CHAPTER 5

NNSA NUCLEAR SECURITY ENTERPRISE

OVERVIEW

The National Nuclear Security Administration (NNSA) is responsible for ensuring U.S. nuclear weapons meet mission requirements and remain safe, secure, and effective. NNSA maintains the nuclear stockpile through the application of science, technology, engineering, and manufacturing exercised throughout the nuclear weapons complex. Additionally, NNSA is responsible for detecting and preventing the proliferation of weapons of mass destruction (WMD), securing nuclear and radiological materials, providing the Navy with fuel for safe and effective nuclear propulsion, and providing the United States with state-of-the-art nuclear counterterrorism and emergency response capabilities.

To ensure U.S. nuclear weapons capabilities meet mission requirements, new capacity demands require reinstating production of components and materials within the NNSA nuclear security enterprise (NSE). Specifically, the United States plans to restore plutonium pit production, increase tritium production, restart lithium processing, and reestablish several uranium production capabilities (to include developing a domestic uranium enrichment capability).

NNSA NUCLEAR SECURITY ENTERPRISE

To provide the research, development, production, dismantlement, and surveillance capabilities necessary to support the nuclear weapons stockpile, NNSA manages a complex of manufacturing, laboratory, and testing

facilities.[1] The NSE (Figure 5.1) spans eight sites with headquarters elements in Washington, D.C. and Albuquerque, New Mexico, including:

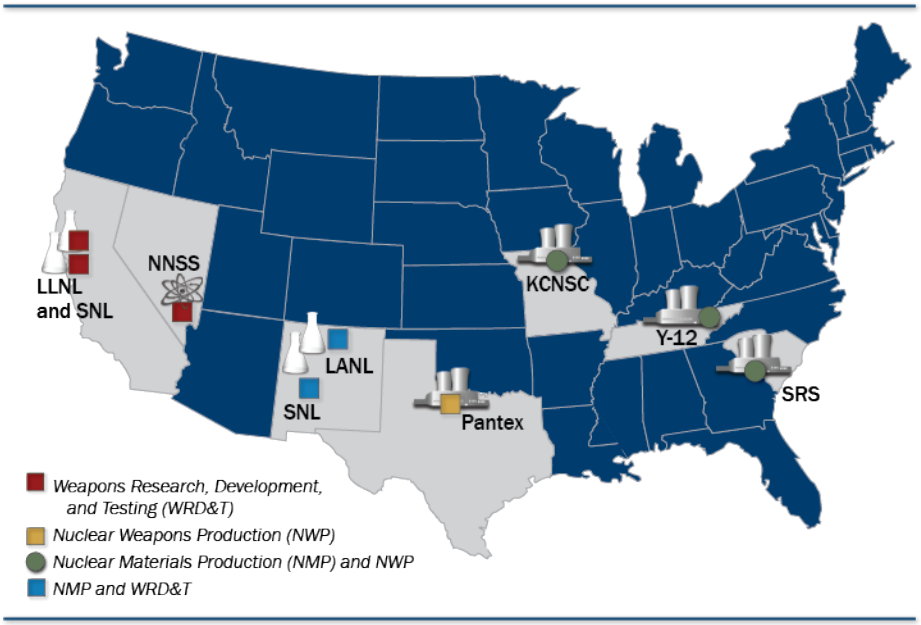

Figure 5.1 NNSA Nuclear Security Enterprise

- **National Security Laboratories:** Los Alamos National Laboratory in Los Alamos, New Mexico; Lawrence Livermore National Laboratory in Livermore, California; and Sandia National Laboratories in both Albuquerque, New Mexico, and Livermore, California.

- **Manufacturing Sites:** Kansas City National Security Campus in Kansas City, Missouri; Pantex Plant in Amarillo, Texas; Savannah River Site in Aiken, South Carolina; and Y-12 National Security Complex in Oak Ridge, Tennessee.

- **Test Site:** Nevada National Security Site in Nye County, Nevada.

Each laboratory, plant, and site within the NSE provides a critical contribution to ensure the safety, security, and effectiveness of the U.S. nuclear deterrent.

These sites work interdependently to deliver the end result-certified nuclear weapons. Figure 5.2 depicts the continuous nuclear and non-nuclear component production transactions among the NSE locations.

[1] There are several facilities that were once part of the NSE and have since been transitioned away from nuclear weapons-related activities. Among the largest of these were the Rocky Flats Plant in Colorado, the Mound Site in Ohio, the Pinellas Plant in Florida, and the Hanford Site in Washington.

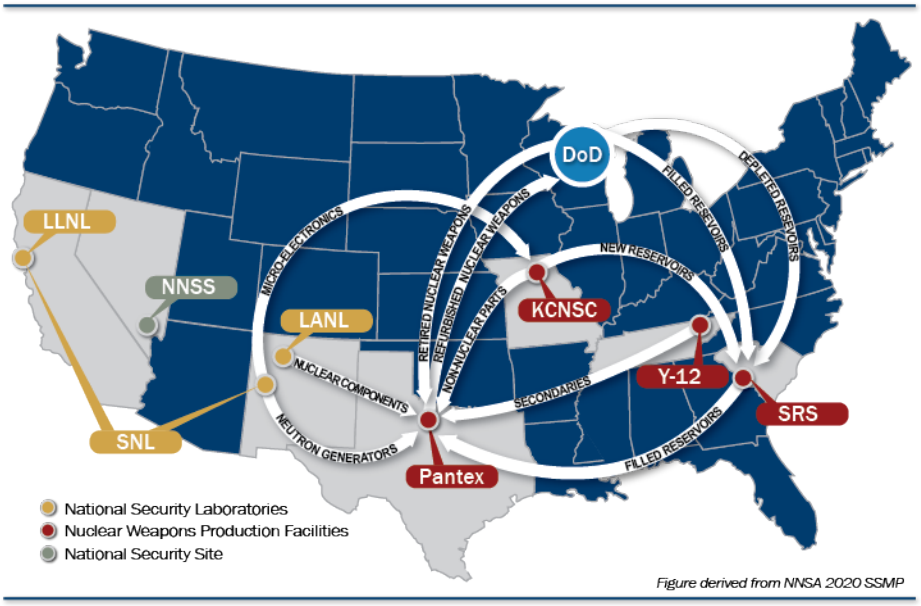

Figure 5.2 NNSA Nuclear Weapon Product Flow

Figure 5.3 describes the contribution of the NSE sites to the key strategic components/materials necessary for weapons performance.

Strategic Material	Site
Plutonium Pits	**LANL, SRS (future capability)**
Plutonium is a radioactive chemical element with fissile isotopes that can sustain a nuclear chain reaction necessary for nuclear weapons. Processing and handling plutonium is essential to assess and maintain nuclear weapons and requires proper storage facilities, safe and secure disposal pathways, and unique equipment and facilities for R&D activities. The largest portion of the U.S. weapons-usable plutonium inventory is in the form of retired pits. NNSA is currently pursuing a two-site strategy to meet the military requirement of producing at least 80 pits per year by 2030.	
Uranium	**Y-12**
Uranium is a chemical element used in fission weapons and processes and can include low-enriched uranium (LEU), high-assay LEU, and highly enriched uranium (HEU). Uranium has a variety of defense and nuclear nonproliferation applications, including weapon components, fuel for naval reactors, fuel for commercial power reactors to produce tritium, and fuel for commercial and research reactors that produce medical isotopes.	
Lithium	**Y-12**
Lithium is a soft, silver-white metal used as a target element in nuclear weapons. Lithium reacts with a neutron to produce tritium.	
Tritium	**SRS**
Tritium is a beta-emitting radioactive isotope of hydrogen. It is used to enhance the efficiency and yield of nuclear weapons in a process known as “boosting.” Tritium enables weapons to meet system military characteristics, increase system margins, and ensure weapon system reliability.	

Strategic Material	Site
Radiation-Hardened (Rad-Hard) Microelectronics	**SNL**
Rad-Hard microelectronics are electronics in nuclear warheads that must function reliably in a range of operational environments, to include radiation sources ranging from cosmic rays to intrinsic radiation within the weapon and from hostile sources. A trusted supply of strategic, radiation-hardened microelectronics meets current program requirements and supports R&D in nuclear weapons components.	
Energetic Materials	**Pantex**
Energetic materials are materials with high amounts of stored chemical energy that can be released. Energetic materials are required for a nuclear weapon to detonate as designed—e.g., high explosives, pyrotechnics, and propellants.	

Figure 5.3 NSE Contributions to Key Strategic Components and Materials

The NSE sites are government-owned but managed by a mix of management and operating (M&O) and federally funded research and development centers (FFRDCs). This status means that the facility is managed and operated through a contract between NNSA and a contractor or contractor team selected by NNSA.

LOS ALAMOS NATIONAL LABORATORY

Established in 1943 as part of the Manhattan Project, Los Alamos National Laboratory (LANL) is a nuclear weapon design laboratory responsible for providing research, development, and manufacturing guidance authority for nuclear explosive packages and other nuclear weapon components. LANL, as part of the annual stockpile assessment process, has responsibilities to ensure the performance, safety, and reliability of nuclear warheads; support surveillance, assessments, refurbishments, and future production of stockpile weapons; and provide unique capabilities in high-performance scientific computing, dynamic and energetic materials science, neutron scattering, enhanced surveillance, radiography, plutonium science and engineering, actinide chemistry, and beryllium technology. LANL is the associated physics laboratory and design agency for the W76-0/1/2, W78, and W88 warheads and B61 family of gravity bombs. LANL operates unique facilities that support both NNSA stockpile and non-stockpile missions, including the Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility (X-ray imaging for non-nuclear testing), the Los Alamos Neutron Science Center (LANSCE) (hydrodynamics, weapons nuclear science, and materials science), and TA-55 (plutonium science and manufacturing). LANL is on track to produce at least 30 plutonium pits a year by 2030 at its plutonium fabrication facility at PF4.

LAWRENCE LIVERMORE NATIONAL LABORATORY

Lawrence Livermore National Laboratory (LLNL), established in 1952, is a nuclear weapon design laboratory responsible for providing research, development, and manufacturing guidance authority for nuclear explosive packages and other nuclear weapon components. The laboratory, as part of the annual stockpile assessment process, has responsibilities to ensure the performance, safety, and reliability of nuclear warheads; support surveillance, assessments, refurbishments, and future production of stockpile weapons; and possess and employ important stewardship capabilities that include high-energy-density physics and unique performance scientific computing assets. For today's stockpile, LLNL is the physics laboratory and design agency for the B83-1, W80-1/4, and W87-0 warheads. LLNL will be the physics laboratory and design agency for the W87-1, which is the replacement warhead for the W78.

The W87-1 will be the first warhead in 30+ years to utilize newly manufactured plutonium pits. LLNL operates facilities that support both NNSA stockpile and non-stockpile missions, including the High Explosives Application Facility (HEAF) (study of chemical high explosives), Site 300 Experimental Test Site (assessment of nonnuclear components through hydrodynamic testing using high explosives), and the National Ignition Facility (NIF) (high-energy-density weapons physics and fusion ignition research).

SANDIA NATIONAL LABORATORIES

Established as Sandia Laboratory in 1948, Sandia National Laboratories (SNL), the engineering arm of the U.S. nuclear weapons enterprise, is responsible for non-nuclear components of U.S. nuclear weapons. It designs, develops, qualifies, tests, certifies, and serves as the system integrator of all components required to safe, arm, fuze, and fire a weapon to military specifications. Sandia's mission encompasses production agency responsibilities for weapon components, including neutron generators and trusted radiation-hardened microelectronics. Like LANL and LLNL, Sandia plays an important role in providing annual safety, security, and reliability assessments in the annual stockpile assessment process. Sandia's mission-essential facilities include specialized test facilities and manufacturing space for microelectronics, neutron generators, and unique power sources. Scientific facilities include reactors, pulsed-power devices, material characterization, and computational modeling and simulation capabilities housed in specialized facilities that provide an understanding of nuclear weapons performance, safety, and security without underground nuclear explosive testing.

Figure 5.4 provides an overview of the nuclear weapons stockpile and the specific physics laboratory associated with each weapon type (with SNL as the engineering laboratory for all).

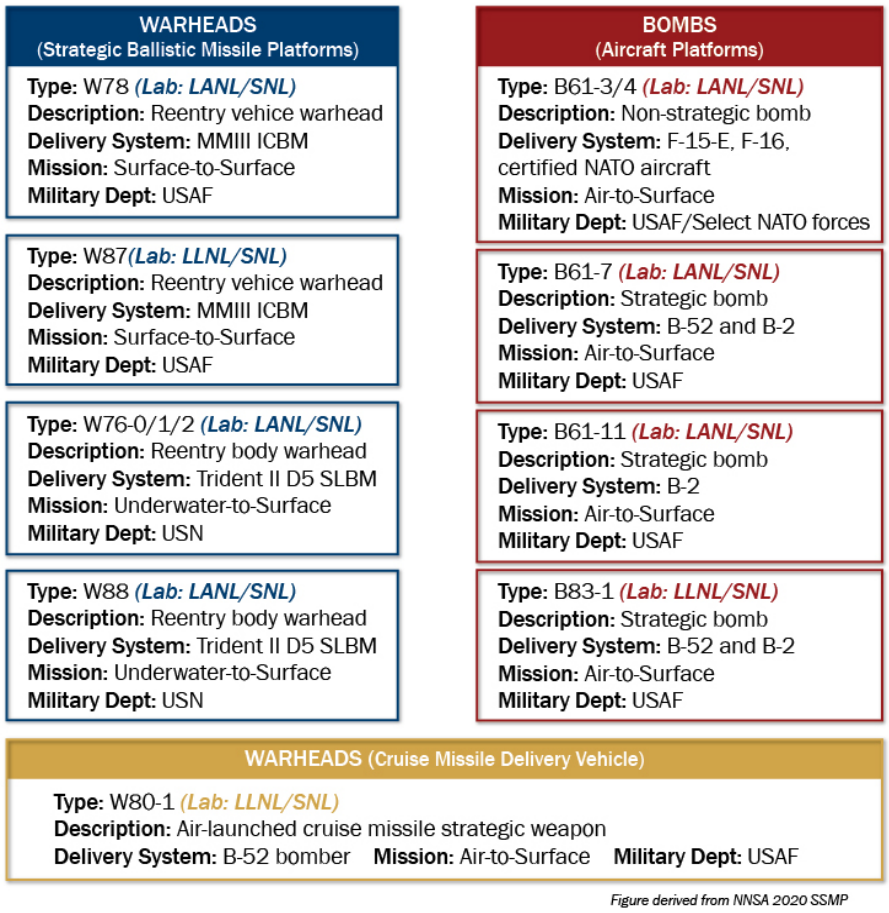

Figure 5.4 NSE Responsible Laboratories for the Current Nuclear Stockpile

KANSAS CITY NATIONAL SECURITY CAMPUS

In 1949, Kansas City was selected by the Atomic Energy Commission (AEC) to produce certain components for the nuclear weapons program. Today, Kansas City National Security Campus (KCNSC) is responsible for the procurement and manufacturing of non-nuclear components for nuclear weapons such as radar systems, mechanisms, reservoirs, joint test assembly components, engineered materials, and mechanical components. KCNSC is also responsible for evaluating and testing of these non-nuclear weapons components.

Specific mission areas of KCNSC include: additive manufacturing; analytical chemistries; training equipment/tools used by the military; design/development/manufacture of production and surveillance testers; surety activities (Nuclear Enterprise Assurance, Production Security Verification, Human Reliability Program, etc.); and generic production and fabrication capabilities (circuit boards, precision machining, miniature mechanisms, plastics, polymers, cables, electromechanical assemblies, etc.).

PANTEX PLANT

In 1951, the Pantex Plant (PX) was established to focus on high explosive and non-nuclear component assembly operations. Today, PX is charged with supporting three key missions: stockpile stewardship, nonproliferation, and safeguards and security. In support of the stockpile stewardship mission, Pantex is responsible for the evaluation, retrofit and repair of weapons, and weapon safety certification and reliability assessments. Pantex also manages the development, testing, and fabrication of high explosive components. In support of the nonproliferation mission, PX is responsible for dismantling surplus strategic stockpile weapons, providing interim storage and surveillance of plutonium pits, and sanitizing dismantled weapons components. In support of the safeguards and security mission, Pantex is in charge of the protection of plant personnel, facilities, materials, and information.

SAVANNAH RIVER SITE

The Savannah River Site (SRS) was established in the 1950 and primarily manages tritium inventories and facilities. As part of this responsibility, SRS personnel load tritium and non-tritium reservoirs to meet U.S. requirements. SRS is also conducts tritium reservoir surveillance operations, the testing of tritium gas transfer systems, and research and development on tritium operations.

In addition to its tritium-related roles, SRS will be responsible (together with LANL) for the production of plutonium pits after the new Savannah River Plutonium Processing Facility is completed. SRS will plan to produce a minimum of 50 plutonium pits per year while LANL will plan to produce at least 30, meeting the minimum national requirement for at least 80 pits per year by 2030.

Y-12 NATIONAL SECURITY COMPLEX

In 1943, Y-12 was established to produce enriched uranium. Today, the Y-12 mission is the production or refurbishment of complex nuclear weapon components and secondaries; the receipt, storage, and protection of special nuclear material; and the dismantlement of weapon secondaries and disposition of weapon components. Y-12 is in the process of constructing a Uranium Processing Facility (UPF), which is intended to replace and consolidate approximately 800,000 square feet of existing uranium facilities that are decades old and do not meet modern safety standards. Y-12 also plans to build a new Lithium Production Facility to replace its current Manhattan Project-era facilities.

NEVADA NATIONAL SECURITY SITE

In 1950, the AEC designated a portion of the Las Vegas Bombing Range as a nuclear test site responsible for nuclear explosive and effects tests. The 1992 moratorium on U.S. underground nuclear explosive testing and the September 11th attacks were significant events which reshaped the mission of the NNSS (formerly the Nevada Test Site). Today, employees across six government agencies, eleven prime contractors, and three national security laboratories work daily at the NNSS to ensure the security of the U.S. nuclear weapons stockpile with high-tech experimentation and training. The NNSS also provides nuclear and radiological emergency response training and capabilities, support to national security customers, and expertise for non-proliferation and arms control initiatives.

FUTURE ENTERPRISE INFRASTRUCTURE ENHANCEMENTS

Modernization of existing infrastructure and construction of new facilities are underway within the NNSA enterprise. These infrastructure modernization projects will ensure key capabilities, such as uranium enrichment, sufficient plutonium pit production, lithium processing, and tritium processing, are established and remain reliable for the nuclear stockpile of the future. A list of construction projects is listed in Figure 5.5. Figure 5.6 is a list of recapitalization/ facility enhancements.

Location/Facility	Description/Completion
LANL: Chemistry and Metallurgy Research Building Replacement (CMRR)	The CMRR project will make it possible for mission-critical technical capabilities, such as analytical chemistry, materials characterization, and metallurgy research and development, to be relocated to modern laboratory facilities that meet or exceed current safety and environmental protection standards. [Completion: FY 2022]
Y-12: Uranium Processing Facility (UPF)	The UPF project ensures the long-term viability, safety, and security of the NNSA enriched uranium capability. It supports the capability to manufacture weapon sub-assemblies containing enriched uranium components and convert excess enriched uranium into forms suitable for safe, long-term storage, and reuse. The new facility replaces the Y-12 enriched uranium processing operations, currently housed in numerous aging, inefficient buildings in poor condition that pose multiple risks to meeting the mission. [Completion: FY 2026]
Y-12: Lithium Processing Facility (LPF)	The LPF project replaces lithium component manufacturing capabilities currently located in a 75-plus-year-old building with structural issues that present a high-risk safety environment for both workers and process equipment. Lithium components are vital to canned subassembly (secondary) production, and lithium capabilities support warhead LEPs, joint test assemblies, international agreements, and other agencies within and outside DOE. [Completion: FY 2027]
SRS: Tritium Finishing Facility (TFF)	The TFF project will construct two new production buildings and relocate the vulnerable reservoir-related capabilities from the current facility to the newer, centralized production facilities. This will reduce operational risk and increase facility reliability compared to continuing operation in the current facility for an additional 20 years. [Completion: FY 2031]

Location/Facility	Description/Completion
SRS: Savannah River Plutonium Processing Facility (SRPPF)	The SRPPF, formerly designated to be the Mixed Oxide Fuel Fabrication Facility, will be home to a facility capable of producing at least 50 war reserve plutonium pits per year by 2030. This is part of the NNSA "two-site solution" for pit production. [Completion: FY 2027]
Y-12: Domestic Uranium Enrichment (DUE)	The U.S. government currently has no uranium enrichment capability. NNSA is conducting an analysis of alternatives (AoA) for a domestic uranium enrichment capability. In October 2018, NNSA initiated another campaign to downblend excess HEU from its stockpiles to provide unobligated and unencumbered LEU fuel in support of its tritium production mission. This campaign extends the need date for delivery of unobligated and unencumbered LEU fuel for tritium production out until 2041. [Completion: FY 2041]
Multiple: Power Sources Capability	Modern infrastructure is required to meet the long-term, full life-cycle requirements for power source capabilities. NNSA has initiated a project to determine mission needs and analyze alternatives to ensure capabilities are sustained. [Completion: FY 2030]
Pantex: High Explosives Synthesis, Formulation, and Production Facility	This facility will consolidate limited legacy facilities that are inadequate for meeting future high explosive workload and mission requirements. Areas to be addressed include explosive and mock formulation operations to support multiple weapon programs, technology development for future programs, and support for strategic partners. [Completion: FY 2029]
Y-12: Consolidated Depleted Uranium Manufacturing Capability (CDMC)	NNSA is currently exhausting usable inventories of high-purity depleted uranium metal feedstock used for weapons production. NNSA is planning to reestablish the capability to convert DUF6 to DUF4 at the Portsmouth site in Ohio. [Completion: FY 2045]

Figure 5.5 Construction Projects
(Derived from NNSA 2020 SSMP)

Location/ Facility	Description/Completion
LANL: Los Alamos Plutonium Pit Production Project (LAP4)	The LANL Plutonium Facility (PF-4) will be recapitalized to produce no fewer than 30 plutonium pits per year by 2026. This is part of the NNSA "two-site solution" for pit production. [Completion: FY 2027]
LANL: TA-55 Reinvestment Project Phase 3	The TA-55 project will support design and construction of fire alarm systems in PF-4 at LANL and removal of the old system. The main fire alarm panel and supporting devices represent a single-point failure risk. [Completion: FY 2022]
SNL: Neutron Generator Enterprise Consolidation (NGE+)	In 1995, SNL was designated the production agency for neutron generators and operations were moved into existing buildings, resulting in operations housed in eight buildings on multiple sites. These facilities are aging and operational risk results with movements and inefficiencies across multiple buildings. The proposed consolidated complex will improve workflow and efficiency, enabling neutron generator operations to better meet national security needs. Flexible-use space would allow for agile response to

Location/ Facility	Description/Completion
	unanticipated requirements, installation, and testing of replacement equipment, and investigation of new technologies. [Completion: FY 2038]
Pantex: Weapon System Assembly and Disassembly Cell Upgrade	This assembly/disassembly cell upgraded project would provide additional production cell capacity to support the forecasted increase in weapon workload and include installation of task exhaust; modifications to blast doors; replacement of dehumidifiers; installation of heating, ventilating, and air conditioning equipment, hoists, fire systems, and radiation alarm monitoring systems; and start-up activities. Expected activities for the third cell include installation of new flooring, minor system modifications, and start-up activities. [Completion: FY 2042]

Figure 5.6 Recapitalization/Facility Enhancements
(Derived from NNSA 2020 SSMP)