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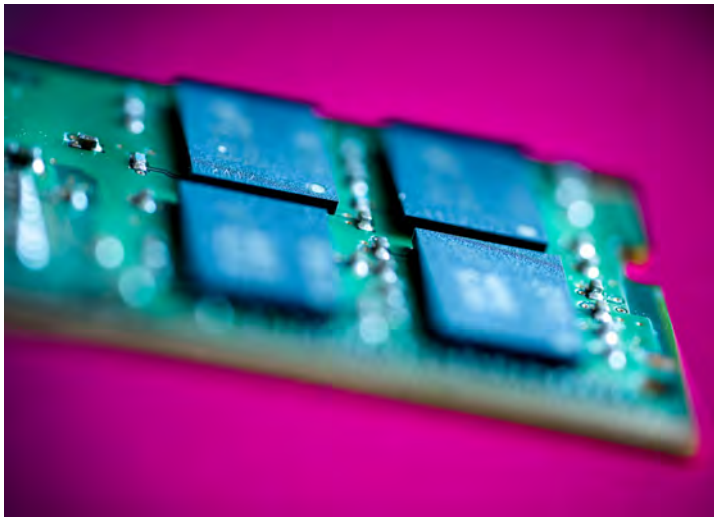
Defense program awardees Page 8

Sandia, Intel seek novel memory tech to support stockpile mission



MAXIMIZED MEMORY — A Sandia team is collaborating with Los Alamos and Lawrence Livermore national labs and Intel Federal LLC to optimize DRAM packages, pictured here and found in many consumer laptops, to increase compute platform performance. **Photo by Craig Fritz**

By **Neal Singer**

In pursuit of novel advanced memory technologies that would accelerate simulation and computing applications in support of the nation's stockpile stewardship mission, Sandia, in partnership with Los Alamos and Lawrence Livermore national labs, has announced a research and development contract awarded to Intel Federal LLC, a wholly owned subsidiary of Intel Corp.

Sponsored by the NNSA's **Advanced Simulation and Computing program**, the three national labs will collaborate with Intel Federal on the project.

"ASC's Advanced Memory Technology research projects are developing technologies that will impact future computer system architectures for complex modeling and simulation workloads," said program director Thuc Hoang. "We have selected several technologies that have the potential to deliver more than 40 times the application performance of our forthcoming NNSA exascale systems."

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Big bomb laid to rest

Dismantlement and disposition required

By **Whitney Lacy**

A massive 25-ton inert nuclear-bomb trainer recently left storage and was slowly and carefully transported to Kirtland Air Force Base for its end-of-lifecycle dismantlement and disposition. Built in 1954, this Cold War relic had been sitting in storage for six decades, retired but not quite forgotten.

Moving this last-of-its-kind weapon trainer took months of planning due to its sheer size and weight. With help from

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SECURE CARGO — Once harnessed, the team loads Mk-17 trainer by crane to a flatbed trailer for delivery. **Photo by John Korbin**

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Sandia National Laboratories

Albuquerque, New Mexico 87185-1468
Livermore, California 94550-0969
Tonopah, Nevada | Kauai, Hawaii
Amarillo, Texas | Carlsbad, New Mexico | Washington, D.C.

Katherine Beherec, Editor kgbeher@sandia.gov
Alicia Bustillos, Production abustil@sandia.gov
Craig Fritz, Photographer cvfritz@sandia.gov

CONTRIBUTORS

Michelle Fleming (milepost photos, 505-844-4902), **Neal Singer** (505-846-7078), **Stephanie Holinka** (505-284-9227), **Kristen Meub** (505-845-7215), **Troy Rummler** (505-284-1056), **Manette Fisher** (505-844-1742), **Valerie Alba** (505-284-7879), **Luke Frank** (505-844-2020), **Michael Langley** (925-294-1482), **Meagan Brace** (505-844-0499), **Mollie Rappe** (505-288-6123), **Skyler Swezy**, (505-850-2063), **Michael Baker** (505-284-1085)

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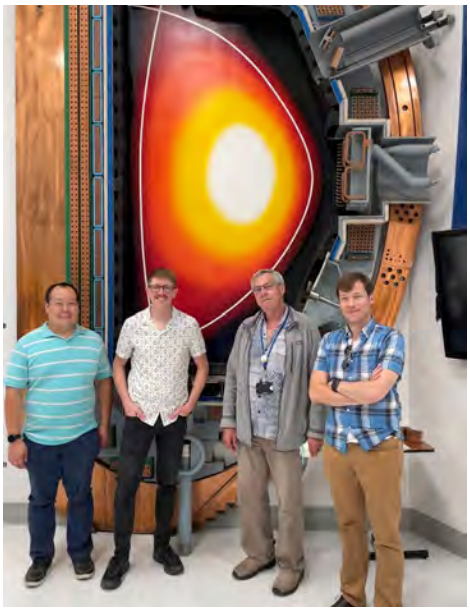
Lab News may contain photos shot prior to current COVID-19 policies. Individuals in photos followed all social distancing and masking guidelines that were in place when photos were taken.

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.



FUSION SQUAD — The team of Sandians working at the DIII-D National Fusion Facility, from left, Dinh Truong, Ryan Hood, Jon Watkins and Jonathan Coburn, stand in front of a scale cross-section replica of the tokamak reactor.
Photo courtesy Jonathan Coburn

Experiments at the heart of a nuclear reaction

Researchers help improve next-gen reactors

By **Michael Ellis Langley**

A team of Sandians working on the reactor at the **DIII-D National Fusion Facility** is testing materials to make the next generation of fusion reactors, in the quest to develop more carbon-free energy sources.

These magnetic confinement fusion reactors, called tokamaks, use magnetic fields to shape plasma into a donut shape that generates power from nuclear fusion. DIII-D is the largest such facility currently operating in the DOE complex. Tokamaks create high heat and particle fluxes which can cause significant erosion of the reactor wall materials. If these materials contaminate the core plasma, it could make it impossible to bring the reactor to a temperature high enough to start stable, safe fusion.

The physics program at DIII-D provides plasma edge diagnostics and measurements in the high heat flux fusion plasma environment as part of a collaboration with a multi-institutional team of more than 200 physicists. The facility, located in San Diego, attracts scientists interested in the science and innovative techniques that will enable the development of nuclear fusion as a next-generation energy source. Sandia

collaborates in fusion materials research to test and develop specialized fusion materials for the hot fusion plasma environment.

"Plasma-material interactions deal with what effects the ions and electrons from the plasma have on a material and vice versa," said Jonathan Coburn, who is part of a Sandia team that collaborates with DIII-D. "Magnetic confinement fusion devices use very strong magnetic fields to generate and then confine the plasma, and so all of these ions and electrons are interacting and producing fusion energy. Inevitably, you have exhaust from the plasma that ends up impacting the walls of your vessel."

The different plasma-facing components of such a reactor are made of materials like tungsten, carbon and beryllium, which interact differently when irradiated by ions and electrons.

"One of the engineering challenges for building a fusion device is to select the right materials to build all of these components out of," Jonathan said. "There are plasma physics-based problems that you're trying to optimize for, and then there are engineering challenges that you're trying to optimize for. Those challenges are different depending on which type of component you're building."

NUCLEUS OF THE TEAM — The Sandia team performing materials experiments at the DIII-D National Fusion Facility includes, from left, Jonathan Coburn, Jon Watkins, Ryan Hood and Dinh Truong.
Photo courtesy Jonathan Coburn

Jonathan and the team perform physical and computational experiments to test material erosion, macroscopic damage, gas retention and recrystallization for tungsten samples after those high-energy interactions.

"The majority of the components in DIII-D are made of carbon, and so in order to perform experiments using different materials, you have to actually have a specific test stand to insert your materials of interest, stick it into the vacuum vessel so it can get close to the plasma and then get your exposures," he said.

Not only must the team figure out how the materials are damaged by the fusion environment, it must also understand how the energetic byproducts of these plasma interactions are retained in the exposed material.

"When those hot ions impact the material surface they are implanted in the material and neutralize. The length scale for that implantation can vary depending on several factors, and you end up having to figure out what the long-term effects are for what's implanted," Jonathan said. "Does it diffuse into the bulk material? Is it eventually released from the surface? What are the consequences of the long-term build-up of implanted species in the material?"

DIII-D creates plasmas with hydrogen, deuterium and helium. In a power-producing reactor, the main fusion interaction will be between deuterium and another hydrogen isotope, tritium.

RADIATION RESISTENT? — The materials container that Sandia researchers at the DIII-D Nuclear Fusion Facility use to test samples is shown with seven samples of innovative tungsten alloys, post-exposure.
Photo courtesy Jonathan Coburn

"What you get out is what's referred to as an alpha particle and a high energy neutron. The neutron comes out with 14 mega electron-volts of energy that provides the power that you're then trying to harness to boil water and create steam, turn a turbine and produce electricity," Jonathan said. "There's also tritium that is not used up in the core plasma but ends up in the exhaust. Tritium is naturally radioactive and is the main concern from a nuclear regulatory standpoint. How much tritium builds up in the machine over time? I'm seeing if certain alloys of tungsten retain less tritium than others. I am also looking at whether specific materials can prevent the diffusion of tritium through the bulk material, serving as a barrier so that the tritium stays in one place and doesn't go off into the cooling water, for example."

The work to make fusion power generation safer and more reliable is being incorporated into the next generation of tokamak reactors. The best example is the ITER tokamak being constructed in France. ITER, meaning 'the way' in Latin, is the largest such reactor. For 50 megawatts of input heating power, ITER will be able to generate 500 megawatts of output power. The team's work is going to impact that project and help ensure ITER's success in producing safe, reliable net fusion energy.

"A lot of the earlier work that was done on DIII-D contributed greatly to the overall design of the ITER tokamak," Jonathan said. "It's pretty exciting to be able to have the opportunity to do these high-level, high-stakes experiments for the DOE and to advance fusion energy sciences. It's just a really satisfying feeling for sure."

Jonathan credited the commitment of his team — Jon Watkins, Dinh Truong, Ryan Hood, Robert Kolasinski, Richard Nygren and Bill Wampler — with advancing the understanding of fusion energy and enhancing Sandia's reputation for engineering solutions to national and international issues.

FUTURE OF FUSION — Sandia researcher Rob Kolasinski stands underneath the DIII-D tokamak reactor preparing to insert a material sample into the chamber. **Photo by Ryan Hood**

Memory tech

CONTINUED FROM PAGE 1

Sandia project lead James Laros said, "This effort will focus on improving bandwidth and latency characteristics of future memory systems, which should have a direct impact on application performance for a wide range of ASC mission codes."

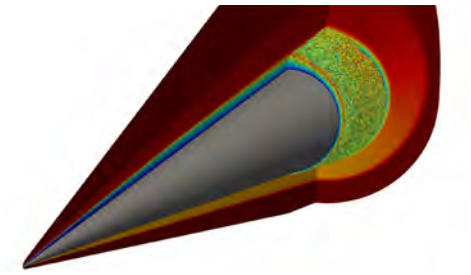
Anil Rao, vice president and general manager of Intel's Systems Architecture and Engineering group, said, "We are already anticipating what future platform challenges must be solved for the next generation. We believe the Advanced Memory Technology program will help us generate support for the next decade of innovation."

Intel Fellow Josh Fryman said, "We are rethinking fundamental aspects of how DRAM — dynamic random-access memory — is organized and coupled with compute platforms for breakthrough performance. We intend to fundamentally advance computer system architecture by studying the hardest problems from scientists at Sandia, Lawrence Livermore and Los Alamos national laboratories. Mainstream memory isn't designed for today's compute platforms, and this multiyear effort will help us to extract orders-of-magnitude performance gains from the basic DRAM design itself – thus enabling a new class of performance across all industry segments. We hope to see these innovations pushed into industry standards to lift the entire ecosystem."

The new contract is part of NNSA's post-Exascale-Computing-Initiative investment portfolio, which seeks to sustain the technology research and development momentum, and strong engagement with industry that the initiative had started via its PathForward program. It aims to foster a more robust domestic high-performance computing ecosystem by increasing U.S. industry competitiveness in next-generation technologies.

"Intel and the ASC program have a long history of partnering to explore new technologies for our HPC system deployments. The project with Intel being announced today will provide important improvements in memory technologies that can support our production workloads," said Simon Hammond, federal program manager for the Advanced Simulation and Computing Computational Systems and Software Environments program.

"Investing in technologies that have the potential to increase the efficiency of our ASC mission applications is critically important in support of our stockpile stewardship mission," said Robert Hoekstra, senior manager of the extreme scale computing group at Sandia. "This collaboration shows great promise in supporting our future mission goals."



SMARTER PREDICTIONS — Developed at Sandia, a high-fidelity simulation of the hypersonic turbulent flow over a notional hypersonic flight vehicle, colored grey, depicts the speed of the air surrounding the body, with red as high and blue as low. The turbulent motions that impose harsh, unsteady loading on the vehicle body are depicted in the back portion of the vehicle. Accurately predicting these loads are critical to vehicle survivability, and for practical applications, billions of degrees of freedom are required to predict physics of interest, inevitably requiring massive computing capabilities for realistic turnaround times. The work conducted as part of the contract awarded to Intel Federal LLC aims to improve memory performance that can greatly benefit mission applications like this one. **Simulation by Cory Stack**

TEAM SUCCESS — The team that successfully moved the nuclear bomb trainer included the NNSA federal program manager and Sandians.

Photo by John Korbin

Trainer transported

CONTINUED FROM PAGE 1

multiple teams across Sandia, including the Structural Services team, the **Accident Response Group** and the Legacy Hardware Laboratory team, the Mk-17 Legacy Nuclear Weapon System trainer was the latest item in the Weapon Dismantlement and Disposition Program to be moved into the final stage of its lifecycle.

Retirement, dismantlement and disposition is an important step in the **lifecycle of a nuclear weapon**, the last but essential phase that ensures our nation's nuclear arsenal remains safe and secure. In Phase 7, a weapon is carefully taken apart piece by piece, and the internal components and materials are identified and disposed of.

Sandians play a key role in this critical step. During dismantlement they must identify all hazards and determine its appropriate disposition path. In the case of a trainer, which has no nuclear material, care must still be taken to ensure there are no other hazards within the internal components.

The process of dismantling and disposition will continue over the next several weeks. To see a replica of the massive Mk-17 bomb, visit the **National Museum of Nuclear Science & History**.

MAKING MOVES — The team carefully removes the 25-ton nuclear bomb trainer from a storage facility for transport to Kirtland Air Force Base.

Photo by John Korbin

How we know they work

Sandia's Weapons Evaluation Test Laboratory simulates everything a weapon would experience

By **Myles Copeland**

Larry Kuykendall doesn't expect everyone to love Amarillo, Texas, but he does.

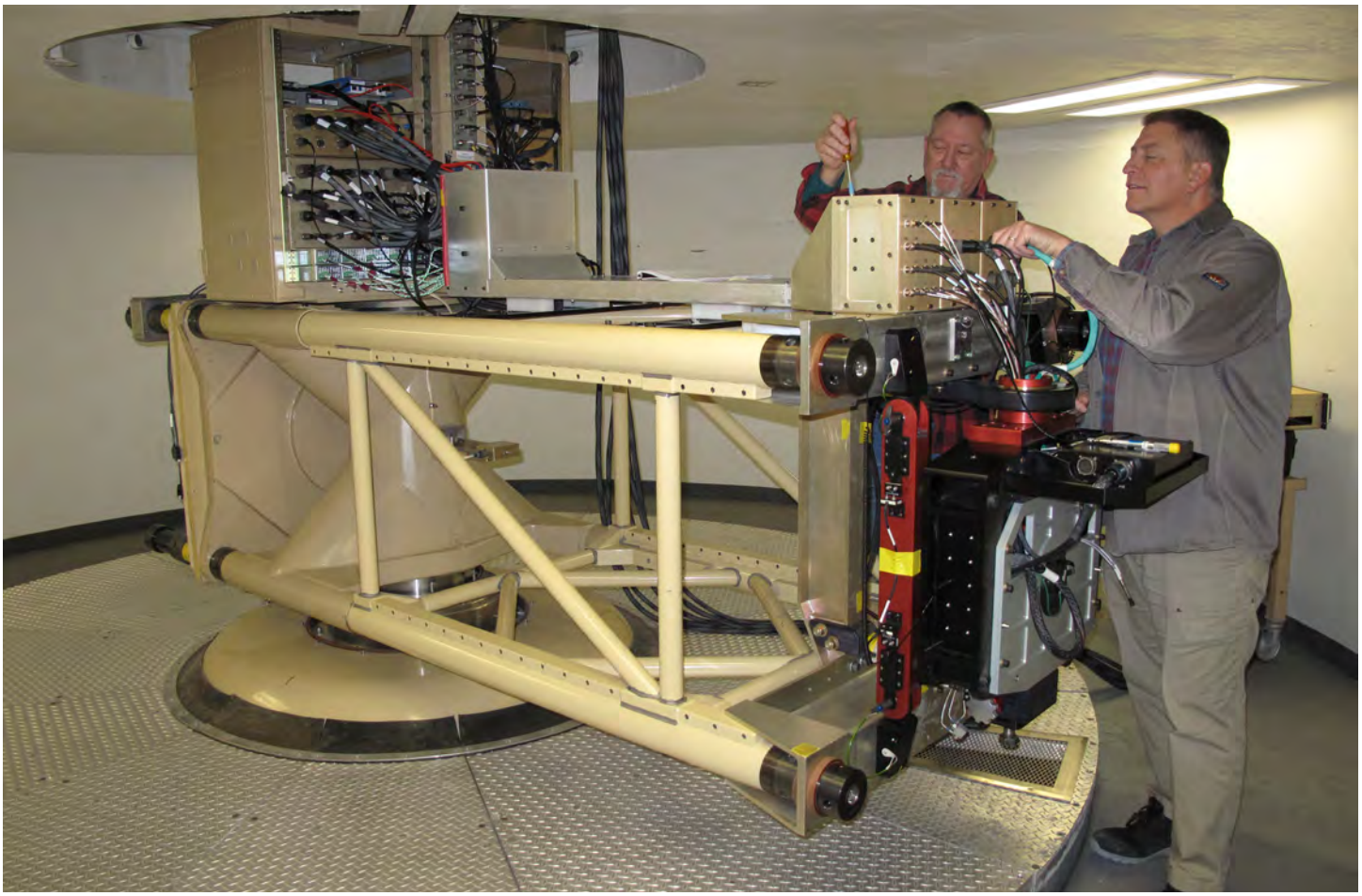
"People that live here love it," said Larry, who was raised in Dumas, Texas, about 45 miles north of his current home in Amarillo. "A big part is the people and how friendly people are. Amarillo is big enough so you have city life, but then it's like a small town… Cooler, dryer summers than Dallas… People take pride in what we do."

What Larry does, along with his colleagues at Sandia's Weapons Evaluation Test Laboratory, is ensure that the United States' stockpile, including newly developed weapons like the B61-12 and the W88 Alt 370, works as intended.

Located at the nuclear security enterprise's Pantex production facility, the testing laboratory puts the non-nuclear components of bombs and warheads through their paces, simulating everything they would experience from launch through impact, and capturing and analyzing more than 1,000 channels of data that provide a detailed picture of the weapon's performance.

"Our job is to find anomalies," said Larry, a team lead at the testing lab. "We're not hoping for a failure, but if there's an issue, it's important that we address it before it becomes an issue out in the stockpile."

To simulate the actions and environments a warhead would experience, from the mind-bending acceleration of a missile launch through the instant stop at target and the series of extreme environments in between, the Weapons Evaluation Test Laboratory leverages several rare capabilities. Shaker tables vibrate the system, temperature chambers ensure it works far below freezing and well above the melting point for many materials, and centrifuges accurately



TEST PREP — David Lander, left, and Jason Cochran prepare a centrifuge for a test at Sandia's Weapons Evaluation Test Laboratory in Amarillo, Texas.
Photo by Larry Kuykendall

simulate the weapon's entire flight path.

While the testing requires long days to conduct pretest calibrations, run the test and finish post-test calibrations, the lab's four 10-hour days per week schedule affords staff a level of work-life balance.

The testing lab also provides constant opportunity for professional growth.

"You can learn something every day here," said team lead Brandon Hill, who had just earned his engineering degree from Amarillo College when he answered a newspaper ad to work at the weapons testing lab in 2002. "Our systems are so complex, it takes years and years to learn. If you're not learning, you're not trying."

Between surveillance to ensure current stockpile assets remain viable as they age and planned testing for future additions to the nuclear deterrent, like the W80-4 and W87-1, the team expects a high volume of activity for the foreseeable future.

"We're booked to the end of the decade," said manager Suzanne Helfinstine, who graduated from Texas A&M University and joined Sandia after gaining experience at several nuclear security enterprise sites.

To meet the need for this work and mitigate risk as the lab's singular infrastructure ages, the NNSA is funding an additional new centrifuge and corresponding expansion. The lab is also seeking funding for space to host new testing equipment that will be needed as the W80-4 program progresses.

Brandon appreciates the larger purpose of the testing lab's work.

"Our job is to find the reliability of the system," he said. "It's important to determine that now, so America and our allies can be confident in our nuclear deterrent."

Mileposts

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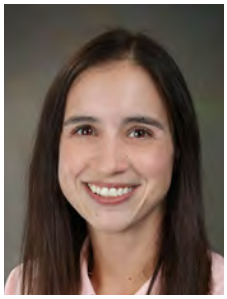

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Questions? Pantex's Tri-Labs Office is here with the answer

Weapons Evaluation Test Laboratory's employees aren't the only Sandians working within 25 miles of Amarillo's Big Texan Steak Ranch, touted on billboards across west Texas with the words "Free 72 oz. Steak Dinner if eaten in 1 hour."

A smaller crew is dedicated to resolving design questions that arise at the Pantex production facility, helping to keep that plant's nuclear explosive assembly and other activities moving. Established at the request of NNSA in 1993, the Tri-Labs Office at Pantex houses representatives from Sandia and, depending on their involvement with the particular systems Pantex is addressing, Los Alamos National Laboratory and Lawrence Livermore National Laboratory.

This on-site expertise is intended to save time as the nuclear security enterprise works toward deadlines in support of national security. Including travel arrangements, it could be 24-to-48 hours for someone to arrive from Sandia in Albuquerque — the Tri-Labs team is able to resolve issues faster.

When Pantex has a question that needs to be answered by the design agency, this team often receives the call. The on-site Sandians are consulted when a process issue is found, a new assembly process is devised, assembly is restarted after a pause and much more.

Team members in the Tri-Labs Office never know how their days will go, but they enjoy having a front-row seat as the Labs' designs are turned into real-world products.

Tri-Labs Sandians express appreciation for the urgency associated with working further downstream in the nuclear security enterprise's delivery of nuclear deterrence products.

"The next person who's going to touch this weapon is the service member," said a Tri-Labs surety systems engineer. "That's important to me."

Defense Programs Awards of Excellence

More than 200 Sandians were honored with the prestigious NNSA Defense Programs Awards of Excellence during a ceremony in Steve Schiff Auditorium on Dec. 1.

Presented annually by NNSA's deputy administrator for Defense Programs, the awards recognize exceptional and significant achievements in quality, productivity, cost savings, safety and creativity in support of NNSA's Stockpile Stewardship Program.

"What you do is so important to national security," Michael Thompson, NNSA principal assistant deputy administrator for Defense Programs, told the crowd of Sandia winners. "There's a very careful vetting process, and the people and teams that end up getting awards are really the best of the best."

Rita Gonzales, Sandia associate laboratories director, Nuclear Deterrence Modernization and Future Systems, followed Thompson to the podium. "The people in this room are heroes," Rita said. "To keep our friends, our families and our country safe, we need to deliver on Sandia's important missions, and every one of the folks we're honoring have gone to heroic lengths to make that happen."

Recognizing work performed in 2021, the awards honored four Sandians — one posthumously, two retired and one current employee — five multimember Sandia-led teams and two Sandia technology transfer teams, totaling 206 participants.

INDIVIDUAL HONOREES

S. Scott Collis

Scott, who died on Sept. 13, created the "Agile Physics Models and Data Centric Computing" strategy for the Sandia Advanced Simulation and Computing Program that subsequently led to the inception and successful launch of the Accelerated Digital Engineering initiative at Sandia in 2021. Scott created this vision in response to the need for a flexible and responsive nuclear weapons enterprise articulated in numerous national documents. His vision is for researchers, analysts and weaponeers to work closely together, spearheading agile methodologies for nuclear weapons components, programs of record and future systems that pave the way for a new era in nuclear weapons design, qualification and certification. The digital engineering initiative is expected to result in better integration between model-based analysis and design and weapon development.

Michael Gomez

Michael retired in mid-2022 after 23 years of dedicated service as an employee at Sandia. Michael worked the last three years of his career as Sandia's manager for Nuclear Deterrence Partnerships and International Programs, which includes managing work under the U.S./U.K. Mutual Defense Agreement. The contributions he made to this special relationship were significant. From his commitment to enabling collaborative exchanges to his ability to prioritize resources, his contributions undeniably benefited the MDA. For example, Michael's commitment to effective resource allocation allowed him to expand the number of personnel in his office dedicated to supporting the agreement. He also initiated an effort to improve information exchange by creating a collaboration site for the exchange of unclassified MDA information between the two nations.

Jim Handrock

For more than a decade, Jim served as the director of Sandia's New Mexico Weapon System Engineering Center, where he was responsible for multiple, high-visibility nuclear modernization programs, including the B61-12, W88 Alt 370 and 940, and Mk21 Fuze programs. To meet these priority needs for the nation, Jim developed high-performance leadership teams, which in turn produced strong program execution to meet the volume and complexity of system integration and non-nuclear component development needs of the nuclear security enterprise. Jim's role as a leader was critical to the success of the Labs and the enterprise at large, and his experience was essential to guiding modernization programs through some of the biggest challenges the Labs have faced. Through this extremely complex modernization portfolio, Jim engaged in critical issues and assured roadblocks to success were eliminated. He consistently demonstrated a principled approach to addressing an individual program's largest challenges while always keeping the end in mind, assuring a future deterrent that will credibly provide the safety, security and reliability demanded in the nation's stockpile. After a career spanning 35 years, Jim retired in August.

Tim Snider

Tim led two separate anomaly resolution teams for the B61-12 program. These teams, which in one case included engineers from Sandia, the Kansas City National Security Campus, the NNSA and the Air Force, successfully determined root causes. With Tim's leadership, these efforts enabled qualification of the B61-12 on the B-2A bomber and on-time delivery of the B61-12 first production unit.

TEAM HONOREES

Stockpile Responsiveness Program Davis Gun Test Team

The Stockpile Responsiveness Program Davis Gun Test Team demonstrated technical excellence by completing five multilaboratory and large-scale tests in 2021 utilizing Sandia's large diameter Davis Gun. The tests significantly advanced knowledge and capabilities both in fielding materials and components for severe mechanical environments, as well as in demonstrating test capabilities to rapidly execute experimental testing in severe mechanical environments. The knowledge and experience gained through these tests advanced the Defense Program's ability to respond rapidly to identified future deterrence needs. This will likely enable multiyear reductions in specific future programs. The test series also demonstrated effective teamwork and coordination across multiple laboratories and partner agencies.

W80-4 Environmental Specifications Team

The W80-4 Environmental Specifications Team worked through the challenges of an aggressive schedule and concurrent missile development by collaborating across disciplines and by developing and applying innovative techniques. The team provided the W80-4 Life Extension Program component teams the data needed for qualification testing and a subsequent final design review. It also helped the Air Force develop the Stockpile-to-Target Sequence, a document critical to W80-4 development. These achievements were instrumental in modernizing the W80-4, a crucial element in the nation's nuclear deterrent.

Weapon Modernization Assembly and Quality Team

The Weapon Modernization Assembly and Quality Team demonstrated uncanny resilience and commitment to keep complex lab and assembly operations on track 100% without a late deliverable despite the COVID-19 pandemic. The team worked on-site throughout the pandemic and delivered every B61-12, W88 Alt 370 and Alt 940, W80-4 and W87-1 activity as scheduled, assembling or disassembling over 70 units in 2021. The team managed this technically diverse modernization work while maintaining a flawless safety and security record that spanned more than 560 days without an injury or security infraction. Its efforts were pivotal to NNSA's success during this high-tempo modernization cycle.

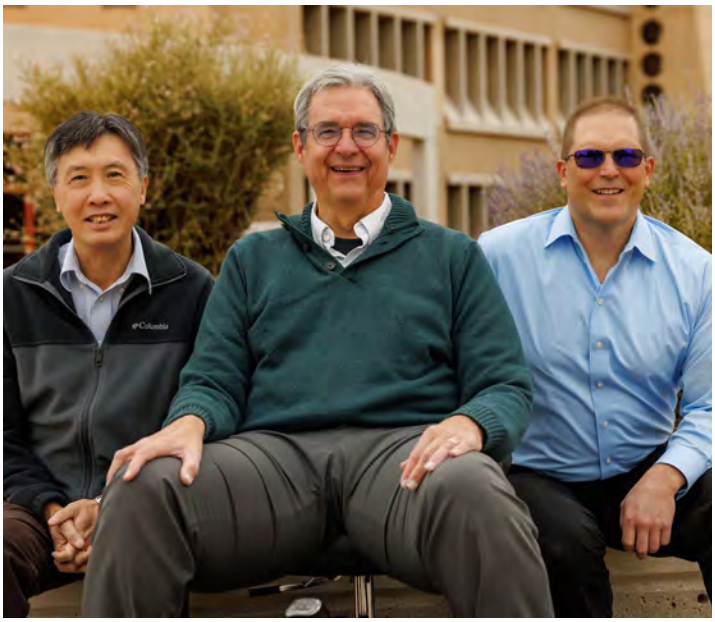
Tonopah Test Range Operations and Missions Support Team

The Tonopah Test Range Operations and Mission Support Team delivered on all testing assignments in 2021, advancing B61-12 qualification and completing reliability stockpile surveillance testing. The team's performance was a linchpin for B61-12 qualification and enabled the program to progress to the first production unit. The team was also a key contributor for the F-35 Dual Capable Aircraft certification and subsequent U.S. Air Force Association's bestowing the prestigious Order of Daedalians Weapons System Award to the F-35 Joint Program Office. The team planned and conducted multiple weeks of flight tests to enable NNSA to meet Congressional and NATO milestones. The range also integrated multiple technical initiatives and mission facility enhancements to improve mission and infrastructure reliability for many years. Tonopah Test Range delivered mission success with zero safety and security incidents in 2021.

Pull-Out-Switch-Assembly Contact Ring Diagnostics Team

Helping to deliver the B61-12 first production unit on schedule, this team developed a non-destructive diagnostic that was used to evaluate of thin-film thicknesses for 100% of the programs' pull-out-switch-assembly contact rings. This innovation allowed acceptance of parts for the B61-12 after destructive statistical sampling resulted in a scrap rate that would have impacted on-time delivery of the first production unit. Sandia's team worked with Kansas City National Security Campus to screen and pass the needed parts keeping the program on schedule, while providing high confidence in these contact rings. This technique also shows promise for application to other production challenges that would benefit from non-destructive thickness measurement.

TECH TRANSFER HONOREES



Advanced technique for chip-level authentication and evaluation

To ensure mission success, NNSA requires that all nuclear deterrence electrical components be authenticated. Using Power Spectrum Analysis with an unconventional biasing scheme to power microelectronic devices, researchers from Sandia developed a nonintrusive, nondestructive technique to authenticate various microelectronic devices. Understanding the potential benefit of the analysis to the electronics market, but realizing the significant cost factors, Sandia submitted the technology to the NNSA NA10.1-sponsored FedTech program for commercialization. After signing a research license with Sandia through the program, Chiplytics was founded in 2021 with the goal of providing a user-friendly, cost-effective Power Spectrum Analysis testing procedure to the commercial electronics market. The company has the potential to save the electronics industry tens of millions of dollars and ensure the authenticity of microelectronics used within nuclear deterrence and national security programs.

Radio-imaging diagnostic for critical component defect detection

The NNSA has an interest in high-energy density, high-reliability capacitors — devices that are often utilized in nuclear deterrence. In 2021, Sandia entered into a Cooperative Research and Development Agreement with TPL Inc., a company specializing in capacitor design, testing, evaluation and manufacturing that has developed custom capacitors. As part of the CRADA, TPL was awarded funding through the New Mexico Technology Readiness Gross Receipts program, which will support critical advances of its domino-style nanocomposite enhanced ceramic capacitor. As a result of the CRADA, Sandia's team demonstrated a radio-imaging analysis method for electrical components and detecting discharge or breakdown in commercial capacitors, transformers, grid-transmission components, and high-reliability aerospace and satellite systems. Radio-imaging will improve the technical basis for qualification and design of nuclear deterrence and pulsed-power components, including TPL's capacitors, enabling nondestructive testing of device limits and validating reliable performance.

A power tower rises

SOLAR PLANS — A time-lapse camera, front right, has been placed on-site at the National Solar Thermal Test Facility to capture the construction of the Generation 3 Particle Pilot Plant, rendered on the right, to demonstrate integrated particle-based concentrating solar power with six hours of thermal energy storage. Construction on the tower is planned to begin in February.
Photo by Bret Latter; Rendering by Jeremy Sment and Kevin Albrecht

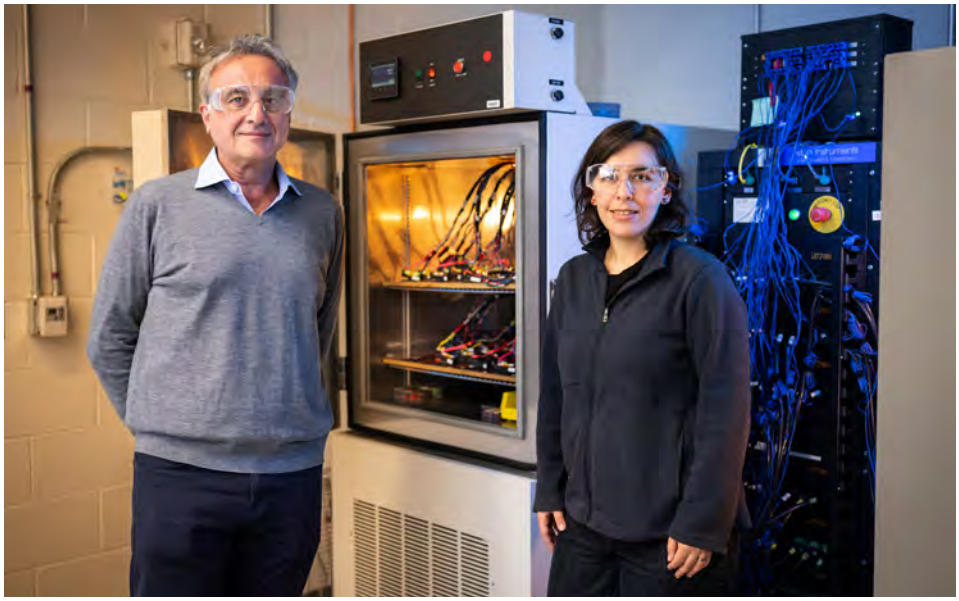
International team plans to transform battery databases

Battery Data Genome aims to spur innovation, green economy

By **Mollie Rappe**

A consortium of researchers, including Sandia battery experts Yuliya Preger and Valerio De Angelis, are working together to stimulate battery innovation by developing battery databases. Ultimately, they hope to expand the role of batteries in supporting the transformation of electric grid infrastructure including the integration of renewable energy resources and electrification of transportation systems.

The team, which includes scientists from other DOE labs as well as academic and industry research institutions around the world, published their **proposal and call to action** in the scientific journal Joule last October.



A BATTERY OF DATA — Sandia battery experts Valerio De Angelis, left, and Yuliya Preger are joining scientists from academia, industry and government research institutions around the world in a call to fuel battery innovation by developing battery databases. Here, they stand beside a battery test that has been running since 2017. The data from this experiment will eventually be included in the Battery Data Genome project. **Photo by Craig Fritz**

Their project, called the Battery Data Genome, expands on the Sandia-supported **Battery Archive**, Yuliya said. The Battery Archive was the first public multi-institution repository of battery degradation data.

"In the last couple of years, the Battery Archive has been used by thousands of people in more than 60 countries to easily visualize and compare battery degradation data," Yuliya said. "These users have included undergraduate students working on class projects, software developers needing battery data to test new models, developers of non-battery energy storage who want to understand how batteries degrade and utility engineers who want to incorporate basic battery degradation into technoeconomic analyses. The impact of the Battery Data Genome would be far greater."

Building better databases

Like the Human Genome Project, the Battery Data Genome aims to develop large battery databases with flexible sharing options to spur innovation in the development of battery technologies.

"The electrochemical science that is urgently needed for a zero-carbon economy requires state-of-the-art data science," said Susan Babinec, Argonne battery scientist and project co-lead. "Tackling the extremely complex technical questions that battery scientists face requires huge amounts of data to generate AI and machine learning algorithms."

The team calls for researchers from basic discovery science to engineers involved in large-scale energy-storage projects to join, first to develop data standards, and then to generate and share data. The project aims to develop standardized, globally accepted methods for data generation, formatting and archiving data. These standardized methods and

formats will enable sharing of information between the various specialized databases.

These databases will be particularly helpful for data scientists, as large sets of data are necessary for algorithms such as machine learning and artificial intelligence. These algorithms can glean insights not readily apparent from the raw data and the team hopes that this will inspire battery innovation from basic discovery research to real-world energy-storage projects.

Databases for climate security

The team hopes that improvements in data science will decrease the time, money and risk of developing, scaling up and deploying new and improved battery technologies, thus spurring more investments in battery technologies and large-scale energy-storage projects. They hope that this will increase the rate of building new energy-storage projects and electrified transportation modes, ultimately reducing our reliance on fossil fuels and mitigating the impacts of climate change.

"When working at the City College of New York and Urban Electric Power, I experienced how difficult it is to relate lab data with field results," Valerio said. "The Battery Data Genome collaborative will provide tools that the community can use to standardize and simplify data analysis and reduce the time it takes to bring new battery technologies to market."

Yuliya and Valerio's work is supported by DOE's Office of Electricity, Energy Storage Program under the direction of Imre Gyuk. Other institutions involved in the Battery Data Genome project so far include Idaho National Laboratory, National Renewable Energy Laboratory, Germany's Aachen University, Carnegie Mellon University, Oxford University, University of Chicago, University of Hawaii, University of Illinois at Chicago and University of Washington. Also involved in the project are the Faraday Institution in the UK; Helmholtz Institute in Germany; SINTEF Industry in Norway and Toyota Research Institute in California.

Sandia steps up, gives back during the holidays

By **Michael Ellis Langley**

In addition to contributing to the nation's security, Sandians impact the communities where they live and work.

In efforts large and small, the very DNA of Sandia is rooted in the call to action to respond in times of need, and many Sandians live by that philosophy.

Sandians have given money, items and many hours of service. As we reflect on 2022, it is important to understand how much we have impacted the world around us.

Toys for many children

The annual Toys for Tots campaign, through a collaboration between the U.S. Marines, Sandia Safeguards and Security, Emergency Management, and Shipping and Receiving teams, shared holiday cheer with many families by collecting 1,004 gifts in New Mexico and California.

The Toys for Tots drive, which ran Oct. 28 to Dec. 8, asked Sandians to give new, unwrapped gifts. The team at Sandia/California collected 190 toys and Sandians in Albuquerque, joined by Air Force and Space Force members at Kirtland Air Force Base, gave 814 toys. Sandia has teamed with the Marines since 2009 with the hope that helping less-fortunate children will inspire them to continue to be responsible and productive citizens. The Toys for Tots effort was coordinated by Jamie Duranleau and Kaela Angelo in Livermore and Todd Harrison and Jacque Ramirez in Albuquerque.

TOYS FOR ALL — Amanda Tafoya helps unload boxes at Toys for Tots in Albuquerque. Sandia donated 814 gifts and two bikes to the nonprofit on Dec. 8. **Photo by Craig Fritz**

Showing the holiday spirit

Sandia/California staff donated presents to 150 northern California children through the Holiday Spirit Gift Campaign, organized by Karelyn Baker. Karelyn and Sandia partnered with the Boys & Girls Clubs of Tracy, Lotus Bloom Alameda and the Food Pantry at Marylin Avenue Elementary School in Livermore to provide a gift for each child.

Making wishes come true

Sandia's annual Holiday Gift Drive donates gifts to children in foster care in Bernalillo County. The program, organized by Roberta Rivera, helped brighten the holidays for 817 children who received donations from generous employees. Sandia is the only sponsor for this annual effort.

Warm coats, warmer hearts

The 11th Annual One Warm Coat drive held in October yielded 175 new or gently used coats and jackets for families in need, said organizer Krissy Galbraith. One Warm Coat is a nationwide nonprofit that started in the Bay Area. The organization facilitates coat drives, collecting warm outerwear that is distributed through nonprofit partners across all 50 states.

In addition to donating coats on campus, Sandians cleared an Amazon wish list of jackets. Krissy said that many Sandians wrote encouraging notes to the recipients of the coats and placed them in the pockets. This year, the donated coats were donated to GLIDE, a nonprofit that provides vital services to individuals and families in San Francisco.

WARM WISHES — One Warm Coat organizer Krissy Galbraith delivered new and gently used coats to GLIDE, a nonprofit that assists families in San Francisco. **Photo by Spencer Toy**

GENEROUS CREW — Sandia Safeguards and Security, Emergency Management, and Shipping and Receiving teams partnered with the U.S. Marines for the annual Toys for Tots campaign in Livermore. **Photo by Spencer Toy**

FASTER DELIVERY — Deputy Labs Director Laura McGill listens to an audience member's question during the Accelerated Product Realization Symposium last month. Implementing an accelerated product realization approach is one of many efforts that support the Labs' strategic goals. **Photo by Craig Fritz**

Improving mission delivery highlighted at day-long technical symposium

By **Jennifer Awe**

Transforming decades-old business and engineering practices takes time and bold ideas. It also takes a village, and that village came together last month at Sandia.

Participants in a day-long symposium tackled accelerated product realization — a Sandia strategic milestone — sharing concepts, accomplishments and lessons learned. The milestone is driven by national security needs as a complex combination of a dynamic geopolitical climate, parallel modernization programs and fiscal constraints all point to moving faster, saving time and resources, and greatly increasing agility without sacrificing quality.

In early 2022, Sandia leadership asked multidisciplinary teams to develop plans to implement an accelerated product realization approach, aimed at reducing the time it takes from nuclear weapon program conception to full-rate production by driving transformational business practices and engineering methods.

Associate Laboratories Director Rita Gonzales kicked off the day by thanking the teams for their dedication and collaboration and stressed that this is a Sandiawide effort.

"To become faster and more efficient, we need solutions across the Labs," she said. "We need to challenge how we have realized product in the past and look for opportunities to improve."

The symposium included presentations from teams on the capability areas of agile methods, digital engineering, modeling and simulation, accelerated business practices, knowledge gaps, accelerated hardware development and delivery, and weapons architecture.

Presenters shared progress ranging from software created to enable sharing lessons learned across the Labs, to mitigating roadblocks in procurement, to using modeling and simulation to provide thermal battery options three times faster than traditional methods. Each presentation allowed time for discussion with the more than 350 Sandians who attended at the Steve Schiff auditorium and those who joined online.

Building momentum

Moving forward in 2023, the milestone will focus more heavily on applying digital engineering tools earlier in processes to further accelerate delivery. Such tools include computer modeling, software and other digital technologies to assist in the creation, testing and analysis of engineering designs.

"We're leveraging digital processes to minimize the risk of human error when moving across the production process," said manager Justin Serrano. The team elaborated on what that means for Sandia's nuclear deterrence mission and shared recent examples of how applying digital engineering practices helps reduce timelines and streamline work.

Deputy Labs Director Laura McGill reinforced the importance of faster decision-making combined with digital engineering during her

address and shared tangible examples of ways leadership has leaned in to improve operations and capabilities, with plans to do even more this year.

"We need to apply modeling and simulation early in the design phase," she said. "We have strong examples of success in conceptual design and test planning, but we still have room to grow in detailed design. Until we have our component design community writing requirements for modeling and simulation developers that support earlier design decisions, we're not taking full advantage of these technologies."

Laura spoke about initiatives that are enabling Sandia to deliver products faster, including Technical Expert Networks, where Sandia's top experts in technical domains provide a framework to resolve roadblocks faster.

"We've made great progress here, with our partners at other labs, NNSA, and across the NSE (nuclear security enterprise)," she said. "I believe we still need to work on our risk tolerance and developing modular component and test architectures so that we're all aligned on the path forward."

Call to action

A common theme for the day was that it "takes all of us" and teams asked for support from the audience. Advanced Systems and Transformation Director Ernie Wilson closed the event via video.

"We need leaders thinking about opportunities in both new and existing work to increase the pace of delivery — whether it's in Human Resources, Supply Chain, Facilities, Security or across the national security missions," he said. "We're built for hard problems at Sandia."

Sandians interested in learning more about these efforts should contact DigEng_APR@sandia.gov or visit the symposium webpage.

Milestones make a difference to Labs' mission

Accelerated product realization, the topic of a lively symposium last month, is just one of several milestones that organizations across the Labs are working hard to accomplish this year, and all of them feed into the overall Sandia **strategy**.

"Wherever people work, and whatever their role might be, they are contributing to at least some of one or more milestones and to the overall strategy," said Cally Maloney, an executive strategy professional. "Accelerated product realization is truly enormous in its scope and impact on our mission, but efforts to achieve other milestones make a big difference day to day, and to future success."

Milestones are aligned to five-year goals in the plan. Speakers at the symposium recounted how accelerated product realization saw significant progress in 2022 and moved Sandia toward achieving its goal to radically improve mission delivery. In fiscal year 2023, the milestone continues moving toward the goal as "accelerated hardware and software delivery through digital engineering," which was discussed extensively during the symposium.

Among other Labswide efforts that tie directly to the **2023 milestones** are reinvigorating Sandia's role as systems integrator across the nuclear security enterprise, improving practices in project management and supply chain resilience, better recruiting and retention, redesign of the performance management system and building a more agile infrastructure to support the Labs' evolving hybrid workforce.

Small teams across the Labs spent last year developing the milestones, and leadership teams have taken responsibility to marshal people and resources to ensure progress on each. A major focus of the 2023 process was how to plan and complete work in the face of rapid change — in the global picture, in the national security threats Sandia confronts and in the workforce.

The Strategic Plan and goals are key guideposts that help focus attention on who Sandia is, where it's going and how it plans to get there, Cally said.

"Our goal in Strategy and Executive Operations is to help everyone understand how the Strategic Plan and the milestones connect directly to their work," Cally said. "It only takes a few minutes to review **materials** that explain the plan, and I think people will be surprised by how relevant the plan is to what they do every day."