

# LABS ACCOMPLISHMENTS

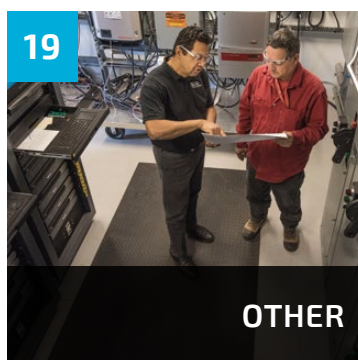
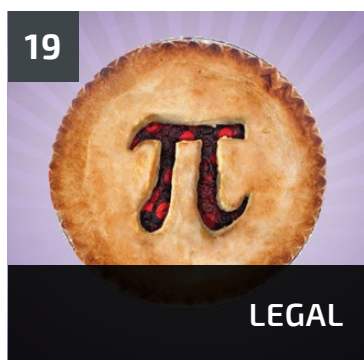
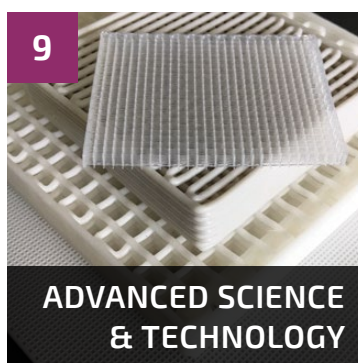


**SANDIA LABNEWS**  
March 2019

*Exceptional service in the  
national interest*



# CONTENTS



## A letter from the Laboratories director



Welcome to the 2019 edition of the annual Lab News Labs Accomplishments. Here you'll find a snapshot of significant work performed this past year by the remarkable staff at Sandia National Laboratories.

Every Sandian plays a role in these accomplishments. Behind each project is a team of dedicated, hard-working people helping to solve the nation's toughest national security challenges. From critical milestones in our key mission areas to scientific breakthroughs reached via Laboratory Directed Research and Development to valuable advances in mission support, Sandians consistently provide "exceptional service in the national interest."

Our work is needed now more than ever. Sandia's national security missions, including maintaining the safety, reliability and effectiveness of the U.S. nuclear deterrent, are becoming more critical as the world faces an array of threats that widens every day.

The scope of our capabilities makes us invaluable. Sandia's deep science and engineering foundations provide a cross-disciplinary advantage that helps us tackle and solve the biggest problems and makes the world a safer place.

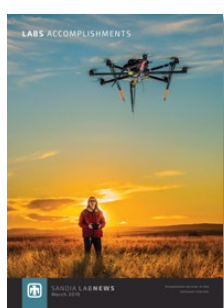
There is much here to be proud of, but it's impossible to collect every accomplishment. Many of our greatest achievements have come in areas of national security that are too sensitive for general publication.

Enjoy this look at the outstanding work done by the people of Sandia. I promise it will be time well spent.

Steve Younger, Laboratories Director

## COVER FEATURES

Photos by  
**Randy Montoya**



### FRONT COVER

*Pilot and engineer Dave Novick flies an octocopter during test and evaluation of the capabilities of unmanned aerial vehicle intelligent systems. His research is part of the Labs' work in advanced controls for unmanned and robotic systems.*



### BACK COVER

*Mike Montoya, a laser technologist, prepares a diagnostic probe for a test at the Thermal Test Complex, where researchers create high-temperature environments to study how they affect a wide range of materials and components.*

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### Sandia National Laboratories

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## NUCLEAR DETERRENCE



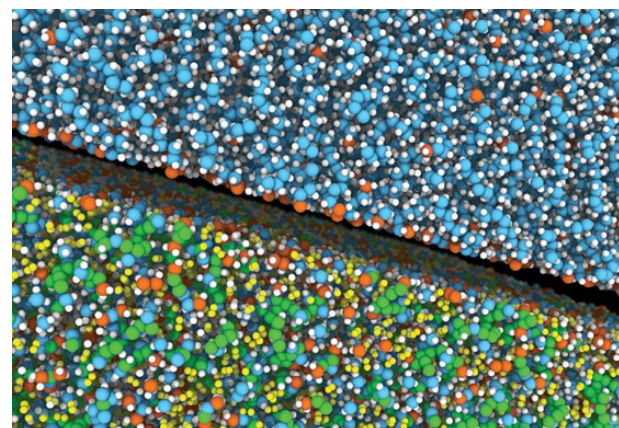
*Astra achieved 1.529 petaflops on the High-Performance Linpack benchmark and a higher relative ranking on the High-Performance Conjugate Gradients benchmark, demonstrating that Astra is more balanced and efficient than many larger supercomputers.*

## World's fastest supercomputer based on low-power architecture

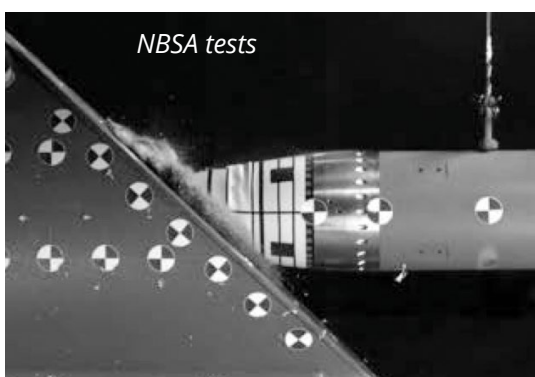
Astra, the first advanced prototype platform deployed to evaluate emerging high-performance computing technologies for NNSA's stockpile stewardship mission, has achieved petaflops performance running an important industry-standard benchmark. This makes Astra the world's fastest Arm-based platform on supercomputing's TOP500 list. Astra has 5,184 central processing units, each with 28 cores, based on the Arm V8 64-bit core architecture. While Arm has been used extensively in low-power mobile computing, including cell phones and tablets, Astra is one of the first applications of Arm technology for supercomputing.

### Unraveling how materials degrade in extreme conditions

From molecular simulation to experiments using the world's brightest X-ray pulses at the Z Machine and National Ignition Facility, Sandia scientists are unraveling the mechanisms of material degradation under some of the most extreme heating conditions produced in laboratory environments. Accomplishments include new diagnostics to characterize rapid expansion of ablation plumes, the first fully-coupled, 3D mesoscale radiation/hydrodynamic simulation and the first implementation of chemistry models fully coupled with the multiphysics Sandia code, ALEGRA, for predicting polymer degradation in radiation environments. (Division 1000/LLNL/LANL/ANL/LDRD)



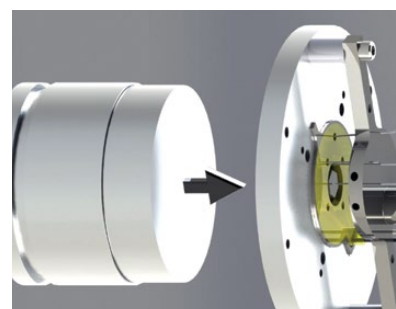
*Molecular dynamics simulation of polyethylene molecules under extreme heating rates identified new recombination effects, featured on the cover of the Journal of Physical Chemistry A.*



### Models validate B61-12 Nose Bomb Subassembly design

An engineering sciences modeling and simulation team supported the design and qualification effort of the B61-12 Nose Bomb Subassembly (NBSA) Product Realization Team. The team developed and validated

highly resolved models of the evolving and final NBSA design. The team applied the models over the range of conditions for impact speeds and angles and target hardness ranging from water to steel and concrete. The impact response of the NBSA was simulated through the model, allowing assessment of functional requirements over the full impact space. (Divisions 1000, 2000)



*Schematic of test configuration to provide dynamic electrical and mechanical response data for contact fuzes subjected to controlled impact loads during simulated stockpile-to-target-sequence conditions*

provided on-site support to the National Security Campus at Kansas City that improved velocity measurements in impact fuze acceptance tests. (Divisions 1000, 2000)

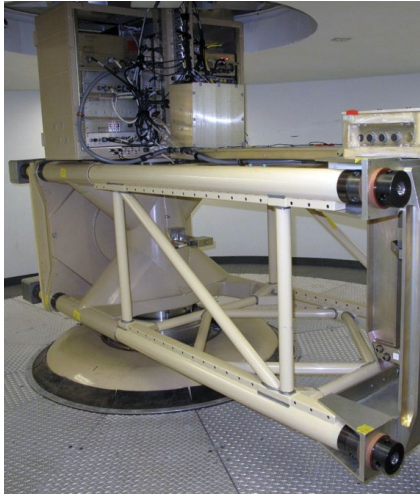
### Material dynamic response experiments support life extension programs

DICE and STAR facilities have generated extensive data to support life extension programs for the B61-12 and other nuclear weapon systems. Experiments on Veloce, STAR, Thor and Z evaluated dynamic response of ceramic, composite and additively manufactured steel materials. Such data validate modeling predictions for performance of specific weapon components. DICE personnel recently



## NUCLEAR DETERRENCE

### Surveillance centrifuge arm fully qualified



The new centrifuge arm as installed at Sandia's Weapons Evaluation Test Laboratory in Amarillo, Texas

To sustain a critical national capability, the surveillance tester centrifuge team qualified the second surveillance large centrifuge (QU2639) with a new and redesigned centrifuge arm. The qualification engineering release marks the culmination of fabrication, integration and prove-in of the centrifuge system with the new arm. Data collected during performance and repeatability testing verify the system will meet all centrifuge testing requirements in a stable, reliable and predictable manner. (2000, 9000, 10000)

### Record yields on Z machine advance fusion

The inertial confinement fusion program made major advances in magneto-inertial fusion research. Partly funded by ARPA-E, new experimental platforms were developed for both the Z pulsed power facility and the Omega laser facility at the University of Rochester. Using these platforms, researchers achieved record yields on Z that tripled the yield relative to the first experiments in 2014, and also demonstrated the same fusion concept on Omega using a factor of 1,000x less energy, strengthening the case for scaling this concept to a future facility.

### Labswide effort aids Kansas City tester development

In support of modernization program production, a Labswide effort directed by NNSA was quickly marshalled to augment tester development at the Kansas City National Security Campus. At its peak, more than 20 staff were provided to complete the development of testers that will be used to evaluate and accept components. Valuable contributions to the success of this effort came from technical, ES&H, program management, financial, legal and procurement organizations. (2000, 8000, 10000, 11000, 600)



Stronglink Safety Tester

### Stronglink tester upgraded

In December 2017, the QU3663 Stronglink Safety Tester Phase II Upgrade was qualified for use in surveillance testing at the Weapons Evaluation Test Laboratory. This upgrade added the ability to test firing sets from multiple weapons systems at temperature extremes and has resulted in testing of many firing sets since the upgrade was completed. (2000, 8000, 9000)

### NNSA labs assess EMP threat to U.S. grid

Sandia, in partnership with Lawrence Livermore and Los Alamos national labs, completed a Tri-Lab Collective Assessment of Nuclear Electromagnetic Pulse Threats and Consequences to the U.S. Electric Grid. This assessment was requested by NNSA Administrator Lisa Gordon-Hagerty and delivered under the signatures of the three lab directors. The assessment provides detailed analyses and assessments of the threat, possible scenarios and potential responses of equipment and the grid, and discusses options for and issues with restoration, recovery and mitigation. The effort provided significant insight into this important national security topic. (1300, 2100, 5800, 6600, 8700, 8800)

### Explosive ignition model developed

As part of the DoD/DOE Joint Munitions Program, Sandia developed an ignition model for the LX-14 DOE/DoD explosive using the 3D finite element Sierra/Aria framework. Predicting the response of explosives in accidents is of mutual interest to Sandia and the U.S. Army for safety assessments, and the project furthered that aim significantly. The model was developed using



various unique small-scale laboratory experiments of LX-14. A 3D full-scale model was successfully validated by the U.S. Army using experiments of a full-scale Tube-launched, Optically-tracked, Wire-guided (TOW) anti-tank missile warhead. (1000, 2000)

Sandia collaborated with the U.S. Army to address safety concerns of TOW missiles.

### B61-12 LEP hits major milestone

The B61-12 Life Extension Program successfully completed its final design review, meeting a major milestone and providing confidence the system is ready to proceed with final production qualification activities and produce the first unit in 2020. An independent team of 12 subject matter experts from the military and across the Nuclear Security Enterprise reviewed three years worth of electrical, mechanical, thermal and flight-testing data and analysis, as well as the program's state of procedures, training and safety to determine that the B61-12 meets its requirements. (2000, 9000)

### W88/Mk5 alterations complete final reviews

The W88/Mk5 weapon system program reached significant design maturity milestones for the two alterations (370 and 940) this past year. Alteration (ALT) 370 successfully completed final system and subsystem design reviews. ALT 940 also had a successful system final design review. These reviews were supported by design engineers at Sandia and across the Nuclear Security Enterprise, showcasing the excellent design engineering and technical basis compiled. The review panels found that the designs met requirements and can be produced. (1000, 2000, 5000, 8000, 9000)



### Thermal analysis predicts B61-12 nuclear safety

Using modeling and simulation, Sandia worked with Los Alamos National Laboratory to provide predictions of B61-12 nuclear safety timelines used to quantify system safety for an external thermal insult. Thermal analysis models were applied by the B61-12 project to predict weapon nuclear safety for credible accident scenarios and weapon configurations not considered in qualification testing because of schedule and cost constraints. The abnormal thermal environment qualification and nuclear safety arguments were presented by systems engineering during B61-12 system final design review. (1000, 2000)

External carriage of two B61-12s on an F-16



## B61-12, engineering sciences simulate fuel-fire accidents

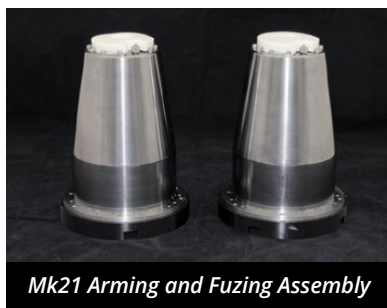
The B61-12 program partnered with engineering sciences to execute the final three abnormal environment tests in the system qualification plan: FastHeat2B, FastHeat3A and Impact3. The FastHeat tests were executed at the Cross Wind Test Facility and were designed to simulate fuel-fire accident scenarios. Impact3 was executed at the Aerial Cable Facility and was designed to simulate a C-17 cargo transport accident scenario. All three tests provided critical model validation data and provided evidence toward nuclear safety qualification for the B61-12. (1000, 1500, 2000)

*Impact3 test unit immediately following impact*



## W88 ALT 370 passes missile integration tests

The W88 ALT 370 program successfully completed the last of a series of missile system integration tests, in coordination with Lockheed Martin. The JT5ALT-17E series tests were successfully completed at three sites: Sandia/NM, the Eastern Range complex at Cape Canaveral and Lockheed Martin's missile integration lab in Sunnyvale. The tests were the final missile system integration tests for the program, showing that the W88 ALT 370 Reentry Body meets all necessary requirements to integrate with the missile system. (2000)



*Mk21 Arming and Fuzing Assembly*

## AFAs delivered to U.S. Air Force

The Mk21 program successfully built, tested and delivered two flight-quality Arming and Fuzing Assemblies (AFAs) to the U.S. Air Force for real-world ICBM flight testing. Assembled at Sandia/NM, both AFAs underwent a rigorous series of mission simulations and testing. The primary AFA was inte-

grated into the reentry vehicle configuration at Sandia/CA and delivered to Vandenberg Air Force Base. Once launched from Vandenberg, the FTU-1 flight mission will evaluate AFA performance during reentry. The other AFA was tested by the U.S. Air Force at Vandenberg to prove compatibility with existing tester interfaces. (2000, 8000)

## 12 First Production Unit milestones achieved

In the summer of 2018, stronglinks and other major components of the W88 ALT 370 and B61-12 programs reached the milestone of First Production Unit. Together, the components comprise several hundred custom mechanical parts. The start of production culminates a multi-year development effort. Each of the components plays a vital role in energy isolation of the nuclear weapon to preclude unintended nuclear detonation. (1000, 2000, 9000, 10000).

## Tonopah B61-12 team busy with flight, compatibility tests

In FY18, the B61-12 program, working with Sandia Tonopah Test Range, Sandia aircraft compatibility group and several U.S. Air Force partners, executed eight development flight tests (DFTs) as well as associated compatibility tests across three aircraft platforms with six distinct test assets. DFT missions on F-16C and F-15E aircraft were staged out of Nellis Air Force Base, while B-2A missions were staged out of Edwards Air Force Base. Completion of the grueling year of testing marks major progress in the B61-12 flight test qualification program. (2000)

*Silhouette of an F-15E carrying a B61-12 and firing afterburners during development*



## Product realization group makes advances

The component center has responded to various new Nuclear Security Enterprise production needs over the past year with great success in the areas of power sources, explosive components and unique, high-priority rapid-turn programs. To meet evolving rapid production needs of Sandia and the enterprise, the center established a dedicated organization for product realization that aims to integrate, adapt and grow Sandia product realization capabilities. The organization is anchored by a limited number of full-time staff with support from matrixed personnel from across the laboratory to meet a given production mission. (1000, 2000, 2500, 5000, 6000, 8000, 9000, 10000)

## Design tested in unique radiation environments

Intensive radiation testing was conducted for Sandia's Mk21 Arming and Fuzing Assembly (AFA) design. In 2018, the AFA qualification team completed radiation environment tests (the RT-1 series) at Sandia's HERMES and Saturn pulsed-power facilities. Performance and diagnostic informa-



tion that could not have been collected elsewhere yielded critical insights into AFA performance in these environments. For these tests, the test team developed a customized dosimetry calibration unit to measure dose and dose rates. Additional testing at Sandia's Annular Core Research Reactor is planned. (2000)

*Testing of an AFA at HERMES*



## ■ NUCLEAR DETERRENCE



### Mk21 Fuze Program completes tests

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. To reduce costs, the Thunderpipe team directly leveraged lessons learned from the W88 ALT 370 Program. 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. (1000, 8000)

*Test of the Mk21 Fuze Thunderpipe reentry vehicle conducted at Sandia's Tech Area III Airblast Facility, which can produce representative endoatmospheric shock environments*

### Flight tests, upgrades completed safely and securely

Tonopah Test Range successfully executed all assigned stockpile and developmental flight tests for the year, far exceeding the nominal test schedule. The tests were executed while Sandia integrated new sensor systems and data reduction software, and completed organic equipment upgrades to optical tracking systems, network and communication and radar systems. Test planning, execution and recovery processes and equipment were significantly adjusted to meet emerging requirements and mitigate associated hazards. All of the work was completed without a single safety or security incident. (2000)

### First production using model-based definition

Sandia is implementing model-based processes and tools on the W80-4 program to modernize and expedite Nuclear Deterrence product realization. Divisions 2000 and 8000 successfully developed the first ND component authorized for production using model-based definition. All product definition is derived directly from the native model, which includes 3D interactive viewable elements that allow direct model interrogation and replaces visual interpretation of 2D drawings, thereby improving quality, decreasing interpretation errors and resulting in overall cost and schedule savings for the Nuclear Security Enterprise. (2000, 8000, KCNSC, NNSA)

### Lab centers deliver 40,000 Components



*Cody Love laser welds an explosive component.*

a major accomplishment, especially considering the volume of work and the number of new products. (2000, 2500, 5000, 5200, 9000, 10000)

The Sandia production community delivered more than 40,000 components in partnership with the Nuclear Security Enterprise and external suppliers in support of 51 products serving six different weapon systems. Nearly half of these components were new or modified designs. This outstanding effort maintained Sandia's historically high product acceptance rate —

### Demonstrator initiative aids stockpile modernization

The California Advanced and Exploratory Systems organization is participating in a continuous demonstrator initiative supported by NNSA and the U.S. Air Force, with potential benefits for future stockpile modernization programs. In FY18, the organization completed two subsystem

tests, a mechanical system-level instrumented fit check of a Sandia-developed ground test unit, and Phase 3 of the Labs' system-level functional demonstrator, providing systems context for both mechanical and electrical functionality. FY19 will add GTU environmental testing and aero-shell packaging of the functional demonstrator to further advance component and system-level technology. (8000)

### New electronic neutron generator qualified

Sandia's modernized electronic neutron generator (ELNG), a nuclear weapon component that promotes the fission reaction, has been qualified for production and use. This represents a major milestone demonstrating the Labs not only can design the ELNG, but also manufacture it. This is the first redesign of the component since 1991, and the first ELNG built at Sandia since the closure of the Pinellas Plant. (1000, 2000, 8000, 9000, 10000)

*The ELNG concurrent qualification effort involved two ELNG form factors and one design. Qualification required a rigorous test regimen to ensure the design met all requirements and reliability goals.*



### Model-based system engineering grows

Sandia created a new organization focused on model-based system engineering within the Nuclear Deterrence portfolio to transform how Sandia captures, traces and integrates system engineering objects such as requirements, tests, functions and components throughout the nuclear weapons lifecycle. MBSE, which uses models instead of long documents, provides information consistency to reduce nuclear weapon cycle time. Over the past five months, the MBS project portfolio has grown in applications within six different programs including the W80-4, Mk21 Fuze, and W76-2. (2000, 8000, 9000)

### Mechanical shock test validates W88 ALT 370 effort

In August 2018, the Light Initiated High Explosive facility successfully simulated a hostile, cold X-ray encounter for the W88 ALT 370 qualification program. This full-reentry-body mechanical shock test provided model validation data and physical evidence for system qualification and also informed component-level mechanical requirements. The Sandia/New Mexico test was conducted in collaboration with Los Alamos National



Laboratory, the National Nuclear Security Administration, Lockheed Martin Space Systems Company, Navy Strategic Systems Programs, Strategic Partnership Programs and Peraton Corp. (1000, 2000)

*Explosive detonation simulating a hostile, cold X-ray induced shock for W88 ALT 370 qualification*



*Greg Valdez, Jasephine Hicks, Hardeep Sullan, Marco Carrillo and Michelle Collins, (left to right) work on the electrical functional demonstrator.*



# NUCLEAR DETERRENCE

## Telemetry Transmitter team on time, on budget

The Legacy Joint-Test-Assembly (JTA) Telemetry Transmitter product realization team completed tester qualification at Kansas City National Security Campus and vendor sites, covering legacy transmitter families while meeting transmitter deliveries for all JTA telemetry next assemblies. The team



worked with counterparts in the Nuclear Security Enterprise and with stockpile systems customers, identified solutions and implemented plans for quick resolution so transmitter deliveries could continue with minimal impact to assembly delivery schedules. The team developed an approach for delivering transmitters that met all requirements on time and on budget. (2200, 2600, 8200, 8400, 9400).

*Legacy JTA Telemetry Transmitter product realization team*

## W88 hardware changes done with minimal impact

In February 2018, during radiation effects testing of the W88 ALT 370 Firing Subsystem, unexpected results occurred, driving significant risk into the remaining 14 months prior to component and systems level First Production Unit dates. The product realization team quickly assessed root cause and conducted initial prove-in of the design change. Simultaneously, the team expertly engaged with internal and external partners and stakeholders to expedite a new group build, alter hardware deliverables, codify testing activities and ultimately negotiate changes to schedule to minimize impacts. (2000)

## First custom radar circuits qualified

Sandia's first custom-designed Radio Frequency Integrated Circuits have been qualified for use in joint radar modules, supporting three nuclear weapons programs. These RFICs were designed in five different foundries offering bulk acoustic wave, gallium arsenide, gallium nitride and complementary metal oxide semiconductor technologies. Eight years of significant design and characterization effort culminated in the qualification of 16 different designs, and more than 100,000 RFICs during FY18. (5000)

## Production soars at MESA

Microsystems Engineering, Sciences and Applications (MESA) processed 25 percent more wafer lot moves than anticipated at the beginning of FY18 while ramping down operations to enable the 6-inch to 8-inch tool conversion in the silicon fab. At the same time, the largest four-year Nuclear Deterrent wafer production run in MESA's history was completed, a 79 percent increase from estimates made in 2014 due to increased customer demand. Wafer deliveries were completed for all current weapon programs, critical sensor programs, pre-builds for future systems and development lots for scores of R&D projects (5000).



*The completed Weapon Design and Cost Report package, based on advanced programmatic tools and processes, signals the W80-4 Life Extension Program's readiness.*

They also delivered two other key reports in preparation for the expected transition to the next phase of the program. The NNSA federal program manager stated, "Our program has done more to get properly prepared for (this) Phase than any other LEP..." (8000)

## NNSA touts W80-4 prep, reporting

The W80-4 program management team submitted its Weapon Design and Cost Report package to NNSA in FY18. Building upon resource-loaded schedules created earlier than for other modernization programs, the team conducted a formal Schedule and Cost, Risk and Uncertainty Analysis to estimate the program cost.



*An AGM-86 air-launched cruise missile in flight*

## W80 ALT 369 goes to full-scale production

The W80-1 ALT 369 project successfully transitioned to full-scale production in FY18, meeting the NNSA production and delivery schedule. Close partnering between Pantex and Sandia during initial builds ensured a smooth production ramp-up. Neutron generator, detonator and gas transfer system components groups provided rapid resolution of production issues. Kansas City National Security Campus implemented a substantially expanded re-acceptance testing program on a major component to detect and screen potential temperature dependencies. The W80 ALT 369 replaces several limited-life components in the warhead, ensuring effective deterrence into the future. (2000, 8000, 9000)

## SP115 Acorn reservoir qualified in Kansas City

In support of the W87 ALT 360 Program, the Sandia/California Gas Transfer Systems product realization team successfully qualified the SP115 Acorn reservoir at Kansas City National Security Campus. The work was accomplished in partnership with the W87 systems team, Kansas City and Savannah River Site. The first production units were delivered to SRS, supporting final MC4957 reservoir qualification in support of the Acorn GTS delivery to the U.S. Air Force in January 2019. This innovative system is designed to extend its life and improve the quality of gas delivered. (8000)



## W80-4 program delivers test assets to U.S. Air Force

The W80-4 Life Extension Program delivered multiple test assets to the U.S. Air Force, including Fit Check Unit types 1 and 2 and Warhead Communication Simulator 1. The team also completed assembly and early testing of a highly instrumented ground test unit. On-time delivery and testing of these assets are critical to mitigate early program risk and forge strong relationships between NNSA and the U.S. Air Force. A key technical achievement for the W80-4 Life Extension Program, the test assets help ensure success of the W80-4 warhead and missile weapon system. (1000, 5000, 8000)

*The W80-4 team successfully met customer requirements for delivery of multiple test assets, assembling complex test articles on a tight schedule and ensuring robustness of the delivered units.*



## GLOBAL SECURITY



### Sandia upgrades electronic security system for U.S. Air Force

Sandia completed an electronic security system upgrade at Francis E. Warren Air Force Base in Wyoming ahead of schedule and under budget. Sandia designed and implemented the system to provide the U.S. Air Force with a turnkey solution and possible model for future upgrades elsewhere. The upgrade further strengthens the capabilities and expertise of Sandia's Physical Security Center of Excellence sponsored by NNSA's Office of Defense Nuclear Security (NA-70), which supports DOE and DoD in ensuring security of the nation's nuclear arsenal and special nuclear materials. (6000)



Larry Miller explains how to conduct a performance test on a fence vibration sensor to ITC participants at Sandia's Sensor Test and Evaluation Center.

### 40 nations take part in 27th nuclear materials protection course

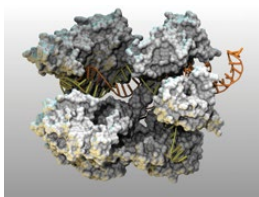
The 27th International Training Course was held at Sandia April 30-May 18, 2018, with 52 participants from 40 countries, making it the largest since the course's inception in 1978. Sandia is the key implementer for the International Atomic Energy Agency in teaching the fundamentals of physical protection for nuclear materials and nuclear facilities. The course offered field testing exercises in detection, delay and response, and allowed participants to collect, record and document performance data in an operational environment, promoting enthusiasm and understanding of physical protection requirements. (6000)

### Advanced Surety Lab completed

Sandia completed construction on the Advanced Surety Lab in July. The ASL provides a unique, large vault-type room with high-fidelity mockups or actual production weapon security systems dedicated to the joint exploration of advanced integrated surety concepts and transformational technologies. The ASL, which used NNSA capability funding and select hardware from the U.S. Air Force Nuclear Weapons Center and Defense Threat Reduction Agency, represents a successful collaboration between NNSA and DoD to enhance nuclear weapon security. (6000, 8000)

### Upgrades provide better space-based sensor data

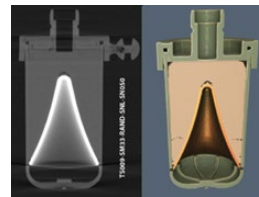
Customer acceptance of the Flexible Reliable Operational Ground System recapitalization occurred in January. FROGS is a real-time command and control and data processing system for a set of space-based sensors that operates 24/7 to provide critical information. The successful recapitalization provided new mission capabilities and significantly increased system robustness and availability. Since recapitalization, Sandia has transitioned to delivering quarterly updates that further enhance mission capability to detect emerging national threats. (6300)



CRISPR-associated protein Cas9 can target and cut DNA, but its ability to efficiently target RNA was unclear. The discovery of RNA targeting by a subset of Cas9 enzymes lays the foundation for programmable RNA targeting applications.

### Researchers discover RNA targeting tool

CRISPR-Cas9 is a breakthrough technology used as a genome-editing tool to target and modify specific DNA sequences in different organisms. Sandia has discovered that, in addition to DNA, certain Cas9 enzymes target RNA, the "genetic middleman" between DNA and proteins. This new capability for Cas9 enzymes opens the door for development of novel RNA targeting therapies, viral countermeasures, cell and nucleic acid diagnostics and gene regulation tools. The patent-pending research was performed in collaboration with professor Jennifer Doudna of the University of California, Berkeley, co-inventor of CRISPR-Cas9 technology. (8000, LDRD)



Computed tomography scans of as-built charge configurations illuminate cracks and voids in the explosive, component misalignments and other imperfections that can affect reliable, repeatable charge performance.

### Computed tomography scans improve response team predictions

Sandia has developed an improved method to qualify dynamic tools employed by explosive response teams. Historically, lot sampling was used for acceptance of these tools, but now has been deemed inadequate for the intended application. The newly developed approach uses computed tomography scans of as-built charges imported directly into the CTH shock physics code for predictions of performance. This process enables a broader distribution of these tools into response communities. (1000, 6000)

### Explosive test sites improved

Improvements to infrastructure and capabilities were completed at the remote explosive test sites managed by the explosive systems and technologies group. The Coyote Test Field improvements increased worker morale and collaboration efficiency while reducing safety, security and other operational risks. The team successfully completed strategic planning and vision development, design and construction of infrastructure improvements, which increased the work area. The work included procurement of safety and capability sustainment equipment and standard operational equipment, which streamlines operations.

### Deployed COMMON tool supports critical programs

The Sandia-developed COMMON tool is now deployed at 32 sites in 12 partner countries. Originally designed as a maintenance support tool for NNSA's Nuclear Smuggling Detection and Deterrence Program, COMMON's capabilities have been extended through data analysis to predict component failures, detect cyber threats and support system lifecycle decisions, making COMMON a powerful tool for programs where deployed data communications monitoring and analysis is critical to success. COMMON has significantly contributed to system readiness of high-consequence/high-risk systems where experts are needed, but not available on site. (6000)



### Security initiative project installed

Nuclear security engineering completed the first security system upgrade design and installation project led by Sandia under the congressionally mandated Center for Security Technology, Analysis, Response and Testing initiative. The \$3.7 million effort was part of a larger NNSA Security Improvement Program to replace aging critical physical security infrastructure. Final site acceptance testing was completed in October.

### Semiconductor techniques support spaceflight sensors

Sandia has developed new semiconductor wafer processing techniques to support advanced spaceflight sensor technology products. Wafer-to-wafer direct bond interconnect and through-silicon vias were demonstrated and subjected to environmental testing. High-fidelity prototypes of the same design, materials, critical dimensions and interfaces as the flight design were fabricated, followed by thermal cycling for twice their expected lifetimes and electrical tests. This is a significant achievement demonstrating a major step in readiness level of the technologies, supporting critical design activities. (6000)



## ADVANCED SCIENCE &amp; TECHNOLOGY



Additively  
manufactured  
pads

## First additively manufactured polymer component for weapons

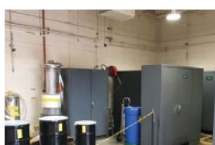
The first additively manufactured, polymer-based component was selected for insertion in a nuclear weapon modernization program. The components are printed on-demand using the direct ink write technique. The additively manufactured silicone pads are printed with well-defined porosity and structure that allow them to be fully tailored for compression performance, a disruptive breakthrough in design and manufacturing science for nuclear weapons. Compression pads are required in weapon systems to distribute mechanical loads, provide compliant interfaces to mitigate shock and vibration and manage assembly tolerances.



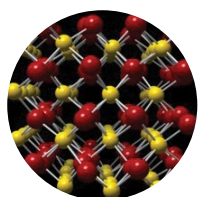
Chantel Nowlen  
inspects rod control  
rack power supplies.



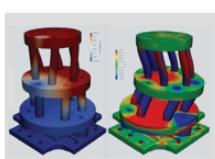
The E3SM model  
relies on  
computational  
science expertise.



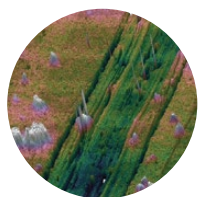
A Lean Six Sigma  
event on combustible  
loading improves  
facility safety.



Topological Dirac  
semimetal, Cd<sub>3</sub>As<sub>2</sub>



Modal validation  
experiment flown on  
HOT Shot flight 1



Experimental  
and simulation  
results of  
wear-resistant alloys

### Research reactor restarts operations

The Annular Core Research Reactor facility received DOE authorization to restart programmatic operations upon successful completion of the reactivity control system upgrade project and federal readiness assessment. The culmination of this multi-year project is a major accomplishment for Sandia's nuclear facilities that involved implementing the nuclear reactor instrumentation and control system hardware and software upgrades, completing extensive acceptance testing and demonstrating operational capabilities. The reactor facility is poised to continue its vital mission to test and qualify nuclear weapons components. (1000)

### Sandia enhances Earth system climate model

Sandia computational scientists are developing key technologies for the Energy Exascale Earth System Model (E3SM), DOE's flagship global climate model. These technologies are critical for achieving effective performance on next-generation exascale computing architectures. E3SM melds state-of-the-art climate and computational science to make projections on how Earth's evolving climate will impact DOE's national security missions over the next decades. Sandia's contributions include algorithmic advances that exploit the new architectures and will allow for resolution of important climate phenomena such as the convective instabilities that cause thunderstorms. (1000)

### New experiment process, waste removal at reactor

Nuclear reactor facilities at Sandia/NM completed several initiatives resulting in improved facility safety and efficiency while reducing programmatic risk at relatively low cost. Staff conducted a Lean Six Sigma event at the Annual Core Research Reactor that meticulously identified and removed thousands of pounds of excess materials and developed new experiment life cycle processes to meet customer needs while preventing future accumulation. Staff at the pulsed reactor reengineered control and electrical systems to reduce combustible loading, trip hazards and the need for compressed gas bottles. (1000)

### Research advances quasiparticles for quantum computers

Sandia materials science researchers highlighted the exciting physics and chemistry of topological quantum materials in a review article appearing in the Journal of Chemistry of Materials. In the last decade, basic physics, chemistry and materials-science research on topological quantum materials — and their potential use to develop reliable quantum computers — has rapidly expanded into a major endeavor. A pivotal goal of this research has been to realize materials hosting Majorana quasiparticles, thereby making topological quantum computing a technological reality.

### HOT Shot advances structural dynamics predictions

HOT Shot enabled transformative advancement in structural dynamics predictive capability. Sandia personnel supported the inaugural flight of the HOT Shot program with assembly and instrumentation support, environmental testing, design modeling and photometrics. They also fielded the modal validation experiment, which demonstrated the ability to predict full-field structural responses throughout the flight. Through a partnership between analysis and experimentation, this experiment paves the way for a generational leap in environment definitions and ground test fidelity. (1000, 1500, 2000)

### Friction research leads to world's most wear resistant alloy

Wear of metal contacts is a critical factor in a wide range of applications, from consumer electronics to spacecraft. Sandia has developed a predictive model of metals friction founded on fundamental structure-property relationships, without adjustable parameters. Researchers established correlations between microstructure and shear strength, enabling prediction of friction coefficients, validated using experiments and simulations. This framework guided the development of an extremely wear resistant alloy, showing approximately 100x greater wear resistance over all other metals, comparable to state-of-the-art materials such as diamond-like carbon. (LDRD, 1000)

### Kokkos eliminates software rewrites

Sandia Kokkos Ecosystem eliminates the need for extensive rewrites of Sandia simulation codes that can cost upwards of \$100 million for each new parallel programming paradigm. Sandia researchers released the Kokkos Ecosystem, a comprehensive performance portability solution for computational science and engineering applications that enables application developers to write performance-focused, single source software independent of CPU or GPU hardware details. Kokkos is now deployed in many Sandia applications and has hundreds of users across other DOE laboratories, universities and international supercomputing centers. (1000)



## ENERGY & HOMELAND SECURITY

### Smart window film cuts energy use

Sandia received a 2018 Federal Laboratory Consortium Excellence in Technology Transfer Award for nanomaterial window films that display “smart” control of infrared transmission and reflection. The window films display both low infrared emissivity and a temperature-tunable solar heat gain due to inclusion of thermochromic vanadium dioxide nanoparticles. A CRADA and ARPA-E program with IR Dynamics company developed films that reduce radiative and conductive energy losses of windows, projected to save billions each year and reduce national energy consumption through window retrofiting. (1000)

*Sandia materials physicist Paul Clem holds a sample of infrared-controlling, nanoparticle-coated glass.*



Chris LaFleur

### Fire risk analysis for clean energy

Chris LaFleur, program lead for Hydrogen Safety, Codes and Standards, won the 2017 Clean Energy, Education and Empowerment Award in Government at the sixth annual C3E Women in Clean Energy Symposium, cohosted by DOE. The award recognizes outstanding women advancing clean, renewable sources of energy, related technologies or clean energy policy. Chris evaluates fire risks for emerging energy technologies, such as hydrogen fuel cell vehicles. Her analyses enable cleaner transportation fuels to be implemented safely, reducing U.S. reliance on fossil fuels. (8000)



Jacqueline Chen

### Engineer garners multiple accolades

Jacqueline Chen, a distinguished researcher at Sandia's Combustion Research Facility, received multiple awards in 2018 recognizing her contributions to the computational simulation of turbulent reacting flows with complex chemistry. She was elected to the National Academy of Engineering, the highest professional distinction for a U.S. engineer; named as an inaugural fellow of the Combustion Institute for outstanding contributions to combustion; elected as a fellow of the American Physical Society; and received the Society of Women Engineers Achievement Award, the society's highest honor. (8000)



John Dec

### Combustion researcher top speaker

Senior Scientist John Dec received his third SAE Lloyd L. Withrow Distinguished Speaker Award, an honor for individuals with demonstrated outstanding presentation skills. Award recipients must have more than two Oral Presentation Awards from SAE meetings. John's first two Lloyd L. Withrow Awards were given in 1999 and 2007. John has worked at Sandia's Combustion Research Facility since 1989 investigating diesel and low-temperature gasoline combustion engines to improve their efficiency and reduce emissions. Many of his studies involved the application of advanced laser diagnostics. (8000)

how one antibiotic pump works, they will work toward developing drugs to plug the pump so it cannot spit out antibiotics, perhaps restoring their effectiveness. (8000, LDRD)



Susan Remppe

### Pump research may cut deaths from antibiotic-resistant bacteria

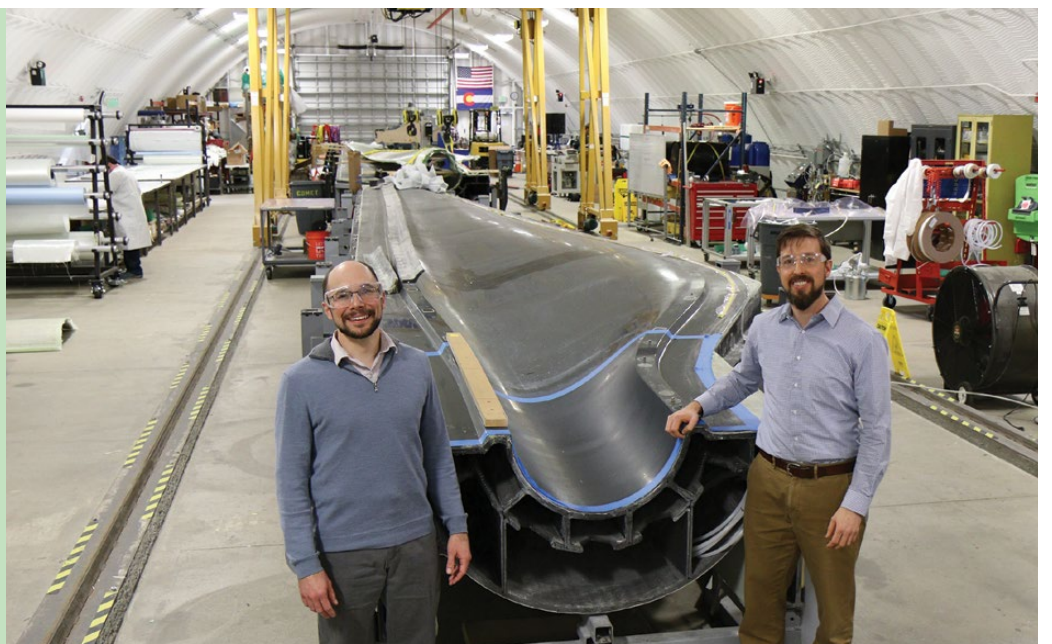
Using computer modeling, researchers from Sandia and the University of Illinois at Urbana-Champaign are developing the means to prevent some of the 23,000 deaths caused by antibiotic-resistant bacteria each year. One way bacteria become resistant to antibiotics is by producing pumps that spit out unfamiliar small molecules, such as antibiotics, before they can cause damage. Now that researchers understand

how one antibiotic pump works, they will work toward developing drugs to plug the pump so it cannot spit out antibiotics, perhaps restoring their effectiveness. (8000, LDRD)

### Team prints first wind turbine blade mold

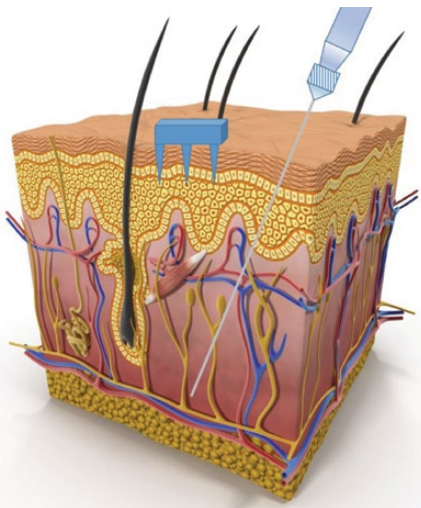
Sandia's wind energy technologies team, in collaboration with Oak Ridge National Laboratory, the National Renewable Energy Laboratory and TPI Composites, developed the first 3D printed wind turbine blade mold. The team used additive manufacturing techniques to demonstrate faster and more economical methods for prototyping new blade designs. The collaboration won a Federal Laboratory Consortium for Technology Transfer 2018 Technology Focus Award. The blade will be deployed at Sandia's Scaled Wind Farm Technology (SWiFT) facility hosted at Texas Tech University. (8000)

*David Maniaci and Brian Naughton stand next to the 3D printed blade mold.*





## ENERGY &amp; HOMELAND SECURITY



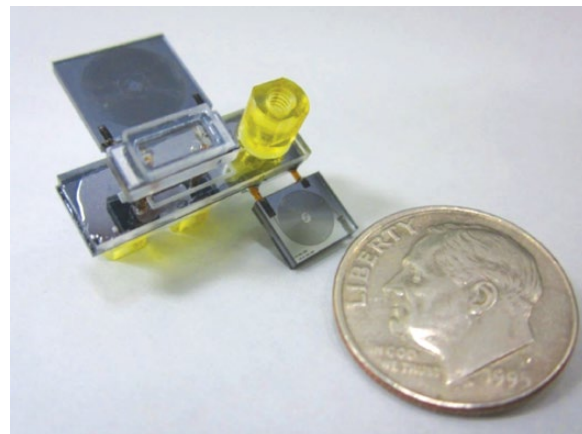
*Sandia-designed microneedles painlessly sip interstitial fluid and will lead to improved wearable health diagnostics. They also help improve irrigation and energy efficiency.*

### Microneedles improve wearable diagnostics, detect plant status

Sandia's microneedles painlessly collect human interstitial fluid, a technology that has marched into exciting new directions this year. Sandia has demonstrated (Comm. Bio. DOI:10.1038/s42003-018-0170-z) that interstitial fluid is a biomarker proxy for blood, reducing the future need for phlebotomy and enabling wearable diagnostics that will be far more information rich than existing fitness monitors. In plants, Sandia has shown that microneedles can continuously detect plant water status, sugars and pathogens non-destructively. This is a significant advancement for agriculture, one tied intimately to energy efficiency and global security. (1000, 8000)

### Record-setting Micro Gas Analyzer has many uses

Sandia has developed state-of-the-art portable gas analyzers for more than two decades starting with the Labs' first Grand Challenge, the Micro-ChemLab. Sandia researchers set a record of separating more than 50 compounds/second in the DoD's Micro Gas Analyzer (MGA) program with the first-ever pressure-modulated, dual micro-gas chromatography (microGCxGC) analyzer. Originally designed to detect dangerous chemicals, the analyzers are testing against physiological stress markers in pilots'



breath, disease biomarkers and volatiles useful for improving agriculture and energy production. The analyzers can be hand-portable or drone-mounted. (1000, 5200, 8600)

*The MGA analyzer has two microGCs, a preconcentrator and micro-valves, made in Sandia's MESA cleanroom facilities.*

### Emergency planners gain valuable tool

Collaboration among Sandia, the California Fire and Rescue Training Authority and the Sacramento Metropolitan Fire District to develop and deploy the Standard Unified Modeling, Mapping and Integration Toolkit (SUMMIT) for emergency planning and exercises won a Federal Laboratory Consortium for Technology Transfer Far West Region Outstanding Partnership Award. Developed at Sandia, SUMMIT allows exercise planners to link together disparate models, enabling a disaster and response scenario to be exercised from start to finish and aiding emergency preparedness communities in preparing for natural disasters and emergency situations. (6000, 8000)

### Arc fault tests aim to stop electrical equipment failures

Small-scale, high-energy arc fault experiments on copper and aluminum conductors will help ensure the safety of U.S. nuclear power generation. Results informed a predictive model that will determine the damage zone from powerful electrical equipment failures in nuclear power plants. The team's unique capabilities in high-speed videography, particle characterization and arc fault analysis are being used for the Nuclear Regulatory Commission's full-scale high-energy arc fault testing to provide novel insights into the physics and dynamics of these destructive events. (1000, 8000)

### Rapid radiation assessments in the field with InterSpec



*Researchers Ethan Chan, Alf Morales and Will Johnson use InterSpec in the field.*

First responders who arrive at an emergency scene involving radiation now have an easy way to swiftly assess the situation for safety by using Sandia's open-source InterSpec app to perform radiation data analysis. InterSpec allows field technicians to validate data quality, while helping field and reachback analysts determine the type and amount of radiation and shielding. InterSpec is also a valuable tool for laboratories and other academic and industrial settings where an accurate understanding of detected radiological material is crucial. (8000)

### Final contaminated soil sites restored

Sandia's environmental restoration program completed restoration of the Labs' last contaminated soil sites, some dating to Sandia's earliest days in the 1940s as the Z Division of Los Alamos. In 1987, Sandia identified more than 100 potentially contaminated sites, initiating a 31-year effort to characterize, and where necessary, remediate soil sites. In June, the New Mexico Environment Department approved Corrective Action Complete status for the last six soil sites baselined for "corrective action." Restoration continues at the three Sandia locations with contaminated groundwater. (600, 8000)



*Technicians sort waste excavated from Sandia's chemical waste landfill.*



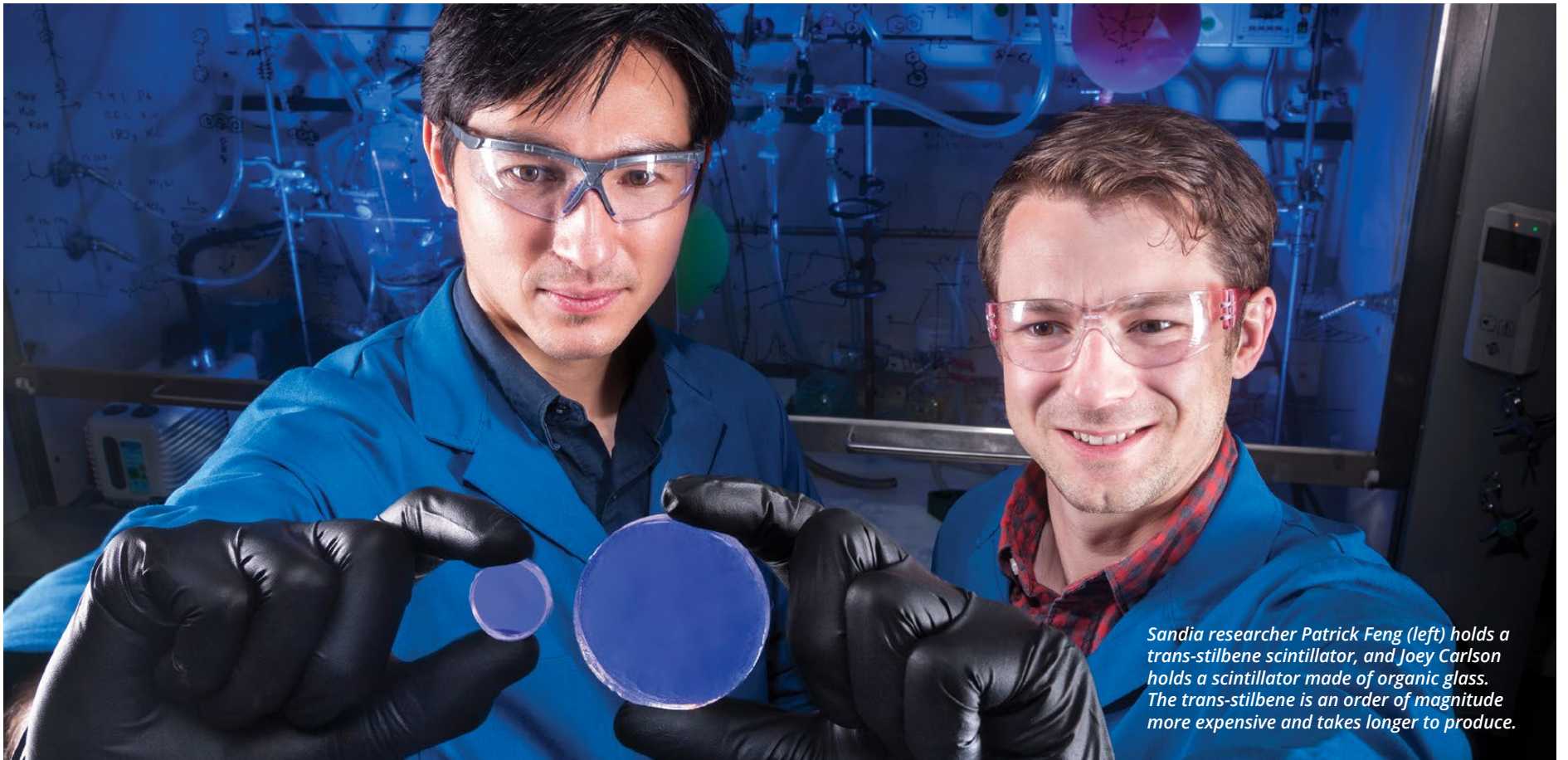
### Burning oil to improve transportation safety

Sandia undertook a test series of large-scale outdoor crude oil pool fires and fireballs to help understand how crude oil physical and chemical properties relate to combustion properties and, ultimately, how they affect relative hazards of crude oil fires that may occur as a result of transportation, storage or handling accidents. Sponsors included DOE, U.S. Department of Transportation and Transport Canada. Results will be made public in 2019. (1000, 8000)

*Sandia crude oil project team assembles in front of the fireball test tank.*



## ENERGY & HOMELAND SECURITY



Sandia researcher Patrick Feng (left) holds a trans-stilbene scintillator, and Joey Carlson holds a scintillator made of organic glass. The trans-stilbene is an order of magnitude more expensive and takes longer to produce.

### Better detector materials stymie smugglers

It could soon be more difficult to smuggle nuclear materials through U.S. ports and borders thanks to detectors that use organic glass scintillators. The small, handheld detectors engineered by Sandia and California-based XIA, LLC, won the Far West Region Outstanding Technology Development Award. Sandia's organic glass scintillator, which produces light in response to the presence of nuclear materials, provides high detection efficiency of radioactive material without high production costs. Due to the advantages over existing scintillator products, XIA is integrating Sandia's scintillator into detectors for real-world applications. (8000)

### Grid, energy, water analyses help Puerto Rico recover



Sandia's Resilient Node Cluster Analysis Tool identifies locations in Puerto Rico for resilient microgrids that provide the best (green) or good (yellow) access to services, based on a variety of social and infrastructure parameters.

Sandia researchers are assisting Puerto Rico to rebuild a sustainable, resilient infrastructure in the wake of Hurricanes Irma and Maria. Using Sandia-developed analytical tools, the team identified key locations for microgrids

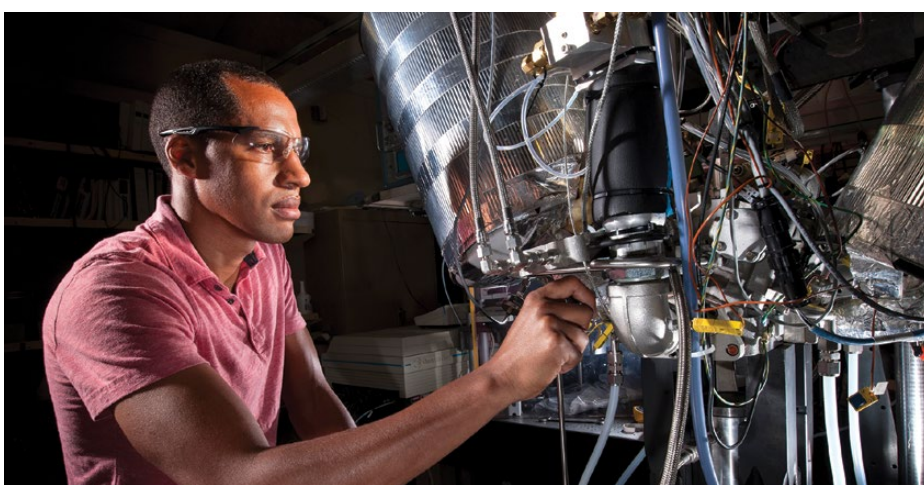
and energy storage systems to allow power systems to remain operational or recover quickly after future severe storms. The advanced technologies are focused on providing emergency services and keeping key industries operational, addressing the most urgent post-hurricane energy needs. In conjunction with the Environmental Protection Agency, Sandia is also addressing municipal water supply resiliency. (1000, 8000)

### Test boosts safety for nuclear fuel casks



Technicians repair damaged field test equipment.

A Sandia team instrumented a spent nuclear fuel storage cask and collected first-of-a-kind data to support an updated safety analysis for nuclear power plants. Despite all possible difficulties, including a near-catastrophic equipment failure early in testing, the data were collected at the highest possible level of quality: Nuclear Quality Assurance, or NQA-1. The test results will increase safety and flexibility of site operations for nuclear power plants using the storage system, upon acceptance of the updated operating license. (8000)



### Paper on fuels for advanced engines captures prize

Isaac Ekoto won the SAE Harry L. Horning Memorial Award for his paper, "Investigation of Fuel Effects on In-Cylinder Reforming Chemistry Using Gas Chromatography," clarifying the impact of fuel composition on advanced, high-efficiency internal combustion engine operating modes. The award recognizes the best paper about the better mutual adaptation of fuels and internal combustion engines. It is the ninth time a Sandian has received the award, more than any other institution. The work was a collaboration with the University of Minnesota. (8000)



## NATIONAL SECURITY PROGRAMS

### Successful rocket test supports science, stockpile stewardship

Sandia successfully launched a research rocket in May, from its Kauai Test Facility in Hawaii, that carried multiple experiments designed to deepen scientific understanding and support the stewardship of the U.S. nuclear weapons stockpile. The High Operational Tempo sounding rocket flight test program seeks to provide an agile technology testing platform to validate modeling and simulation assumptions and perform other non-nuclear, non-explosive research. NNSA plans to continue sounding rocket launches to advance modernization and life extension programs. (1000, 2000, 5000, 8000, 10000)



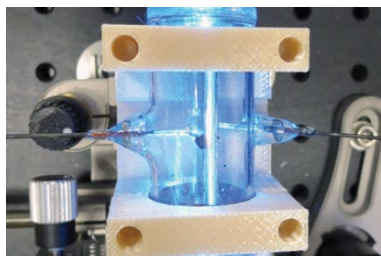
Artist's rendition of a hypersonic boost-glide flight vehicle

### Intermediate range flight experiment succeeds

Sandia, on behalf of the DoD and U.S. Navy strategic systems programs, successfully conducted an Intermediate Range Conventional Prompt Strike Flight Experiment-1 test from its Kauai Test Facility in Hawaii on Oct. 30, 2017. The Sandia team served as the lead technical integrator, provided the majority of hardware and software and integrated the entire flight system. The flight test collected data on hypersonic boost-glide technologies that will anchor ground testing, modeling and simulation of future conventional prompt strike concepts. (1000, 2000, 5000, 10000)

### Required overseas training offered in-house

Due to changes from the U.S. Department of State, members of Sandia's workforce are now required to take High Threat Security Overseas Seminar training prior to international work travel to any country outside the United States, not just high-risk countries. Through the efforts of the international security operations team, Sandia is now the only national lab to offer the training in-house. The web-based course is available free of charge, saving time and money while supporting critical mission work.



The Rb vapor cell with laser beams passing through

### Most sensitive detection of weak electric fields achieved

Sandia achieved the most sensitive known detection of weak electric fields (E-fields) by exploiting the change in atomic Rydberg states in an atomic vapor, demonstrating an E-field sensitivity of less than 1 mV/(m·Hz<sup>1/2</sup>) over frequencies ranging from DC to 10 kHz. In comparison, E-field sensing methods based on transistors and electro-optic materials have shown, at best, E-field sensitivity of a few mV/(m·Hz<sup>1/2</sup>) for similar frequency range of detection. The Laboratory Directed Research and Development effort is enabling the realization of ultrasensitive atomic electrometry for dual-use applications. (5000, LDRD)

### Deployed security professionals support mission

Sandia's safeguards and security organization expanded its integrated support team that places security professionals in high-risk mission areas. Embedded and deployed security professionals who support projects such as B61-12 and W80-4 programs are identifying potential risks and implementing protection strategies into daily work processes. In addition, classification technical reviewers are developing critical classification guidance and providing consistent derivative classification support. These programs integrate security professionals into mission work, allowing Sandia strategically to mitigate some top security concerns.



System test field team

### Multi-mission payload passes milestone

In September, Sandia's advanced RF systems team, in partnership with threat intelligence and systems mission engineering, successfully passed its Phase III "live environment" milestone for the Labs' newest multi-mission payload. The distributed system performed without issue and accomplished all tasked missions while logging 135+ operational flight hours. This included successfully executing a detection algorithm developed by U.S. Air Force Research Laboratory for its system, onboard the Sandia platform. The military exercise culminated with several successful live demonstrations to a large stakeholder audience, including the vice chairman of the Joint Chiefs of Staff. (5000)

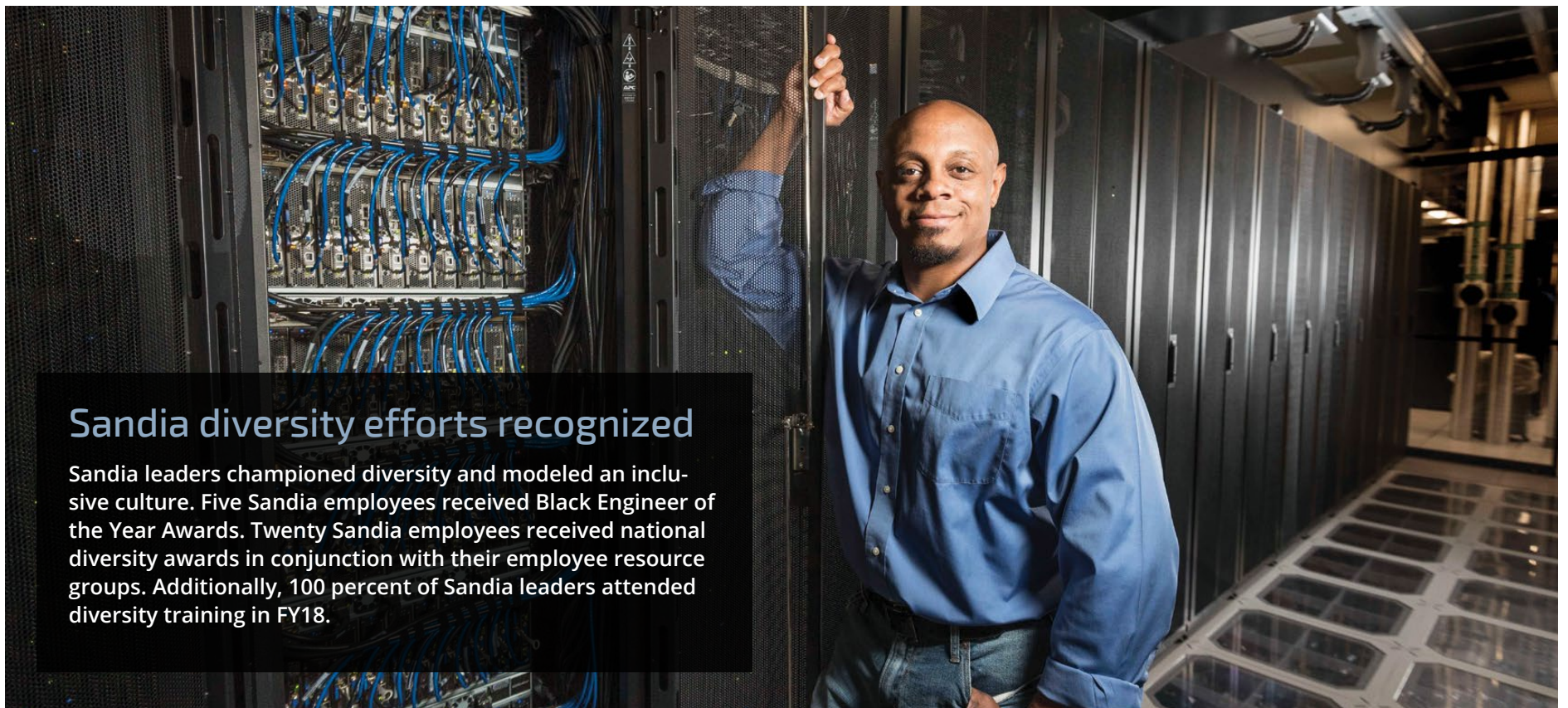
### SCEPTRE provides training environment for major U.S. cyber exercise

Sandia's SCEPTRE team participated in CYBERFLAG 18-1, the U.S. Cyber Command's largest annual cyber exercise, from June 13-30. CYBERFLAG is an interagency, reserve forces and combined military exercise focused on the defense of critical U.S. infrastructure key resources and the DoD information network. Sandia's SCEPTRE team delivered the most comprehensive and robust training environment ever fielded. Sandia's knowledge, expertise and unique capabilities in industrial control systems/supervisory control and data acquisition modeling and simulation was reflected in compliments and comments by CYBERFLAG leadership. (5000)

The first High Operational Tempo sounding rocket launch from Sandia's Kauai Test Facility in Hawaii



## ■ HR & COMMUNICATIONS



### 4/10 work schedule successful

The successful pilot of a 4/10 alternative work schedule at Sandia/California led to leadership approval of offering a 4/10 option Labwide. The rollout of this flexible schedule option provides Sandia with a new tool for attracting and retaining employees in a competitive hiring environment. Surveys conducted before during, and after the pilot showed a dramatic increase in work schedule satisfaction among pilot participants. The data-driven pilot resulted from a collaborative, cross-disciplinary, cross-site effort among California Human Resources, Systems Analysis and Human Factors. (8000, 9000)

### Healthcare package, Medicare contracts create savings

Sandia delivered a healthcare benefits package below benchmark costs, with benefits better aligned with changing demographics. In addition, new Medicare contracts will result in additional cost avoidance in FY19 and FY20, with anticipated savings of \$10.2 million. The anticipated savings enables flexibility to address other Labs' priorities within normal budgets, avoiding an increase of fringe budget to cover higher healthcare costs. The strategy for cost savings enhances the Labs' total rewards package through consumerism, effective management and active employee engagement in managing health risks.



### New performance system measures results, behaviors

Leveraging Honeywell best practices and responding to employee and leadership feedback, Sandia implemented a new performance management system that links employee performance and development by measuring results and behaviors. The system encour-

ages leadership engagement and professional development conversations, assesses employee contributions fairly and supports pay-for-performance principles. Sandia tailored Honeywell's performance behaviors to an FFRDC environment and launched the Management Resource Review, which resulted in formal succession plans and clear line-of-sight for associate Labs director and director positions.

## Communicators score awards for video, social media, writing

Three 2017 ethics videos were recognized among the best corporate films internationally by the New York Film Festivals, validating the quality of Labs' communication efforts while amplifying the important work of the Labs and positioning Sandia as a desired employer. Sandia also received five national awards for publication excellence in areas of social media, feature and "green" writing for the Lab News, and technical and technology news releases. (800, 3600)



*Sandia won numerous national and international awards in internal and external communication, social media and video production.*



## Peer review meeting draws praise for Labs practices

In November, Sandia and the NNSA Sandia Field Office hosted senior leaders from DOE, the NTESS board of managers and the National Security Enterprise for a mandated NNSA Governance Peer Review that took an in-depth look at Sandia operations and management, and included meetings with Labs mission and support organizations and members. In its executive summary, the peer review team noted several best practices, including transparency with governing bodies, streamlined policies and processes, emphasis on safety, security and ethical behavior, an engaged board and a trusted relationship with SFO. (9200)

### Quality Assurance team aces audit

Quality Assurance teamed with subject matter experts from across the Labs to complete the ISO 9001:2015 certification audit for Sandia with zero non-conformities and only a handful of opportunities for improvement. The audit moved Sandia from the 2008 version of the ISO standard to the expanded 2015 version. Required by the Labs' contract, the annual audit assures customers that Sandia's work consistently produces products and services that meet customer and regulatory requirements. (9100)



### Prize garnered for improving marking across NNSA

The surety engineering and weapons quality NAP-24 stamping and marking policy improvements core team received a Defense Program Award of Excellence for teaming with seven NNSA sites to reduce policy complexity, which resulted in labor savings and cost avoidances estimated at over \$10 million over the next five years. The integrated team addressed costs and waste associated with inconsistent stamping and marking that could trigger "false positive" quality alerts and re-work when assets are shipped between sites. (9400)

### Quality audit responses on target for completion

The surety engineering and weapons quality team successfully led preparations for and completion of the QAS 1.0 audit, an end-to-end quality evaluation against the Nuclear Weapons Quality Standard (NAP-24A). Final audit results included 10 noteworthy observations (best practices), 11 remarks, and nine findings. All findings and remarks that require responses and corrective action are on target for on-time completion with monthly QAS 1.0 updates to the Sandia Field Office. (9400)

### Common Engineering Environment cuts licensing costs

The Common Engineering Environment grew significantly under the new financial simplification model, while costs remained relatively low. Subscriptions to CEE services grew 74 percent with only an 8.6 percent increase in maintenance costs. The program spent approximately \$1.5 million on new licenses that would have cost approximately \$13 million if purchased individually. Efficiencies are realized by concurrent software licenses, active monitoring of license use and economies of scale. CEE enables technically creative work in a disciplined, common environment, which promotes increased quality and usability. (9300)

### Software upgrade improves weapons production

The logistics, accountability, planning, and scheduling phase 2 team modernized and significantly enhanced two outdated systems that support nuclear weapons production activities. Completed on time and within budget, the updated software is now used across the Nuclear Security Enterprise. As part of these projects, the team enabled several new capabilities, including Program Control Documents that provide authorization and directive schedules to program production agencies and cross-site scheduling that ensures components are shipped to the right location at the right time to meet PCD schedules. (9300)

### System for performance analysis improved

Sandia improved its Contractor Assurance System to provide more appropriate data and deeper performance analysis. Examples include deploying an enterprise risk management framework, initiating the executive risk review board and engaging with senior leadership and the NTESS board of managers to establish a set of Labs-level risks; improving processes for risk and issues management and replacing non-integrated assurance tools with an enterprise platform; deploying an assessor qualification program; and establishing a Labswide requirements management and traceability project to identify, communicate, actively manage and verify contractual requirements. (9200)

### Sandia/CA reduces data reviews by 90 percent

Sandia responded to an urgent request from the Kansas City National Security Campus to help reduce a backlog of test data transfer data reviews for components for the B61-12 Life Extension Program and W88 Alteration that had affected program schedule and cost. During the five-month collaboration, personnel from Sandia/California teamed with Kansas City to reduce the accumulated reviews from more than 550 to 60, a 90 percent reduction. The effort showcased clear communications and creativity, and set the stage for future partnership opportunities across the Nuclear Security Enterprise. (8100, 9400)

### New system makes policies easier to use

A new Laboratory Policy System, introduced in August, makes it easier for the workforce to find, understand and apply the appropriate policies and processes that govern work. This four-year project reduced the volume of content in the policies tool by about 70 percent, cut the average time of discovery from 5 to 1.5 minutes and cut in half the average time to process policy changes. The corporate simplification effort was led by policy management in partnership with information technology, policy leads and subject matter experts from across the Labs. (9100, 10700)

*Celebrating completion of the new policy system are (left to right) Marcey Hoover, Becky Krauss and Matthew Schwartz.*





## INFRASTRUCTURE OPERATIONS

### Largest active-shooter exercise improves emergency response

Sandia's largest-ever active shooter exercise was held at Sandia/New Mexico in July 2018 after months of planning and collaboration among internal and external agencies. What started as a multiple-casualty exercise quickly escalated into a incident involving hostages and explosives. More than 200 Sandia personnel worked with local law enforcement, emergency medical services and explosives experts to evacuate personnel, treat and transport victims and mitigate the shooter and explosive threats. Collaborative efforts such as this are crucial in helping Sandia improve its emergency response activities and preparedness.



Eddie Rey (left) and Adam Martinez track Sandia travelers and monitor security threats around the world.

### Security officers aid travelers

A new Regional Security Officer role was established to ensure the security of anyone travelling internationally on official Sandia business. The officers perform in-country security advances to investigate hotels, transportation systems and emergency facilities; conduct pre-travel security

briefings; and, when necessary, offer personal protection in-country. They work closely with Counterintelligence to monitor global threats and maintain extensive networks with U.S. embassies and military assets abroad. With experience that includes diplomatic security and military special forces, RSOs play an important role in Sandia's global mission.

### Labs campus first in NM with green building certification

Sandia achieved the first LEED v.4 for campus effort as a DOE lab, the largest site to date and the first in New Mexico. Leadership in Energy and Environmental Design v.4 is a framework for achieving sustainability measures that will contribute to LEED certification for Labs buildings, giving Sandia the opportunity to improve metrics and apply green practices to building design and construction. The new high-performance computing facility is anticipated to be Sandia's first building certified under the LEED campus effort.

### Liquid nitrogen safety upgrade protects key building

Working with Sandia facilities organizations, the remote sensing systems team completed a liquid nitrogen safety upgrade for a key building. Should sensors detect an oxygen deficiency, the system automatically stops the flow of liquid nitrogen. The system also has fail safes, e.g., valves close if power to the building is lost. The system is monitored by the Facility Control System, which would notify Sandia's Emergency Operations Center, which in turn would notify lab owners and managers and safety personnel. Further processes are being developed. (4000, 6000)



### New battery test facility designed

A new battery test facility was designed to house operations for power systems testing. The 7,600-square-foot, mixed-occupancy building completed construction in October 2018 and contains testing

and assembly labs, offices, a break room, loading dock and exterior hazardous materials storage. The new building is dedicated to testing performance and electromechanical analysis of energy-storage devices and was constructed to LEED Gold standards.



### Strategy sets priorities for future investments

The Infrastructure Investment 2040 Strategy communicates a single Sandia vision for the highest priority major capital investments through the year 2040 and beyond. Site planning and partnerships, line representatives, program offices and government relations developed the 2040

Strategy collaboratively. The document impacts decisions regarding facilities and infrastructure investments, with a more holistic view of the Labs' future needs. The strategy resulted in better communication of Sandia's needs internally and with NNSA partners.



### New facilities system increases efficiencies

Sandia's facilities organizations had a transformative year with the implementation of the Facilities Management System. By strategically embedding facilities personnel across the Labs' diverse sites, the approach provides better visibility of each facility's needs and addresses customer requests more quickly by reducing the number of square feet each individual manages. To increase efficiencies in completing the average of 136 work orders received each day, IT enhancements and a new work coordination and control department have improved the workflow between the planning and execution organizations.

Kimberly Pino and Rico Ortiz (left to right), facilities area managers, Josh Dominguez, building manager, and Doug Andrews, project manager, examine drawings.



## MISSION SERVICES

**Electronic checkout encourages reuse**

Implementing an electronic self-checkout kiosk at Reapplication improved the customer experience by simplifying and speeding up the former time-consuming, paper-based manual process. The solution live updates the shopping cart database, mitigating the risk of someone requesting an item online while someone is requesting it in person. The change will encourage the workforce to shop Reapp's free, preowned items first before buying new items, and ensures compliance with DOE "first source" guidance to reuse property and supplies before spending federal resources to acquire new ones. (10000)

**Weapons support processes take hold**

Sandia and the Kansas City Nuclear Security Campus launched a Tier 6 and Tier 7 process with NNSA and National Security Enterprise executives to support first production unit realization for the B61-12 LEP and W88 ALT. Sandia and Kansas City established the basis for implementing the new product introduction process for the W80-4 to create sufficient schedule contingency and ensure schedule execution through improved integration and shared process and tools. (10000)

**Labs collaborate on indirect R&D costs**

Sandia, Lawrence Livermore and Los Alamos national labs together developed principles and examples of technical activities essential to maintaining science, technology and engineering capabilities. The resulting agreement supports the development of a consistent and repeatable process for the management of indirect costs associated with research and development. Sandia's process features two key internal controls for the early identification, responsibility and accountability of research and development costs funded from an indirect cost pool other than Laboratory Directed Research and Development. (10000)

**Skype rooms added Labswide**

An additional 108 rooms were added to the list of Skype-enabled rooms at Sandia. The rooms have the advantage of a one-click join, built-in screen sharing, small equipment footprint and built-in video streaming integration. All rooms are designed for meetings with multiple participants from a variety of locations and user devices. This increased Sandia's ability to connect multiple participants across various locations and user devices. More than 300,000 Skype conferences were held this year. (10000)

**Phone upgrades improve security**

Key upgrades made to 3,700 Labs phone systems helped ensure future reliability for the entire Sandia phone network by moving the underlying Voice Over Internet Protocol system onto a new hosting platform and upgrading to the latest version of the supporting software and firmware. Also completed was a security upgrade for more than 3,500 VOIP telephones in limited areas at the New Mexico and California campuses. The efforts bring Sandia into compliance with revised DOE and NNSA security requirements. (10000)

**App cuts badge processing by 41%**

The new START application greatly simplified the clearance application process for Sandia by streamlining several separate manual interactions into a single system — clearance, contractor badge request on the restricted network, contractor badge request on the external collaboration network, companies, grant, reinvestment and SF86 questionnaire review tool. The app eliminated paper forms and reduced manual badge processing by 41 percent. (10000)

**UNM, Sandia ink agreement**

The University of New Mexico and Sandia in January signed a memorandum of understanding that included the development of an internship course for undergraduate and graduate students with a focus on project controls and program and project management, an undergraduate concentration in project management and project controls and a master's of science program in the field. The agreement will provide a broader pipeline for hiring personnel for the project management job family at Sandia, and more career development opportunities for established Labs personnel in the field. (10000)

**Finance model garners high marks**

The NNSA board has ranked Sandia's financial simplification model as the third highest-ranked best practice in a review of best practices across the enterprise. Based on FY18 results, the model provides less transactional activity, more transparency into functional costs and less effort to manage cost pools. It also sets the stage for identifying opportunities for efficiencies to be realized this year and in the future. (10000)

**Targeted curriculum offered for project management**

The corporate project management office released a training program designed for those with roles in project management and/or project controls. The targeted curriculum provides a consistent foundation of competency and knowledge for project teams at Sandia and is the beginning of a larger learning development program focusing on developing skills and knowledge for the entire project management job family. Sandia managers and employees can use the curriculum to choose courses that help meet mission needs. (10000)

**Procurement quality effort goes live**

A new quality level program for purchasing went live in October. The consolidated strategy implements a graded approach informed by supply chain risk management for procurement across the Labs. It uses 76 data elements that roll up into eight risk sub-categories to provide an appropriate level of rigor in analysis, verification, documentation, activities, procedures and controls on all purchases and subcontractors used by the Labs. (10000)

**LOS amplifies innovation**

Sandia's capacity to learn, innovate and respond in rapidly changing environments was amplified with the launch of the Laboratory Operating System. Honeywell provided expertise, processes and tools and NTESS developed and executed its FY18-20 LOS roadmap. The tiered accountability process was deployed Labswide to more than 1,000 organizations; user-centered design methodologies enhanced key processes, products and services; and the Labs built a stronger foundation for developing and implementing new products, evaluating external best practices, identifying key stakeholders and establishing a framework of LOS tools and practices. (10000)

**Hiring process improved**

To address Sandia's needs in hiring project managers and project controllers, the talent acquisition team held an improvement event in April. The improved process cut the overall external hiring cycle time of experienced project managers and controllers in half. Sandia's needs list was reduced from an average of 15 to seven, indicating quality candidates were available in the pools. The improved process should provide candidates and hiring managers with a clearer and more enjoyable user experience. (10000)

**Small NM businesses get support**

Sandia exceeded all socioeconomic procurement goals for FY18, awarding 60.28 percent of subcontract dollars, valued at more than \$700 million, to small businesses. Additionally, Sandia reached out to New Mexico small businesses in big ways. Sandia implemented a 5 percent pricing preference for New Mexico small businesses that bid on qualifying competitive subcontract awards. Sandia also opened its doors with the first supplier technical open house focused on manufacturing and machining, drawing 22 suppliers from 17 companies. (10000)



## EXECUTIVE SUPPORT GROUP



### Hundreds contribute to Labs' strategic direction

The strategic planning team led and collaborated with a cross-functional, multi-level team and drew upon perspectives of roughly 1,000 external and internal participants to aid the senior leadership team in developing the Labs' seven strategic priorities, using a 20-year outlook and a robust environmental scan. The result was the publication of the Labs' strategic direction document, *Creating the Future*, which was shared with NNSA and the workforce.



#### Labs safety record improves by 28.2 percent

Sandia's safety performance has improved, with a 28.2 percent reduction in the total recordable case rate. In response to increased overexertion and struck-by or -against injury rates, ES&H partnered with the line in rolling out a Labwide overexertion and industrial ergonomics initiative. Training, ergonomic evaluations and a strong Labwide communication plan contributed to the reduction. Division-level improvements and increased focus on safety through safety improvement plans positively impacted performance.

#### Environmental commitment certified

The Environmental Management System was certified to the ISO 14001:2015 standard, a requirement of the management and operating contract. Continuous improvements in risk analysis and management review assisted in moving toward the 2015 standard. The recertification is an achievement for all Sandia personnel and demonstrates a continued commitment to protect the environment in all operations. It is a well-defined management system designed to reduce the impact on the environment from the Labs' activities, products and services.

#### Audit and ethics efforts highlight risks, recommendations

The audit, ethics and business conduct center conducted 42 internal audits in areas that highlighted risks and recommendations in such areas as financial and business operations, ES&H and information technologies. Center staff also conducted 97 contract audits to validate contractors' claimed costs of approximately \$159 million. During the year, ethics advisory and investigative services successfully merged with equal employment opportunity investigations to create a single investigative organization, with the goal of improving consistency and increasing efficiency.



#### Labs 100 percent compliant for wastewater, hazardous waste

The Albuquerque Bernalillo County Water Authority awarded Sandia and NNSA Gold Awards for six waste water permits, achieving 100 percent compliance with the Waste Water Discharge Permit reporting requirements and zero Notices of Violation during the reporting period. Additionally, the New Mexico Environment Department's hazardous waste inspection resulted in no violations and Sandia was found to be in full compliance, an indication of the success of continuous improvement activities implemented since the 2015 audit.



## International export and trade group supports mission

International export and trade compliance supported programs such as Global Security and Cooperation and Nuclear Deterrence program management and partnered with many others to enable mission work across all of Sandia. In parallel, the organization worked to reduce risk, educate the workforce and create better internal efficiencies and response times through such efforts as an awareness campaign, self-assessments and enhancements to its information technology infrastructure. Specific changes were made to the review and approval, international travel and hand carry and explosives inventory system applications.



## Program cuts risk of organizational conflicts of interest

The organizational conflicts of interest team implemented a robust program mitigating risk across the Labs in support of the mission organizations. The organizational conflicts of interest mitigation strategy has enabled many programs to continue their work. An example of the program's impact was the articulation and definition of interactions with University Research Association affiliate members, which allowed work with these universities to continue. The team also worked diligently to provide NNSA with assurance that NTESS is adequately mitigating organizational conflicts of interest risk.



### New data journal gets Sandia editor

Tamara Kolda, a distinguished member of the technical staff, led the creation and serves as editor-in-chief of the Society of Industrial and Applied Mathematics Journal on Mathematics of Data Science. The new SIAM journal publishes innovative research that advances mathematical, statistical and computational methods in the context of data and information sciences. (8000)



## Labs sign 83 Cooperative agreements worth \$63 million

Sandia signed 42 Cooperative Research and Development Agreements in FY18 with such companies as Goodrich, IonQ, Battelle and Sensor Kinesis, the highest number of new agreements in the past 19 years. The total for FY17 was 41. Contract value of the 83 new CRADAs, including in-kind and government dollars, was more than \$63 million. The agreements demonstrate diversity of partnerships and scope as companies included Emera Technologies Ltd., CalWave Power Technologies Inc., Georgia Tech Research Institute, the Electric Power Research Institute and the German Aerospace Center.



