



S A N D I A

LABNEWS

PUBLISHED SINCE 1949

Vol. 74, No. 16, Aug. 25, 2022

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10,000 years
into the future
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California & Beyond Edition

Modernization and stockpile programs meet key milestones



NATIONAL PRIORITY — Teams of Sandians are working to expand and improve the W80-4 program for national defense. **Photo by Randy Wong**

Nuclear deterrence programs see rapid expansion, take steps to bolster national defense

By **Paul Rhien**

Sandia's nuclear deterrence programs are responsible for stewardship and modernization of the U.S. nuclear weapons stockpile, from foundational and exploratory science and technology through annual assessment and modernization activities to final disposition.

"Nuclear deterrence continues to be the core mission for Sandia and the Integrated Security Solutions division," said Associate Labs Director Andy McIlroy. "We are growing quickly, significantly increasing both hiring and facility development to ensure we have people and resources to keep pace with the rising demands of our

— CONTINUED ON PAGE 4

For such a time as this

Answering the rally cry to protect our nation and the world

By **Andy McIlroy**

Sandia has helped make the world a safer place for more than seven decades; it's what we do and who we are. Ever since the Cold War, we've designed and certified America's nuclear stockpile — a deterrence to others who would use nuclear power to enforce their will upon the world. During the energy crisis of the 1970s, Sandia stepped forward again, creating the Combustion Research Facility and launching countless avenues of research into renewable energy and energy efficiency.

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EVERYONE'S PRIORITY — Associate Labs Director Andy McIlroy leads Sandia's Integrated Security Solutions division, which has the responsibility to execute significant elements of the W80-4 program. **Photo by Matt O'Neill**



ANSWERING THE CALL

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Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Published on alternate Thursdays by Internal, Digital and Executive Communications, MS 1468

LAB NEWS ONLINE: sandia.gov/LabNews

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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.

Creating opportunities for America's future leaders

Military cadets gain national security experience at Sandia

By **Michael Ellis Langley**



FUTURE LEADERS — United States Military Academy Cadets Riley Hoyes and Nate Campbell, center, are given Sandia challenge coins to mark their successful tenure as Military Academic Collaboration program participants. The cadets are flanked by, from left, Executive Protocol officer Matt Green, research and development manager Lance Hansen, researcher Robert McCoy and MAC program coordinator Gabe Serna. **Photo by Randy Wong**

By participating in Sandia's Military Academic Collaboration program, cadets and midshipmen from U.S. service academies gain experience for a possible future in science or engineering while performing valuable work for the nation — just ask Cadets Riley Hoyes and Nathaniel "Nate" Campbell. Both Riley and Nate are aspiring Army officers currently studying at the **United States Military Academy at West Point**.

"It was a really good experience," said Nate, who is in his final year of pursuing an electrical engineering degree. After explaining that his pre-Sandia technical activities focused on analyzing numbers in the classroom, rather than for a real-life project or goal, Nate said he now felt more prepared for Army work in functional areas, such as those that apply electrical engineering to satellites or other equipment in the field.

A broad, strategic understanding of Sandia's mission

Riley and Nate both came to Sandia as part of the MAC program. The program is designed to give military cadets practical experience with the Labs' missions and a broad, strategic understanding of Sandia's role in national security.

"The mission of all **military service academies** — providing a challenging undergraduate education that prepares future leaders by emphasizing discipline, duty, honor, country and teamwork — fits perfectly with Sandia's creed to provide exceptional service to the nation," explained Lance Hansen, manager of Sandia's Exploratory Systems Technologies team and a 1988 West Point graduate who participated in a predecessor to the MAC program. "Nate, Riley and every MAC participant, by virtue of their training, understand the importance of service to a larger cause and how Sandia can fit into that dynamic future."

Lance added that the cadets are exposed to elements of national security priorities that extend beyond their service's specific mission. These priorities include energy, homeland security, nuclear deterrence and global security.

Meaningful projects to support the nation

MAC participants work on meaningful Sandia projects that contribute to national security. The Labs offer more than 35 project areas spanning various disciplines and skill sets, so each cadet can find a suitable match.



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"Sandia's MAC program has been around for at least 12 years and serves as a great platform and opportunity for students to gain experience and knowledge by working with world-class leaders and staff in New Mexico and California," said MAC coordinator Gabe Serna. "Some of our MAC program leaders and mentors are former military personnel who welcome the opportunity to give back and mentor these students. It's a win-win for everyone involved and very rewarding for me personally as the program lead."

Both Nate and Riley attested to learning a great deal in just a few weeks at the Labs. Nate's project focused on using a W80-1 system analyzer to test equipment.

"I tested the amplifier for eight or nine different components," said Nate, noting that his tasks involved different resistances and voltages.

Riley, a systems engineering major, was asked to begin developing a technical history book for the Exploratory Systems Technologies department. Her first step was conducting interviews with both current Sandians and retirees. She then created an overview spread and timeline to highlight the department's prototypes, such as the Explosive Destruction System.

"I designed a layout to show how the EDS project impacted the U.S. Army overall," said Riley, adding that the document provided an in-depth explanation of how the EDS aligns with different Sandia portfolios, such as Global Security and Energy & Homeland Security.

New perspective on careers at the national labs

Riley said she was happy to have the opportunity to document Sandia's long history of contributions to the nation through the eyes of the women and men who performed this work in relative anonymity.


"I learned just how much they want to tell their stories," the cadet recalled of the interviews. "They love to talk and are very passionate about their work. This project is a great way for them to tell their stories. They otherwise would never have been asked. They were happy to provide insight on how their projects contributed to the nation."

It was an eye-opening experience, she said.

"I was not aware of the different types of projects conducted by the national labs. When I thought of a lab, I pictured test tubes and lab coats. But [the interviewees] talked about the Labs' systems engineering aspects, which I found to be very interesting."

Nate said he would recommend the MAC program to his fellow cadets.

"I would definitely encourage it," he said emphatically. "I'm not sure how long I'll stay in the Army, but I think it'd be cool — if I decide not to make it a 20-year career — to come to a place like this where you're still able to give service to the nation and work on something that matters."

The MAC program is open to qualified cadets and midshipmen of any United States service academy. [Watch a video about this program](#), or for more information, email mac-program@sandia.gov. 

Key milestones

CONTINUED FROM PAGE 1

complex and challenging nuclear deterrence modernization and stockpile programs.”

The program updates and recently completed milestones below offer a glimpse into the critical efforts being undertaken by the division’s nuclear deterrence community.

Nuclear Weapons Council extends the W80-4 program by 24 months

The Nuclear Weapons Council on June 29 approved a 24-month extension to the deadline for the W80-4 Life Extension Program, moving the target for the first production unit to September 2027. Following the decision, Sandia began realigning program schedules to meet the more realistic date while continuing to focus on system integration and flight testing and working toward System Baseline Design Review this fall.

Sandia’s California systems engineering team led the W80-4’s initial design phases in partnership with Lawrence Livermore National Laboratory, the lead nuclear design agency, and NNSA production plants. They developed warhead design options and technologies to make the W80-4 one of the safest and most secure systems in the stockpile. Through these partnerships, Sandia is working to reduce its dependency on expensive and long-lead hardware, increase the use of digital engineering and deploy additively manufactured products.

“With the rapid expansion of our ND programs, it has never been more important to leverage our experience and institutional knowledge across all programs, both internally and with our colleagues throughout the nuclear security enterprise, to achieve our common goals,” Andy said, citing tri-site executive reviews for the W80-4 LEP that are strengthening relationships, improving communications and developing innovative solutions for shared challenges.

W87-1 program moves to Phase 6.3

NNSA’s W87-1 modernization program is heading into **Phase 6.3 of the U.S. nuclear warhead lifecycle** — an important engineering development phase that includes flight testing. The program recently

completed Phases 6.2 and 6.2A, defining the system architecture and then costing the program’s development and execution.

To move into Phase 6.3, the program completed and submitted its Weapon Design and Cost Report to the W87-1 NNSA Federal Program Office in May. Teams across California and New Mexico developed resource-loaded schedules for the program’s projected lifespan, informing the final cost estimate. The teams held countless meetings and devoted hundreds of hours to ensuring that the artifacts and final report were of the highest quality and met rigorous requirements.

The W87-1 will provide enhanced safety and security compared to the legacy W78 warhead it will replace in the U.S. nuclear stockpile. Sandia is responsible for engineering the program’s nonnuclear components and executing system integration and qualification, in partnership with other organizations across the nuclear weapons complex.

Mk21 Fuze Replacement Program completes final qualification testing

The Mk21 Fuze Replacement Program is developing a modernized fuze to be used on intercontinental ballistic missiles as part of the land leg of the nation’s nuclear deterrent. Working on behalf of the Air Force and targeting a May 2024 first production unit,

Sandia is completing its final round of qualification testing that includes flight testing, electrical system reviews, vibration and shock testing and qualification.

The Mk21 Fuze leverages components and expertise at the Labs, especially the W88 Alteration 370 Fuze designed for the U.S. Navy.

W87-0 successfully executes firedown test

With a goal of developing the first warhead to be fielded on the Air Force’s new Sentinel ground-based strategic deterrent missile, the W87-0 team is creating a joint environmental test unit to provide Sandia, Lawrence Livermore National Laboratory and the Air Force with environmental data from test flights to certify the weapon system for operational use. The team is also developing an updated joint test assembly to provide encrypted telemetry for instrumented flights.

Sandia’s W87-0 program successfully executed a firedown test in July on the updated joint test assembly and ground test unit. The team collected data, and the telemetry ground station recorded the simulated flight test. Initial results indicate that the system tester provided the proper signals to the fuze and weapon components to charge and fire.

The ground test unit performed as expected and was a success. The test



MEETING THE NATIONAL NEED — Teams at Sandia are developing advanced concepts, technology and materials to make the W80-4 one of the safest and most secure systems in the stockpile.


Photo by Randy Wong

provided mission confidence data for the upcoming Mk21 Fuze flight telemetry system and reduced qualification risks on the instrumented joint test assembly for the Sentinel missile by gathering evidence of a capable design just prior to the program's baseline design review.

Annual stockpile assessment moves forward

The California stockpile systems teams are instrumental in preparing Sandia's portion of the annual stockpile assessment — a review of the safety, reliability and performance of the nation's nuclear stockpile. In preparation for the Labs Director's annual nuclear weapons stockpile assessment letter, teams have completed the Cycle 27 annual assessment report, the technical basis annual

review and component assessment reports. Sandia's results are compiled with those from other nuclear weapons laboratories and included in the final report, which is delivered to the president and secretaries of energy and defense.

"The United States relies on its nuclear weapons stockpile to deter aggression from adversaries," said Dan Fonte, director of Stockpile Systems and Component Engineering. "To serve effectively, our weapons must be highly reliable and function when called on to do so, but must remain safe from unintended detonation at all other times. The annual assessment is significant, and it is to this end that we work with the highest diligence and integrity." 

Experiential design upgrades California campus


Sandia's mission inspires the design of workspaces across the Livermore site

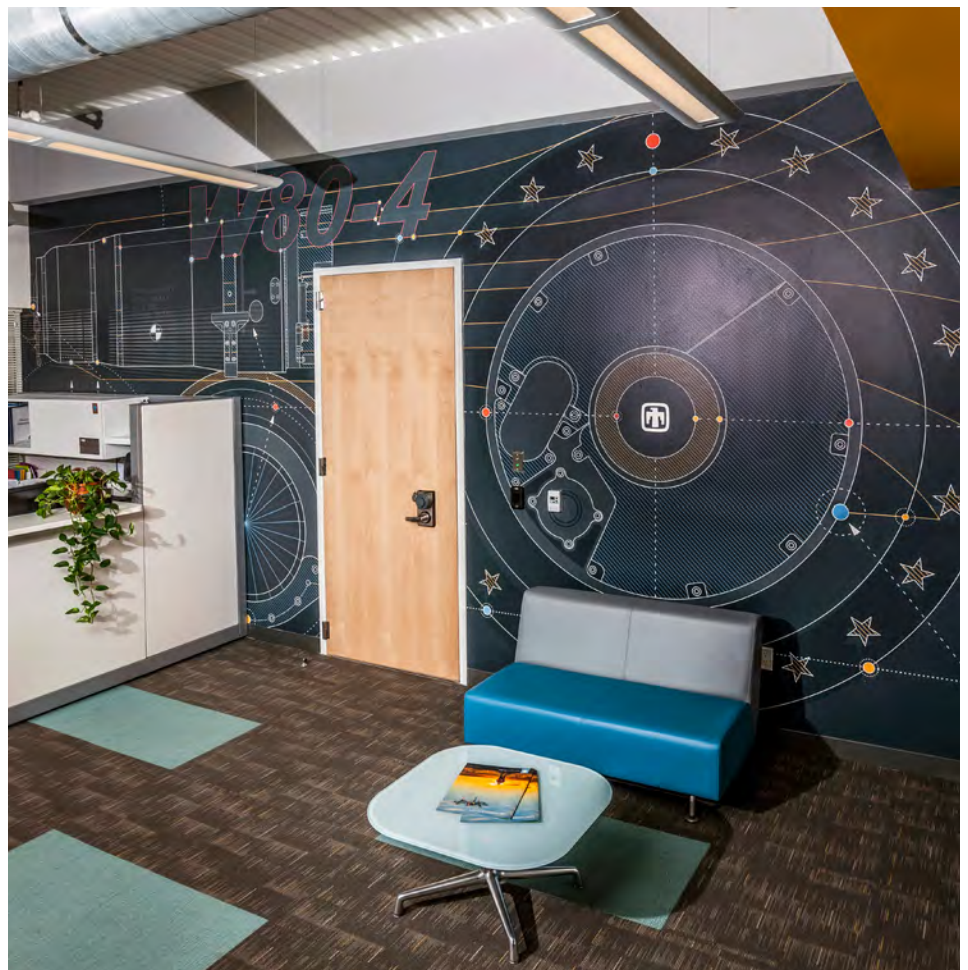
By **Trina West**

During the last few years, the Sandia/California site has been busy constructing new buildings and remodeling common areas. The improvements showcase Sandia's achievements and provide workforce members with thoughtfully designed and interactive work environments. Drawing upon Sandia's history of serving the nation through advanced science and technology, the wall designs were inspired by engineering drawings and include fun "Easter eggs," or hidden images. The result is a timeless aesthetic that engages visitors by using abstract patterns that can be interpreted in multiple ways.

Each experiential-design project requires a long-term commitment — with extensive collaboration among multiple departments — to complete. The teamwork involved in every installation is a testament to Sandia's culture, mission and values. The following photo gallery highlights some of the most recent transformations that have taken place on-site.

What's next

Future experiential-design projects at Sandia/California include signage to help visitors make their way across the Livermore campus, a new cafeteria and a remodeled Badge Office. 

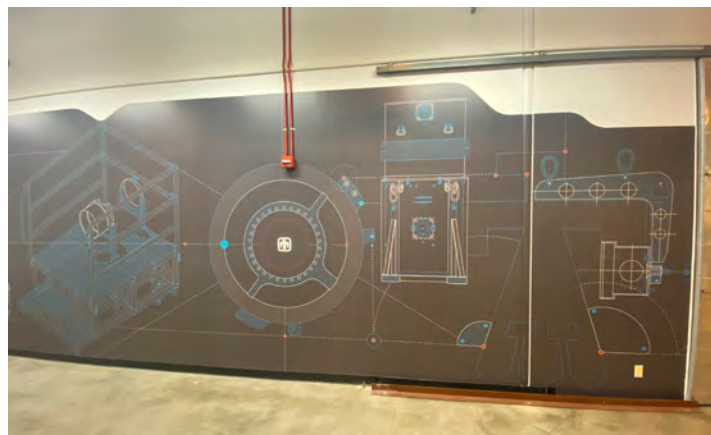


W80-4 SUITES — The wallpaper design features abstract concepts inspired by unclassified drawings of the W80-4 model. **Photo by Randy Wong**



INTERACTIVE BLUEPRINTS — Custom backlit graphic panels, layered with face and halo lighting, line the corridor of the Building 915 weapons exhibit.

Photo by Loren Stacks



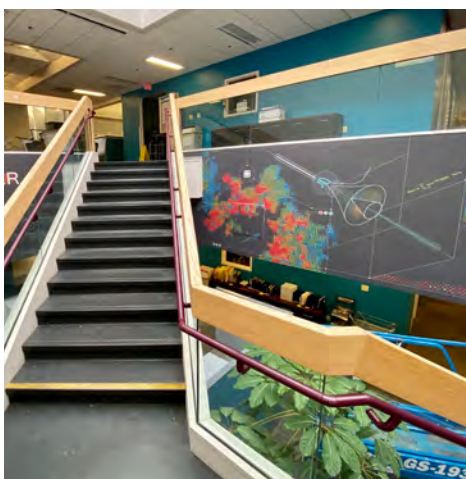
BUILDING 928 — The Handling Gear High Bay project was completed this summer and highlights unclassified engineering drawings of the handling gear and test gear weapon models.

Photo by Loren Stacks



BUILDING 914 TAG — Abstract patterns inspired by unclassified nuclear deterrence engineering drawings are combined with photos of delivery vehicles to create wallpaper for the Test Assembly Group hallway.

Photo by Dino Vournas



FRESH PAINT — Accent walls throughout Building 905 complement the new graphics, which bring together images of actual flames with graphs, charts, technical illustrations and formulas.

Photo by Dino Vournas



DISCOVER CRF — The Combustion Research Facility logo in Building 905 was updated with a more modern feel.

Photo by Dino Vournas

For such a time as this **A global nuclear deterrent**

CONTINUED FROM PAGE 1

And following the tragic events of 9/11, Sandia helped stand up the Department of Homeland Security, accelerating innovations to protect our nation.

I believe Sandia can once more light the way to help our nation address foreign nuclear threats. But as Labs Director James Perry **stressed in his rally cry**, we need everyone's contributions to answer the call.

External threats to national security are at a level of criticality not seen since the height of the Cold War. Today, we face two nuclear-capable near peers at the same time: Russia has recently threatened to employ nuclear weapons, and China is quickly developing global nuclear capabilities. This is an unprecedented global situation, and U.S. nuclear weapons are needed more than ever for world peace.

Sandia's success in our core mission of assuring a safe, secure and reliable nuclear deterrent has never been more important.

Sandia serves as both the systems integrator and a design agency for U.S. nuclear weapons, and we create their nonnuclear components. The W80-4 Life Extension Program is the Labs' highest priority and will provide U.S. Strategic Command with a vital military capability. The W80-4 LEP is an estimated \$11 billion effort across the nuclear weapons complex. Responsibility for executing Sandia's portion (estimated to cost \$3.8 billion) is distributed throughout the Labs. Beginning in fiscal year 2023, primary responsibility for systems engineering, integration and several nonnuclear components will lie within the Integrated

Security Solutions division, which I first joined in 1991 as a postdoctoral researcher and now have the immense honor to lead.


Everyone at Sandia contributes to our mission

Everyone at Sandia can answer Labs Director Peery's rally cry to step up in this time of need. Some may work directly in nuclear deterrence, while others may contribute to non-ND projects that solidify our reputation for assuring the U.S. nuclear deterrent. Still others provide the infrastructure needed to carry out our mission, attract talented staff to Sandia, work as project managers ... the list goes on. In short, meeting this national need is a collective effort.

Our reputation as a national lab is built on the public achievements in our energy and open-science programs. For example, when Sandia transfers technology to the commercial sector or is acknowledged for our contributions to grid modernization or preparing for future pandemics, we demonstrate our cutting-edge engineering capabilities and our ability to deliver on our commitments.

Sandia's success depends not only on what we do but on our identity as a lab and as individuals. I can tell you from personal experience that our duty as Sandians must be equaled by our humanity. The Labs' core values — integrity and respect for one another — are vital to how we do what we do.

We must continue to exhibit compassion for one another and bridge divides by doing in life what we already do scientifically: seek understanding. That's what makes Sandia a special place. Our exceptional service is shown not just through our technical products but in how we live out each and every day.

I urge every Sandian to remember these principles and see what we will achieve together with both our minds and our hearts committed to excellence. 

Andy McIlroy is the associate labs director for the Integrated Security Solutions division at Sandia.



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Answering the call

Sandians support national security mission

In support of the Nuclear Deterrence Modernization Efforts Rally Cry, Lab News continues to highlight employees and the variety of ways that they contribute to Sandia's core mission. Lab News will run these stories in future editions and online. Read more profiles in the [July 28](#) and [Aug. 11](#) editions.

Photos by **Randy Wong**

Kate Stamper

*Systems engineer
9 months at Sandia*

We often see reminders of Sandia's roots in the Manhattan Project. For Kate Stamper, this isn't just history — it's a family tradition.

"I'm from middle-of-nowhere Tennessee. My grandfather worked at Y-12, and they basically worked on creating enriched uranium. I grew up hearing all these stories, and at one point half my family worked in the nuclear security complex," she said. "When I was in college, the Sandia talks were the ones my professor said I had to go to. So, I had this thing in the back of my brain that national labs were cool, and Sandia stood out among them."

Kate works as a mechanical engineer on the W80-4 program.

"I make sure everything fits together the way it's supposed to and meets the requirements for safety," she said. "I like to work on something bigger than myself that means more than just my personal input. That makes me feel that I'm working to make the world a better place for security and stability — as opposed to making a car one percent more efficient."

— David Hill



Jaideep Ray

*Computer scientist
23 years at Sandia*

Educated as an aerospace engineer, Jaideep Ray later became intrigued by the tremendous ease of collecting data as sensors became cheaper and computers got faster. After the 9/11 anthrax letters, he trained himself on statistical inference and worked on ways to estimate the cause of a disease outbreak or bioterrorism attack from limited data.

For the past decade, he's developed data-driven technologies to solve engineering problems — for instance, where a nuclear weapon's actual performance may differ from what models predict, usually because of shortcomings in the model. With statistical inference, he said, "We use measurements to discover the problems with our models and update them." These techniques are being used by Sandia in hypersonics — for aircrafts or missiles that fly faster than five times the speed of sound.

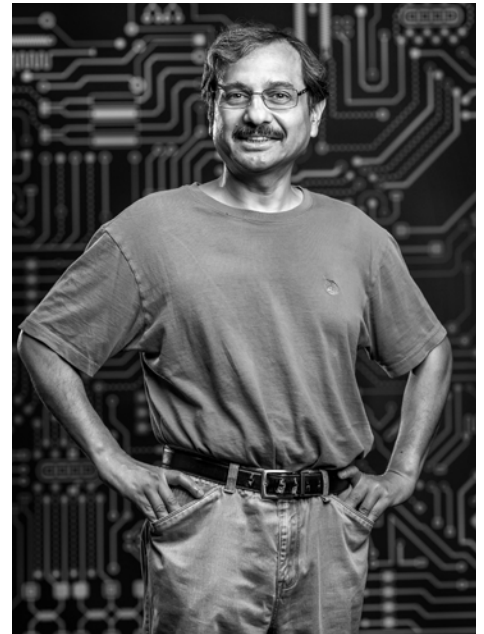
Currently he's working with colleagues to predict future pandemics. "DOE has some fantastic capabilities to predict climate change. With animals and insects forced to change their location and expose humans to new pathogens, could we predict pandemics that might come through and how bad they might be?" he asked. "Because data is so plentiful, machine learning will help us solve this problem first — if we don't fall behind other countries."

— J.C. Ross

Habib N. Najm

*Senior scientist in mathematics
29 years at Sandia*

Habib holds a doctorate in mechanical engineering from the Massachusetts Institute of Technology. In addition to supervising and mentoring a group of postdoctoral researchers, Habib devotes most of his time to research topics in computational



modeling of physical systems, combustion science, uncertainty quantification, statistical data analysis and scientific machine learning applications in chemistry and materials.

Habib said his focus on uncertainty quantification in computational science provides value to nuclear deterrence programs.

“The ability to make computational predictions of physical systems with quantified uncertainty is essential for physical model validation, system design optimization and risk analysis,” he said.

The best part of his job is “mentoring young scientists and the continuous learning inherent in a research career.”

— Krystal Martinez



Catherine Mageeney

Bioengineer

4 years at Sandia

Catherine completed her postdoctoral research at Sandia after earning her doctorate at Lehigh University in Pennsylvania. She has been in her current role for two years as a senior member of the technical staff in bioengineering and biotechnology.

Catherine leads a team of undergraduate students in the Applied Bioscience Lab at Sandia/California.

Catherine’s expertise in phage biology and genetics has broad applications and implications for scientific research. Phages, or viruses that infect bacteria, are the most numerous and diverse biological-organism in Earth’s



biosphere. With approximately 10^{31} existing phages to be identified and studied, there is no shortage to identify, characterize, sequence and analyze. Introduced to this work as a Cabrini College undergraduate, Catherine has spent years in this field of discovery science and trained dozens of students in bioscience and influenced many to pursue the subject.

Catherine’s phage research bridges several related areas of bioscience, including not only infectious diseases, but also climate study, biomanufacturing and bioenergy. Catherine sees the plethora of phages “as a toolkit for solving complex biological problems by delivering useful genetic material to alter or kill unwanted bacterial pathogens.”

— Krystal Martinez

Scott Kiff

Nuclear engineer

13 years at Sandia

When nuclear engineer Scott Kiff moved from Pacific Northwest National Laboratory to Sandia, he brought a special interest in radiation detection. Since then, he’s been heavily involved in characterizing special nuclear material via neutron emissions.

“There are a lot of applications,” he said, “where neutron detection tells you about the quantity of nuclear material present and its configuration. That’s important in arms control and emergency response — from locating nuclear materials, to characterizing unknown packages like material in a crate, to predicting the consequences if

there’s a detonation. Both areas present opportunities for interesting research and development, they’re of high importance to the nation and NNSA labs like Sandia are in a unique position to contribute because of our historical roles and capabilities.”

Perhaps not surprisingly, Scott has been a key contributor to the development of the MC-15 neutron multiplicity detector. Teams from Sandia, Los Alamos and Lawrence Livermore national laboratories took it from conceptual design to production and use for nuclear security. “It’s designed to be rugged and one-person portable (less than 50 pounds) for field use,” he said. “It’s very satisfying that I was able to contribute to something that is actively used by other parts of government to keep the nation safe.”

— J.C. Ross



Looking 10,000 years into the future

Sandia's Carlsbad site serves as science adviser to Waste Isolation Pilot Plant

By **Paul Rhien**

Since 1974, Sandia has served as the DOE Office of Environmental Management's science adviser for the [Waste Isolation Pilot Plant](#) in Carlsbad, New Mexico.

WIPP is the world's only licensed and operating deep geologic repository for the permanent disposal of transuranic waste. At WIPP, defense-related waste is placed in excavations within ancient salt beds found 2,150 feet below the Earth's surface. To fulfill the Labs' advisory responsibilities for WIPP, Sandia maintains offices, computing platforms, laboratories and other technical capabilities in southeastern New Mexico.

The Sandia Communicator Podcast recently sat down with Paul Shoemaker, senior manager of the Labs' defense waste programs group, to learn more about Sandia's Carlsbad remote site and involvement with WIPP.

Nuclear waste management

Lab News: Can you give a brief historical overview of Sandia's work in nuclear waste management and tell us about DOE Environmental Management's clean-up responsibility and waste emplacement mission?

Paul Shoemaker: In 1973, an internal committee recommended that Sandia become engaged in nuclear waste management activities. Specifically, the committee recommended that Sandia identify segments of the waste management sequence where Sandia's general research and engineering skills could be useful and to seek out long-term major problems not being worked by other laboratories.



SCIENCE ADVISER — Sandia operates a remote site in Carlsbad, New Mexico, supporting the Waste Isolation Pilot Plant and its nuclear waste management mission. **Photo by Jeff Palmer**

One of the very first projects in which Sandia became involved was in support of what we now call the Waste Isolation Pilot Plant. Sandia's first funding for this work focused on site characterization in southeastern New Mexico. We have received funding from DOE and its predecessor agencies for our work on WIPP continuously from 1974 to today. Over that 48 years, the focus of Sandia's work has evolved into the science adviser role we play today for the DOE. I argue that the work on WIPP that Sandia has engaged in over time makes WIPP the longest-running single project in the history of Sandia.

The notion [behind WIPP's creation] was that the nation had created a substantial amount of defense-related transuranic waste as a result of nuclear weapons design, development and production. That material needed to be sequestered from the accessible environment.

Based on findings from a National Academy of Sciences panel in 1957, salt was suggested as a good geologic medium for isolating this waste. A site was chosen in southeastern New Mexico where there is a substantial formation of bedded salt a couple thousand feet thick. A spot in the middle of that bedded salt

formation, 26 miles east of Carlsbad, was selected as the site to be developed. Openings were mined out at a depth of 2,150 feet below the surface, and that is where WIPP is located today. The waste disposed of at WIPP is neither spent fuel nor high-level waste. It is therefore suitable for disposal in the repository that has been designed for that purpose.

Collaboration with WIPP partners

LN: Could you tell us more about Sandia's partnership with many of the other collaborative partners on WIPP — the WIPP management and operating contractor, DOE Office of Environmental Management, Los Alamos National Laboratory and other organizations that support WIPP? How does the proximity of Sandia's Carlsbad office support that collaboration?

PS: For the first two decades of Sandia's work on WIPP, our center of gravity for staff was in Albuquerque. DOE's WIPP project office was also



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located in Albuquerque.

When Hazel O'Leary was the secretary of energy, city officials in Carlsbad reasoned that since this was — and remains — one of the very few locales in the country that enthusiastically hosts a nuclear waste repository, DOE should locate the project work here [in Carlsbad], rather than having it done remotely. Secretary O'Leary agreed and directed that the DOE project office for WIPP relocate to Carlsbad.

Not long after the DOE project office for WIPP moved from Albuquerque to Carlsbad, Sandia also set up a remote site here in the mid-1990s. We've operated our WIPP project with the project managers physically residing here in Carlsbad ever since.

The management and operating contractor for the WIPP site today is Nuclear Waste Partnership. We regularly host what we call an integration meeting every week — where all the WIPP participant organizations send representatives to update each other on their WIPP work and to coordinate all the moving parts of our work.

Technical expertise and scientific advice

LN: What are some areas of technical expertise among Sandia's staff in Carlsbad? Can you tell us more about the scientific advice Sandia provides DOE on matters related to WIPP?

PS: Sandia currently serves as the science adviser to DOE on matters pertaining to the long-term performance of WIPP — that is, 10,000 years into the future.

Our primary role is to estimate cumulative releases from the repository over that 10,000-year regulatory period of interest. Barring a human intrusion, once WIPP is sealed, the waste

disposed there will never see the light of day again. That's why we characterize the emplacement of waste at WIPP as disposal and not storage.

We are required by regulation to assume human intrusions will take place once active institutional controls have been suspended a few hundred years after WIPP is buttoned up. So, in the event that future societies go looking for things underground, like oil and gas or other minerals, they may inadvertently drill down through the waste that's emplaced in the underground repository. Releases could take place as a result of that inadvertent human intrusion, and that's the primary focus for Sandia's work on WIPP.

We also assist with certain operational challenges at the WIPP site. Our Sandia colleagues who are experts in robotics and automation are deeply engaged in supporting WIPP operations by demonstrating robotics and automation to enhance productivity and improve worker safety.

Our workforce here in Carlsbad numbers on the order of 55 people and includes both Sandia employees and contractors. Additionally, we rely on an equal number of Sandians in Albuquerque to support us in both our long-term repository performance work and dealing with certain operational challenges that the management and operating contractor and DOE's Carlsbad Field Office experience in running WIPP.

Of our staff in Carlsbad, we have a number of applied-math individuals who perform the computer modeling that leads to estimates of cumulative releases over time. We also have very accomplished geochemists and geohydrologists who engage in applied and fundamental studies that help inform our computer modeling.

Finally, we have people in Albuquerque who are experts in



NUCLEAR WASTE MANAGEMENT — At the Waste Isolation Pilot Plant near Carlsbad, New Mexico, Sandia engages in shaping technical solutions to national nuclear waste management challenges that go beyond the disposal of transuranic waste.

Photo courtesy of the DOE

geomechanics. They model the behavior of the salt as it seeks to close the openings that people have made in the underground. Salt is a good medium for this because it tends to creep closed, trying to close any openings or fractures that occur within it and encapsulating anything that happens to be in those openings.

Current developments at WIPP

LN: What are the latest developments or milestones at WIPP? What are some drivers behind the demand for Sandia's work in Carlsbad? I imagine some of that demand is driven by regulatory submittals and other compliance certifications.

PS: Part of the regulations that pertain to the operation of WIPP are related to the radioactive constituents in the waste. These are regulated by the U.S. Environmental Protection Agency. The nonradiological, but still hazardous, constituents of that waste are regulated by the New Mexico Environment Department. Sandia provides very limited support to DOE on matters pertaining to the nonradioactive constituents in the waste.


WIPP received its first shipment of waste in March 1999. Every five years after that date, DOE must submit a compliance recertification application to the EPA. Sandia is heavily involved in the creation of these recertification applications, which provide the EPA with the comfort they need to allow WIPP to remain certified and to continue waste emplacement. Sandia traditionally writes 70% or more of the content — by page count — in those applications. We also provide a substantial amount of computer modeling work, as well as the underpinning technical work that supports that modeling.

We will begin our performance assessment calculations for the next recertification application in February 2023. We'll then write our portions of the compliance recertification application that will be submitted by DOE to the EPA in March 2024.

In the interim, DOE finds it necessary to create additional physical space in the underground to dispose of waste that we anticipate will be coming to WIPP in the future. We have been deeply engaged in the development of a planned change request, supporting DOE as it requests permission to create new waste disposal areas in the underground in addition to the areas that have already been created.

There are currently eight waste disposal areas, or panels, in the underground. Each panel has seven disposal rooms. DOE's planned change request will request permission for two additional waste disposal panels. But as we think farther down the road, designs have been advanced that would provide for nine additional panels, effectively doubling the physical footprint for waste disposal in the underground at WIPP.

LN: Sounds like a lot of unique challenges associated with that growth. Anything else you'd like to share with our listeners about Sandia's WIPP project and the Carlsbad site?

PS: WIPP is a unique resource. It's the world's only licensed and operating deep geologic repository for the permanent disposal of radioactive waste. And we are quite proud to have been engaged with the community of Carlsbad, with DOE and with the WIPP project for what is now well over 45 years. 



WIPP PARTNERSHIP — Paul Shoemaker, left, senior manager for Sandia's defense waste management programs group, and Sean Dunagan, president and project manager for Nuclear Waste Partnership LLC, the management and operating contractor for the Waste Isolation Pilot Plant.

Photo courtesy of the DOE



UNDERGROUND REPOSITORY — In a 1999 photo, Wendell Weart, Sandia fellow and first project leader for Sandia's work on the Waste Isolation Pilot Plant, shines a light in the repository, which sits two thousand feet underground. WIPP is the world's only licensed and operating deep geologic repository for transuranic nuclear waste disposal.

Photo by Randy Montoya



NUCLEAR WASTE MANAGEMENT EXPERTISE — Senior managers from Sandia's nuclear fuel cycle and grid modernization program tour the Waste Isolation Pilot Plant in 2019.

Photo courtesy of the DOE

Sandia soil scientist studies climate change impacts

By **Sarah Jewel Johnson**

Creating new knowledge in the field of soil carbon storage and dynamics is Umakant Mishra's life work, his calling, his passion — and it's also his career. Umakant, a biological sciences and engineering soil scientist at Sandia, spends his days studying the terrestrial carbon cycle and the ways in which excess carbon in the atmosphere, as a result of climate change, may impact other soil properties and functions. Umakant is driven by his desire to discover and share new knowledge that could positively impact climate change research and education. He has published more than [100 soil- and climate-related articles and presentations](#) and is passionate about providing an environment in which future generations of researchers and scientists will have support to pursue climate-related work.

"I have had a very fortunate professional career with opportunities to work with brilliant minds of our time, and the things that I have learned from my career — especially about honesty and ethics in sciences — I try to instill those features in the people who work with me. I try to do my best so that the students, post-docs and the early career staff who work with me have the same kind of learning environment that I experienced early in my professional career," said Umakant.

In 2022, Umakant was awarded the International Union of Soil Sciences Jeju

award, which recognizes mid-career scientists who have "innovative and outstanding accomplishments in education, research or extension in soil sciences." In 2020, he received a Certificate of Excellence from the Regional and Global Model Analysis program area within the DOE Office of Science. His publication, "[Observational needs for estimating Alaskan soil carbon stocks under current and future climate](#)," was ranked by the DOE Office of Science as one of 2017's top stories. Umakant is the chair of the International Soil Science Award Committee for the Soil Science Society of America, an executive board member of the International Soil Modeling Consortium and an active associate editor and technical editor for multiple journals.

Umakant was born in Nepal, where he received his bachelor's degree in agriculture from Tribhuvan University. He then moved to Ghent, Belgium, receiving a master's degree in physical land resources before

completing his doctorate in soil science at The Ohio State University. Prior to joining Sandia a year and a half ago, Umakant spent eight years at Argonne National Laboratory and two years as a geological postdoctoral fellow at Lawrence Berkeley National Laboratory.

Lab News: Why are you passionate about climate change?

Umakant Mishra: I'm a scientist, and it is my job — along with my team — to create new knowledge in our area of study: the terrestrial carbon cycle. This has been my area for the last 13 years. I study the feedback between carbon and climate, and more specifically, how land use and climate change are impacting or altering soil properties and soil functions.

This is not just a job for me. If I were not at Sandia, I would still do the same thing. Studying the terrestrial carbon cycle is what I will be doing probably my whole life. This is the area where I contribute. This is where I



BASE CAMP BOUND — Sandia soil scientist Umakant Mishra starts his hike to the base camp of Mount Everest.

Photo courtesy of Umakant Mishra

want to spend my scientific career.

LN: What does “climate security” mean to you?

UM: So, when we use the term climate security, we typically mean the security risks induced by climate change. Climate change does not directly cause a security risk, but it does amplify and accelerate the security risks in society. For example, climate change impacts the risk on food security, the risk on water security, the risk on energy security and the risk on ecosystems and soil resilience.

I study the risks on soils and vegetation as a result of climate change. If you look at the total carbon cycle, soils store the largest amount of carbon in the terrestrial ecosystem. Therefore, I’m confident that unless soils and terrestrial ecosystems are managed properly and scientifically, no significant contributions can be made towards enhancing or achieving climate security.

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

UM: Climate change impacts a large number of components in the environment we live in. It impacts soils, water, vegetation and many other components of the terrestrial ecosystem. The research my team and I conduct is guided by two simple questions. The first one is, “How is climate change altering the terrestrial carbon cycle?”

The second question is, “How will the projected climate extremes, such as heavy rainfall or excessive drought, impact the sustainability of agroecosystems?” In our research, sustainability means the ability to function properly. For example, soils provide many ecosystem services: water, minerals, food production and storage for a large number of biodiverse organisms. We are interested in quantifying how soil properties and functions will be altered or impacted by changing climate.

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

UM: Because we conduct fundamental research, my team and I make original contributions through peer-reviewed publications at the intersection of climate, soil and vegetation. We try to create new knowledge in the domain of the terrestrial carbon cycle.

For example, we recently published a study that predicted the vulnerability of surface soil organic carbon in the continental U.S. under high- and moderate-emission scenarios. If we have moderate emission levels, how much soil carbon will we lose from the continental U.S. and what could happen in extreme emission scenarios?

In another recent publication, we quantified how change in soil carbon affects other soil properties and recommended management practices to help mitigate climate change and advance food security.

We advance climate security through our research contributions by quantifying and reducing the uncertainties in the impacts of climate change on different components of terrestrial ecosystems.

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

UM: Sandia can’t address the climate crisis alone — it’s a global phenomenon. But Sandia can contribute to the mitigation efforts in a unique way. I have been at Sandia a year and a half, and — from my perspective — I think we bring carbon cycle research knowledge to the table. Sandia has very good measurement capabilities: measuring atmospheric properties, sensing technologies, computational tools and models. As an engineering lab, we can provide engineering solutions to, let’s say, enhance soil or terrestrial carbon sequestration. That means Sandia can deploy engineering technologies that can help sequester more carbon from the atmosphere into soils and safely store them.

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

UM: This is a hypothetical scenario because I would say we can only be part of the solution. We cannot solve climate change on our own because it’s a global crisis. But obviously we can be a part of the global effort that is addressing climate change through mitigation and adaptation.

Without collaborations, we cannot produce new knowledge towards mitigation and adaptation technologies. Ideally, if our collective efforts succeed, we will have fewer climate-extreme events in the future, more confidence in predicting the ecosystem

response to changing climate, improved agricultural productivity and, ultimately, more resilient ecosystems. Basically, we will be serving humanity in multiple facets if we successfully learn to mitigate climate change.

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

UM: Climate change provides us opportunity to make our technologies and solutions more equitable. For example, we can direct our approaches to address climate change while also thinking about how we can use our technologies to benefit minorities and disadvantaged populations.

Currently, we are part of a multilab team working on proposals for urban science. Our proposed research hopes to use measurement and mitigation approaches focused on benefiting the disadvantaged populations typically found in urban centers. These groups have limited access to certain resources. Research opportunities like this are becoming more and more popular in the DOE domain, so I think we are making efforts to integrate equity and justice in the research efforts we are conducting.

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

UM: I always say this to my team members: if they want to contribute to scientific knowledge, they should work with me. I enjoy working with motivated people who are passionate about generating new knowledge — those who enjoy doing so because by creating new knowledge, we are helping humanity grow.


We are trying to make our world a better place to live, so I try to motivate students and postdoctoral researchers to become more curious and to think critically. If they are passionate about their research and able to internalize it, then we can make a great team and work much better to address the problems of global concern that humanity cares about.

I provide my graduate interns with a storyline to work on. If they are passionate or find it interesting, then they should be able to write their own papers with my help. I always try to encourage the younger generation toward the kind of science that is

impactful — or science that has a wisdom component.

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

UM: I think human civilization is all about telling stories from one generation to another. Writing research stories that can be found interesting by a large population is a great start towards addressing the climate crisis.

When conducting research, I try to involve students and interns and develop research collaborations with universities and other national labs. We then can present our research to communities, federal agencies and scientific societies to draw attention to our findings and new knowledge. 

This article is part of Sandia's Climate Community Series highlighting Sandia's work in a diverse range of climate research and categories of action.

Staff are invited to join Sandia's climate community by signing up for the climate email list, attending all-hands meetings and participating in conversations on Microsoft Teams. A link to join the community is available on the Climate Security at Sandia webpage.

Solar thermochemical process produces low-carbon ammonia

Researchers explore making ammonia with little more than sun, air and hydrogen

By **Diana Hackenburg**

Sandia scientists are working to make feeding the world much less carbon intensive by developing a new chemical-producing process.

About half the world's food production relies on nitrogen fertilizer primarily composed of ammonia synthesized via the Haber-Bosch process. This process uses fossil fuels made of hydrocarbons to drive the reactions that convert hydrogen and nitrogen into ammonia for fertilizer, medicine, plastics and other synthetic products. Haber-Bosch ammonia production accounts for almost 1.5% of global carbon dioxide emissions, the main driver of global climate change.

"We've been making ammonia the same way for almost 100 years," said Andrea Ambrosini, an inorganic chemist in Sandia's concentrating solar technologies department. "Conventional ammonia production via the Haber-Bosch cycle requires high pressures and temperatures to efficiently react nitrogen and hydrogen. This is a very energy- and carbon-intensive process."

Andrea leads a team of Sandia researchers collaborating with partners at

Arizona State University and the Georgia Institute of Technology. Together, they are exploring ways to decarbonize ammonia production by using concentrated solar thermal power. Their work is funded by DOE's Solar Energy Technologies Office.

"We're leaders in concentrating solar power and have the only concentrating solar power tower test facility in the United States," Andrea said, referring to Sandia's National Solar Thermal Test Facility. "Currently, CSP is mainly used to produce heat for electricity generation, but a natural progression is to explore using CSP-generated heat in other ways, like splitting water to produce hydrogen or

producing ammonia."

The team developed — and submitted a patent for — the Solar Thermal Ammonia Production, or STAP, process, which uses advanced solar thermochemical looping technology to purify nitrogen from the air and synthesize ammonia under relatively low pressures. "Basically, we're trying to create a synthesis method for ammonia that uses sunlight rather than hydrocarbons," Andrea said.

Shining light on novel materials

The first step of this new potentially carbon-free, renewable process addresses



SOLAR SYNTHESIS — Andrea Ambrosini, left, and Evan Bush place thermocouples inside the receiver cavity of the solar reduction reactor.

Photos by Craig Fritz

emissions from current methods for producing the pure nitrogen needed to synthesize ammonia. In addition to using concentrated solar energy, rather than fossil fuels to generate heat, the team turned to materials science in search of a greener alternative to generate nitrogen, which is currently sourced from greenhouse gas-emitting hydrocarbons.

The research team developed a metal oxide material that thermally reduces, releasing some of its oxygen when heated. “This primes the material to pull oxygen out of the air flowing over it, producing almost pure nitrogen gas,” said Evan Bush, who started as a postdoctoral researcher on this project and is now a full-time Sandia staff member.

A solar simulator at Sandia will be used to test the metal oxide reduction reaction when heated with concentrated light. “You flip a switch to turn on lamps that concentrate light into a very small space,” Evan said. “This means you don’t have to worry about solar intermittencies or time of day. It’s a good test-bed system to prove concepts before moving to a bigger scale.”

Like the first step, the second step of the team’s STAP process relies on novel materials. Metal nitrides are needed to react in a low-pressure looping process that yields a greener, renewable pathway for producing ammonia.

“This step is an important area for novel materials research because these nitride materials are much less known,” Evan said. The team tests small — less than one gram — quantities of candidate nitrides under specific conditions to determine their ammonia-production potential. When a promising nitride is identified, larger samples of one to two grams are synthesized and tested in a benchtop prototype reactor.

In one such reactor, constructed and used at Arizona State University, the metal nitride is exposed to hydrogen gas, which reacts with nitrogen in the material to produce ammonia at a pressure level about one order of magnitude lower than the level required in the Haber-Bosch process.

To replace the lost nitrogen, the metal nitride is replenished with the high-purity nitrogen generated during the first step of

the process. This uptake of nitrogen closes the cycle, returning the material to its original state. Since the particles in both the nitrogen and ammonia-production steps are not consumed as part of the overall process, both the metal oxide and metal nitride can be recycled to repeat the loop.

The result? Ammonia made from little more than sun, air and hydrogen.

If that last input — hydrogen — can also be renewably sourced, this would decrease ammonia’s carbon footprint even more. While not part of this project, efforts at Sandia and elsewhere are underway to [produce green hydrogen](#) by splitting water with solar energy.

From lab to field

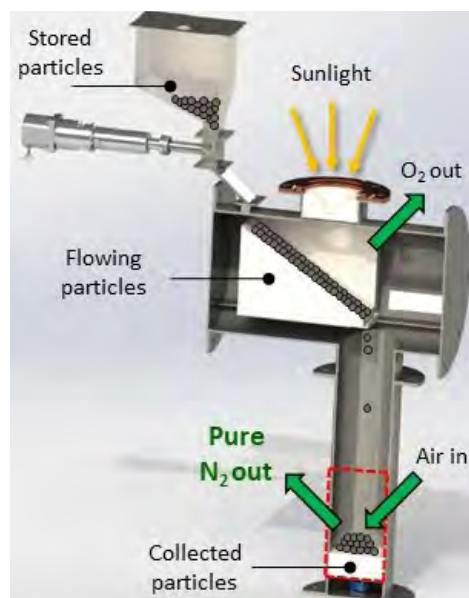
Although Andrea’s team has demonstrated proof of concept, they have not yet physically coupled the first and second steps of the STAP process. Coupling these two steps, as well as scaling up materials synthesis and reactor designs from the lab to a large-scale demonstration, is the next challenge in developing this low-carbon technology.

“Eventually, you would want to develop reactors that sit on top of a solar tower and have a heliostat field, or field of mirrors, concentrating the sunlight to run the metal-oxide priming process,” Evan said, adding that the total amount of ammonia produced would depend on the size of the reactors.

In addition to providing research expertise, Sandia brings a unique capability to the overall research team: access to the National Solar Thermal Test Facility, which includes a solar furnace and the full-scale concentrating solar tower, for testing the STAP process at a greater scale.

To take advantage of economies of scale, Haber-Bosch ammonia facilities are typically quite large. Large-scale production will remain important, explained Andrea, but ideally, the STAP process could also be deployed more locally. Producing ammonia where it is needed — for example, by locating a smaller-scale plant closer to agricultural land — would further reduce carbon emissions by decreasing the need to transport ammonia over long distances.

Andrea said more research is needed



SOLAR SIMULATOR TESTS — In the top rendering, the metal oxide reactor sits inside the solar simulator, which uses lamps to concentrate light and generate the heat needed to produce nitrogen from air. In the bottom graphic, a cross-sectional view of the reactor depicts the metal oxide reduction process; the air separation step, which results in purified nitrogen, is shown within the red boundary and is performed in a second reactor.


Renderings by Evan Bush

to understand the basic mechanisms by which the novel materials make ammonia. “Figuring out exactly how these materials work would be very interesting. There may be even better material out there that we haven’t studied yet.”

Evan said, “There’s definitely more work we can do in terms of figuring out the optimal material to run the ammonia-formation step. We’re seeking

a balance between what produces a lot of ammonia and what is actually cost-competitive.”

As part of this project, their collaborators at Arizona State University are conducting a techno-economic analysis to better understand the overall benefits and costs of this new process.

The lessons learned from producing ammonia with concentrated solar energy could also be applied to other chemical-making processes, such as producing synthetic fuels or hydrogen, said Evan. “The things we learn will expedite the development of all sorts of different processes, including materials generation and solar electricity production from concentrating solar power.” 




PRODUCTION PROCESS — Evan Bush, left, and Andrea Ambrosini explore using concentrating solar power-generated heat to produce ammonia.

Photos by Craig Fritz

Hobby sessions build virtual connections

About once a month, members of Sandia/California’s community come together for a virtual hobby session, where they learn about a colleague’s favorite pastime over lunch. California Weapon Systems Engineering Director Mike Hardwick kicked off the popular series shortly after the pandemic started as a way to help maintain connections and build engagement among staff, and it worked.

Staff members began signing up to present, and the sessions have continued with entertaining talks that inspire great questions and lively conversations. The photos below provide a glimpse into some of the many fascinating topics volunteers have shared. 



MODEL TRAIN ENGINEER — To kick off the Hobby Sessions, California Weapon Systems Engineering Director Mike Hardwick discussed what inspired him to start building model trains and how his hobby informs the technical and operations planning skills he uses at work. He also shared photos of the railroads and infrastructure he has created.

Photo courtesy of Mike Hardwick



PHOTOGRAPHY TIPS — Bryn Miyahara shared her passion for photography with a presentation full of beautiful images and tips for taking planned and candid photos.

Photo courtesy of Bryn Miyahara



FISH TALES — California Stockpile Systems and Components Engineering Director Dan Fonte described his favorite hobby — recreational and tournament fishing — with some amazing fish tales and the photos to prove it. For skeptics, a lie detector is included on his essential equipment list.

Photo courtesy of Dan Fonte



INTRICATE DESIGNS — Helen Smith started crocheting as a creative outlet and then took it to a new level by using her engineering and math skills to design and publish original patterns. In her hobby session, she walked attendees through crochet and pattern design basics, sharing photos of her beautiful creations.

Photo courtesy of Helen Smith



OUTDOOR ADVENTURES — After providing vivid details about his exciting backpacking and raftpacking experiences, David Marangoni-Simonsen encouraged attendees to join an email group he started to bring together Sandians interested in similar adventures.

Photo courtesy of David Marangoni-Simonsen



SMOKING MEAT — Senior Manager Hung Nguyen prepared a visual feast of mouthwatering photos, recipes and tips for smoking meat. He enjoys the food but said the best thing about his hobby is how it helps him connect and make memories with family and friends.

Photo courtesy of Hung Nguyen



CRAB HAUL — Frank Griffin, right, and Hung Nguyen invited attendees along for a fun virtual peek at their weekend crabbing adventures, which began shortly after they both transferred to Livermore from Sandia's Albuquerque site.

Photo courtesy of Frank Griffin and Hung Nguyen



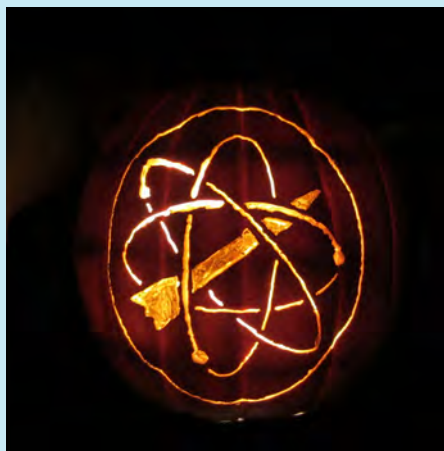
THE ART OF BREADMAKING — In his hobby session, "Dr. Breadlove or How I Learned to Stop Worrying and Love the Gluten," Mike Maguire took the audience on a culinary adventure into the art and science of baking bread, exploring everything from the properties of different flours to the best methods for measuring and mixing to the impact of external factors like humidity on baked goods.

Photo courtesy of Mike Maguire



BACKYARD ORCHARD — Gilbert Wong has cultivated more than 20 fruit trees in his backyard. He described his process — from planning to planting to harvesting — including helpful tips for local growers.

Photos courtesy of Gilbert Wong



PUMPKIN CARVING — Steven Paradise, a pumpkin-carving artist, shared a visual display of his hobby, along with helpful tips, tools and techniques for carving elaborate designs.

Photo courtesy of Steven Paradise



UNCOVERING FAMILY HISTORY — Senior Manager Ben Markel guided attendees through the process of researching their family history and genealogy. He offered ideas for discovering new connections with their ancestors, including collecting biographical information, stories and photos, like this one of his family.

Photo courtesy of Ben Markel

Improving hydrogen safety codes and standards

Award highlights research advancing the safe deployment of hydrogen technologies

By **Mattie Hensley**

Drivers might not always ponder the safety features that surround them as they cruise into their local gas stations for a fill-up. But for Sandia researcher Ethan Hecht, the design and safety of fueling stations have been the focus of several years of experiments and research.

The goal is to ensure hydrogen can be used safely and easily at fueling stations where hydrogen-powered vehicles can refill their tanks, much like their gasoline-powered counterparts.

Specifically, Ethan's work has centered on the National Fire Protection Association's Hydrogen Technologies Code, known as NFPA 2. Ethan and his

collaborators have investigated prescribed setback distances for storing liquid hydrogen in bulk — distances that dictate how far storage tanks must be from other infrastructure.

For this work, DOE's Hydrogen and Fuel Cell Technologies Office presented Ethan with an award for technology acceleration during its annual merit review in June.

The award highlights how Ethan's work to promote hydrogen safety and minimize risk has enabled a decrease in the footprint and cost of hydrogen fueling stations. His research was noted for "facilitating the advancement of hydrogen and fuel cell technologies and laying the framework for the safe deployment of hydrogen technologies at scale."

"Our hydrogen team focuses on the scientific basis for codes and standards. We use hydrogen flow models, experimental validation and risk assessments to establish an understanding of hydrogen behavior. Ethan's experiments are critical to this understanding," said Kristin Hertz, Sandia's



HYDROGEN SAFETY STANDARDS —

Sandia researcher Ethan Hecht was recognized for outstanding contributions to the development of science-based codes and standards at DOE's Hydrogen & Fuel Cell Technologies Office annual merit review, which was held virtually June 6-8.

Photo courtesy of Ethan Hecht

hydrogen program manager. "To enable this result, Ethan had to develop instrumentation and diagnostics to remotely sense hydrogen concentrations in the lab as well as outdoors. His laser-based diagnostic is a first-of-its-kind capability."

NFPA 2 is a fire code that provides requirements and guidelines for many types of hydrogen systems. Among other recommendations and requirements, the code dictates how fueling stations handle and store hydrogen. According to a report written by Ethan and his colleagues, "One key barrier to the deployment of fueling stations is the land area they require (i.e., their "footprint"). Space is particularly a constraint in dense urban areas where hydrogen demand is high but space for fueling stations is limited." By helping to characterize cryogenic hydrogen plumes, Ethan's experiments supported revised safety standards and setback distances for liquid hydrogen storage.

"It's thrilling to see this work recognized, especially because the improved



FUTURE FUELING STATION — Hypothetical layout of a hydrogen vehicle refueling station featuring a compact layout that uses revised setback distances for liquid hydrogen.


Graphic illustration by Ethan Hecht

understanding and modeling of hydrogen behavior have led to the first update to liquid hydrogen separation distances since their inception half a century ago,” Ethan said. “I want to thank the entire hydrogen safety community — who are all collaboratively working hard to enable this carbon-free energy carrier — particularly the team at Sandia, both current and past. This includes postdoctoral researchers Pratikash Panda and Bikram Roy Chowdhury, who were instrumental in developing the diagnostics we are using for liquid hydrogen

experiments.”

Hydrogen fueling stations have the potential to support a more widespread use of fuel cell electric vehicles. During the annual merit review’s plenary session, Secretary of Energy Jennifer Granholm addressed the larger role of the research presented at the review: “Those of you who joined us for the 2021 review might recall us in fact saying that hydrogen has the potential to be perhaps the most important clean-energy innovation in the world. And getting this right is going to mean unlocking a source of

clean, dispatchable power and really a new method of energy storage.”

This work is funded by the DOE Hydrogen & Fuel Cell Technologies Office in the Office of Energy Efficiency and Renewable Energy. The Safety Codes and Standards subprogram has funded research by Sandia since 2003 to provide data and analyses to support science-based regulations, codes and standards for hydrogen and fuel cell technologies. 

Mileposts





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Cory Sisk22

Encouraging minority students in STEM

Interns learn technical skills and gain insight into national labs

By **Sarah Jewel Johnson**

Sandia electrical engineer Rachid Darbali-Zamora is proof that the pipelines created by the **NNSA Minority Serving Institution Partnership Program** can help students make lasting impacts at the DOE national labs.

Rachid was one of the first Sandia interns in the Consortium for Integrating Energy Systems in Engineering and Science Education, a precursor to the present-day Consortium of Hybrid Resilient Energy Systems, or CHRES. He credits his internship experience and research over three summers at Sandia for shaping his dissertation topic in advanced power electronics and motivating him to graduate with his doctorate from the University of Puerto Rico, Mayagüez. Now a member of Sandia's renewable energy and distributed systems integration group, he supports the CHRES program by mentoring future generations of student interns.

The opportunity to impact communities around the world was a major inspiration for Rachid's university studies and decision

to become a Sandian.

"Coming from Puerto Rico, I was attracted to all the research being performed to help modernize the electric grid back home," Rachid said. "One of the greatest outcomes has been the ability to contribute to Sandia-led projects that focus on increasing energy resilience for communities in Puerto Rico. That was my ultimate goal in joining Sandia."

A pipeline for top talent

CHRES is one of 24 consortium-based teams currently supported by the Minority Serving Institution Partnership Program to provide students underrepresented in science, technology, engineering and mathematics the opportunity to work at NNSA sites. Taken as a whole, the teams connect dozens of minority-serving colleges and universities from around the United States with NNSA labs and plants.

Led by Puerto Rico-based Ana G. Méndez University, CHRES offers summer internship and visiting faculty opportunities at Sandia, Lawrence Livermore National Laboratory and the National Energy

Technology Laboratory. Other Hispanic-serving institutions in CHRES include the University of New Mexico, the University of Texas at El Paso and University of Puerto Rico, Mayagüez.

Sandia's CHRES coordinator is Abraham Ellis, senior manager for renewable energy technologies. He was also involved with the previous program, which ended in 2020 prior to the forging of the current CHRES partnership. Both Sandia internship opportunities have focused on renewable and nuclear energy, microgrids, power electronics, energy storage and fire science. Such programs bridge research opportunities for students with diverse interests, backgrounds and goals.

"When they come to Sandia, CHRES interns work with top-notch researchers to investigate important science and technology questions using the Labs' state-of-the-art tools and capabilities," Abraham said. "They see what it's like to work at a national laboratory and picture themselves in that role. We make sure that the internship experience furthers their education and motivates them to consider Sandia as a potential place to work when they graduate."

He points out that CHRES is a great way to recruit top talent and enables stronger collaboration between Sandia and the Minority Serving Institution Partnership Program. The process takes time, but the benefits are significant and tangible.

"In 2017, during the first year of the CIEESE program, I hosted four students and one visiting faculty member from UPRM. For each of those students, the internship project turned into their thesis or dissertation, and one of them [Rachid] eventually became a Sandia employee. Witnessing that progression was very rewarding to see," Abraham said.

Far-reaching impacts

Taking into account the former and current programs, Sandia has hosted nearly 70 summer interns and several visiting faculty members. These interactions have



TOURING INTERNS — From left, interns Abner Vega, Sol Alverio and Namir Huertas tour Sandia's Center for Global Security and Cooperation training center in Albuquerque. **Photo by Lu Hunter**

led to multiple joint research projects outside the Minority Serving Institution Partnership Program and dozens of joint conference and journal publications.

The benefits of the CHRES program are far-reaching, leaving a positive impact on students, Sandia and the students' universities. The partnership with University of Puerto Rico, Mayagüez has been particularly strong and led to a cooperative research and development agreement in 2019 and a memorandum of understanding in 2020.

"This program is valuable because it provides excellent opportunities for CHRES students and faculty," said Erick Aponte, the CHRES liaison for the University of Puerto Rico, Mayagüez. "It is also a win-win strategy for the laboratories because of the research and the potential for workforce development. The facilities that Sandia offers, combined with a state-of-the-art research culture, provide a unique opportunity for our students to complete part of their research work in a perfect research environment with the support of UPRM faculty and Sandia researchers."

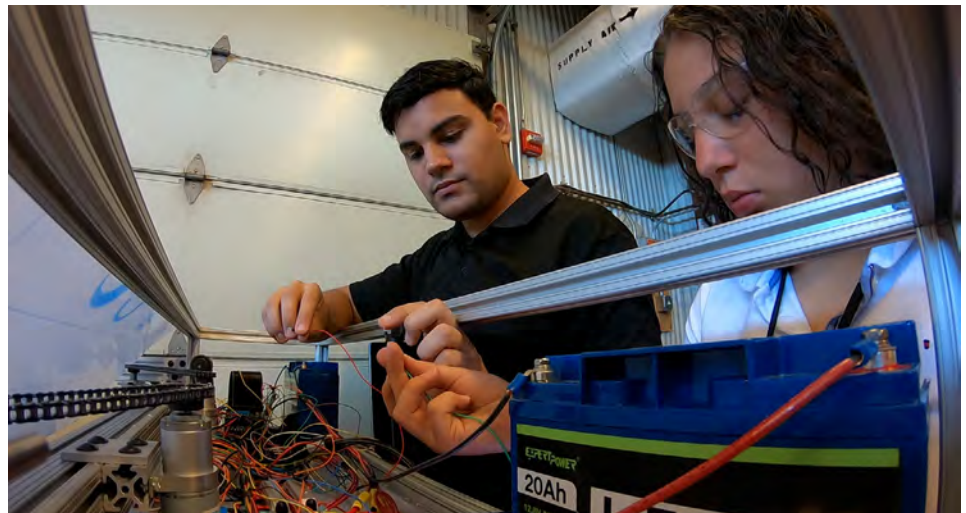
Internship successes

The environment at Sandia provides a safe space for interns to experiment, learn and gain unique insight in a team-focused research environment.

"I chose to participate in the CHRES program to explore new career interests and broaden my research skills," said intern Namir Huertas, a doctoral student at Ana G. Méndez University. "I learned so much. My favorite part about Sandia is how passionate and dedicated everyone has been to ensure that interns have a fulfilling experience. My team made me feel welcomed and valued."

Ansel Blumenthal, a current CHRES intern and University of New Mexico graduate student, agrees that the potential for workforce development and academic impact is substantial.

"The balance of responsibility and accountability when assisting on cutting-edge research projects, along with managers and coworkers who are willing to provide support and guidance when needed, has made for an ideal learning environment," Ansel said.



ROBOTIC WORK — Michael Vázquez Nieves, left, and Alanis Colón González, Sandia interns from the Consortium of Hybrid Resilient Energy Systems, work together to build a photovoltaic robot.

Photo by Vince Gasparich

Recruiting future generations

Big plans are in store for the future of the Labs' CHRES program. In partnership with Ana G. Méndez University, Sandia has established a CHRES Undergraduate Research Capstone initiative to enable more undergraduate students to benefit from CHRES internships and be motivated to pursue graduate degrees in science, technology, engineering and math.


"We want to work with undergraduates throughout the fall and spring semesters, so they can gain more experience with research before applying for summer internships at Sandia. The initiative involves directed mentoring by university faculty and Sandia staff. We also expect these interactions to lead to broader partnership opportunities with university researchers and faculty," Abraham said.

In addition to enhancing research opportunities for underrepresented undergraduate students, the CHRES program can help bring undergraduate

and graduate students to Sandia.

"Programs such as CHRES can help us recruit talent for skill sets that are more difficult to find," Abraham said.

The success of the Labs' CHRES program is rooted in a commitment to supporting and inspiring each participant. Mentors, researchers and staff at Sandia are passionate about sharing their insight and experiences with the interns.

"As a student, I didn't have a chance to work as an intern at a place like Sandia. My hope is that the CHRES program will help more minority students pursue successful careers in STEM," Abraham said. 

JOIN THE CONVERSATION

Sandia Labs has official social media accounts on several online communities to engage in conversations about our work, update followers about the latest Labs news, share opportunities, and support the open government principles of transparency, participation and collaboration.

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Bay Area giving together

Sandia partners with other DOE labs to combat food insecurity

Story and photos by **Tatiana Del Cid**

For students, summer offers a welcome respite from classes, tests and homework. However, food insecurity does not take school breaks, causing many food banks to experience summer as a season of low monetary donations and few volunteers.

To promote support for local food banks during their time of need, Sandia joined forces this year with the other DOE national laboratories in the San Francisco Bay Area: Berkeley Lab, Lawrence Livermore National Laboratory and SLAC National Accelerator Laboratory.

With this partnership, known as the Bay Area Charitable Giving Initiative, each lab dedicated a month of activities to help combat food insecurity throughout the region.

Alameda County Community Food Bank volunteer event

Sandia/California kicked off the charity initiative on July 8 at **Alameda County**

Community Food Bank. A group of 16 hardworking volunteers helped package food items for distribution and sorted through bins of fresh apples and plums. In total, the volunteers helped prepare more than 12,000 pounds of food, the equivalent of about 10,230 meals, for distribution to individuals and families in need.

Before wrapping up the event, Sandia presented a \$12,000 check from the Labs' corporate contributions program. The donation will support continued food nourishment operations at Alameda County Community Food Bank.

Fertile GroundWorks community garden

On July 26, the Community Involvement team visited the Fertile GroundWorks garden in Livermore. The garden was blooming with a variety of ready-to-harvest crops, including fresh cucumbers that Sandia volunteers helped plant during a spring Sandia Serves volunteering event.

During the visit, Fertile GroundWorks President Teresa Win and Executive Director Brenda Kusler were presented with a \$10,000 check from Sandia to continue supporting their mission to grow and distribute more than 20,000 pounds of fresh produce for local communities each year.



FOOD SERVICE — Project manager Brian Duong carts away food items that are ready to be distributed to local food banks by Alameda County Community Food Bank.



FOOD FOR THOUGHT — Fertile GroundWorks President Teresa Win, left, shows Sandia community relations specialist Michelle Walker-Wade some of the volunteer-planted crops that are now ready for harvest.



FOOD FOR ALL — Technologist Hiroko Suzuki helps sort food items at Alameda County Community Food Bank.

One Nation Dream Makers healthy breakfast food drive


Sandia's activities for the Bay Area Charitable Giving Initiative culminated with a Bay Area Healthy Breakfast Food Drive to support Livermore nonprofit One Nation Dream Makers on July 28 and 29.

"The need for food support is higher than ever in our communities," said Ronnie Forbes, the founder of One Nation Dream Makers. "We are excited to grow our partnerships with organizations like Sandia National Laboratories to expand how we can support our local communities."

"Sandia is proud to support organizations like One Nation Dream Makers, Fertile GroundWorks and Alameda County Community Food Bank that work year-round to collect quality food items to deliver meals to local food pantries and local community members' homes," said Michelle Walker-Wade, the community relations specialist for Sandia/California.

Although the Bay Area Charitable Giving Initiative ended in July, Sandia continues its commitment to supporting the family stability and educational success of local

community members throughout the year by offering corporate contribution grant cycles for local nonprofits and opportunities to volunteer.

To learn more about these opportunities and how you can participate, visit Sandia's [Community Involvement webpage](#). 



PICKED WITH CARE — Talent acquisition specialist Erin Chandler sorts and packages fresh apples at Alameda County Community Food Bank.



READY FOR PLANTING — Michelle Walker-Wade visits a hoop house, funded by Sandia's corporate contribution donations to help extend the growing season at Fertile GroundWorks.



HELPING THEM GROW — Sandia/California Community Involvement team members Tatiana Del Cid, second from left, and Michelle Walker-Wade, second from right, present a \$10,000 check to the Fertile GroundWorks leadership team on July 26.

Photo courtesy of Fertile GroundWorks