2021 Year In Review

INNOVATE. COLLABORATE. DELIVER.
For 21 years, NNSA’s vital nuclear security mission has leveraged innovative science and technology capabilities from across the enterprise to achieve success. Led by a world-class workforce, NNSA overcame the many challenges of operating during a pandemic and executed its largest program ever in 2021. This past year, NNSA delivered on its mission by taking an innovative approach to each of the following eight objectives:

- Modernizing the Nation’s Stockpile
- Achieving Amazing Scientific Successes
- Making Our World a Safer Place
- Supporting Our World Class Navy
- Building Better Infrastructure
- Combating the Pandemic
- Hiring Next-Gen Workforce
- Bringing the Enterprise Together
Achieved system-level First Production Unit for the W88 Alt 370 and the B61-12 Life Extension Programs (LEP). The updated W88, which can be launched on missiles from Ohio-class submarines, will gradually replace older W88 warheads in the stockpile. The B61-12 LEP will consolidate and replace three of the B61 variants (3, 4, and 7), and will be certified for delivery on strategic and dual capable aircraft.

Completed Annual Assessment Cycle 25: The three NNSA Laboratory Directors certified that the stockpile remains safe, secure, and effective, and that underground nuclear testing is not required at this time.

Delivered two next-generation computational simulation capabilities to support environmental specification, design, and qualification for future weapon systems. These code suites (SPARC and EMPIRE) simulate re-entry into the atmosphere and weapon response to hostile environments. Both capabilities have been designed to effectively use the full power of NNSA’s current and next-generation supercomputers including the NNSA exascale system, El Capitan.

Maintained a spotless record of accomplishing 100% of assigned secure transportation missions safely and securely, with no mission degradation despite the ongoing operational challenges during the COVID-19 pandemic.

Completed seven tritium extractions at the Savannah River Site’s Tritium Extraction Facility, more than doubling previous records and meeting Department of Defense requirements.
Modernizing the Nation’s Stockpile

Modernizing the Nation’s Stockpile

NNSA 2021 Year in Review

DELIVER COLLABORATE INNOVATE

Modernizing the Nation’s Stockpile

NEVADA NATIONAL SECURITY SITE
Executed a record three subcritical experiments (SCE) in a single year in collaboration with Los Alamos National Laboratory while planning and preparing for three additional SCE series to be executed in support of stockpile certification needs.

SANDIA NATIONAL LABORATORIES
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NEVADA NATIONAL SECURITY SITE
Advanced stockpile certification diagnostic development, vastly improving the quantity, quality, and recovery of data for the Nuclear Security Enterprise National Laboratories including visual imaging, radiographic imaging, plutonium resonance measurements, and ejecta properties.

LAURENCE LIVERMORE NATIONAL LABORATORY
Awarded a subcontract to Dell Technologies for additional supercomputing systems to support NNSA’s nuclear deterrent mission. The contract will provide at least $40M for more than 40 petaFLOPs of expanded computing capacity delivered to the NNSA’s three labs (LLNL, LANL, and SNL). Initial system deliveries are scheduled to begin in mid-2022 and will continue through 2025.

NEVADA NATIONAL SECURITY SITE
Achieved major milestones on the $1B plus Enhanced Capabilities for Subcritical Experiments (ECSE) line item project in collaboration with all three weapons laboratories. ECSE will allow the laboratories to execute experiments in support of stockpile stewardship, certification, and modernization for many decades to come.

SANDIA NATIONAL LABORATORIES
Performed two consecutive experiments using the Z-Machine to measure the dynamic response of aged plutonium. These were the first back-to-back plutonium experiments on Z, which resulted in operational efficiencies and returned valuable data for stockpile stewardship.

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Modernizing the Nation’s Stockpile

**SAVANNAH RIVER SITE**
Developed the Savannah River Plutonium Processing Facility 50 Pits per year (PPY) plan - which provides NNSA with a comprehensive overview of the approach, resources, and actions necessary to establish the capability to produce at least 50 PPY at the Savannah River Site.

**KANSAS CITY NATIONAL SECURITY CAMPUS**
Introduced Curie, Kansas City National Security Campus’s latest high-powered computer, which doubled the site’s computing capacity and supports advanced simulations needed to help solve some of the Nation’s most complex national security challenges.

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**SANDIA NATIONAL LABORATORIES**
Launched the largest missile ever (60 feet tall X 6-foot base diameter) from Sandia National Laboratories Kauai Test Facility which showed the test range is still growing to meet the testing needs of advanced weapons systems. The missile sailed over the Pacific Ocean as a medium-range ballistic missile-like target for Flight Test Aegis Weapon System 31 Event 1, a test coordinated by the Missile Defense Agency and the U.S. Navy.
Achieving Amazing Scientific Successes

**Lawrence Livermore National Laboratory**

For the first time, Lawrence Livermore National Laboratory’s National Ignition Facility achieved a yield of more than 1.3 megajoules (MJ) from fusion reactions. This record-breaking accomplishment is a major advancement in capability for Stockpile Stewardship applications.

**Los Alamos National Laboratory**

Finished remediating breached cesium-137 source at a research facility at the University of Washington in Seattle; personnel from the University of Washington have now reoccupied the building after two years.

**NASA’s Perseverance rover** started zapping rocks on Mars with the SuperCam instrument to study rock composition. SuperCam, whose design and build were led by Los Alamos National Laboratory, also features the first scientific microphone to ever operate on Mars.

**Sandia National Laboratories**

Led a major upgrade to the NNSA’s High Operational Tempo Shot (HOT Shot) sounding rocket program, culminating in a successful launch at the NASA Wallops Flight Facility in Virginia. HOT Shot collects scientific data that benefits aerospace research and informs future weapon designs for the U.S. nuclear enterprise.

**Sandia National Laboratories**

Demonstrated the potential for falling particle receiver technology to advance concentrating solar power (CSP) and was subsequently selected by DOE to expand its R&D capabilities with a new pilot tower that has an integrated supercritical carbon dioxide power conversion loop. Particle-based systems have potential scalability and cost advantages over other CSP systems.
Making Our World a Safer Place

**DEFENSE NUCLEAR NONPROLIFERATION**

Converted a cumulative total of 1,164.4 kg of plutonium to an oxide form in preparation for final disposition and completed construction of a characterization and storage pad for the first shipment of downblended plutonium to the Waste Isolation Pilot Plant in 2022.

**NEVADA NATIONAL SECURITY SITE**

Achieved operating capability to conduct Unmanned Aerial Vehicle experiments and safely and securely executed sustainable test range activities in support of federal, national laboratory, and industry missions.

**SAFETY, INFRASTRUCTURE, AND OPERATIONS**

Completed removal of 50 samples of unneeded radioactive materials from the Lovelace Biomedical Research Institute (LBRI) located on Kirtland Air Force Base in Albuquerque, New Mexico. LBRI, a former DOE-contract facility, requested assistance in dispositioning the legacy materials that had no commercial disposition pathway.

**DEFENSE NUCLEAR NONPROLIFERATION**

Issued millions of dollars in cooperative agreements to U.S. companies to support the commercial production of molybdenum-99 (Mo-99), a critical isotope used in more than 40,000 medical procedures in the United States each day, including the diagnosis of heart disease and cancer. This effort led to the end of highly enriched uranium exports.

**COUNTERTERRORISM AND COUNTERPROLIFERATION**

Conducted 50 virtual workshops with U.S. public information officers, law enforcement, first responders, and technical experts concerning radiological counterterrorism to build radiological response capacity and improve crisis and risk communication among the U.S. incident response community.

**DEFENSE NUCLEAR NONPROLIFERATION**

Developed counter nuclear smuggling capabilities in over 80 countries, including with six new partner agencies, to prevent terrorist acquisition of radioactive and nuclear materials.

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Integrated two nuclear detonation detection sensor suites on GPS Block III satellites that were launched by the U.S. Space Force on two SpaceX rockets. Each satellite hosts a Global Burst Detector III payload with X-ray, radiofrequency, and optical sensors designed to help detect above-ground nuclear explosions.

Completed the provision of advanced equipment and training to regional Federal Bureau of Investigation counter-weapons of mass destruction teams as part of the “Capability Forward” initiative. As a result of this initiative, responses to nuclear and radiological threats in the United States will be accelerated, potentially saving large numbers of American lives.

Established DOE’s overseas presence in the United States’ diplomatic missions in Belgium, Israel, Poland, and South Korea.

Conducted 23 engagements with foreign partners and international organizations to advance U.S. nuclear threat reduction and emergency preparedness objectives, including Israel, Taiwan, Japan, Canada, the Arctic Council, and the International Atomic Energy Agency.

Engaged with over 100 countries on international nuclear safeguards issues and transferred seven new technologies to international safeguard partners including the International Atomic Energy Agency.

Executed Low Yield Nuclear Monitoring experiments including new capabilities to distinguish low- to no-yield weapons development activities from natural occurrences. These experiments included first time collaborations with the Subcritical Experimentation Program.

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Making Our World a Safer Place

**PANTEX**
Installed the Seismic-Acoustic Network, allowing for continuous collection of meteorological, seismic, and infrasound signals, contributing to the development of domestic and international explosive monitoring capabilities.

**Y-12**
Advanced global nuclear security by providing uranium-molybdenum castings for U.S. high performance reactors, completing Distance Alarm Response Training courses and a new Dispatcher Training course, and executing the Relentless Rook exercise for the Mobile Uranium Facility.

**COUNTERTERRORISM AND COUNTERPROLIFERATION**
Conducted preventative radiological/nuclear detection activities for several National Special Security Events, including the 59th Presidential Inauguration and Super Bowl LV, in coordination with the Federal Bureau of Investigation and other partners.

**DEFENSE NUCLEAR NONPROLIFERATION**
Completed a full-scale exercise of the Mobile Uranium Facility and the Mobile Plutonium Facility, systems NNSA maintains to expeditiously characterize, stabilize, package, and remove weapons-usable nuclear materials.

**SAVANNAH RIVER SITE**
Moved Plutonium Downblending operations (also known as Dilute & Dispose) to multi-shift operations. The Surplus Plutonium Disposition (SPD) Project is underway to expand the existing downblending capability to meet NNSA’s commitment to remove materials from South Carolina in accordance with a legal settlement.

**COUNTERTERRORISM AND COUNTERPROLIFERATION**
Partnered with the Federal Bureau of Investigation to plan, execute, and evaluate the Marble Challenge 21 (MC-21) full-scale exercise in Washington, D.C. MC-21 exercised interagency counter-weapons of mass destruction capabilities, including new authorities under a National Security Presidential Memorandum governing the interagency response to a terrorist incident.
USS GERALD R FORD (CVN 78) safely executed Full Ship Shock Trials between June and August 2021, the first on a nuclear aircraft carrier since 1987.

Christened the 22nd VIRGINIA Class submarine, USS HYMAN G. RICKOVER (SSN 795).

Installed the power unit and completed the refueling work at the S8G Prototype in New York.

NAVAL NUCLEAR PROPULSION

Poured over 135,000 cubic yards of concrete (13,500 truck loads) for the Naval Spent Fuel Handling Facility in Idaho.

Continued construction of COLUMBIA (SSBN 826), the lead ship of the COLUMBIA class, 16 VIRGINIA Class Submarines, and aircraft carriers JOHN F. KENNEDY (CVN 79) and ENTERPRISE (CVN 80).

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Building Better Infrastructure

**DEFENSE PROGRAMS**

Approved Critical Decision 1 milestones for both the Plutonium Facility-4 (PF-4) at Los Alamos National Laboratory and the Savannah River Plutonium Processing Facility project at the Savannah River Site (SRPPF). The PF-4 project will repurpose existing spaces within the LANL Plutonium Facility to produce 30 pits per year in 2026. SRPPF will establish the Department’s capability to fabricate at least 50 war reserve pits per year at the Savannah River Site.

**DEFENSE NUCLEAR SECURITY**

Broke ground on the West End Protected Area Reduction Project (WEPAR) at Y-12. WEPAR reduces the size of the protected area by approximately 50%, which reduces the risk of catastrophic security system failure and decreases costs for decontamination and decommissioning process-contaminated facilities.

**DEFENSE, INFRASTRUCTURE, AND OPERATIONS**

Placed lease orders with the General Services Administration to replace gasoline engine vehicles with approximately 50 Zero Emission Vehicles (ZEV) nearly doubling the number of ZEVs in NNSA’s fleet from 61 to 111. NNSA also allocated $1.9M to Electric Vehicle (EV) charging infrastructure to install 40 EV charging stations in FY 2022.

**SAFETY, INFRASTRUCTURE, AND OPERATIONS**

Broke ground on the West End Protected Area Reduction Project (WEPAR) at Y-12. WEPAR reduces the size of the protected area by approximately 50%, which reduces the risk of catastrophic security system failure and decreases costs for decontamination and decommissioning process-contaminated facilities.

**PANTEX**

Exceeded the FY 2021 planned infrastructure dispositions requirement. While the goal was 14, Pantex completed 17 building dispositions.

**ACQUISITION AND PROJECT MANAGEMENT**

Completed construction of the new John A. Gordon Albuquerque Complex which remains on budget and on schedule for move-in to occur in June 2022.

**PANTEX**

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Building Better Infrastructure

**Building Better Infrastructure**

**Y-12**
Achieved exterior construction completion milestones at the Uranium Processing Facility (UPF) on the Main Process Building, the Salvage and Accountability Building, and the Process Support Facility, while energizing the Mechanical Electrical Building. UPF also completed the delivery of all structural steel and all multi-commodity pipe rack modules for the project.

**ACQUISITION AND PROJECT MANAGEMENT**
Completed Phase 2 of the Radiological Laboratory Utility Office Building Equipment Installation (REI-2) two months ahead of schedule and $120M under budget. REI-2 enhances analytical chemistry and material characterization capabilities that support plutonium missions at Los Alamos National Laboratory and the NNSA complex.

**KANSAS CITY NATIONAL SECURITY CAMPUS**
Commemorated the successful completion of a new light manufacturing facility close to the main campus. The 275,000 square-foot facility expands manufacturing capabilities and is home to a state-of-the-art advanced manufacturing training center.

**LAWRENCE LIVERMORE NATIONAL LABORATORY**
Achieved beneficial occupancy at a Livermore National Laboratory polymer enclave facility and began classified operations. This enclave established a partnership with Kansas City National Security Campus to reduce polymer development timelines with a more seamless transition from the development phase to production phase.

**ACQUISITION AND PROJECT MANAGEMENT**
Completed construction and turnover items for the Plutonium Facility Equipment Installation Phase 1 Project at Los Alamos National Laboratory 15 months ahead of schedule and $110M under budget.
Building Better Infrastructure

**Y-12**
Began site preparation work on the Oak Ridge Enhanced Technology and Training Center, a unique federal- and state-funded concept to provide first responder training and technology demonstrations.

**ACQUISITION AND PROJECT MANAGEMENT**
Awarded NNSA’s first fixed-price contract line item under a management and operating contract for the 138kV Power Transmission System Replacement project at the Nevada National Security Site for approximately $39M.

**SAFETY, INFRASTRUCTURE, AND OPERATIONS**
Acquired the LeMond Carbon Facility in Oak Ridge, Tennessee, near the Y-12 National Security Complex. The acquisition marks NNSA’s successful conclusion of a first-ever Option to Purchase Agreement, which gives NNSA the opportunity to modernize infrastructure without the need for new construction. With this novel approach, NNSA was able to secure the needed development space early and then perform required due diligence during the option period.

**LOS ALAMOS NATIONAL LABORATORY**
Transformed infrastructure to create a state-of-the-art training center for new hires, repurposed more than 300 workspaces for Weapons Production, leased buildings in Santa Fe for the first time in over 60 years, remodeled 180,000 sq. ft. for teleworkers, and built two new parking garages.

**LAWRENCE LIVERMORE NATIONAL LABORATORY**
Completed construction of a new Small Firearms Training Facility. The building replaced aging infrastructure and made improvements to other co-located structures, removed non-permanent trailers that were onsite past their intended date. The project was completed ahead of schedule and under budget.

**SAFETY, INFRASTRUCTURE, AND OPERATIONS**
Accelerated NNSA’s infrastructure recapitalization by mobilizing four Enhanced Minor Construction and Commercial Practices pilot projects, completing three new minor construction buildings to meet urgent mission needs, and demolishing 19 assets (a total of 28,569 sqft), including nine process-contaminated facilities.
Collaborated with field offices to create an inventory of available and needed Personal Protective Equipment (PPE) and consumable cleaning supplies. Created a web-based system to collect and track the data and facilitated PPE transfers between sites to ensure necessary PPE was available to continue operations.

**SAFETY, INFRASTRUCTURE, AND OPERATIONS**

**INFORMATION MANAGEMENT**
Collaborated with DOE to ensure software and hardware resources were supplied to employees during the COVID-19 pandemic and coordinated efforts to deploy equipment to the Federal workforce, which included the purchasing of equipment and facilitating pickup.

**SANDIA NATIONAL LABORATORIES**
Supercomputers simulated sneezes to help researchers understand how far coughs and sneeze droplets can travel to spread COVID-19. Their findings reinforced the importance of wearing masks, maintaining social distancing, avoiding poorly ventilated indoor spaces and washing hands frequently.

**EMERGENCY OPERATIONS**

**LOS ALAMOS NATIONAL LABORATORY**
Made a number of important contributions at the state and federal level during the COVID-19 pandemic:

- Led a global effort to successfully decode the delta variant.
- COVID-19 model used by CDC and New Mexico.
- Website with freely available data for all states.
- Laboratory modelers worked with Department of Health to project disease transmission and school reopenings.
- Science capabilities to help understand viruses, predict spread, and quantify the impact of vaccine strategies.
- Led COVID-19 Testing Team for the DOE’s National Virtual Biotechnology Lab.
- Invested more than $24M in R&D since the pandemic began.

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Collaborated with Emory University to implement a first-of-its-kind tech-transfer market research program that also introduced business and legal students to our national labs – a potential recruitment path for the next-generation workforce.

Awarded 13 Minority Serving Institution Partnership Program grants for a total of 24 consortia grants to better serve tens of thousands of students and Minority-Serving Institutions in STEM disciplines.

Achieved the highest Federal workforce level for NNSA since 2013 with a total 1,825 Federal employees onboard.

Collaborated with Emory University to implement a first-of-its-kind tech-transfer market research program that also introduced business and legal students to our national labs – a potential recruitment path for the next-generation workforce.

Conducted an enterprise-wide review of staffing to understand NNSA’s future federal staffing level required to execute its mission.

Led an enterprise partnership to develop recommendations and performance measures to improve formality of operations and enhance NNSA mission execution.

Executed the Safety, Analytics, Forecasting, Evaluation, and Reporting (SAFER) software tool to connect with any NSE database and extract information for users in a simple and secure web browser. This innovative resource will help bridge gaps that arise when using a variety of systems to address complex tasks.

Launched the Strategic Outlook Initiative, NNSA’s first enterprise-wide analysis that looks over the horizon to identify emerging risks and opportunities with the potential to shape the NNSA mission space over 5 to 20 years.

Through the Supply Chain Management Center (SCMC), the National Security Enterprise achieved the highest total annual strategic savings in the 15-year history of the SCMC, saving more than $415M in taxpayer dollars in FY 2021. The SCMC worked with DOE and NNSA contractors to combine their purchasing power to award multi-site commodity agreements for operating supplies, information technology, and services.
Congratulations to NNSA’s Nuclear Security Enterprise for another great year of accomplishments.