SANDIA LABNEWS
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High-energy arcing faults

High-speed fire footage reveals key insights for power plant safety

By ***Melissae Fellet***

VAPORIZED STEEL — High-speed video footage taken by researchers at Sandia shows a high-energy arcing fault vaporizing a steel panel of power plant equipment, providing data that could help keep power plants operating safely.
Photo courtesy of Sandia National Laboratories

High-energy arcing faults are high-power electrical discharges between two or more conductors that can release tens of thousands of amps of current. They can result in explosions that reach about 35,000 degrees Celsius (about the temperature of a lightning strike), vaporizing steel and spewing hot metal particles into the air.

In a power plant, such a fault can spread quickly, which is just the thing Sandia researchers are trying to prevent by finding a new way to peer into the flames. Those flames are filled with useful information that can help keep power plants operating safely.

Sandia fire protection and optical engineers are using high-speed cameras and advanced algorithms, imaging and analytic methods to understand these dangerous arc faults between conductors such as the high-voltage bus bars in a switchgear at a power plant.

Power plants evaluate risk from arc faults by knowing their zone of influence — the distance that neighboring cables and equipment would be damaged beyond functionality. In a nuclear power plant, this helps engineers evaluate the potential of damaging the reactor core if the neighboring equipment plays a role in safely shutting down the reactor.

But precise data about a rapid arc fault is hard to collect. Bright flames and smoke obscure the view, and the high heat destroys many diagnostic instruments. The electromagnetic interference associated with the flash also impairs the ability to collect data.

Sandia optical engineers have a way around those challenges. They often train high-speed cameras on fiery tests at Sandia's blast tube and rocket-sled track. Now they've turned their lenses toward arc faults at power plants.

Working with Sandia fire protection engineers and colleagues at the National Institute of Standards and Technology, the group recently participated in some large-scale tests at an independent lab in Pennsylvania. The project is funded by the Nuclear Regulatory Commission.

Data from the tests will enable researchers to develop a computer model that will predict an arc fault's zone of influence. The results could be applied to low- or medium-voltage cabinets at any facility, said Sandia fire protection engineer Chris LaFleur, who led the Sandia effort.

Power and intensity

Conductors running though these electrical cabinets were traditionally made of copper, the metal on which zones of influence have been determined over the past 50 years; however, newer bus bar systems use aluminum conductors or a combination of copper and aluminum. Aluminum, while less expensive and lighter than copper, is much more reactive during a

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UNDER PRESSURE — Plasma is generated in atmospheric pressure helium between two tungsten electrodes for diagnostic development. **Photo courtesy of Ed Barnat**

Images in a trillionth of a second

Sandia establishes collaborative research facility to study pervasive and versatile low-temp plasmas

By ***Neal Singer***

A collaborative plasma research facility to help researchers worldwide study low-temperature plasmas, the most pervasive state of matter in the universe, is being stood up by Sandia.

The 5-year, $5.5 million project, called the Sandia Low Temperature Plasma Research Facility, is sponsored by DOE's Office of Science. Participants will be selected biannually through a proposal process supported by Sandia and the Princeton Plasma Physics Laboratory, where a similar collaborative facility is being established by the same agency.

Low-temperature plasma — a state of matter, along with solids, liquids and gases — consists of gaseous mixtures of ions and electrons that interact with background neutral atoms or molecules to make them reactive. It also generates energetic photons.

This activity means there's no shortage of plasma uses to study. They decontaminate surfaces, decompose materials and strengthen a wide range of industrial catalytic reactions. Medically, they offer new tools to cut and heal tissues. Plasma makes metal-arc welding possible and lights up plasma lamps.

But that's small scale. Consider that the ionosphere wrapping the Earth is a plasma that carries large electric currents in the polar regions. And low-pressure, collisionless plasmas that generate little heat are of interest to astrophysicists studying plasmas hanging out between stars.

Built-in versatility

"In my view, a collaborative plasma research facility is different from a center for research," said facility leader Ed Barnat, an internationally recognized expert in diagnosing conditions associated with low-temperature plasmas. "While a center can be a team of people focused on a specific subset of plasma science, a collaborative research facility is more customer-oriented: We help the visiting scientists set up their

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NNSA DEFENSE PROGRAMS AWARDS OF EXCELLENCE
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LABNEWS Notes

Waxing poetic

Beekeeper's talents put to use at Sandia's California campus

Story and photos by ***Richard Ellenson***

NEWBIES — Jessica Williams introduces new bees to one of the hives she maintains at a garden center in Livermore, California.

Jessica Williams has worn several hats at Sandia, in some cases quite literally: she dons protective gear, including a hat made of beekeeper netting, when working with the swarms of bees that visit the Labs' California site.

"I'm the one who gets called when there is a swarm onsite," Jessica said. "It's important to save swarms rather than killing them, which some people do out of fear. Bees are important; they pollinate many of the plants we eat, and they make honey. Their decline is a symbol of the dangers of global warming and pesticide use."

Outside Sandia, Jessica and her husband keep an apiary with 300,000 honeybees and sell the honey they produce. She welcomes the opportunity to share her knowledge.

"I started to really get interested in beekeeping in 2009. There was a lot of discussion at that time about the honeybee decline, and I had always been intrigued by entomology," she said.

Jessica's interest was piqued by a friend of her father's who keeps bees, so she took a beekeeping course in Marin County and has been hooked ever since.

"I've always enjoyed science, and this is a way to learn about one aspect of the natural world," she said.

Bees and Sandians — two communities at work

"A beehive is an example of a community working toward a common end, and no bee can live without its hive. All of the bees must do their part in order for the community to survive," Jessica said, comparing beekeeping to working at Sandia.

Jessica's Sandia career has taken her from the Combustion Research Facility to Human Resources, where she leads Sandia/California's student programs. She said a mainstay throughout her time at Sandia has been the quality of her coworkers.

"I really like the people here. There are good people throughout Sandia," she said. "Sandia has always given me opportunities to move around and has allowed me to stay and grow."

Harvesting raw honey

When Jessica first started raising bees, she kept the hives in her backyard. Later on, she moved her operation to a local garden center that wanted to sell its own brand of honey. Jessica bottles raw honey from the bees, selling enough to pay for a family vacation each year.

"Livermore is beekeeping heaven," she said, adding that bees will continue to fly as long as the outside temperature is above 55 degrees, so they can collect nectar on mild winter days.

Jessica and her husband practice foundationless beekeeping, meaning they do not use a preformed foundation to direct the bees' honeycomb design or centrifuges to remove wax. Instead, they crush the honeycomb, strain the honey through a nylon filter to remove the wax and collect the unpasteurized honey directly into bottles. Typically, her six hives yield 20-30 gallons of honey.

Beekeeping requires a smoker, a hive tool with a hook on one end and a pry bar on the other to separate boxes, a bee brush, a veil/hat, gloves, hive boxes and frames. Jessica visits her bees every two to three weeks to make sure the bees are making straight honeycombs, the queen is healthy and laying eggs and pests like mites and wax moths are not hurting the hive.

"A beekeeper cannot walk away from a hive for good and expect it to carry on without problems," she said.

Beekeeping first steps

For those interested in pursuing beekeeping, Jessica recommends spending a few hundred dollars for equipment, starter bees and training (she took a four-part class). She also emphasizes having enough open space for the bees, ensuring a variety of plants nearby to pollinate and checking local laws about beekeeping.

One final tip from Jessica: providing free honey to neighbors may help alleviate their concerns about having extra bees nearby.

BEE HAPPY — Jessica and her husband keep an apiary that is home to 300,000 bees.

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LABNEWS Notes

EDITOR'S NOTE: Lab News welcomes guest columnists who wish to tell their own "Sandia story" or offer their observations on life at the Labs or on science and technology in the news. If you have a column (500-800 words) or an idea to submit, contact Lab News editor Tim Deshler at tadeshl@sandia.gov.

Ambassador Wolcott visits Sandia

GLOBAL SECURITY — From left, Ambassador Jackie Wolcott shares a light-hearted moment with Global Material Security NNSA/DOE Senior Advisor Maegon Barlow and Sandia Associate Labs Director for Global Security Doug Bruder on her tour of Sandia's Center for Global Security and Cooperation. Ambassador Wolcott is Representative of the United States to the Vienna Office of the United Nations and Representative of the United States of America to the International Atomic Energy Agency. **Photo by Randy Montoya**

Built for speed

New Mexico kids design electric cars to race at annual challenge

FULLY CHARGED — During the oral competition, the students impressed the judges with their car design and testing procedures.

*By **Luke Frank***
*Photos by **Bret Latter***

The fastest time from start to finish was 3.422 seconds of pure acceleration down a 50-foot strip. The cars were electric, the students were energized and the event was a gas.

In its 12th year, the New Mexico Electric Car Challenge brought students from across the state to Albuquerque last November to race their team-designed model electric cars head-to-head down a straightaway course.

As Carlsbad Intermediate School Team 2 raced to first place, some students cheered, some groaned and others stared with the intensity of a kid eating a melting ice cream cone.

The challenge, sponsored by Sandia and Los Alamos national labs, attracted nearly 250 students this year, batched in 48 teams of 6th, 7th and 8th graders, to build the fastest model electric car. Student teams from 19 schools in 13 New Mexico communities formed in September, and this event was the culmination of weeks of compelling exploration connecting science and math with hands-on activities outside of the classroom.

The motor and battery pack were required and provided, but the students gathered and assembled the parts, including car body and chassis, axles, gears, wheels and more. Teams were scored on three elements: car design, oral presentations and the actual car races.

While there was ample drama on the race track, the real action started months ago with teams of elementary and middle school students forming, ideas churning, designs emerging, prototypes failing, redesigns succeeding and overall engineering principles being explored and tested in earnest.

Roosevelt Middle School Team 1 from Tijeras told judges that they designed their "Real Deal" hotrod with the body modeled after a Lamborghini to be low tension, low friction, light weight and indestructible. Almost in concert, they explained the several prototypes they built and tested, experimenting with gear ratios. "Our car just wasn't fast enough," said one. "On our fourth try, we had something that was working pretty well," explained another. "Then we built a fifth prototype that was too fast and kept smashing into walls," a third chimed in.

The team, composed of four girls and two boys who took second place overall in the challenge, went on to enthusiastically talk about gears, aerodynamics and power sources. The judges were impressed. "It's absolutely astounding what your team has done," one said. "What an amazing process you've put yourselves through."

"The New Mexico Electric Car Challenge is designed to create and feed a hunger for science, technology, engineering and math," said organizer and Sandia community involvement manager Amy Tapia. "The concepts and excitement that these students bring to their projects demonstrate that hunger. They are unquestionably inspired."

New Mexico Electric Car Challenge results

Overall winners

1st place/$750 school donation:
Carlsbad Intermediate School Team 2

2nd place/$500 school donation:
Roosevelt Middle School Team 1

3rd place/$250 school donation:
Sierra Vista Middle School Team 2

Carlsbad Intermediate School's teams took home five trophies, also placing in the Second-Chance Race Design and Oral competitions. The Carlsbad teams dedicated their cars to fellow students battling cancer.

Roosevelt Middle School's teams took home three trophies, also placing in the Design and Oral competitions.

PROPULSION COMPULSION — Students anxiously compelled their car to the finish line during one of the performance races.

START YOUR ENGINES — Student teams designed and raced electric cars with guidance from their coaches in the 12th annual New Mexico Electric Car Challenge.

HIGH PERFORMANCE — Many teams found themselves making last-minute adjustments or repairs on the spot.

NNSA Defense Programs Awards of Excellence recognize Sandia contributions

The NNSA's Defense Programs Awards of Excellence for calendar year 2018 have been announced, and three Sandia individuals and 31 multi-member, Sandia-led teams have been honored, totaling more than 1,000 Sandians. The awards are based on individual and team contributions to NNSA's Stockpile Stewardship Program.

These prestigious, annual awards are granted to National Security Enterprise teams nominated from across the complex. They are selected by NNSA representatives from the office of Phil Calbos, NNSA's Acting Deputy Administrator for Defense Programs.

Winning teams meet stringent eligibility criteria, require written justification and go through a competitive process. The awards are a significant tradition that started in the 1980s, when Major General Ted Hoover created the DOE Weapons Program Excellence Award. Today, DPAE honors the ingenuity and innovation of the NSE's world-class talent, who make positive advances every day benefiting U.S. national security in an ever-changing and complex global environment.

Nineteen of Sandia's CY18 award-winning teams include members from outside Sandia, including representatives from Los Alamos, Lawrence Livermore and Savannah River national laboratories; Kansas City National Security Campus; Pantex Plant; Y-12 National Security Complex; Savannah River Site; NNSA; U.S. Navy; NASA; U.S. Air Force; Naval Surface Warfare Center; Scientific Applications and Research Associates; University of Michigan and Harvard Smithsonian Center for Astrophysics.

INDIVIDUAL HONOREES

Nathalie Le Galloudec

As a team lead, Nathalie Le Galloudec is shepherding the Labs' stockpile systems into a new area of risk-informed stockpile evaluation. She is responsible for directing local technical-basis activities. As an emergent leader, she is driving innovative approaches to stockpile evaluation and uniting key systems and science and technology stakeholders.

Jonathan Murray

Jon Murray has demonstrated exceptional leadership as an aerodynamics and range safety lead, while delivering credible qualification evidence for the program. Through his efforts, a comprehensive model-based design and qualification process was developed, integrating multiple elements to form a complete characterization of flight performance relative to qualification requirements.

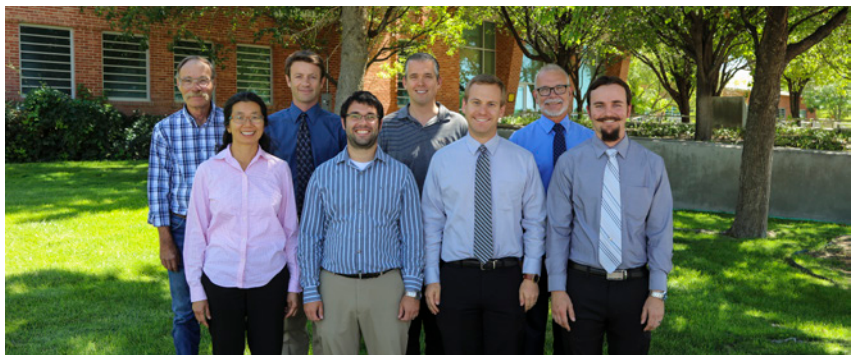
Gregory A. Ten Eyck

Greg Ten Eyck was recognized for his technical leadership in sustaining nuclear deterrence for the coming decades. His strategic thinking, creativity and collaboration are yielding effective concepts and a coordinated set of technology developments. His focus on collaboration is building a growing team across the Labs to deliver innovation to the future stockpile.

TEAM HONOREES

MESA SiFab Nuclear Weapons ASICS Wafer Production

The Sandia Microsystems Engineering, Science and Applications Silicon Fabrication team delivered the largest Application-Specific Integrated Circuits wafer production build in Labs' history to support the B61-12 LEP, W88 ALT370 and the Mk21 fuze replacement programs. MESA successfully met customer commitments by improving performance, quality and efficiency over the past five years. Improvements resulted in increased lot production velocity of 25%, yield improvement of 15% and an overall operational productivity increase of 35%.



W88/Mk5 ALT370 Propellant Fire Testing

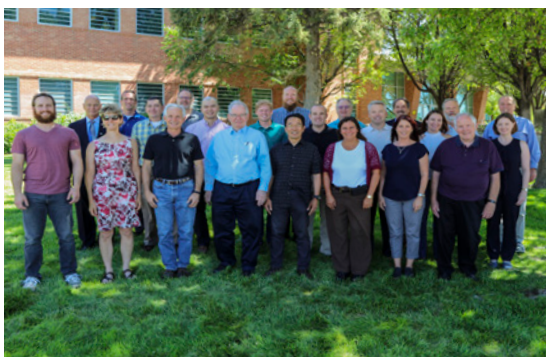
The team successfully developed a new thermal test capability for simulated propellant fire conditions using electrically powered silicon carbide rods (as opposed to performing tests with real propellant). The project was accomplished on schedule, provided substantial cost savings relative to using real propellant fuel and provided good results. Two tests were performed, and data were gathered on both tests. An integrated test and ModSim approach were used with test personnel teaming with ModSim personnel.

SIFTer and Support Tools PRT

The System InterFace Tester is an innovative software-based nuclear weapon testing solution that in 2018 played a key role in multiple use-control and weapon testing and qualification activities. The product realization team demonstrated that SIFTer functionality provides more flexibility, testing and reporting capability than using hardware. SIFTer's automation features reduced the overall time to execute product tests by at least a third and improved the results of the tests by taking out the error-prone manual steps. High demand and limited supplies of hardware such as controllers frequently made their availability for scheduled tests uncertain, but having SIFTer for the testing alleviated the need for the resource-constrained hardware, enabling the testing to remain on schedule and freeing up the hardware for use in other activities.

W87 ALT360 PRT

The W87 ALT360 product realization team successfully delivered Qualification Evaluation Release of the Acorn Gas Transfer System, MC4957 Assembly December 2018, enabling on schedule First Production Unit to the Ultimate User in January 2019. The success of this effort was a result of a strong interagency partnership including personnel from Sandia, Kansas City National Security Campus, Savanah River Site, Pantex Plant, NNSA and the U.S. Air Force working through Military Liaison. This FPU represents the first fielded Acorn GTS in an Air Force ICBM delivery platform. The MC4957 Assembly is an extended life reservoir, reducing the Limited Life Component Exchange burden on the Air Force. The reservoir also provides improved gas deliveries. The W87 ALT360 PRT successfully delivered this reservoir product on time and on or under budget every year. The W87 ALT360 PRT displayed exemplary teamwork, communication and dedication throughout the project.



W88 SFENG Hostile Radiation Environment Assessment

The Hostile Radiation Environment assessment team demonstrated exceptional dedication and execution of the hostile environment assessment for the W88 Small Ferro-Electric Neutron Generator Qualification. The qualification of such weapon components to hostile radiation environments is essential to deliver the First Production Unit to NNSA. The team's extensive evaluation of the survivability, performance and functionality of the neutron generator provided detailed analytical and testing evidence for the qualification of the W88 SFENG to customer-specified hostile radiation environments. The team's dedication, commitment and ability to execute this multi-year effort was exemplified by their energy and creative ideas, which allowed the completion of a major deliverable for the W88 ALT370 within budget, on time for neutron-gamma HEA and early for the x-ray HEA. Three elements enabled success: extension of 3D physics codes for greater evaluation validity, use of all-Sandia workforce coupled with external peer review and leveraging previous work for significant cost savings.

B61-12 Impact Sensor Tester Calibration

The B61-12 Tester Calibration team was able to increase the production yield of the sensor by more than 60% within a three-month period while also significantly improving the production quality. To ensure the product meets minimum performance requirements, sources of error, including calibration uncertainty, must be accounted for in the output acceptance limits. In accounting for tester calibration uncertainty in acceptance limits, it was discovered that the production yield would be significantly reduced to an unacceptable level. As a result, the team was tasked to assess, develop and implement a new mechanical shock measurement system to reduce the calibration uncertainty of the tester, thereby improving the production yield. Additionally, this new calibration system capability has a multi-program impact, as other weapon systems can now calibrate their shock pulse to a higher degree.

Weapon Modernization Lab Operations

The Weapon Modernization Lab team, composed of talented employees representing 13 departments spanning six Sandia divisions, spearheaded the consolidation of lab operations of four major modernization programs (B61-12, W88 ALT370, ALT940 and W80-4) and ensured activities were executed in a safe and secure manner exemplifying the highest standards of engineering excellence. The team performed a huge body of work, including hardware planning for all programs, all hardware operations (inspection, accountability, marking/bonded stores), assembly/disassembly of all test units, W88 electrical functional testing and design agency support to PX production for the B61-12. Team members supported the planning and execution of two B61-12 Hazard Analysis Task Teams and release of peer reviewed weapons response, which laid the foundation for authorization basis to initiate production at Pantex Plant. The team expertly managed more than 100,000 pieces of hardware while executing the assembly/disassembly of more than 80 test units — pivotal to the success of the nation's nuclear weapon modernization programs.

Legacy Classified Weapon Characterization and Disposition

The team successfully characterized and dispositioned 2,500 kgs of accountable nuclear material contained in legacy classified weapon components, while identifying unique items that will contribute to the future training of Sandia weapon engineers. This project exemplifies Sandia's teamwork environment and unique capabilities by using all the right channels in one location, working safely and cohesively to determine each item's path of either retention or disposition based on real-time assessment.

Mobile Guardian Transporter Security Performance Test

The Mobile Guardian Transporter team at Sandia is responsible for the development and qualification of the next generation over-the-road transportation system for the U.S. Secure transportation is a critical element of U.S. nuclear deterrent strategy, and Sandia has been entrusted by the NNSA Office of Secure Transportation with development of the MGT to ensure the enduring safety and security of the stockpile for the coming decades. The MGT Security Performance Test team was challenged to evaluate security performance of design options within a limited budget and time constraint. The team demonstrated creative thinking and problem solving to meet this challenge with an efficient series of scaled explosive tests, completing all tests on budget.

Functional AMAC System Tester 2 Production

The FASTER2 data recorder production team completed its Qualification Evaluation Release and the production of 26 units on time and with exceptional quality to fully support the B61-12 Compatibility Test Unit builds and all pending aircraft compatibility flight tests. The FASTER2 Data Recorder continues to be an invaluable tool for validating the B61-12's Department of Defense electrical interfaces (i.e., signals from the planes on which it flies and the Tail Kit Assembly).

Mk21 Fuze Thunderpipe Airblast

The Mk21 Fuze Program Thunderpipe test series was successfully executed in FY18. The series evaluated Mk21 vehicle response to representative hostile shock environments during the reentry phase. The Thunderpipe team directly leveraged W88 ALT370 lessons learned to reduce costs. The successful design, fabrication and assembly of three reentry vehicles culminated in the execution of seven outdoor explosive tests. The Thunderpipe test series marked a significant milestone for the U.S. Air Force customer and Mk21 Fuze Program, a large Strategic Partnership Project at Sandia.

Astra Supercomputer

The Astra team successfully delivered the first advanced prototype system for NNSA's Advanced Simulation and Computing Program, moving from requirements definition through acquisition to delivery, integration and acceptance of the large-scale computing system in less than 12 months. The team, including system integrator Hewlett Packard Enterprise, exhibited extraordinary dedication to the program by working long hours and overcoming new facility issues to complete system integration and testing by a tight deadline (within three weeks of hardware delivery). This successful integration project involved coordination across several divisions and the collaboration of many teams to ensure that the computer facility was available to site the new system.

HOT Shot

The HOT Shot team exceeded expectations by successfully executing the first HOT Shot flight mission in less than 15 months of effort, culminating in a successful launch on May 23, 2018. Sandia flew a two-stage Terrier-Malamute rocket carrying a payload of seven experiments focusing on enhancing computational models, advanced manufacturing and technology maturation for the W87-1 system and demonstrations of modularity and novel telemetry concepts. This flight capability provides launch environments such as acceleration, vibration, ignition and stage separation shocks similar to those of fielded stockpile systems, allowing rapid maturation of technology and system concepts and exercising agility and responsiveness.

W80-1 ALT369

As a result of this strong Nuclear Security Enterprise/U.S. Air Force partnership, the W80-1 ALT369 limited life component exchange and warhead electrical system reacceptance testing/screening are expanding system understanding and ensuring a credible deterrent until the arrival of W80-4 and beyond.

Joint Technology Demonstrator

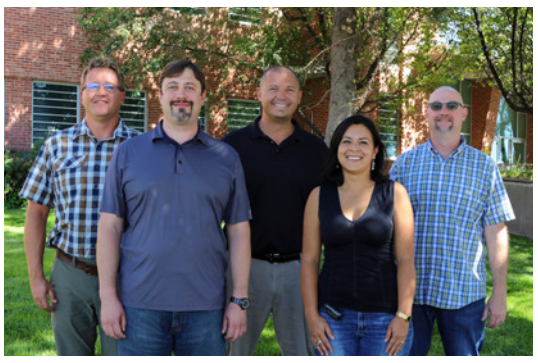
Workstream 1 successfully delivered a baseline design and joint nuclear safety and security themes while maintaining momentum on the component technology maturation. Workstream 2 successfully delivered a multi-lab fit-check unit for a system design and completed a system-level functional demonstration that is maturing new system-level architectures.

W80-4 Model-Based Definition

Applying model-based definition concepts, the design engineering and W80-4 systems team created and released a 3D product definition for a piece part, which represents a major step for improving model quality and manufacturing for nuclear weapon product realization. This is a first piece-part released with formal 3D product definition in the Nuclear Security Enterprise.

100X Agile Simulation Workflow for Stronglinks

The team developed a new modeling and simulation workflow that significantly reduces the time needed to model the mechanical response of stronglinks in both normal and abnormal environments. The previous modeling technique, based on hexahedral finite elements, was cumbersome, slow and expensive, taking up to six months to deliver simulation results of a new stronglink design. The new agile workflow, based on tetrahedral finite elements, reduced that time to a few weeks, with significantly reduced total labor hours. The team overcame numerous hurdles in developing a new tetrahedral finite element applicable to large deformation mechanics, its incorporation in a production high-performance finite-element software and the adoption of agile workflow concepts for model set-up, including a complex geometric defeaturing process.



Threat Vector Model

The Threat Vector Model team developed a methodology to evaluate the residual risk on a system, based on its design features and lifecycle threats. This methodology uses an advanced uncertainty theory (belief/plausibility) to capture and evaluate evidence provided by subject matter experts. Potential scenarios were developed from a comprehensive fault tree analysis of the system's design. The main objective of the TVM was to rank-order scenarios in terms of risk and use this to inform system design selection of features that provide the most security benefit for the most credible scenarios. The study also integrated a methodology that captured the uncertainty within the SME estimates. Capturing uncertainty not only helps with understanding the full significance of the risk, but also in identifying technical basis gaps. The ultimate goal of this work is to provide decision makers with the analysis to make risk-informed decisions on design choices that most benefit the security of their system and then qualify/assess the system against the highest risk scenarios.

Wolter Imager on Z

In 2018, a multi-institutional team of researchers from Sandia, Lawrence Livermore National Laboratory, NASA and the Harvard Center for Astrophysics demonstrated a novel imaging diagnostic, the Wolter Imager, on Sandia's Z machine and applied it to the understanding of warm x-ray radiation sources that are needed to advance radiation effects testing for the nation's nuclear weapons program. The complete imager has been fielded on six experiments on Z, collecting high-resolution images of the x-ray sources that will enable further optimization. This dataset includes three wire-array z-pinches designed to emit at 17 keV and three advanced x-ray sources designed to emit at about 22 keV. In both cases, the Wolter data far exceeded the spatial resolution and signal-to-noise levels previously available with other systems. Detailed deconvolution techniques are required to obtain the maximum information from the imager. Initial deconvolution algorithms developed at Sandia in collaboration with LLNL have illustrated the potential of the new instrument.

Z Line VISAR Development

The Z Line VISAR team completed the design, installation and commissioning of a new diagnostic that will measure current as a function of position near the Z target, providing new insight into pulsed power energy coupling. The team included optical measurement experts, mechanical and control system engineers and scientists from Sandia and Lawrence Livermore national laboratories. The level of coordination between the two laboratories was extraordinary, including exceptional project and budget management for a complex system over an aggressive timeline. The alignment system worked flawlessly during commissioning, including several motorized mirrors in a climate-controlled beam tube that was suspended across the oil and water tanks at Z. The system must endure the extreme shock and electromagnetic environment produced when the machine fires. The Z Line VISAR diagnostic produced data on the first downline shot at the facility, and the high-quality results are now being compared to numerical magnetohydrodynamic simulation of the target for model validation and physics discovery.

Subcontractor Risk Assessments

The globalization of modern supply chains has resulted in many new risks to Sandia's nuclear weapons programs and mission. The potential impact of counterfeit products, tampering, theft, malicious software, poor manufacturing and/or development practices and the influence of foreign governments has become more obvious as new threats and compromises continually emerge. The supply chain risk management team was formed specifically to understand and address these risks. They developed and optimized an effective risk assessment process for critical suppliers, called Subcontractor Risk Assessments. These elevated screening techniques are planned and delivered in a cost-effective way for Sandia's programs (no increase to purchasing burden rates) and demonstrate due diligence to NNSA as a component of Sandia's overall Subcontractor Risk Managment strategy. SRAs are communicated in a concise, one-page format complete with recommendations as well as links to reference materials for those who require additional details about the SRA process and results.

JT5 ALT7 Series Test

JT5 ALT7 Series was a critical test series for the W88 ALT370 electromagnetic qualification. This test series was successfully executed over a two-month test window at the Naval Surface Warfare Center Dahlgren Division. The team overcame huge logistic complications to move this testing ahead about nine months to support a deliverable for the U.S. Navy Special Safety Study, as well as stand up the necessary shipping channels and coordination to transport three test bodies and test equipment to an offsite location. All objectives were successfully met, including verifying that all reentry body configurations are HERO safe, a first for a Navy development program. The team came up with a creative use of limited hardware, completing 13 separate tests on three test bodies. All of this was realized in a time-constrained schedule with unmovable start and finish dates to support the Navy Special Safety Study. The results of this test series are essential to the final EM qualification of the W88 ALT370 system.

Reliability Uncertainty Quantification

Sandia engineers worked diligently to develop and implement methods to quantify and report reliability uncertainty in our nuclear deterrence stockpile assessments to improve STRATCOM's ability to develop and modify plans for holding targets at risk around the globe. The team initiated several pilots to explore candidate methods to quantify the uncertainty in reliability assessments, which resulted in the application of advanced statistical methods to develop a framework and deploy a tool that can use the broad suite of testing to inform stakeholders of our ability to sample defects in the stockpile. The results of the team's efforts allow for enriched nuclear war planning and stockpile stewardship and have opened the door to innovative approaches to support a risk-informed stockpile surveillance program.

High-current Linear Transformer Driver Cavity

The team created a Linear Transformer Driver cavity with unprecedented manufacturability, reliability, repeatability, flexibility and maintainability. This enables LTD pulsed power technology to be the basis for the next generation of high-energy-density drivers for stockpile stewardship applications such as combined radiation environments and extreme pressures. For years, achieving this level of performance was elusive. The state-of-the-art driver a few years ago required maintenance after a few hundred shots even at de-rated charging voltage. Only small cavities could be assembled easily and repeatably, and large cavities suffered from manufacturability woes. Over the past three years, this team dedicated itself to a myriad of technical challenges and succeeded beyond expectations. They used a careful approach that examined and improved nearly every aspect of the technology. The result was a demonstration of exceptional performance over a series of 10,000 shots, equivalent to 25 years of facility operation. The team's impact is game-changing for LTD technology.

W80-4 Weapon Design and Cost Report

Sandia's W80-4 team used programmatic processes and tools more advanced than any prior life extension program to complete the W80-4 Weapon Design and Cost Report, one of the largest deliverables for Sandia and the W80-4 Life Extension Program. The WDCR package is a major deliverable for the Phase 6.2/6.2A period of the LEP lifecycle. Throughout this period, Sandia's WDCR team pursued rigorous schedule and cost analysis activities using defendable, resource-loaded schedules and conducting a formal schedule and cost, risk and uncertainty analysis to estimate program cost. Their pioneering efforts resulted in on-time delivery to NNSA of a comprehensive WDCR package, a critical step in the W80-4 LEP's progression to the next phase of development. The team set a new standard for the amount of detail to include in a WDCR and worked collaboratively with partners across the National Security Enterprise to create a solid deliverable for their NNSA customer.

Mk21 Fuze Flight Test Unit 1

The delivery of the first flight test unit marks the completion of a significant milestone on the Mk21 Fuze Program, a large Strategic Partnership Program at Sandia. The delivery of the vehicle to the U.S. Air Force customer is the culmination of years of effort by many Sandians to ensure the safe and secure delivery of a high quality, flight-ready vehicle that will meet its mission of evaluating the design of the Mk21 replacement fuze.

W76-1 System LEP

The W76-1 Life Extension Program systems team has sustained an extraordinary work ethic and dedication to quality while working to understand and resolve issues to maintain the required production of non-nuclear components, and the resolution of integration and assembly issues, enabling the Nuclear Weapons Enterprise to meet the delivery requirements of our DoD customer, ultimately providing the nation with a safe, reliable and creditable deterrent.

W88 ALT370 Firing Subsystem PRT

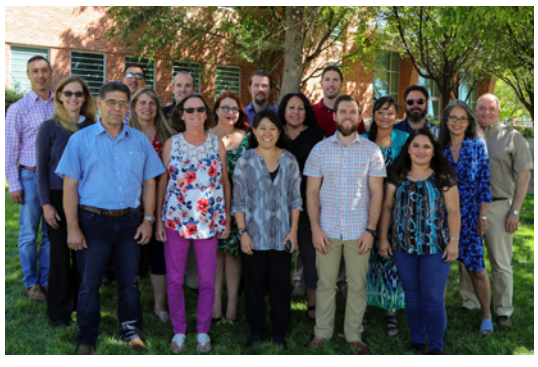
The W88 ALT370 Firing Subsystem product realization team made a significant process improvement after testing in early 2018. Collaborating with partners in various Sandia organizations, the Kansas City Nuclear Security Campus, NNSA and the U.S. Navy, the FSS PRT redesigned, tested and implemented schedule changes enabling performance requirements to be met on the path to production and fielding.

ACRR Reactivity Control System Upgrade

The team successfully completed a system upgrade to ensure continued reliable reactor operation for nuclear weapons program testing and component qualification at the Annular Core Research Reactor. Through performance of the nuclear facility readiness assessments, the project team demonstrated that the upgraded system will perform as expected; that the operations, engineering and support staff were knowledgeable of system upgrades; and that the Tech Area-V processes and procedures were properly implemented to support operations. Readiness assessment findings were addressed promptly and appropriately. The team applied Sandia corporate policies and TA-V processes to perform causal analyses, identify corrective actions, evaluate extent of conditions and take actions to prevent recurrence of issues to the satisfaction of assessors and stakeholders.

Dragonfly Rad-Hard Field Programmable Gate Arrays

The Dragonfly Rad-Hard Field Programmable Gate Arrays development team demonstrated the world's first high-density programmable logic device that is radiation-hardened for the nuclear battlefield. This new class of programmable logic device will reduce electronic hardware realization times from months to hours and will enable unprecedented levels of agility in nuclear weapon system development cycles. Future weapon life extension programs that deploy these strategically radiation-hardened programmable logic devices will benefit from significant cost savings and accelerated schedules. The groundbreaking technical and programmatic approach that the Dragonfly FPGA team pioneered has received noteworthy praise from other U.S. government agencies and their approach is now being adopted by leading aerospace companies.



Weapon Quality Assurance Diamond Stamp

The weapon quality assurance team has successfully received full Diamond Stamp authority, allowing Sandia to accept Mark Quality products as a delegate of NNSA for the first time ever. The two-year process to obtain Diamond Stamp authority resulted after the completion of 20+ Quality Assurances Surveys, which included QAS 4, QAS 3 and QAS 2 audits. To successfully meet the high standards set forth by NNSA, the team had to revise more than 20 work instructions, create a Quality Assurance Inspection Procedure/Certificate of Inspection/Quality Assurance Defect Report process along with revision control, create a new electronic records and employee training process and much more. This effort could not have been completed were it not for the help of the NNSA Sandia Field Office, NNSA Weapon Quality Division and Sandia Production Governance Board.

Experiential design at California

By **Paul Rhien**

Recently tasked by Division 8000 leadership with helping to raise the profile of the Livermore site, the California communications department has developed a strategy and concept that will modernize high-traffic spaces and create an engaging experience across the campus.

"The idea is that as employees and visitors move through these spaces, they are left with a memorable impression of Sandia," said Florencia Prada, California communications department manager. That becomes especially important to the division's strategic priority around attracting and retaining talent, she said, noting that Sandia competes for talent with Bay Area tech companies, which typically have attractive, well designed workplaces.

Over several months, creative designers Loren Stacks and Krissy Galbraith and creative services coordinator Trina West worked with managers Florencia, Donna Djordjevich-Reyna and Craig Tewell to create a branded experience for the café, main corridor and lobby of one of the campus's main buildings. They also worked closely with the W80-4 communications and information management team on the California weapons engineering suites.

"Our approach was guided by two fundamental principles — flexibility and adaptability," Krissy said. "The design needed to accommodate a growing demand for space at the California site and withstand the test of time. It was equally important that our spaces clearly reflect Sandia's culture, mission and values and communicate the important work performed here."

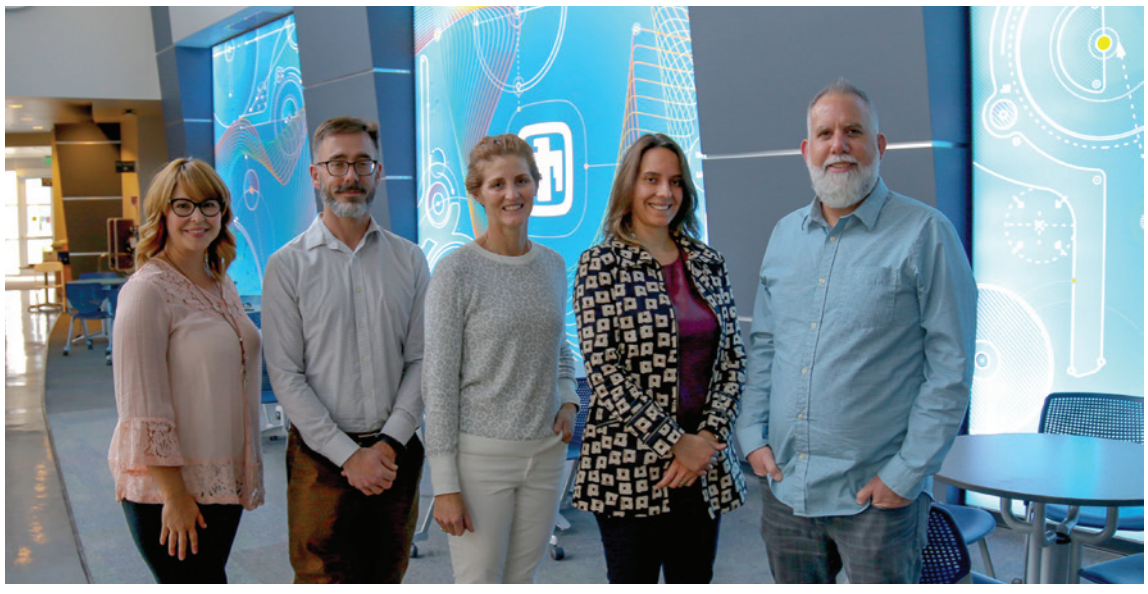
With a background in experiential design, Loren began developing a visual-design concept for several high-traffic spaces across the campus that would leave a statement about the high-impact work conducted at the Labs.

After months of planning and development, the team worked with vendors and the site's procurement, information technology and facilities departments to install new physical design elements in early September. The timing worked out perfectly for an unveiling of the new design at the Sandia/California Family Day in September.

"We didn't plan it that way. It was coincidental that the installation went up the week before Family Day, but it was really nice that we finished just in time," Loren said.

On Family Day, Associate Labs Director for Integrated Security Solutions Andy McIlroy enjoyed showing the new designs to campus visitors.

"It's been wonderful to see the experiential design project come together and hear how well it has been received by the workforce and guests," Andy said. "Feedback has been uniformly positive regarding how we're transforming the campus and creating excitement around Sandia's culture and story."



BRAND AMBASSADORS — The experiential design team created a branded experience in the café and other areas around the California campus. From left, Krissy Galbraith, Craig Tewell, Florencia Prada, Donna Djordjevich-Reyna and Loren Stacks. **Photo by Paul Rhien**

CAFÉ CULTURE — The newly installed experiential design at the Livermore campus café showcases the high-impact work being conducted at Sandia/California. **Photo by Loren Stacks**

California café

In the Livermore campus café, three large LED-backlit fabric panels feature a fun and colorful abstract design that represents various areas of Sandia science and research. The design includes elements from across the Labs, such as molecules for chemistry, waves for physics, cells for biology and engineering drawings. In the center panel, Sandia's thunderbird logo is the focal point of the design.

"All of these elements tie together in the illustration, representing how we're all connected in working toward one mission — service in the national interest," Loren said.

The design includes a diversity and inclusion element with different colored dots woven throughout the illustration, along with lines connecting those dots to each other and to the sciences.

In the days and weeks after the panels were installed, many employees and guests tried to make sense of the numbers, letters and symbols throughout the design.

"It's been fun to see a lot of people engaging with the displays and trying to figure out the different design elements," Loren said. "But it's all just abstract — they don't really mean anything literal."

W87-1 weapons and computing suites

The lobby and corridor of the W87-1 weapons design and computing suites also have been redesigned, complementing the design concept in the café area.

"We had an opportunity to elevate this high-traffic area to a platform to communicate the important work performed in the building in support of Sandia's mission — particularly in

Power plant safety

CONTINUED FROM PAGE 1

high-energy arc fault. This difference can affect how much energy and material an arc fault emits.

To learn about the impact of an arc fault in a full range of electrical equipment with both copper and aluminum conductors, the researchers took their commercial high-speed and infrared cameras to KEMA Laboratories in Chalfont, Pennsylvania, an independent testing lab with unique electrical equipment capable of generating high-energy arc fault conditions.

Optical engineer Anthony Tanbakuchi and lead technologist Byron Demosthenous put the cameras behind a cinder-block wall to get them close to the arc fault while also protecting them from the heat. They pointed the cameras toward high-grade mirrors and recorded the reflection of the explosion at more than 1,000 frames per second.

The team recorded an arc fault that lasted four seconds, with 26,000 amps of current. Reviewing the high-speed footage, the researchers saw for the first time how the steel panel enclosing the switchgear vaporized within half a second of the arc initiation.

"In seconds, a perfectly good cabinet was destroyed," Chris said.

One video, several perspectives

Sandia's optical engineers have developed advanced imaging and analytic methods to show several kinds of data in one video. After collecting video during a test, the group uses algorithms to stabilize and merge footage from multiple cameras.

For the arc fault tests, the fire protection engineers wanted to see through the smoke and monitor the temperature of the flames, so Anthony and Byron also filmed the explosion using thermal imaging. They then combined that footage with a view from a high-speed camera recording visible light from the explosion. The results showed the temperature profile of the explosion relative to the physical equipment without smoke obscuring the view. These efforts allow the researchers to use video as test data.

Another challenge involved accounting for bright flames and shaking cameras. Anthony and Byron set up three high-speed cameras to record the explosion. Each was set to a different exposure so that combining the views produced high-dynamic-range footage with more detail in the bright and dark areas of the image. Then they stabilized the footage with a specialized computer program. The result was a video with enough visual contrast to see where the ejected particles at the edge of the explosion traveled. The particles' movement helps Chris track how the explosion turns energy into speed, momentum, chemical reactions and electrical energy.

Sandia researchers also mounted small rectangles of carbon tape and silica aerogel at various distances in front of the explosion to catch ejected particles, which they collected and took back to their lab for further analysis. The size, shape and chemical composition of the particles provide clues to reactions that occurred during the explosion.

Chris and her colleagues are hoping to use data from these tests to create a computer model that accounts for the energy, mass and momentum balances during an arc fault. Then the researchers can create a table that provides the zones of influence for a high-energy arc fault of given voltages and currents in a cabinet with specific metal conductors. This information can help nuclear power plant operators analyze risks, she said.

campus showcases Sandia mission

weapons systems engineering and cybersecurity," Krissy said.

Three LED-backlit panels include a futuristic and technical pattern in black and Sandia blue. The left panel features an abstract engineering drawing and, on the right, a circuit board pattern. The design blends together in the middle to create one pattern — again symbolizing partnership and service in the national interest.

The LED panels surround a 70-inch digital display. The next stage of the project consists of developing interactive content for the display, to highlight Sandia's mission and communicate detailed information about weapons systems engineering and cybersecurity through animated graphics, videos and interactive presentations.

If you look closely at the pattern of circuits and circles in the display, you will find several unexpected features, including an American flag pattern, the state of California, an atom, a Pac-Man ghost (portraying a cyber threat), the original Sandia thunderbird logo, a shield and small locks.

The corridor outside one of the meeting rooms was also redesigned to represent Sandia's past, present and future. The modern thunderbird logo and Sandia mission statement are presented prominently in brushed aluminum with the classic thunderbird logo displayed subtly in the background.

By the end of the calendar year, a model of the B83 — the last megaton-class weapon in America's nuclear arsenal — will be suspended in the stairwell between the building's two floors. Wallpaper with blue skies and clouds now furnishes the walls in preparation for the installation. In the next phase of the project, designers will expand other weapons exhibits throughout the first-floor lobby and corridors.

W80-4 weapons suite

Hallways and conference rooms in the W80-4 weapons suite were also given a refresh this fall. The illustrations throughout the workspace keep much of the same look and feel as the public displays in the W87-1 suite.

The environmental design team worked with the W80-4 communications and information management team, including Amanda Cervantez, Jana Cuiper and Noel Richmond, to develop the new design concept for the weapons engineering suites. The California designers deconstructed the W80-4 logo and used elements of the logo throughout the illustration, combined with engineering designs and graphics of the external image of the warhead.

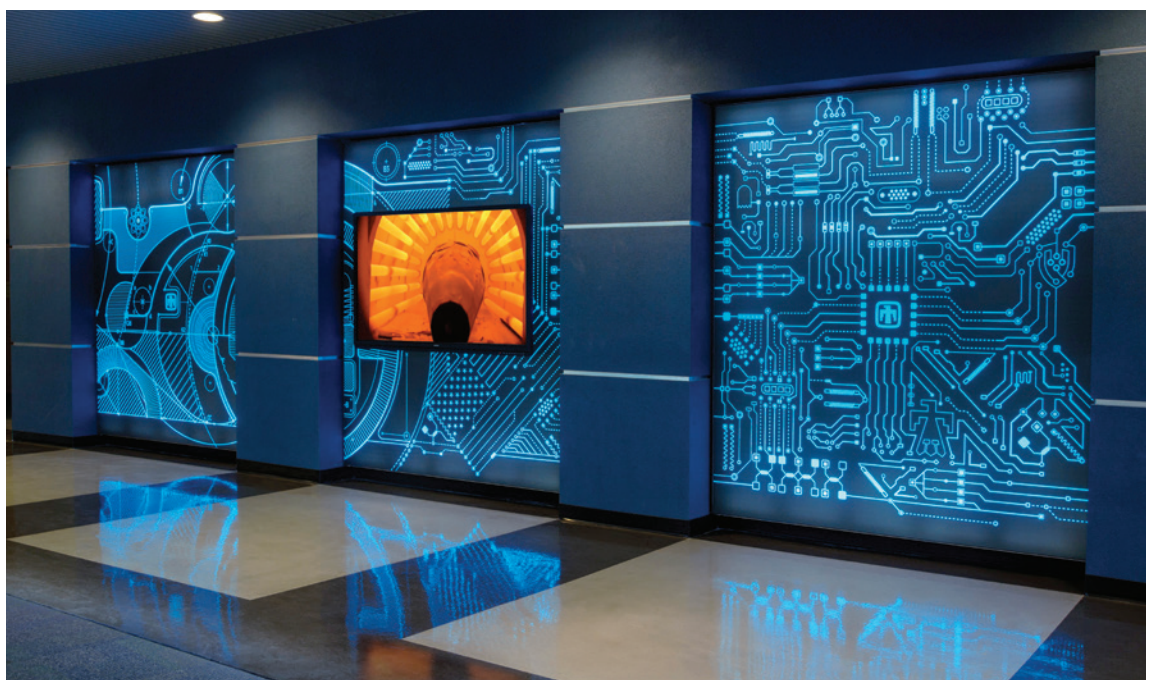
Looking ahead

Everyone involved in the experiential design project was gratified to see the visual transformation take place, and they look forward to future opportunities to expand the branded experiential design to other buildings and spaces at Sandia/California.

HISTORIC MISSION — The corridor outside one of the meeting rooms was also redesigned to represent Sandia's past, present and future mission. **Photo by Randy Wong**

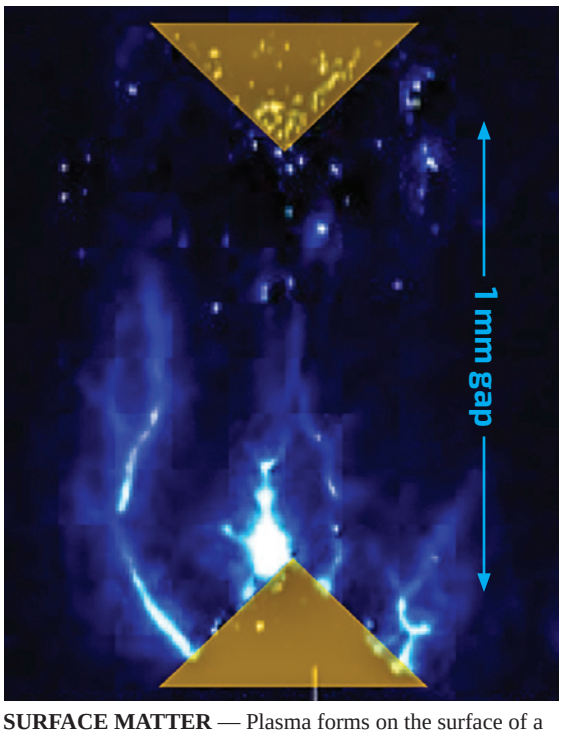
ENGINEERED ART — The abstract illustrations throughout the W80-4 weapons suite contain visual elements of the program's logo, engineering designs and graphics of the warhead. **Photo by Randy Wong**

CONCEPTUAL DESIGN — From left, Noel Richmond, Amanda Cervantez and Jana Cuiper, helped develop the new concept for the weapons engineering suites. **Photo by Paul Rhien**



LIGHTING THE WAY — New backlit panels in the W87-1 weapons design and computing suites at the California campus highlight work conducted at Sandia in weapons system engineering and cybersecurity. **Photo by Randy Wong**

Additionally, the team will continue to bring digital interactive kiosks online across the Livermore campus in order to communicate fresh and relevant content, including details of upcoming campus events and other important division announcements. This versatile medium provides an efficient way to provide real-time communication while eliminating paper and poster waste.



SURFACE MATTER — Plasma forms on the surface of a dielectric surface in air. The image was obtained using a sensitive CCD camera. **Photo courtesy of Ed Barnat**

Low-temperature plasmas

CONTINUED FROM PAGE 1

systems in our laboratories and utilize our capabilities to help answer their questions.

"Our job will be to interface with the potential collaborators and help them find the right tools and people in our Sandia facilities," Ed said.

Other Sandia researchers supporting the collaborative facility are Matt Hopkins, a computational modeling and simulation expert for plasma physics; Ben Yee, an experimentalist and modeling and simulation scientist; and Jonathan Frank, Chris Kliewer and Nils Hansen, three researchers at Sandia's Combustion Research Facility in California, who all have extensive experience developing and applying laser diagnostics and mass spectrometry to explain the physics and chemistry occurring in reacting flows.

Extreme tools and expertise

Tools available to visiting scientists to analyze plasma behavior include nanosecond (a billionth of a second), picosecond (a trillionth of a second) and femtosecond (one millionth of one billionth of a second) laser systems, picosecond-shuttered cameras, massively parallel computers to simulate the range from vacuum to atmospheric-pressure plasma, a wide variety of spectrometers and the equipment needed to build or incorporate a broad range of plasma sources and operating conditions.

Sandia researchers expect to engage with scientific collaborators to design, set up and execute proof-of-principle studies to enable participants to further their research objectives and analyze data generated during the collaboration.

For the past decade, Ed has received funding from DOE to operate a prototype collaborative plasma research facility, said Sandia manager Shane Sickafoose.

"This experience made Ed's expertise, along with Sandia's one-of-a-kind diagnostic tools, available to the larger community," Shane said. "His team has provided critical insights regarding characteristics of electrical breakdown and plasmas. We have images resolved in picoseconds — trillionths of a second — that detect and display electrical fields prior to and during electrical discharge events."

Recent Patents

April — June, 2019

- **George Burns, Adam Jones and Shanalyn A. Kemme:** Full-field surface roughness. Patent #10254112
- **Edward I. Cole Jr. and Ryan Helinski:** Test circuits for integrated circuit counterfeit detection. Patent #10254334
- **Jeffrey A. Brooks, Ivan Lizarraga, Katherine M. Simonson and Roger Derek West:** Small mover target detection in synthetic aperture radar imagery. Patent # 10254399
- **Todd Bauer, Ryan Michael Birmingham and Jason Hamlet:** Circuit that includes a physically unclonable function. Patent #10256983
- **Christian Lew Arrington, Eric Langlois, Todd Monson and Jamin Ryan Pillars:** Microfabricated magnetostrictive resonator. Patent #10260969
- **Jason Hamlet:** Field programmable gate array bitstream verification. Patent #10262098
- **David P. Adams, Kira L. Fishgrab, Ronald S. Goeke, Karl Douglas Greth, Michael David Henry, V. Carter Hodges, Randy J. Shul and Jeffrey Stevens:** Lateral vias for connections to buried microconductors. Patent #10262931
- **Eric A. Shields:** System for outputting a spectrum of light of a scene. Patent #10267680
- **Joseph S. Schoeniger:** Linear peptides that mimic structural epitopes for antibody assays. Patent #10267788
- **Richard M. Naething:** Doppler assisted sensor fusion. Patent #10267895
- **Steven F. Glover and Jason C. Neely:** Emulator apparatus for microgrid testing and design. Patent #10270251
- **Ronald L. Akau, Patrick S. Barney, Aaron M. Ison, Theodore E. Salas and Nathan Weir:** Rotation flexure with temperature controlled modal frequency. Patent #10288121
- **Mark W. Smith:** Extended cavity laser absorption spectroscopy. Patent #10288482
- **Douglas L. Bickel and Armin W. Doerry:** Apodization of spurs in radar receivers using multi-channel processing. Patent #10288729
- **Gerald M. Boyd, Jeffrey Farrow, Dominic A. Montoya and Gregory L. Wickstrom:** Bus based timed input output module. Patent #10289573
- **Dylan Andrew Crocker, Troy Satterthwait and Bernd H. Strassner II:** Dual-band GPS antenna with horizontal polarization. Patent #10290950
- **Cy Fujimoto:** Halo-containing anion exchange membranes and methods thereof. Patent #10294325
- **Joshua Mark Christian and Clifford K. Ho:** Bladed solar thermal receivers for concentrating solar power. Patent #10295224
- **Edward Steven Jimenez Jr.:** Hyperdimensional visualization tool. Patent #10297054
- **Jay Tillay Johnson, David A. Schoenwald and Mark A. Smith:** Systems, methods and computer program products for electric grid control. Patent #10298016
- **Timothy J. Boyle and LaRico Juan Treadwell:** Nickel metal nanoparticle synthesis. Patent #10301340
- **James Bradley Aimone, Frances S. Chance, John H. Naegle and Craig Michael Vineyard:** Temporal data system. Patent #10303697
- **Kristina Rodriguez Czuchlewski:** Automatic peak interval, relative volatility and relative amplitude detection in high-volume temporal data. Patent #10303841
- **Mohamed Salah Ebeida:** Generating an implicit voronoi mesh to decompose a domain of arbitrarily many dimensions. Patent #10304243
- **Paul J. Resnick and Carlos Anthony Sanchez:** High performance ultra-thin solar cell structures. Patent #10304977
- **Travis Mark Anderson, Harry Pratt and Leo J. Small:** Nonaqueous redox flow battery electrolyte comprising an ionic liquid with a metal cation coordinated to redox-active ligands. Patent #10305133
- **Jeffrey T. Spooner:** Predictive guidance flight. Patent #10317852
- **Travis Mark Anderson, Dorina F. Sava Gallis and Harry Pratt:** Metal-organic framework electrodes for sodium ion batteries. Patent #10320028
- **Sigifredo Gonzalez, Jason C. Neely and Lee Joshua Rashkin:** Subharmonic power line carrier-based island detection systems and methods. Patent #10326279
- **Jeffery A. Greathouse:** Estimation of conductivity for nanoporous materials. Patent #10330657
- **Elizabeth M. Huffman and Jonathan D. Madison:** High resolution, non-contact removal rate module for serial sectioning. Patent #10260865 B1
- **Edward Steven Jimenez Jr. and Kyle R. Thompson:** Material identification system. Patent #10261033 B2
- **Darren W. Branch:** Shear horizontal surface acoustic wave (sh-saw) resonators and arrays thereof. Patent #10261078 B2
- **Kenneth Miguel Armijo, Richard Karl Harrison, Jay Tillay Johnson and Eric John Schindelholz:** Arc plasma-generating systems and methods thereof. Patent #10261120 B1
- **Paul G. Clem, Leo J. Small and Erik David Spoerke:** Electroless process for depositing refractory metals. Patent #10263241 B2

Note: Patents listed here include the names of active Sandians only; former Sandians and non-Sandia inventors are not included.

Following the listing for each patent is a patent number, searchable at the U.S. Patent and Trademark Office website (www.uspto.gov).

SANDIA CLASSIFIED ADS

***NOTE:** The classified ad deadline for the Jan. 17 Lab News is noon, Monday, Jan. 13.*

AD SUBMISSION GUIDELINES

AD SUBMISSION DEADLINE: Friday noon before the week of publication unless changed by holiday.

Questions to Michelle Fleming at 505-844-4902.

Submit by one of the following methods:

- **EMAIL:** Michelle Fleming (classads@sandia.gov)
- **FAX:** 505-844-0645
- **MAIL:** MS1468 (Dept. 3651)
- **INTERNAL WEB:** Click on the News Tab at the top of the Techweb homepage. At the bottom of the NewsCenter page, click the **"Submit a Classified Ad"** button and complete the form.

Due to space constraints, ads will be printed on a first-come, first-served basis.

MISCELLANEOUS

TRACTOR, Craftsman GT5000, w/Kohler 25V TwinPro snowblower, price negotiable; portable inverter generator, Champion model, 3100-W, used twice, $650; in East Mountains. Willmas, djwillmas@gmail.com.

TV STAND, wide, glass/metal, Roccio, see at tinyurl.com/qp2r6am. Weagley, 505-385-4059.

PEKING ACROBATS TICKETS, 2, Sun. Jan. 12, 3 p.m., Popejoy, M301 & 302, $80. Caledon, 505-219-8224.

ELLIPTICAL, Precor EFX-5.25, lightly used, excellent condition, paid $2,500, asking $1,200. Weiland, 505-203-5130.

SOFA, large pillow back, very comfortable, great condition, $200 OBO. Mann, 505-401-0988.

POOL TABLE, Connelly, disassembled, ready to move, email for photos, free. Dye, jndye@msn.com.

SKI RACKS: Yakima, luggage rack mount, lockable, $40; older Barracrafters, luggage rack mount, lockable, $20 OBO. Lopez, 505-206-2011.

PIANO, Yamaha Clavinova CLP-220, Advanced Wave Memory, excellent condition, w/stand & bench, $400. Barkocy, 505-239-9587, ask for Ed.

EXERCISE BIKE, training bike, Le Tour de France, Pro-Form TDF Pro 5.0, purchased in 2016, ridden minimally, $650. Ballantine, marissadevan@gmail.com.

ELLIPTICAL TRAINER, Horizon Fitness Evolve 5, folding version, rarely used, Albuquerque, $350. Copland, 510-292-5032.

WASHER & DRYER, top-load, Kenmore, 2012, 1 owner, nonsmoker, pickup in Edgewood, $350 OBO. Height, 602-538-5783.

COUCH, IKEA Knopparp, lightly used, light gray, you pick up, $100. Galhotra, 602-697-5016.

FLOOR JACK, 3-ton, low profile, $80; film camera equipment, 35 mm to large format, Nikon DSLR, point & shoot. Wolfgang, 505-414-1483.

LAPTOP, MacBook Air, 13-in., 2017, 1.8 GHz Intel Core i5, 8 GB memory, 1600 MHz, HD graphics, $500. Milligan, 505-331-9921.

REFRIGERATOR, Samsung model RT18M6215SG, 18-cu. ft., SS black, new, still-in-box, $720. Grabowski, 505-340-1521.

TRUCK BED TRAILER, Datsun, $400 OBO. Robertson, 505-407-4808.

GOLF CLUB HARD TRAVEL CASE, The Vault, fits full-size golf bag, in-line wheels, great condition, $200 new, asking $130. Amend, 505-453-4751.

FLAT BED TRAILER, Big Tex model 50LA, 8' x 14', tandem axle (3,500-lb. ea.), permanent plate, $750. Fleming, 505-869-9165.

AUTOGRAPHED MAJOR LEAGUE BASEBALLS, Mickey Mantle, Willie Mays, market price or best offer. Simon, 505-508-5309.

STATIONARY EXERCISE BIKE, excellent condition, $35. Marchi, 505-265-6211.

HIGH PUB-STYLE TABLE, TEMA, metal/glass, w/4 upholstered chairs, $300; Ashley sectional & 2 accent chairs, $300; negotiable. Chavez, 505-280-1244.

TRANSPORTATION

'17 TOYOTA SIENNA LE, white, gray cloth interior, 14,600 miles, transferable maintenance to 2023. Lacy, 505-974-0456, ask for Don.

'99 LINCOLN CONTINENTAL, new Michelins, battery, water pump, cold AC, overheating issue, NM car since new, 128K miles, $1,800. Gutierrez, 505-239-7059.

'06 VW BUG, 73K miles, clean title, great condition, great gas mileage, great vehicle, $4,000. Blanc, 505-239-5855.

'04 GMC 1500 SIERRA, extended cab, lifted, exhaust, suspension, 101K miles, excellent condition, $10,500. Richardson, 505-331-9882, leave message.

'17 VW JETTA, leather, camera, 43K miles, excellent condition, on Texas Street lot. Flynn, 505-401-4369.

'83 VW VANAGON GL, water-cooled 1.9L, 4-spd. manual, good upholstery/tires, nice patina, runs, manuals, make offer. Hatley, 505-830-0469.

RECREATION

'02 SUZUKI SV650S MOTORCYCLE, silver, 4,100 actual miles, runs great, looks good, ready to go, $2,500. Embry, 505-205-2618, call or text.

BMW G310R, nearly new, spotless, 367 miles, tinyurl.com/scnezpu, $4,000. Coakley, hjcoakley@gmail.com, 435-512-5426.

'08 HARLEY-DAVIDSON FXCWC, RockerC, maroon w/black flames, great ride, but no time w/family, $9,000 OBO. Chavez, chavez999.jc@gmail.com.

'07 DAMON CHALLENGER MOTORHOME, 37-ft., Ford V10 engine, 10K miles, $43,500. Endres, 505-263-1616.

REAL ESTATE

3-BDR. HOME FOR RENT, 2-1/2 baths, 1,630-sq. ft., 5 mins. from base, Volterra, going on assignment for Sandia, $1,700/mo. Heeger, heegerds@gmail.com, 317-696-8241.

WANTED

VOLUNTEERS, help rescued cats, Fabulous Felines charity, fabulousfelines.org. Stubblefield, 505-263-3468.

HELP DIGITIZING 16MM FILM, family memories, call for more info. O'Toole, 505-382-6051.

AD RULES

1. Limit 18 words, including last name and home phone (web or email address counts as two or three words, depending on length).
2. Include organization and full name with ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. The same ad may not run more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce and retired Sandians only.
10. Housing listed for sale is available without regard to race, creed, color or national origin.
11. Work wanted ads are limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in poor taste.

Mileposts

New Mexico photos by Michelle Fleming
California photos by Randy Wong


Penny Jones 40


Rick Harris 35


Jeffrey Gruda 30


Reed Jackson 30


Allison Kane 30


Gary Nordyke 30


Emily Crespin 20


Aaron Hall 20


Matthew Allen 15


Kathy Aragon 15


Tien Bui 15


Andre Claudet 15


Alvaro Cruz-Cabrerra 15


Jason Finn 15


Sergio Gonzalez 15


Govinda Haines 15


Elaine Legan 15


Maria Matos 15


Monique Melendez 15


Todd Miner 15


Todd Monson 15


Anthony Salazar 15


Eileen Snyder 15


Gisel Soriano 15


Huu Tran 15

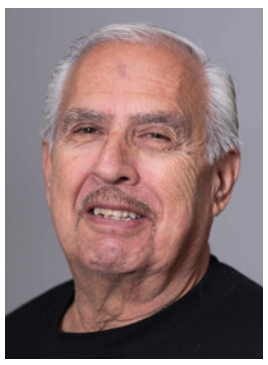

Joe Trujillo 15


Jennifer Turgeon 15


Cody Washburn 15

Recent Retirees

New Mexico photos by Michelle Fleming
California photos by Randy Wong


Manny Gonzales 51

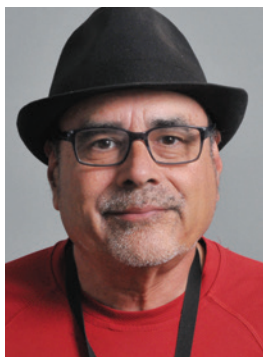

Vawter Allen 31


William Jenkins 30


Dave Corbett 29


Richard Dramer 27


Cheryl Huppertz 26


Paul Sanchez 25


Gordon Box 20


Beverly Rudys 20


Susan Kline 14

Strengthening the international nuclear security community of practice

DESIGN TEST — ITC 28 participants conduct tabletop exercises to test their physical security system designs.

*By **Janeen Miller***
*Photos by **Bret Latter***

The International Atomic Energy Agency and NNSA recently cohosted the 28th International Training Course on the Physical Protection of Nuclear Material and Nuclear Facilities at Sandia. The three-week session provided 59 participants from 40 countries with the knowledge and practical skills to effectively define, design and evaluate physical protection systems that guard against the unauthorized removal of nuclear materials and sabotage of nuclear facilities.

The course involves both classroom training and hands-on exercises. Some of these exercises are held at Sandia's Integrated Security Facility, which was originally designed to protect nuclear material, but now serves as a venue for advanced training and in-depth testing and evaluation of security systems. With its fully functional security systems, ISF is invaluable for demonstrating the operational and technical elements required for effective physical security, including physical protection, nuclear materials accounting and controls, response, transport security, sabotage, insider threat, cybersecurity, drills and exercises and national-level infrastructure.

During the final week of the course, participants divided into subgroups to design a security system for one of three hypothetical nuclear facilities — a nuclear power plant, a nuclear material research reactor and a small modular reactor — and then tested that design with various evaluation tools. The subgroups also created adversary scenarios and conducted a tabletop exercise that included an attempted act of sabotage. For the first time, the subgroups used Scribe3D, a new software tool that documents the exercise and provides real-world context. The course concluded with international speakers from the IAEA and presentations from each of the subgroups on their findings.

Noting the long history of collaboration between the IAEA, NNSA and Sandia, Muhammad Khaliq, head of the Nuclear Security of Materials and Facilities section of the IAEA's Division of Nuclear Security, said, "We continuously update the course materials to reflect the needs of the member states. This time, we have included new modules on security for small modular reactors and information about insider threats. The ITC continues to be our flagship course on physical security."

Sandia ITC Director Gregory Baum said, "Our participants come from a wide variety of backgrounds — some work in operational areas at nuclear power plants or research reactors, some are regulators or policy makers. Beyond the training, ITC gives them the opportunity to form professional connections and build a stronger international community of practice."

The ITC has been held every 18 months since 1978 and has provided training on international best practices for physical protection of nuclear material and nuclear facilities to more than 1,000 participants from more than 70 countries.

Scribe3D brings tabletop exercises to life

To test physical security systems at facilities that house nuclear materials, defenders visualize potential attacks and train to mitigate threats.

"Attacks can come from every possible direction — defense is not two-dimensional," said Jordan Parks, Sandia's Scribe3D team lead. "While tabletop exercises are an important tool for testing physical security designs, a three-dimensional model that coordinates multiple response factors in real time can reveal weaknesses not visible on paper."

Developed to enhance the physical security curriculum established by Sandia's international nuclear security engineering team for the International Atomic Energy Agency and NNSA, Scribe3D records tabletop exercises and plays back simulated videos of the scenarios and responses developed, which helps to direct operational discussions, capture results and visualize consequences. The software was designed to be used in countries with any technical maturity level and is fully exportable at no cost.

"Defenders can develop scenarios that test current defenses, then use the tool to look at how changes to procedures, facilities or technology might influence the outcome," Jordan said. "It allows physical security forces at facilities worldwide to continuously improve their response to current and future threats."

With multiple licensing agreements in process, Scribe3D has gained wide domestic and international acceptance. The tool is already being used by NNSA International Nuclear Security transportation, sabotage, response and physical protection functional teams and at Idaho and Oak Ridge national laboratories, and has been requested by multiple domestic sites and other national labs. The Scribe3D team has demonstrated the tool in Taiwan, Romania and South Africa, and will provide training in South Asia in 2020. Scribe3D also will be highlighted at the NNSA-INS Technology and Capacity Exposition at Sandia in April 2020.

DELAYED REACTION — Hands-on exercises teach participants about the importance of delay technologies in developing a physical security system.

FRONT ROW SEAT — Tours of the Integrated Security Facility give participants the opportunity to see first-hand the technologies discussed in ITC classes.