start?" or "surely people with more experience have this figured out, know more than me, could do it better than I can." These are thoughts that I've had, and I think many people new to a field do. But there's a good chance that you will have something valuable to bring to the table, especially if you're coming from a different background and bring a different perspective. You don't have to know everything all at once. If you can integrate ideas from your prior technical experience, improve how we communicate with one another or have an experience which can help encourage buy-in from others, you'll be making a difference.

LN: How can we educate and involve more people in addressing the climate crisis?

EB: One way is by improving communication between media and researchers. Many of the myths about climate science and renewable energy have come about because of failures in communication. At Sandia specifically, one way is by improving our programs for student internships, specifically at the undergraduate level. I became involved with concentrating solar power as a college sophomore due to fortunate timing, and because my first Sandia mentor, Chuck Andracka, had an interest in educating students and getting them involved in CSP research. Otherwise, I may have missed an opportunity to be involved in such an interesting and rewarding research field. I think we should promote collaborations with universities and getting students on-site to work with these technologies so that they think about renewable energy when they're looking for a graduate program or career. [f](#)



The graphic features a central blue square icon with a white lightning bolt and a stylized figure, surrounded by colorful, radiating lines. Below the icon, the text reads: "SANDIASPARK DIVISION SPOTLIGHT SERIES". A quote follows: "Sandia Spark is about igniting thunderbird pride. Spotlights are fun and informative, providing new and seasoned employees a glimpse into the work performed within each division." At the bottom, a green banner contains the event details: "DIVISION 3000 SPOTLIGHT Monday, January 30 10:00 a.m. – 11:00 a.m. MST". At the very bottom, there is a search bar with the word "Spark" and a "Search" button.

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