SANDIA LABNEWS
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Sandians step up to answer the call **Page 9**

Reinventing offshore wind turbines

LEGACY TURBINE — A historical photo shows Sandia's experimental 34-meter-diameter, vertical-axis wind turbine built in Texas in the 1980s. **Lab News file photo**

Software aids design of floating turbines

By **Mollie Rappe**

Brandon Ennis, Sandia's offshore wind technical lead, had a radical new idea for offshore wind turbines: instead of a tall, unwieldy tower with blades at the top, he imagined a towerless turbine with blades pulled taut like a bow.

This design would allow the massive generator that creates electricity from spinning blades to be placed closer to the water, instead of on the top of a tower 500 feet above. This makes the turbine less top-heavy and reduces the size and cost of the floating platform needed to keep it afloat. Sandia filed a patent application for the design in 2020.

— CONTINUED ON PAGE 4

We've got the power

Sandia test delivers electricity to the grid

By **Mollie Rappe**

For the first time, Sandia researchers delivered electricity produced by a new power-generating system to the Sandia-Kirtland Air Force Base electrical grid.

The system, which uses heated supercritical carbon dioxide instead of steam, is based around a closed-loop **Brayton cycle** to generate electricity. The Brayton cycle is named after 19th century engineer George Brayton, who developed this method of using hot, pressurized fluid to spin a turbine, much like a jet engine.

Supercritical carbon dioxide is a nontoxic, stable material that is under so much pressure it acts like both a liquid and a gas.

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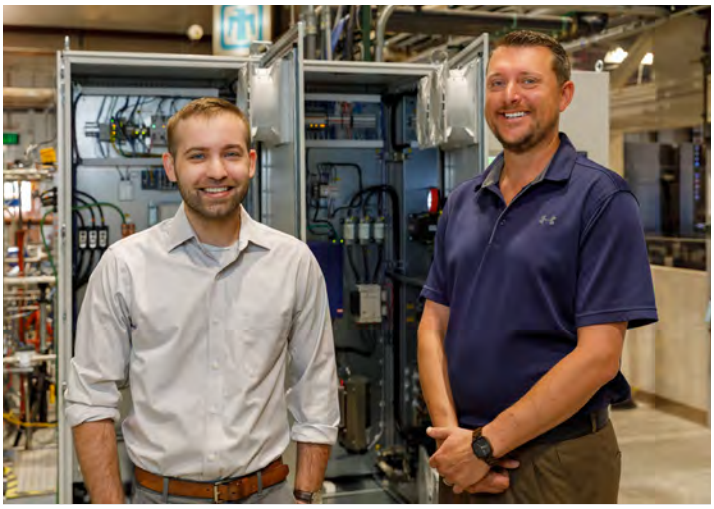

POWER PEOPLE — Logan Rapp, left, and Darryn Fleming, Sandia mechanical engineers, stand with the control system for the supercritical carbon dioxide Brayton cycle test loop. The system delivered electricity to the grid for the first time earlier this year. **Photo by Bret Latter**

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TABLE of CONTENTS

LABNEWS 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: Please send your comments and suggestions for stories or for improving the paper. If you have a column (500-800 words) or an idea to submit, contact Lab News editor Katherine Beherec at kgbeher@sandia.gov.

Leading from the front

LEVEL UP — Electrician Felipe Diaz grabs a length of conduit while installing an elevator at Building 800. The elevator is designed to operate with less power than the one it replaced. **Photo by Craig Fritz**

Labs decreases energy usage, increases efficiency on-site

By **Jennifer Sawayda**

While Sandia is known for research that helps communities become more energy efficient and the nation address climate and energy security, the Labs is also focused on decreasing its own energy usage for the same reasons and in response to new federal requirements for sustainability aimed at addressing the climate crisis.

Sandia New Mexico and California use enough electricity annually to power 40,000 houses for a year.

"To put that into perspective, the electricity consumption at Sandia is higher than the local government in Michigan that I worked with on a previous project," said energy engineer Joao Oliveira, who specializes in energy data management.

The challenge is that many buildings on Sandia campuses are older, built before sustainable practices were a major part of design and construction. It would be cost- and mission-prohibitive to tear down every energy-inefficient building and start over, Joao said. As an alternative solution, Sandia is working toward retrofitting some of these older buildings to make them more energy efficient.

Joao is one member of Sandia's cross-department energy management team. Led by manager Robin Jones, the team investigates and identifies ways to make site-sustainability initiatives happen.

Renegotiation of Sandia's utility contract was one successful step toward making these goals a reality. The renegotiation has provided the Labs with $2.3 million in avoided costs to fund energy-efficiency projects this fiscal year. Further savings from reductions in energy usage will be reinvested in future projects.

"A major part of the initiative involves using some of this funding to upgrade old, archaic buildings, using the technology we have today to reduce energy inefficiencies and take advantage of energy savings," said energy manager Nicole Rinaldi.

The funding will increase the initiatives that Sandia's energy team can pursue, in addition to building upgrades. One recent upgrade included replacing the drive systems of six service elevators on the New Mexico campus with more modern systems. Six elevators might not seem like much, but together they used double the energy needed to power an American home for a single year.

"After installing these new elevator drive systems, the annual energy expended by the elevators decreased by 19,700 kilowatt hours — the equivalent of charging over 1 million smart phones," Joao said.

Sandia has also begun replacing old lighting fixtures with more efficient LEDs throughout the campuses.

"Lighting is one of the most cost-effective ways to reduce energy in a building and it's one of the less invasive projects," Nicole said.

LEDs use up to 90% less electricity than incandescent bulbs and last up to 25 times longer. Retrofitting two buildings with LEDs reduced electricity usage by 56,000 kilowatt hours.

Sandia's energy management team is also using the funding to proactively monitor buildings to identify and solve problems before they become major issues. The monitoring-based commissioning program is led by energy engineer Anthony Menicucci, who explained how their team can use existing building sensors to identify and fix heating, ventilation and air-conditioning problems as they occur.

"Older HVAC systems can create inefficiencies that use up energy," Anthony said. "We use a program called SkySpark that gathers data from the sensors in real time and identifies subtle operational problems. Correcting these subtle problems not only saves energy but can reduce wear and tear on equipment."

This proactive stance toward identifying and implementing energy-efficient solutions is estimated to save $100,000 next year. Additionally, by updating these systems, the monitoring-based commissioning program has also been able to improve climate control in the buildings.

"We've been able to anticipate customer complaints of being too hot or cold and use the program to identify where the problems are," Anthony said. "In some instances, it takes only a few changes to the facility's programming to fix the problem and increase occupancy comfort."

This program is just one way the energy management team is using technology to integrate occupancy safety or comfort with energy-cost reduction and increased energy efficiency. Meeting occupant needs is a priority when the team launches energy-saving initiatives. Rather than sacrificing one over the other, the energy team views both goals as inseparable and achievable.

"Every time we upgrade a system in a building, this new technology allows us to take advantage of energy savings," Nicole said. "Everything our energy team does at Sandia in this area is for occupant comfort, energy savings or federal requirements."

POWER UPGRADES — Ramon Silva applies sealant to pits to hold water and support for a new cooling tower that will replace the one on top of Building 823. The new towers will be ground level and use less power to operate. **Photo by Craig Fritz**

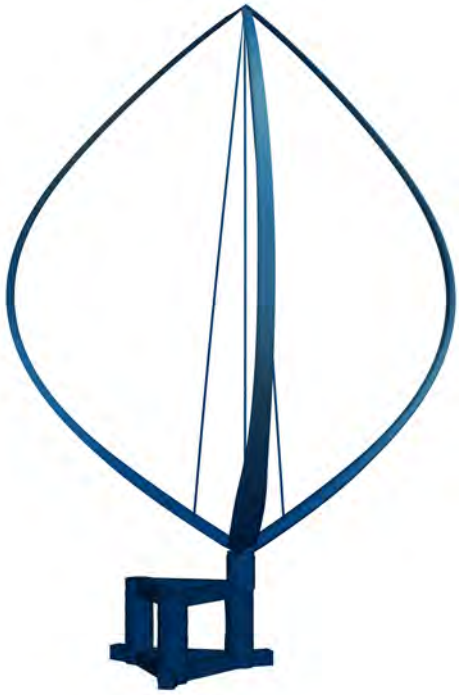
Wind turbines

CONTINUED FROM PAGE 1

However, before Brandon could set his idea in motion, the team needed to build software capable of modeling the response of the turbine and floating platform to different wind and sea conditions to determine the optimal design of the whole system.

Now, the Sandia team has a functional design tool, or "drawing board," and can start designing and optimizing their lighter floating wind turbine system.

"To design our floating wind turbine system, we needed a design tool that can simulate the wind, waves, blade elasticity, platform motion and the controllers," Brandon said. "There are a few tools that can do some of what we need but without all of the pertinent two-way coupled dynamics for design and optimization of this kind of wind turbine. It was a big undertaking, but it was essential. There can't be a floating, vertical-axis wind turbine industry without a trusted tool like this."



MODELED, IN MOTION — An image of an analysis of Sandia's innovative floating vertical-axis wind turbine by the team's new design tool. **Image by Kevin Moore**

Lighter, cheaper turbines for offshore wind

Much of the U.S.'s offshore wind blows across water more than 200-feet deep. At those depths, it would be very expensive to build the rigid support structures typically used by wind turbines. However, wind turbines that can float above the sea floor could play an important role in diversifying our sources of renewable energy and improving the stability of the grid as cities and states move closer to achieving their net-zero emission goals, said Ryan Coe, a mechanical engineer in Sandia's water power group.

"The high electrical demand on the coasts is one reason why offshore wind looks attractive; people tend to live away from where the onshore wind is the strongest and there's not enough space in cities for solar panels," Ryan said. "Also, offshore wind provides power at different times of the day than solar and onshore wind."

However, floating offshore wind does come with its own challenges, Brandon added. Chiefly, it is very expensive to support the wind turbines and to maintain them when they're out at sea. The goal of one DOE Advanced Research Project Agency-Energy program is to optimize the design of floating wind turbines, platforms and control systems to maximize power output while minimizing costs, he said.

"For us the question becomes how do we remove mass and cost from the system while maximizing energy capture, which is where we got our innovative, towerless, vertical-axis design," Brandon said.

Most wind turbines today are based around a tall tower with three blades turning a horizontal shaft that cranks a generator behind the blades in the turbine's nacelle, the box at the top of the turbine that contains the rotor and other important components. But that's not the only way to design a wind turbine, Brandon said. Some turbines have two or more blades supported by a vertical shaft with a generator below the blades. This design, called a Darrieus vertical-axis wind turbine, has a lower center of gravity and can weigh less than a traditional wind turbine, he said, but one of its main challenges is that it's difficult to protect the turbine from extreme winds.

For traditional, horizontal-axis wind turbines, the blades can rotate away from intense, damaging winds, but the Darrieus design catches the wind from every direction. The Sandia design replaces the central vertical tower with taut guy wires, Brandon said. These wires can be shortened or lengthened to adjust for changing wind conditions to maximize energy capture while controlling strain. Additionally, replacing the shaft with wires reduces the weight of the turbine even more, allowing the floating platform to be even smaller and less expensive.

Development and validation of design tool

Kevin Moore, a mechanical engineer in Sandia's wind power group, and the rest of the team built upon earlier work of Sandia engineer Brian Owens to develop the vertical-axis wind turbine design tool. Ryan and Michael Devin, another mechanical engineer in the wind power group, also worked on it. The team worked on integrating physics algorithms while also improving the accuracy and speed of the algorithms.

Kevin also led the efforts to validate the design tool using data from a land-based, 34-meter-diameter, vertical-axis wind turbine built by Sandia in the '80s.

"While working on the validation effort, it has been amazing to see the design quality and innovation of the legacy designers," Kevin said. "It is a privilege to stand on the shoulders of giants while leveraging modern computational resources."

One of the reasons why the Sandia team is validating the design tool is so that it can eventually be used to certify vertical-axis wind turbine designs to the pertinent design standards, Brandon said.

"Right now, if a company wants to certify a vertical-axis wind turbine, there's not a trusted design tool so there's a lot of uncertainty in that

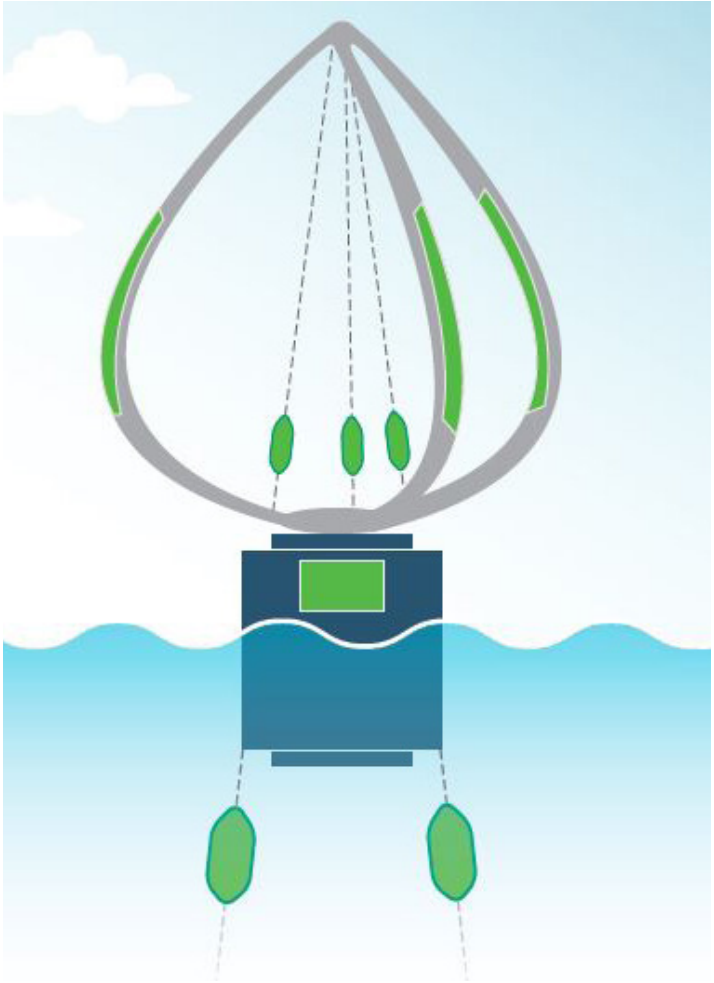
process," Brandon said. "For us to be able to provide a trusted design tool means that the certification bodies would be more willing to approve vertical-axis wind turbine designs, which is necessary for financing and their ultimate deployment."

Spinning up an optimized turbine design

Now, the team can start designing the floating, vertical-axis wind turbine system. The design tool can be used to model and optimize any vertical-axis wind turbine, whether it has a traditional tower or taut guy wires, Brandon said. The team is using a process called control co-design to find the most cost-effective floating vertical-axis wind turbine system design and control.

"We're designing the entire system, the turbine and platform and their control, concurrently to reduce the levelized cost of energy, not just the cost of the turbine itself," Brandon said. "Normally one company will design the turbine, another company designs the floating platform for that fixed turbine design, and then a third company installs that with other systems to make an offshore wind plant; and you get what you get in the end in terms of cost."

The team hopes to have an optimized floating, vertical-axis wind turbine system design by the end of the year, Brandon said, but the project would not have been possible without their new specialized software.



INNOVATIVE TURBINE — Sandia's design for offshore wind turbine eliminates the heavy tower and instead uses wind blades pulled taut with guy wires. **Illustration by Brent Haglund**

"This is a neat tool in terms of the way that it integrates all of these different capabilities," Ryan said. "We were able to link tools developed for modeling the aerodynamics and structural dynamics of vertical-axis wind turbines — areas that Sandia has always been a leader in — and combine it with hydrodynamics and make it more suited for design optimization."

Development of the offshore wind turbine design software and future work optimizing the design of the whole system is supported by the DOE's **Advanced Research Project Agency-Energy's ATLANTIS program**. The Sandia team is working with project partners **FPS Engineering & Technology** and the **American Bureau of Shipping** on the project.

Brayton cycle

CONTINUED FROM PAGE 1

This carbon dioxide, which stays within the system and is not released as a greenhouse gas, can get much hotter than steam — 1,290 degrees Fahrenheit or 700 Celsius. Partially because of this heat, the Brayton cycle has the potential to be much more efficient at turning heat from power plants — nuclear, natural gas or even concentrated solar — into energy than the traditional steam-based Rankine cycle. Because so much energy is lost turning steam back into water in the Rankine cycle, at most a third of the power in the steam can be converted into electricity. In comparison, the Brayton cycle has a theoretical conversion efficiency upwards of 50%.

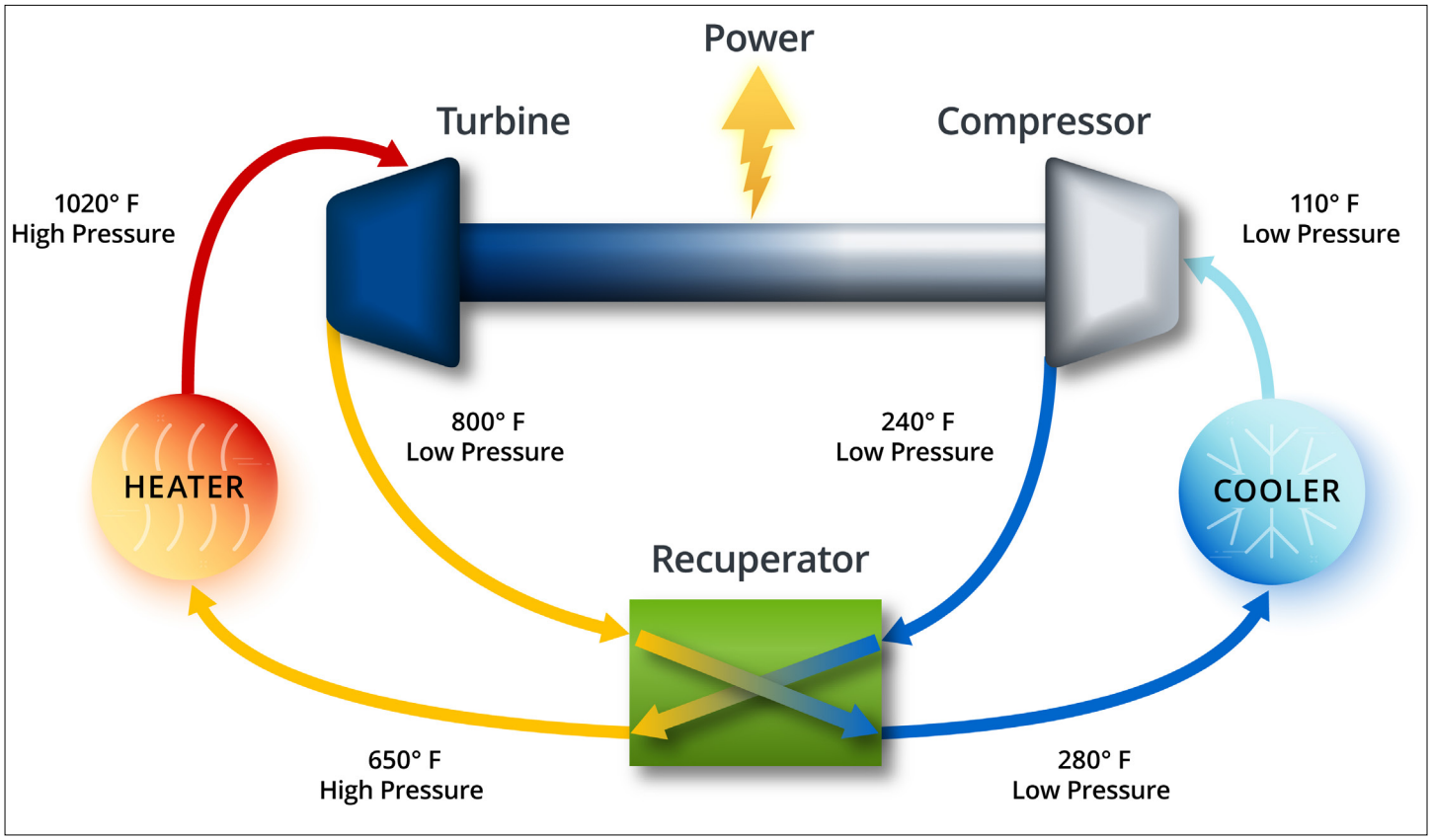
"We've been striving to get here for a number of years, and to be able to demonstrate that we can connect our system through a commercial device to the grid is the first bridge to more efficient electricity generation," said Rodney Keith, manager for the advanced concepts group working on the Brayton cycle technology. "Maybe it's just a pontoon bridge, but it's definitely a bridge. It may not sound super significant, but it was quite a path to get here. Now that we can get across the river, we can get a lot more going."

Getting power to the grid

On April 12, the Sandia engineering team heated up their supercritical CO_2 system to 600 degrees Fahrenheit and provided power to the grid for almost one hour, at times producing up to 10 kilowatts. Ten kilowatts isn't much electricity — an average home uses 30 kilowatt hours per day — but it is a significant step. For years, the team would dump electricity produced by their tests into a toaster-like resistive load bank, said Darryn Fleming, the lead researcher on the project.

"We successfully started our turbine-alternator-compressor in a simple supercritical CO_2 Brayton cycle three times and had three controlled shutdowns, and we injected power into the Sandia-Kirtland grid steadily for 50 minutes," Darryn said. "The most important thing about this test is that we got Sandia to agree to take the power. It took us a long time to get the data needed to let us connect to the grid. Any person who controls an electrical grid is very cautious about what you sync to their grid, because you could disrupt the grid. You can operate these systems all day long and dump the power into load banks, but putting even a little power on the grid is an important step."

In a simple closed-loop Brayton cycle, the supercritical CO_2 is heated by a heat exchanger. Then the energy is extracted from the CO_2 in a turbine. After the CO_2 exits the turbine, it is cooled in a recuperator before entering a compressor. The compressor gets the supercritical CO_2 up to the necessary pressure before it meets up with waste heat in the recuperator and



LOOP DE LOOP — A diagram of Sandia's simple closed-loop Brayton cycle test loop. The working fluid being compressed, heated and expanded to produce power is supercritical carbon dioxide. Supercritical carbon dioxide is a nontoxic, stable material that is under so much pressure it acts like both a liquid and a gas.

Graphic by Laura Hatfield

returns to the heater to continue the cycle. The recuperator improves the overall efficiency of the system.

For this test, the engineers heated up the CO_2 using an electrical heater, fairly similar to a home water heater. In the future, this heat could come from nuclear fuel, burning fossil fuels or even highly concentrated sunlight.

Importance of advanced power electronics

In fall 2019, Darryn began exploring how Sandia's closed-loop supercritical CO_2 Brayton cycle test loop could be connected to the grid. Specifically, he was looking for advanced power electronic control systems that could regulate supplying electricity into the grid. The team then found KEB America Inc., which produces advanced power electronics for elevators that could be adapted for this application.

Elevators use electricity to lift the elevator car up to the top floor of the building, and some elevators convert the potential energy stored in the lifted car back into electricity for the grid as the car is lowered to another floor. These elevators use equipment very similar to that used in the Brayton cycle test loop, called a permanent magnet rotor, to convert this energy, Darryn said. This similarity allowed the Sandia team to adapt commercial-off-the-shelf power electronics from an elevator parts company to control feeding power from their test loop into the grid.

"The achievement here was coupling the system with the advanced power electronics and syncing it to the grid," said Logan Rapp, a Sandia mechanical engineer who was involved in the test. "We have never done that before; we'd always gone to the load banks. You can draw a pretty clear line from the work we're doing at 10 kilowatts to about 1 megawatt. One megawatt is pretty useful; it can power 500-1,000 homes or replace diesel generators for remote applications. Our industry partners are targeting 1- to 5-megawatt systems."

Logan primarily works on refining other supercritical CO_2 Brayton cycle equipment, but during the test he was in control of heating the supercritical CO_2 before it reached the turbine and operating the recuperator. Darryn focused on controlling and monitoring the turbine and generator.

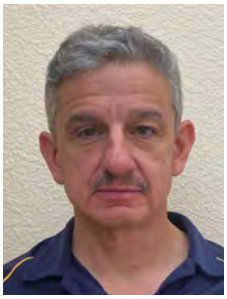
Having successfully completed this test, the team will work on modifying the system so that it can operate at higher temperatures, 1,000 degrees Fahrenheit and above, and thus produce power with greater efficiencies, said Darryn and Logan. In 2023, they plan to work on getting two turbine-alternator generators operating in a recompression configuration on the same system, which is even more efficient. The team's goal is to demonstrate a 1-megawatt supercritical CO_2 Brayton cycle system by fall 2024. Throughout this process, they hope to occasionally test the system by supplying electricity to the grid, provided they get approval from the grid operators to do so.

"For actual commercial applications we know that we need bigger turbo machinery, power electronics, larger bearings and seals that work for supercritical CO_2, closed Brayton cycles," Darryn said. "There's all these different things that need to be done to de-risk the system, and we're working on those now. In 2023, we'll be putting it all together into a recompression loop and then we'll take it to even higher power output, and that's when the commercial industry can take it from there."

This work is supported by the DOE's Supercritical Transformational Electric Power program. Collaborators at Barber-Nichols helped with getting the specifications for the advanced power electronics.

Mileposts


Joselyne Gallegos 35


Rich Lehoucq 25


Sean Rager 20


Joel Means 15


Nathan Moore 15


Renee Motteler 15

Recent Retirees


Rusty Elliott 25

Anthony (Tony) Lentine 15

Sandia gives $1M to nonprofits

Labs celebrates community partners on National Nonprofit Day

By **Katrina Wagner**

As National Nonprofit Day approaches on Aug. 17, Sandia recognizes organizations that make a major impact in their communities. National Technology and Engineering Solutions of Sandia LLC, on behalf of Sandia, is proud to support nonprofit organizations that focus on families and education as part of its corporate contributions program.

In 2022, more than $1 million in grants have been awarded to 85 nonprofits in New Mexico and California that improve lives in our local communities by increasing family stability and improving educational success.

Community relations specialist Michelle Walker-Wade helps award grants to agencies that serve the community near Sandia/California.

FEEDING HUNGRY PEOPLE — Volunteers present the Alameda County Community Food Bank, in California with a $12,000 grant to support their work in food insecurity.

Photo courtesy of the Alameda County Community Food Bank

"The use of corporate dollars and employee engagement show support for various causes in our community and demonstrates a sense of caring and togetherness," Michelle said. "When we support nonprofit organizations, it demonstrates to CEOs and board members that Sandia values their investment in the community and encourages them to keep doing great work."

HELPING, GROWING — Sandians volunteer at the Rio Grande Food Project urban garden, which received a $20,000 grant in support of their emergency food assistance program to help feed people in the Albuquerque metro area.

Photo by Meagan Brace

Answering the call

Sandians support national security mission

Lab News is again highlighting the Nuclear Deterrence Modernization Efforts Rally Cry with short employee profiles showcasing how each of us can and does support Sandia's core mission. We launched this series on July 28 and will continue to run these stories in future editions and online.

All the employees profiled for this project have one thing in common: They are answering the call.

Photos by **Craig Fritz**

Joanna Gardner

Cybersecurity researcher
10 years at Sandia

Joanna started as an undergrad intern at Sandia, became a graduate intern and was then hired as a staff member — all in the same department. She said as an intern she recognized that what she does is important. "Even as a little cog in the big machine, if I was doing my job well, everyone could do their jobs well. We're all important.

"When I think about what I do, I'm bowled over. In my job, I get to lead a small team to strategize cyber implementation for Sandia's nuclear deterrent manufacturing," she said. "That means I am the subject matter expert in security operations, data and systems in support of building and testing parts. If my data is unreliable, so are the parts. It matters to me to know that my efforts directly affect national security. My family and friends are safer because I do what I do every day."

— Antonia Cardella

Caleb Roy

Production engineer
6 years at Sandia

As a mechanical engineer working in nuclear deterrence, Caleb recently accepted a new position in Sandia's advanced product realization because he noticed how the department's focus on customer responsiveness and problem solving accelerated the product life cycle.

"I want to help fill the gap to meet the critical needs of the nation," said Caleb. "This new role resonates with me because I can make an impact and help provide quality products at a rapid pace."

Caleb recognized how the group's flexible and responsive approach is tackling crucial and quickly changing national security challenges.

"We were able to deliver on an urgent request from a customer and field a system by moving through design to production in approximately half the time it typically takes while still meeting all the quality requirements for war-reserve use," he said.

— Jill Janov-Kelly

Malia Orell

Strategic planner
10 years at Sandia

Malia has led several corporate planning efforts that have improved the way Sandia understands, plans and funds capital facilities and infrastructure projects, and she's led the nuclear deterrence program's facilities and infrastructure capital investment planning for 10 years.

Malia led ND through assessing the current and future state of facilities, identifying gaps and planning needed investments to sustain key capabilities. Additionally, she has been instrumental in the long-range strategic planning that has led to Sandia delivering its first line-item project, Power Sources Capability, in nearly 20 years.

"My role has morphed over the years, depending on where planning focus was needed, which makes for a very interesting career," Malia said. "I've had the opportunity to be involved in several important ND facility projects as well as corporate investments that have benefited Sandia as a whole."

Malia also led a multidisciplinary, cross-divisional team through the development of the new Sandia Infrastructure Investment Planning Process, integrating numerous disparate data collection processes into one call to identify and rank facilities and infrastructure needs. This enabled the Labs to clearly communicate investment needs and priorities to sponsors. The team received an Employee Recognition Award and a LOS Continuous Improvement Award.

— Valerie McKinney

Christopher Lino

Molecular biologist
8 years at Sandia

Chris joined Sandia as a postdoctoral appointee. He spent four years working in biodefense before he took on a different role as an Environment, Safety & Health coordinator supporting the nuclear deterrence program and weapons stockpile management.

"When working in a lab on experiments, safety and critical thinking are woven into everything you do," Chris said. "No matter your background, problem solving and collaborating to finding solutions to complex issues are skills that can be applied in all areas at Sandia. Just like when an experiment reveals new or unexpected evidence, we have to be able to work the problem with all available information."

Now a manager in ES&H, Chris encourages other ES&H coordinators who support ND programs to bring their creativity, viewpoints and critical thinking skills to solve problems and find efficiencies. Safety and environmental requirements can often bring about compliance challenges, but Chris and fellow ES&H professionals focus on helping find effective, collaborative solutions that keep ND and weapons stockpile management programs operating safely.

— Karli Massey

Jennifer Awe

Corporate communications specialist
10 years at Sandia

There's always a story to tell in nuclear deterrence, and Jennifer tells them. In her 10 years at Sandia, she's shared the voices of Executive Vice Presidents and Deputy Labs Directors Jerry McDowell, Steve Rottler and Laura McGill; Associate Lab Directors Steve Girrens and Rita Gonzales; and Advanced Systems and Transformation Director Ernie Wilson. The breadth and depth of ND never leave her at a loss for words.

Photo courtesy of Sandia National Laboratories

"The topics surrounding nuclear weapons are incredibly complex, but I've seen many examples of what can happen when we tell a cohesive story," Jennifer said. "When we communicate clearly to help people understand what we do, why we do it and why we need support, decision-makers can rally behind us."

Her audiences vary greatly from the nation's most senior advisers to the broader public. Her portfolio includes drafting congressional testimony, speech writing, internal communications, message development and communications strategies and products.

"I feel fortunate to work within Sandia's core mission," she said. "I've learned so much and played a small role in teams that speak directly to our nation's leaders. Addressing communication challenges makes me feel like I'm contributing to the greater, collective mission of national security, and that's motivating."

— Nancy Salem

How to answer the call

Labs Director James Peery has **put out the call** for all Sandians to support critical nuclear deterrence modernization efforts. The need to accelerate nuclear weapons modernization is a top national priority as Russia and China have increased their efforts.

Employees can go to the **Nuclear Deterrence Modernization Efforts Rally Cry** internal website to let Sandia know how they can answer the call or submit questions.

Sandia's role in the nuclear weapons life cycle

As Labs Director James Peery calls upon staff to fill gaps in the nuclear deterrence program, education about Sandia's role in national security is critical. While many Sandians work outside of the nuclear deterrence programs, all the work that happens here has a connection to national security and Sandia's key role in developing, producing and maintaining the nuclear stockpile.

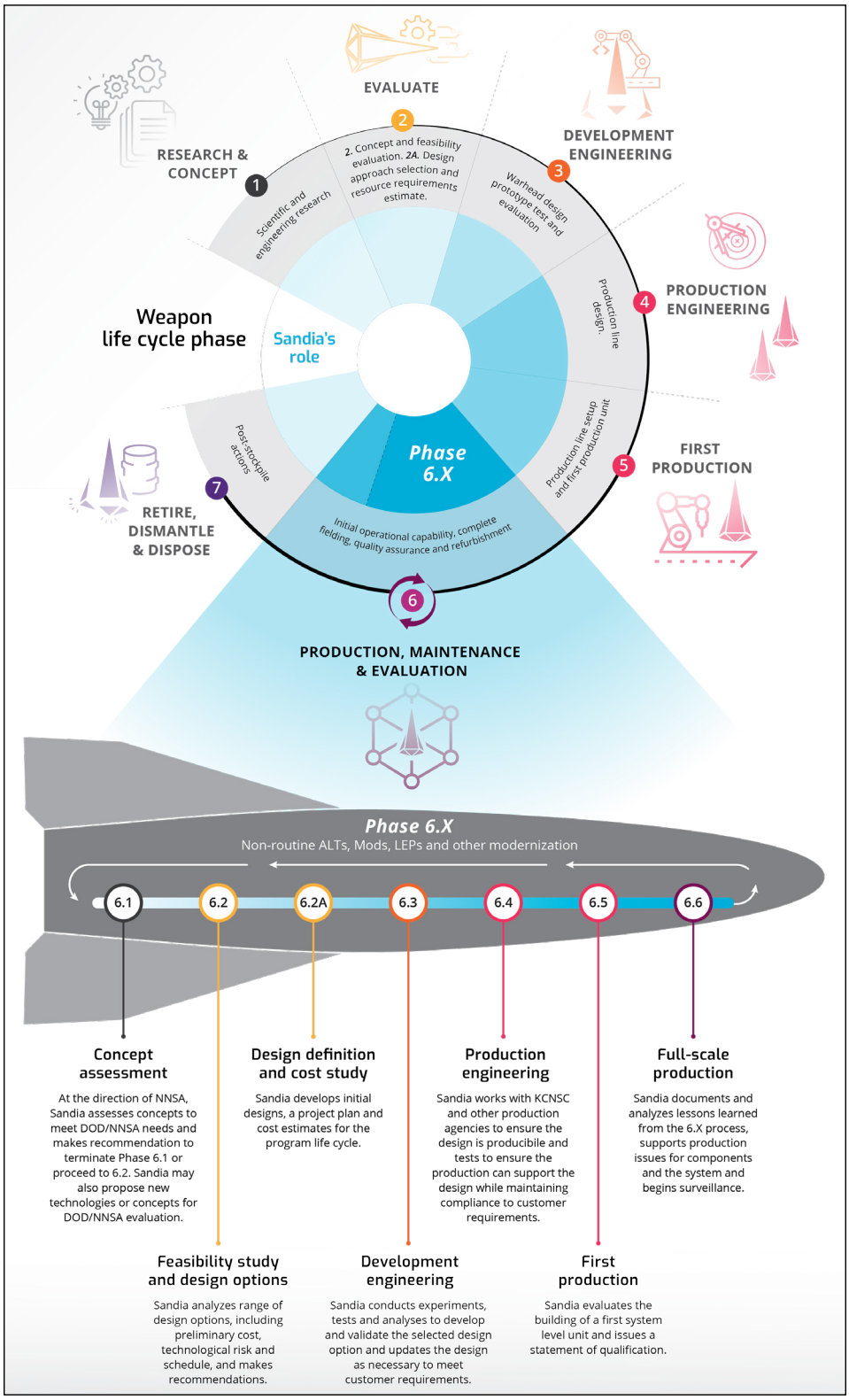
Lab News worked with the nuclear deterrence program to illustrate the nuclear weapon life cycle. Each phase represents teams of talented staff members who are committed to their work and the mission. For more information about how to contribute expertise to the nuclear deterrence programs, visit the Nuclear Deterrence Modernization Efforts Rally Cry website.

Life cycle at a glance

Nuclear weapons are developed, produced and maintained in the stockpile, then retired and dismantled. This sequence of events is known as the nuclear weapons life cycle.

The Phase 6 Process was developed for routine maintenance, stockpile evaluation, enhanced surveillance and annual assessment. Since 1999, major stockpile sustainment activities have been guided by the Phase 6.X Process, developed for nonroutine nuclear weapon alterations, or ALTs, and modifications, or Mods, at the system, subsystem or component level; Life Extension Programs, or LEPs; and other warhead modernization activities.

The W93 program has been approved by the Nuclear Weapons Council to enter Phase 2 and is the first "clean sheet" nuclear weapon development program in nearly 40 years. It will follow the older process, illustrated at the top of the graphic.



Graphic by Stephanie Blackwell and Victoria Aranda; Information provided by Whitney Lacy

Summer STEM with Girls Inc.

By **Katrina Wagner**

Women in STEM groups from Sandia and Los Alamos National Laboratories teamed up this summer to inspire campers at Girls Inc. in Santa Fe. About 70 girls, ages 5 to 14, made rubber band cars, learned about geology and experimented with coding with volunteers from both labs.

COMBINING EFFORTS — Los Alamos National Laboratory solutions architect Valerie Steinhaus, left, and Sandia mechanical engineer Dana Turon made binary-encoded solar bead bracelets with girls who attended the camp. **Photo by Katrina Wagner**

CREATING CARS — Campers at Girls Inc. created their own rubber band cars during STEM Day with Los Alamos National Laboratory and Sandia. **Photo courtesy of Girls Inc.**

INSPIRING GIRLS IN STEM — Sandia systems researcher Leslie Munyao and mechanical engineer Monica Barry demonstrated concepts of potential and kinetic energy by making rubber band-powered cars during the camp. **Photo by Katrina Wagner**