U.S. DEPARTMENT OF ENERGY

Fiscal Year 2014

Stockpile Stewardship and Management Plan

Report to Congress
June 2013

United States Department of Energy
Washington, DC 20585

MESSAGE FROM THE SECRETARY

This report provides the Department of Energy National Nuclear Security Administration *Fiscal Year 2014 Stockpile Stewardship and Management Plan* (SSMP), satisfying the statutory requirements of Section 4203 of the Atomic Energy Defense Act (50 U.S.C. 2523) and related Congressional requests.

This plan continues the Administration's commitment to maintain a safe, secure, and effective deterrent without new underground nuclear testing. It remains fully aligned with the national nuclear security strategy laid out in the April 2010 *Nuclear Posture Review Report*. This SSMP is a critical document for the nuclear security enterprise since it puts forward new strategies for stockpile stewardship and management and introduces the Nuclear Weapons Council's "3+2" strategic vision for the stockpile. This SSMP takes on a more ambitious scope of work relative to its predecessors, placing most of the stockpile into some phase of life extension in this decade.

The President's budget request to Congress will increase funding by 9 percent in the critical areas of modernizing and sustaining the infrastructure and the stockpile. This fiscal year (FY) 2014 SSMP, however, does not include the impact on planning and budget of the FY 2013 budget sequestration which would lead to adjustments to out-year plans. As technology advances and planning matures, requirements and resources will be balanced accordingly.

With this plan and the support of Congress, the Nation's nuclear deterrent will maintain a stable environment as we continue to take concrete steps toward a world without nuclear weapons.

Pursuant to the statutory requirements this report is being provided to the following members of Congress:

- **The Honorable Barbara Mikulski**
  Chairman, Senate Committee on Appropriations

- **The Honorable Richard Shelby**
  Ranking Member, Senate Committee on Appropriations

- **The Honorable Carl Levin**
  Chairman, Senate Committee on Armed Services

- **The Honorable James M. Inhofe**
  Ranking Member, Senate Committee on Armed Services

- **The Honorable Dianne Feinstein**
  Chairman, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

- **The Honorable Lamar Alexander**
  Ranking Member, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

- **The Honorable Mark Udall**
  Chairman, Subcommittee on Strategic Forces
  Senate Committee on Armed Services

- **The Honorable Jeff Sessions**
  Ranking Member, Subcommittee on Strategic Forces
  Senate Committee on Armed Services

- **The Honorable Harold Rogers**
  Chairman, House Committee on Appropriations

- **The Honorable Nita M. Lowey**
  Ranking Member, House Committee on Appropriations

- **The Honorable Howard P. McKeon**
  Chairman, House Committee on Armed Services

- **The Honorable Adam Smith**
  Ranking Member, House Committee on Armed Services

- **The Honorable Michael Rogers**
  Chairman, Subcommittee on Strategic Forces
  House Committee on Armed Services

- **The Honorable James Cooper**
  Ranking Member, Subcommittee on Strategic Forces
  House Committee on Armed Services

- **The Honorable Rodney P. Frelinghuysen**
  Chairman, Subcommittee on Energy and Water Development, and Related Agencies
  House Committee on Appropriations

- **The Honorable Marcy Kaptur**
  Ranking Member, Subcommittee on Energy and Water Development, and Related Agencies
  House Committee on Appropriations

If you have any questions or need additional information, please contact me or Mr. Bradley Crowell, Acting Assistant Secretary for Congressional and Intergovernmental Affairs, at (202) 586-3592.

Sincerely,

Ernest J. Moniz
Secretary

EXECUTIVE SUMMARY

With the support of the President's budget for FY 2014, this *FY 2014* SSMP continues the National Nuclear Security Administration's (NNSA) commitment to the objectives in the *Nuclear Posture Review Report* (DoD 2010). The FY 2014 budget request for the Weapons Activities[1] account reflects a 7.6 percent increase over the Weapons Activities account in the enacted FY 2013 budget. The FY 2014 President's budget is the fourth consecutive increase in the Weapons Activities budget, resulting in an approximate 28 percent increase since the FY 2010 budget. This support from both the Administration and the Congress comes at a time when NNSA is undertaking the significant task of modernizing and sustaining the infrastructure and the stockpile.

This SSMP has two purposes. First, it is Defense Programs' overarching plan to achieve its highest priorities—that is, to ensure a safe, secure, and effective nuclear stockpile, and sustain and modernize the stockpile and the infrastructure consistent with national policy and Department of Defense (DoD) requirements. Second, it is the formal means by which NNSA communicates the status of Defense Programs activities and the 25-year strategic program of record to Congress. In conjunction with the classified Annex, this SSMP discusses the current and projected composition and condition of the stockpile. A key focus is implementing activities in support of the *Nuclear Posture Review Report*, including the objective to reduce both the number of warhead types and the stockpile size. For instance, by formulating life extension options for interoperable warheads, we can reduce the number of warhead types while improving the safety and security of the Nation's nuclear deterrent.

To better accommodate the number and scope of the life extension programs (LEPs) currently planned, the Nuclear Weapons Council has conveyed a number of changes to DoD's requirements. Among these changes are the following. The W76-1 LEP production will be completed in FY 2019 rather than in FY 2021, while still meeting the Navy's schedule for the operationally deployed units. The first production unit of the B61-12, consolidating the B61-3, -4, -7, and -10, is planned for completion in FY 2019. NNSA plans to complete the first production unit for the W88 Alteration, which comprises improvements to arming, fuzing, and firing components and provides for sufficient logistical spares through the weapon lifetime by early FY 2019 rather than by late FY 2018. NNSA is conducting a study for an interoperable warhead, the W78/88-1, to meet the DoD requirement for a first production unit in FY 2025 rather than in FY 2023.

In addition, NNSA is conducting the initial steps to understand the requirements for a cruise missile warhead life extension with a first production unit as early as FY 2024. Ultimately, the plan to sustain the stockpile is to consolidate the stockpile to three ballistic missile warheads and two air-delivered systems (*i.e.* the "3+2" vision). Such a stockpile would have a number of advantages such as being simpler to maintain and improving overall safety and security. Advanced science, technology, and engineering (ST&E) capabilities are critical to meet the objectives in the *Nuclear Posture Review Report*. These ST&E capabilities, together with the complementary suite of experimental facilities and supercomputing platforms and codes, underpin NNSA's ability to assess the safety, security, and reliability of each nuclear weapon system on an annual basis. ST&E provides the tools to assess the condition and performance of the stockpile, the fundamental basis for the predictive assessment of each

[1] *Weapons Activities budget for FY 2014 and beyond no longer includes Nuclear Counterterrorism Incident Response. The comparison in the paragraph adjusted prior years for this change.*

weapon's life, and a framework for maturation of technologies and components that are required to address stockpile issues.

The Science, Engineering, Advanced Simulation and Computing, and Inertial Confinement Fusion Ignition and High Yield Campaigns are increasing their emphasis on primary physics and boost. These aspects of weapon performance are critical to assess the stockpile and to prepare for LEPs that may involve component reuse and pit manufacturing. Hydrodynamic experiments, which are essential to NNSA's predictive capability validation, will be prioritized to support LEPs. Integration of research on surrogates and plutonium will be critical to stewardship success. Although this plan will reduce the number of experiments at NNSA's high energy density facilities by about 10 percent, it will emphasize support of high energy density weapons research and near-term stockpile needs. Because ignition was not achieved in FY 2012, NNSA will emphasize non-ignition stockpile stewardship activities at the National Ignition Facility while supporting a reduced scientific effort to achieve ignition. Although reductions have been made in elements of the ST&E capability development, the resulting program will continue to meet the critical objectives outlined in the *Nuclear Posture Review Report* and allow NNSA to sustain the stockpile without the need for new underground nuclear testing.

Plans to revitalize the aging nuclear security enterprise are another critical element of this SSMP. Facilities that support the stockpile tend to be costly and require years to complete because of unique safety, security, materials, and specialized processing requirements. NNSA has made difficult choices to phase key infrastructure investments while meeting the needs of the stockpile. The most significant planning adjustment was the decision to archive the design for the Chemistry and Metallurgy Research Replacement Nuclear Facility (CMRR-NF) in FY 2012 and then defer construction of the CMRR-NF for at least 5 years. This deferral is only possible by leveraging previous investments such as the new radiological laboratory for analytical chemistry; conducting the plutonium characterization work at Los Alamos National Laboratory (LANL), and possibly other available laboratories, as necessary; and accelerating plans to process, package, and ship excess special nuclear material out of the plutonium facility at LANL. NNSA plans to phase in capabilities sooner than planned for CMRR-NF by adding equipment in the existing infrastructure. NNSA is also evaluating the feasibility of constructing small laboratory modules connected to existing nuclear facilities that could accommodate higher risk plutonium operations in more modern space. This solution would provide NNSA with continuity of the current capabilities essential for meeting future plutonium manufacturing and characterization requirements. When combined with equipment and infrastructure upgrades to pit manufacturing capacity, this plutonium strategy would meet the needs of the stockpile defined in this 25-year plan.

NNSA has also adjusted plans for the Uranium Capabilities Replacement Project at the Y-12 National Security Complex (Y-12) to "front load" the requested funding profile and sequence the scope to enable transition of operations out of Building 9212. Phase I of the project will consist of transitioning the required support, administration, logistics facilities, and infrastructure and utilities, as well as the processes and capabilities (*e.g.*, uranium casting and chemical processing) associated with Building 9212. Phase II will consist of relocating processes and capabilities associated with Buildings 9215 and 9998 (*e.g.*, uranium metal working, machining, and inspection) to the new facility. Phase III will consist of relocating processes and capabilities associated with Building 9204-2E (*e.g.*, radiography, assembly and disassembly, quality evaluation, and production certification for nuclear weapons secondaries) to the new facility.

The nuclear security enterprise requires a diverse workforce with the capabilities and essential skills vital to sustain the deterrent. NNSA has identified workforce challenges for the future, developed and refined plans to address those challenges, and implemented strategies to sustain the essential skills and acquire future talent. Stable funding and robust programs with strong ST&E content are critical to manage the workforce and will enable NNSA to retain key personnel and hire the next generation of stockpile stewards to meet emerging stockpile challenges and broader national security goals.

This SSMP describes NNSA's efforts to maintain the physical security of its sites and the secure transportation capabilities that link the sites and DoD together. The plan describes effective business practices that include governance initiatives to make the process more efficient, deployment of wireless technology, and implementation of one-card access to reduce costs. The SSMP integrates the scope and schedule necessary to sustain a safe, secure, and effective deterrent as long as nuclear weapons exist. Some of the updates reflected in this SSMP will require further adjustment as planning matures, technology advances, and requirements and resources are balanced. However, based on the *Nuclear Posture Review Report* requirements, coordination with DoD, and a thorough analysis by the men and women who are the actual stewards of the nuclear stockpile, this is an executable plan for the modernization and sustainment of the infrastructure and the stockpile.

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Fiscal Year 2014 Stockpile Stewardship and Management Plan

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AF&F	Arming, Fuzing, and Firing
Alt	Alteration
ASC	Advanced Simulation and Computing
BEEF	Big Explosives Experimental Facility
BMAC	Business Management Advisory Council
CAPE	Cost Analysis and Program Evaluation
CD	Critical Decision
CHE	Conventional High Explosives
CMF	Component Maturation Framework
CMR	Chemistry and Metallurgy Research
CMRR-NF	Chemistry and Metallurgy Research Replacement Nuclear Facility
CoLOSSIS	Confined Large Optical Scintillator Screen and Imaging System
CSA	Canned Subassembly
CSL	Cyber Sciences Laboratory
DARHT	Dual Axis Radiographic Hydrodynamic Test
DM	Deferred Maintenance
DoD	Department of Defense
DOE	Department of Energy
DSW	Directed Stockpile Work
EPAT	Enterprise Portfolio Analysis Tool
FCI	Facility Condition Index
FD	Facilities Disposition
FY	Fiscal Year
FYNSP	Future Years Nuclear Security Program
GTS	Gas Transfer System
ICBM	Intercontinental Ballistic Missile
ICF	Inertial Confinement Fusion
IHE	Insensitive High Explosive
ISO	International Organization for Standardization
IT	Information Technology
IW	Interoperable Warheads
JASPER	Joint Actinide Shock Physics Experimental Research
JC3	Joint Cybersecurity Coordination Center
JLON	Joint Laboratory Operations – Nevada
KCPNSC	Kansas City Plant National Security Campus
KCRIMS	Kansas City Responsive Infrastructure Manufacturing and Sourcing
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LEED	Leadership in Energy and Environmental Design
LEP	Life Extension Program
LLC	Limited Life Component
LLNL	Lawrence Livermore National Laboratory
M&O	Management and Operating
MC	Mission Critical

MDNC	Mission Dependent Not Critical
MOD	Modification
MRL	Manufacturing Readiness Level
MSIPP	Minority Serving Institution Partnership Program
NBI	National Boost Initiative
NEP	Nuclear Explosive Package
NMD	Not Mission Dependent
NNSA	National Nuclear Security Administration
NTO	Nuclear Test Organization
OCIO	Office of the Chief Information Officer
PCF	Predictive Capability Framework
PF-4	Plutonium Facility
PIDAS	Perimeter Intrusion Detection and Assessment System
PLOAS	Probability of Loss of Assured Safety
PPBE	Planning, Programming, Budgeting, and Evaluation
PRIDE	Product Realization Integrated Digital Enterprise
QMU	Quantification of Margins and Uncertainties
R&D	Research and Development
RLUOB	Radiological Laboratory Utility Office Building
SFI	Significant Finding Investigation
SLBM	Submarine-Launched Ballistic Missile
SNL	Sandia National Laboratories
SRS	Savannah River Site
SSMP	*Fiscal Year 2014 Stockpile Stewardship and Management Plan*
STA	Secure Transportation Asset
STARS	Standard Accounting and Reporting System
ST&E	Science, Technology, and Engineering
TA	Technical Area
TATB	Triaminotrinitrobenzene
TBSTP	*Technical Basis for Stockpile Transformation Planning*
TPBARs	Tritium-Producing Burnable Absorber Rods
TRIM	Tritium Responsive Infrastructure Modifications
TRL	Technology Readiness Level
TVA	Tennessee Valley Authority
U.S.C.	*United States Code*
UCRP	Uranium Capabilities Replacement Project
UGT	Underground Nuclear Test
UPF	Uranium Processing Facility
USEC	United States Enrichment Corporation
V&V	Verification and Validation
WBS	Work Breakdown Structure
WFO	Work for Others
WR	War Reserve
Y-12	Y-12 National Security Complex
2NV	NNSA Network Vision

LEGISLATIVE LANGUAGE

The National Nuclear Security Administration (NNSA) is required to report on how it plans to maintain the nuclear weapons stockpile. Specifically, Section 4203 of the Atomic Energy Defense Act (50 U.S.C. 2523), as amended by the National Defense Authorization Act for Fiscal Year 2013, requires that "The Administrator,[1] in consultation with the Secretary of Defense and other appropriate officials of the departments and agencies of the Federal Government, shall develop and annually update a plan for maintaining the nuclear weapons stockpile. The plan shall cover, at a minimum, stockpile stewardship, stockpile management, stockpile surveillance, program direction, infrastructure modernization, human capital, and nuclear test readiness." Pursuant to previous statutory requirements, except in 2012,[2] a version of the document has been submitted to Congress annually since 1998. However, starting in 2013, reports on the plan are only required every odd year, with summaries of the plan being sufficient in even years.

The bulk of the *Fiscal Year 2014 Stockpile Stewardship and Management Plan* (SSMP) is captured in a single, top-level, unclassified document. In addition, one classified Annex to the SSMP is also provided. The Annex contains supporting details concerning U.S. nuclear stockpile and stockpile management issues and describes the science, technology, and engineering base for the stewardship and management of the stockpile.

[1] The term 'Administrator' means the Administrator for the National Nuclear Security Administration.

[2] In 2012, an FY 2013 SSMP was not submitted to Congress because analytic work conducted by DoD/NNSA to evaluate the out-year needs for nuclear modernization activities across the nuclear security enterprise was ongoing and as such pre-decisional.

Chapter 1

Defense Programs – Central to the Nuclear Security Enterprise

CHAPTER 1
DEFENSE PROGRAMS – CENTRAL TO THE NUCLEAR SECURITY ENTERPRISE

1.1 Policy Framework and Mission Definition

Events over the past 3 years have reshaped the strategy for the nuclear security mission. The President's *National Security Strategy* (White House 2010), the *Nuclear Posture Review Report* (DoD 2010), and the ratification of the New Strategic Arms Reduction Treaty have underscored the importance of the NNSA's domestic and international nuclear mission. These documents have provided a clear path forward and, more specifically, have renewed NNSA's mandate to maintain a safe, secure, and reliable stockpile for as long as nuclear weapons exist.

The mission of NNSA's Defense Programs is to ensure the Nation sustains a safe, secure, and effective nuclear deterrent through the application of ST&E and manufacturing. As a result of the changing face of nuclear deterrence and more widely dispersed nuclear knowledge, Defense Programs also ensures the United States maintains excellence in nuclear science and technology that is second to none and can be applied to broader national security challenges. This SSMP is the long-term guide for executing the NNSA Defense Programs mission.

The Stockpile Stewardship and Management mission is broad and directly depends on continuing to improve the Nation's ST&E and manufacturing capabilities as applied to nuclear weapons. Stockpile stewardship is primarily focused on certification and assessment of the Nation's stockpile to provide documented assurance that the weapons can meet the national security mission. Stockpile management oversees the specific processes by which the stockpile is sustained, while meeting DoD requirements, and its safety and security features are modernized. This mission includes extending the effective service life of weapon systems through planned LEPs, pursuing opportunities to modernize the stockpile to increase safety and security, and exchanging limited-life components (LLCs). Stockpile sustainment encompasses the broad set of activities to maintain the stockpile through LLC exchanges and to address stockpile changes via modifications, alterations, and LEPs. The ST&E base enables these stockpile actions by providing the underlying capabilities to surveil and assess the stockpile, the analysis tools of simulation codes and validated models to accomplish the assessments, and the experimental facilities to provide that data to validate the computer models.

The success of these mission elements relies on a technical Federal and contractor workforce and an effective business model. Achieving the nuclear security mission also relies on completing the full scope of Defense Programs activities.

This SSMP describes the overarching 25-year plan to accomplish the following mission elements:

- Ensure the U.S. nuclear weapons stockpile remains safe, secure, and reliable.
- Sustain the stockpile and modernize the safety, security, and use control features of the stockpile without conducting underground nuclear tests.

- Strengthen the ST&E base that allows stockpile stewardship without underground nuclear testing and provides insights to nonproliferation efforts.
- Use only nuclear components that are based on previously tested designs and provide no new military capabilities while developing and implementing LEPs.
- Study options to ensure the safety, security, and reliability of nuclear warheads on a case-by-case basis, consistent with the Congressionally-mandated Stockpile Management Program.
- Consider the full range of LEP approaches, including refurbishment of warheads, reuse of nuclear components from different warheads, and replacement of nuclear components.
- Give preference to options for refurbishment or reuse when considering any decision to proceed to engineering development of warhead LEPs.
- Replace nuclear components only if critical Stockpile Management Program goals cannot otherwise be met and only if specifically authorized by the President and approved by Congress.
- Refurbish and modernize the physical infrastructure to ensure the long-term safety, security, and reliability of the nuclear arsenal.

1.2 Partnership with the Department of Defense

NNSA partners with the DoD to provide an effective nuclear deterrent for the Nation. This partnership is facilitated through the coordination and cooperation of the Nuclear Weapons Council, which is jointly organized by NNSA and DoD. Decisions that affect the stockpile are determined by the Nuclear Weapons Council, which provides an interagency forum to achieve consensus and establish priorities. The Nuclear Weapons Council has provided the following directions:

- Pursue B61 life extension Option 3B, with completion of a first production unit no later than FY 2019.
- Complete W76-1 production by FY 2019, while supporting U.S. Navy W76-1 fleet deployment requirement timeline.
- Continue the Phase 6.2 Study of the W78/88-1 LEP to enable completion of the first production unit as early as FY 2025.
- Complete a W88 arming, fuzing, and firing (AF&F) first production unit in FY 2019 to avoid impacting U.S. Navy operational forces and support the W78 and W87 fuze activities.
- Adjust downward the mix of active and reserve status of the B83 weapons.
- Downselect the cruise missile warhead family in FY 2013.
- Defer construction of the CMRR-NF for at least 5 years and execute a plutonium strategy that achieves a 30 pit per year capacity by 2021 and that may achieve up to 80 pits per year as early as 2030.

Nuclear Weapons Council "3+2" Vision

The Nuclear Weapons Council recently adopted a long-term "3+2" strategic vision to transition the composition of the stockpile to a total of five unique systems:

- *Three ballistic missile-type warheads, each deployable on both Air Force and Navy delivery systems, employing three interoperable nuclear explosive packages with adaptable non-nuclear components.*
- *Two types of air-delivered nuclear weapons, both deployable in a cruise missile and a bomb weapon system, employing interoperable nuclear explosive packages with adaptable non-nuclear components.*

- Modify Uranium Capabilities Replacement Project[1] plans to accelerate construction and modify the priorities to equip the new facility with Building 9212 capabilities first.
- Continue constructing the High Explosive Pressing Facility, which will replace three aging high-explosive facilities at the Pantex Plant.

1.3 Stockpile Stewardship and Management Planning

This SSMP describes the strong integration of the mission activities of Stockpile Stewardship and Management. For example, many ST&E methods are used to obtain information to make key stockpile management decisions and plan efforts. The Stockpile Stewardship and Management mission requirements flow from a well-defined set of national policy, strategy, military, nuclear deterrence, and technology requirements, as illustrated in **Figure 1–1**.

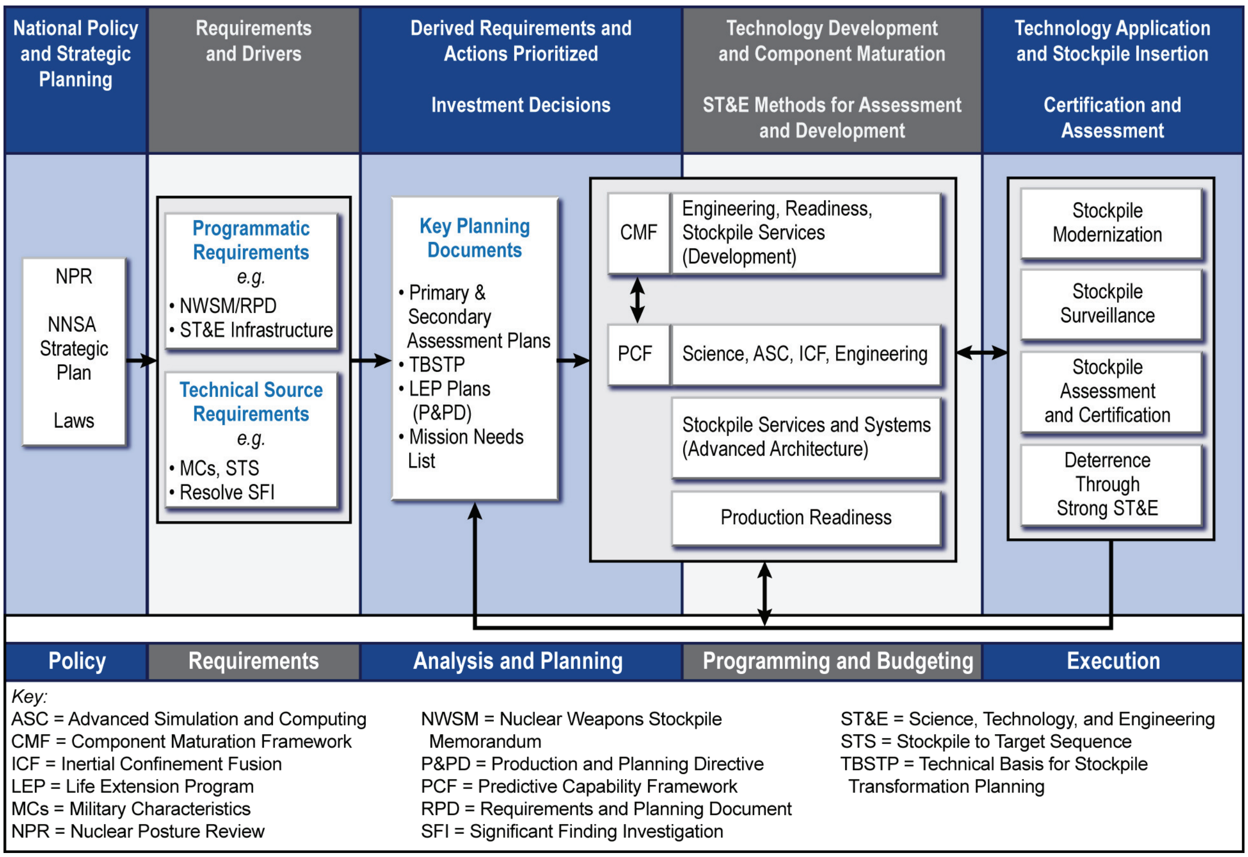

Figure 1–1. Flow of planning activities in the SSMP that begins with national policy and culminates in actions to provide a safe, secure, and reliable stockpile and an effective deterrent

A number of methodologies have been developed to translate the military, nuclear deterrence, and technology requirements into a systematic, interlinked array of activities and deliverables. This iterative process begins by examining the key planning documents that provide analyses of stockpile and nuclear deterrence needs. The basic stockpile requirements are in the LEP plans, which the annual Production and Planning Directive summarizes. These LEP plans are the culmination of analyses involving

[1] *The National Defense Authorization Act for Fiscal Year 2013 refers to this project as the Uranium Capabilities Replacement Project. NNSA previously used the term Uranium Processing Facility to describe this project in planning documents.*

surveillance, assessment, and associated activities. Other planning documents include the *Primary* and *Secondary Assessment Plans* and related weapons materials plans. The plans evaluate the evolving state of the Nation's stockpile, including options to improve safety and security and resolve other issues. The plans also address aspects of significant finding investigations (SFIs). The *Technical Basis for Stockpile Transformation Planning* (TBSTP) document provides analyses of the evolution of stockpile technology needs based on component aging and changes in performance, as well as the implementation of safety and security options. The TBSTP also determines the date when technologies must be matured for LEP insertion, which takes into account the replacement of components that have reached their end of life.

The Predictive Capability Framework (PCF) and the Component Maturation Framework (CMF) define the high-level activities to be executed by Defense Programs, as illustrated in the fourth column of Figure 1–1. The PCF identifies the complex set of interlinked analytical, computational, and experimental activities needed for stockpile assessment, the evaluation of some surveillance data, and the coordination of related efforts. The PCF then provides a plan of action to accomplish those activities. The PCF also includes schedules for a sophisticated set of experiments to validate stockpile modeling tools. Similarly, the CMF identifies components to be matured and ensures that the best technologies and manufacturing processes are available on timely schedules to supply components to meet LEP requirements. **Figure 1–2** shows how these planning documents align with the phases of each LEP.

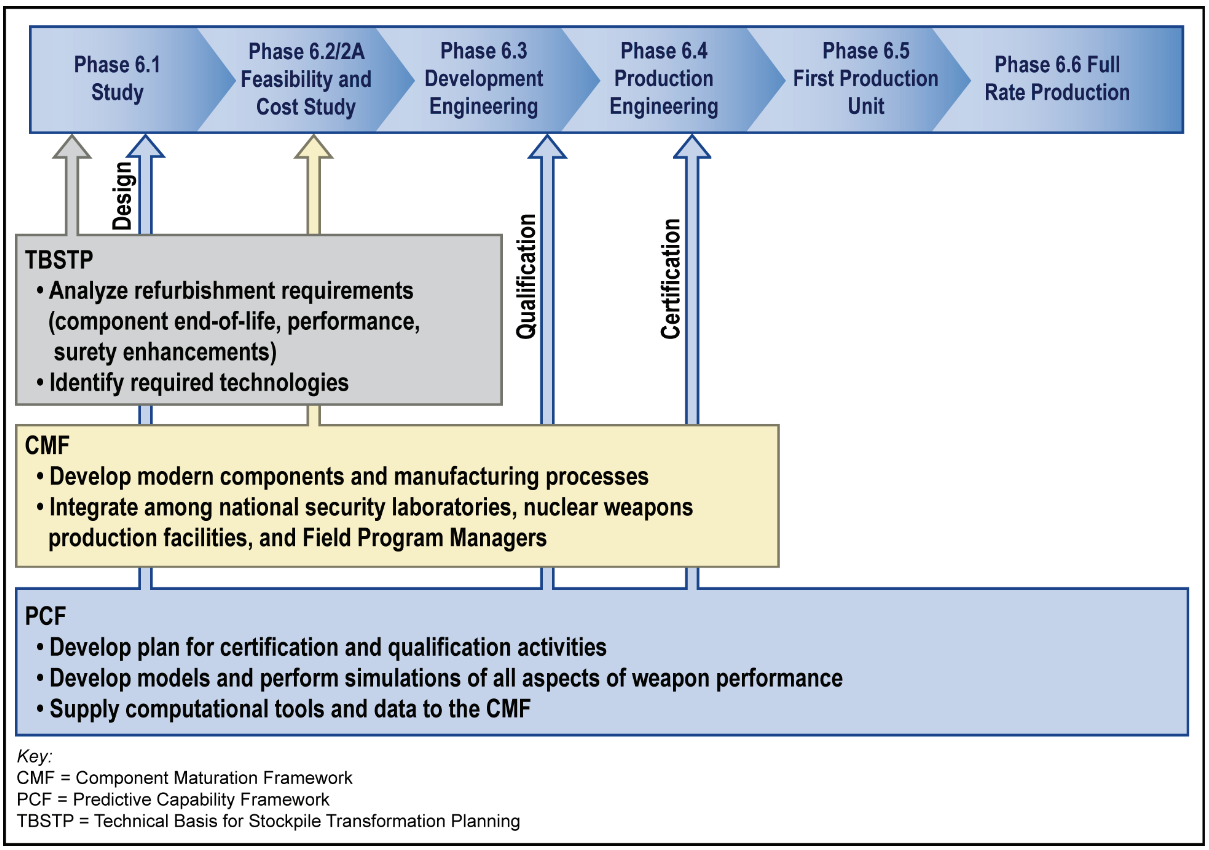

Figure 1–2. Linkage of science, technology, and engineering activities to weapons component life extension programs

Defense Programs conducts regular surveillance and performance assessments to provide a knowledge base to plan the continual maintenance and sustainment of the stockpile. Defense Programs also conducts SFIs of issues identified through these assessments (*e.g.*, discovered defects or departures from design or manufacturing specifications), identifies and evaluates aging phenomena that could degrade stockpile performance, and resolves the resulting issues. These activities are essential for assessment and certification of the stockpile and for determining whether weapons components are built to design specifications, whether the components perform to those design specifications over time, and whether material choices and production processes could alter the performance.

1.4 Stockpile Management

In the next 25 years, the U.S. nuclear weapons stockpile will be sustained and modernized through vigorous surveillance, assessment, life extension, maintenance, and dismantlement efforts. The overall U.S. stockpile, which consists of active and inactive warheads, will also experience changes via LEPs to improve its longevity, safety, and security and to reduce its size. The composition of the stockpile will reflect the needs of the nuclear deterrent strategy, as informed by feasibility studies and cost analyses. The stockpile will continue to include a mix of bombs, warheads delivered by submarine-launched ballistic missiles (SLBMs), warheads delivered by intercontinental ballistic missiles (ICBMs), and air-delivered warheads from air-launched cruise missile platforms. NNSA will not develop new nuclear warheads or provide new military capability, except to improve safety, security, and reliability.

Defense Programs will continue to assess the stockpile annually to ensure it remains safe, secure, and reliable. Surveillance coupled to assessments provides the cornerstone of our understanding of the condition of the stockpile. Surveillance will be conducted by sampling quantities and by in-depth component evaluations. The technical issues discovered will be understood and resolved through rigorous independent reviews and analyses using ST&E tools and without new underground nuclear tests.

LEPs will address known issues in weapon systems (*e.g.,* aging, manufacturing, and design) and evaluate the options for increasing safety, security, and reliability on a case-by-case basis. LEPs will only use nuclear components based on previously tested designs. The full range of LEP approaches will be considered, including refurbishment, reuse of nuclear components from different warheads, and replacement, with a strong preference for refurbishment and reuse. Safety, security, and use control[2] feature options will be pursued in coordination with DoD.

In addition to improving the safety of nuclear explosive packages (NEPs), LEPs will develop and introduce modern non-nuclear components and subsystems to replace aging and obsolete non-nuclear parts. Throughout this period, the production of LLCs used for recurrent exchanges of neutron generators, gas transfer systems, and power sources will be fully supported.

Weapons retired prior to 2009 will be dismantled by the end of FY 2022. By FY 2038, NNSA will have dismantled weapons in addition to those retired by 2009. Based on current warhead numbers, NNSA will have the capacity to complete any additional dismantlement in a timely manner.

Demand for strategic and special materials will continue. For the foreseeable future, production of newly generated fissile material will not be needed. Fissile materials will be recovered, recycled, and reprocessed from retired components to meet current needs. Other material challenges will be addressed by managing acquisition lead times. Irradiation of source materials is required to support

[2] *Use control refers to system features to deter or delay the unauthorized use or detonation of a nuclear weapon while facilitating authorized usage. Use control includes both passive and active protection devices, as well as command disable.*

production of tritium (a radioactive isotope of hydrogen). These rates may be three times greater than the present rates to satisfy the tritium requirement.

New technologies will be developed for implementation during the next 25 years to improve the safety, security, and reliability of the stockpile and to mitigate aging concerns and address problems created by "sunset materials and technologies."[3] The CMF will identify components to be matured and then support their systematic, timely, and cost-efficient insertion into nuclear weapon systems.

Chapter 2 describes the stockpile management activities (including annual assessments, surveillance, and maintenance), LEPs, and weapons dismantlement and disposition.

1.5 Science, Technology, and Engineering in Stockpile Stewardship and Management

Many ST&E fields of study underpin the weapons program and are used to understand the broad issues facing the stockpile. ST&E studies can be targeted to conduct stockpile assessments, resolve stockpile issues, evaluate design and production readiness for emerging programs, and certify life-extended warheads without new underground nuclear testing.

Nevertheless, success in dealing with stockpile issues is not a foregone conclusion. Many involve grand technical challenges that add schedule and technical risk and have no ready solutions. Moreover, as the stockpile ages, new challenges and unforeseen issues will arise. To ensure timely and effective responses to these issues, the ST&E base—both people and facilities—must be robust and agile.

By 2038, a new generation of weapons designers, code developers, experimentalists, and design and production engineers must demonstrate an understanding of nuclear weapons functionality using more predictive and more precisely calibrated computer-aided design and assessment tools than are possible today. High-fidelity experimental capabilities will produce quantitative data that preclude resumption of underground nuclear testing. Predictive capabilities, driven by stockpile and other security needs, will continue to evolve in response to improved computer simulations, experiments, and diagnostics.

A robust ST&E program will enable an accurate assessment process that drives a responsive production capability. Stockpile surveillance will produce quantitative data to both feed the annual assessment and drive corrective actions. Design and production specifications will be based on material properties and component characteristics that are linked directly to defined performance boundaries. Warhead design certification and component qualification based on known properties and characteristics will minimize dependence on qualitative controls and yield data for use in complex simulations.

ST&E will include direct interaction with related national defense initiatives that highlight technical challenges, encourage scientific curiosity, avoid technological surprise, and combat proliferation threats.

Chapter 3 describes the ST&E efforts planned for the next 25 years.

1.6 Nuclear Test Readiness

The Administration is committed to maintaining a safe, secure, and effective nuclear deterrent without underground nuclear testing, as described in the *Nuclear Posture Review Report* (DoD 2010), and to reducing the size of the Nation's stockpile. The NNSA is required to maintain a nuclear test readiness

[3] *"Sunset materials and technologies" are weapon components that no longer have an existing manufacturing base within or domestically outside the nuclear security enterprise.*

posture to conduct an underground nuclear test within 24 to 36 months, if specifically directed by the President. The NNSA approach to that requirement has been to maintain the facilities, equipment, diagnostics, operational capabilities, including some specific to underground nuclear tests, and personnel at the Nevada National Security Site and to make use of the extensive expertise and competencies of the Stockpile Stewardship Program to be prepared for such a test. The NNSA readiness strategy considers the possibility that an underground nuclear test or series of tests might be requested if a serious technical issue with the present stockpile is discovered or the possibility that a less complex test might be requested, for political purposes, if another nation executes a nuclear test.

NNSA and its national security laboratories possess the technical skills to plan and execute an underground nuclear test. However, a number of technologies unique to these tests are not exercised by stockpile stewardship, most of the equipment unique to nuclear test readiness has had minimal maintenance, and the number of personnel available, or with actual underground nuclear test experience, has continued to decline. Of the experiments conducted for stockpile stewardship, subcritical experiments (that is, those with no nuclear yield) most closely resemble nuclear tests in terms of the capabilities required to design, manufacture, assemble, diagnose, and field such a test. In FY 2012 and FY 2013, NNSA executed “scaled” subcritical experiments with surrogates and plutonium that exercised these skills.

Chapter 4 describes the elements of the NNSA strategy for test readiness and the present status of the technologies unique to underground nuclear testing that are not exercised by stockpile stewardship.

1.7 Physical Infrastructure

In 25 years, much of the physical infrastructure will have evolved from a post-World War II and Cold War era into an efficient 21st century nuclear security enterprise with less environmental impact. The post-2038 nuclear security enterprise will retain the required production and experimental capabilities. It will consist of eight major locations, each of which will have undergone significant changes. A modernized infrastructure will sustain the functions for plutonium, uranium, tritium, high explosives, weapons assembly and disassembly, non-nuclear component production, special nuclear material handling, as well as design, certification, experiments, and surveillance. As systems and facilities are updated, safety system reliability, personnel safety and security, greenhouse gas emission reductions, and operational costs will be improved.

The SSMP provides a 25-year plan to revitalize and sustain the nuclear security enterprise. NNSA maintains the physical infrastructure of a highly technical, and in many cases unique, set of nuclear weapons production, scientific, and engineering capabilities. The minimum capability-based physical infrastructure will require additional investments, as summarized in Chapter 5, Table 5–2. In the near term, NNSA will complete two major projects that greatly improve the capabilities of the infrastructure. In 2014, NNSA will complete the transfer from an aging and inefficient production plant in Kansas City to a new facility that is smaller, more efficient, and built with modern energy and environmental design. In addition, in 2017, NNSA will complete a new High Explosive Pressing Facility. In the long term, NNSA will complete two major capability improvements for uranium and plutonium activities. The first is the plutonium strategy, which is composed of a number of subprograms and projects that will result in a 30-pit-per-year capacity by 2021. The second is the Uranium Capabilities Replacement Project, which will complete Phase I in 2025. Other changes over the next 25 years include reductions in facility Perimeter Intrusion Detection and Assessment Systems (PIDASs) and disposition of excess facilities and materials.

Chapter 5 describes the current infrastructure of the nuclear security enterprise and its future requirements in detail.

1.8 Federal and Contractor Workforce

In 2038, the next generation of nuclear designers, scientists, technicians, and engineers will continue to be NNSA's greatest asset. The 21st century nuclear security enterprise, with cutting-edge science and manufacturing facilities and a continuing mission of national importance, will provide the environment for management and operating (M&O) contractors to attract and retain the best and brightest scientists and engineers. In addition, defense initiatives beyond stockpile stewardship, such as nuclear forensics to support attribution and treaty-verification activities, will provide a broadened mission that pushes the envelope of nuclear technology and further challenges and develops nuclear security professionals.

By 2038, the Federal workforce will be better optimized to respond to customer requirements, stockpile issues, and a world of fewer nuclear weapons. A new NNSA Pathways Program is replacing the Future Leaders Program, which has been used to recruit people to fill Federal positions. By 2038, this new program will provide dividends that enhance the quality and diversity of backgrounds within the Federal workforce.

The nuclear security enterprise will also have implemented a comprehensive workforce strategy geared toward retention of staff through career development programs. Additionally, the nuclear security enterprise will have established a pipeline of opportunities and internships, shared teaching opportunities, and challenging science and math programs to attract, select, mentor, and retain top candidates. The hiring, retention, and retirement rates of the Federal workforce and the M&O contractors should therefore be stable.

Efforts to sustain the nuclear security enterprise workforce are discussed further in Chapter 6.

1.9 Security of the Nuclear Security Enterprise

Since September 11, 2001, security requirements have increased and resulted in a more secure nuclear security enterprise. This is true for both cyber and physical security at the sites, as well as for the Secure Transportation Asset (STA) program, which ensures safe and secure transport of the Nation's nuclear assets among the sites. NNSA will continue efforts to ensure the security posture of the nuclear security enterprise. In light of the security breach at Y-12 on July 28th, 2012, some investment increases in this account have been sanctioned. Chapter 7 discusses aspects of the nuclear security enterprise's security posture.

1.10 Overview of Projected Budgetary Requirements and Management Processes and Procedures

The projected budgetary requirements to accomplish the 25-year strategy described in this SSMP are illustrated graphically in a series of figures and tables. These projections supplement the March 2013 *Department of Energy FY 2014 Congressional Budget Request* for FY 2014 – 2018, as well as for the 20 years beyond the Future Years Nuclear Security Program (FYNSP). An additional series of figures project the 25-year costs to sustain and extend the life of the weapon systems in the active stockpile.

NNSA's budget for Weapons Activities is increasing to meet stockpile requirements. In response, NNSA will seek to find efficiencies and prioritize the work that must be done. NNSA continues to pursue performance-based contracting and to streamline business practices for its M&O contracts. With a nuclear security enterprise-wide work breakdown structure, NNSA will achieve more-transparent reporting and greater flexibility for its M&O contractors. Key nuclear facilities within the nuclear security enterprise will have been replaced or modernized to incorporate more engineered controls and less reliance on administrative controls. NNSA legacy waste issues will have been resolved, and NNSA will be managing newly generated waste with an emphasis on minimizing that waste at its source. As a result, NNSA's safety posture should be greatly enhanced.

Chapter 8 describes the projected budgetary estimates for Weapons Activities and summaries of initiatives related to managing NNSA and its Defense Programs element to reduce risks and achieve efficiencies and cost savings.

1.11 Additional Information

The conclusions to the FY 2014 SSMP are found in Chapter 9, and additional information is provided in the five appendices to this SSMP. Appendix A lists statutory reporting requirements and related Congressional requests, and maps these to specific chapters or sections of chapters in the FY 2014 SSMP. In some instances, the mapping is to the accompanying classified Annex. Appendix B contains detailed information about subprograms that support ST&E activities. Appendix C contains details on readiness for an underground nuclear test, if needed. Appendix D contains additional information about the physical infrastructure of the nuclear security enterprise. Appendix E contains detailed information about the composition of the NNSA and its contractor workforce, including future requirements.

The classified Annex, a companion to Chapters 2 and 3 as well as to this chapter, provides extensive details about key elements of nuclear weapon operation and the evolution of weapons as the stockpile ages. A comprehensive picture of the Nation's nuclear stockpile, including a primer on nuclear weapons ST&E, is presented in Appendix A of the classified Annex. Quantitative analysis of the stockpile today provides the starting point for future planning.

Chapter 2

Stockpile Management

CHAPTER 2
STOCKPILE MANAGEMENT

Stockpile Management encompasses the activities of the Directed Stockpile Work (DSW) program, including assessments, surveillance, and maintenance of active weapons systems, LEPs, and weapons dismantlement and disposition. Also, it includes the base capabilities to do each activity. Science, technology, and engineering programs support stockpile management by providing the tools and capabilities for assessing, qualifying, and certifying the performance of weapon components, materials, and systems and include knowledge in engineering, high energy density physics, modeling and simulations, and manufacturing, as discussed in Chapter 3.

Chapter 2, in conjunction with Chapter 2 in the classified Annex, provides an overview of the status of the U.S. nuclear weapons stockpile in terms of weapon types, quantities, and age, as well as details about how the stockpile will be sustained for the next 25 years, including modernizing its safety and security features when feasible. Progress on and plans for the safe dismantlement of retired nuclear weapons are also discussed.

2.1 Nuclear Weapons Stockpile

2.1.1 Stockpile Overview

The nuclear weapons stockpile was developed to provide DoD with the military capabilities to implement national deterrence and assurance policy. The information in this chapter on the size and composition of the stockpile is consistent with the *FY 2011-2017 Nuclear Weapons Stockpile Plan,* which the President signed in July 2011, the *FY 2011-2024 Requirements and Planning Document* authorized by the Nuclear Weapons Council, and recent Nuclear Weapons Council memoranda and meetings regarding programmatic requirements for stockpile activities. Furthermore, these documents reflect the policy described in Chapter 1. Chapter 2 of the classified Annex provides additional information, including stockpile quantities and surveillance activities, life extension plans, and weapon dismantlement and disposition activities. Chapter 8 lists the total NNSA direct life cycle costs for weapons in the stockpile.

2.1.2 Stockpile Composition

The U.S. nuclear stockpile consists of active and inactive weapons. Active weapons are maintained in an operational, ready-for-use configuration and must be ready for deployment within a short time frame. Inactive weapons are maintained in a nonoperational status and typically have some LLCs removed. Retired weapons are not considered part of the stockpile, are not functional, and are in the queue for dismantlement and disposition. **Table 2–1** summarizes the major characteristics of the current stockpile, which is composed of two types of submarine-launched ballistic missile warheads, two types of intercontinental ballistic missile warheads, multiple types of bombs, and a cruise missile warhead delivered by aircraft. For additional details on yield and the number of deployed units, refer to Chapter 2 in the classified Annex.

Table 2–1. Current U.S. nuclear weapons and associated delivery systems

Type [a]	Description	Carrier	Laboratories	Mission	Military
Warheads—Strategic Ballistic Missile Platforms					
W78	Reentry vehicle warhead	Minuteman III intercontinental ballistic missile	LANL/SNL	Surface to surface	Air Force
W87	Reentry vehicle warhead	Minuteman III intercontinental ballistic missile	LLNL/SNL	Surface to surface	Air Force
W76-0/1	Reentry body warhead	D5 submarine-launched ballistic missile Trident submarine	LANL/SNL	Underwater to surface	Navy
W88	Reentry body warhead	D5 submarine-launched ballistic missile Trident submarine	LANL/SNL	Underwater to surface	Navy
Bombs—Aircraft Platforms					
B61-3/4/10	Non-strategic bomb	F-15, F-16, certified NATO aircraft	LANL/SNL	Air to surface	Air Force/ Select NATO forces
B61-7	Strategic bomb	B-52 and B-2 bombers	LANL/SNL	Air to surface	Air Force
B61-11	Strategic bomb	B-2 bomber	LANL/SNL	Air to surface	Air Force
B83-1	Strategic bomb	B-52 and B-2 bombers	LLNL/SNL	Air to surface	Air Force
Warheads—Cruise Missile Platforms					
W80-1	Air-launched cruise missile strategic weapons	B-52 bomber	LLNL/SNL	Air to surface	Air Force

LANL = Los Alamos National Laboratory
LLNL = Lawrence Livermore National Laboratory
NATO = North Atlantic Treaty Organization
SNL = Sandia National Laboratories

[a] The suffix associated with each warhead or bomb type (*e.g.*, “-0/1” for the W76) represents the modification associated with the respective weapon.

2.2 Stockpile Assessments, Surveillance, and Significant Finding Investigations

Stockpile assessments and surveillance are essential to evaluate the safety, security, and effectiveness of the U.S. nuclear deterrent. The Surveillance Program conducts evaluations of stockpile systems, components, and materials to discover faults in expected performance and establish trends based on the collected data. An anomalous experiment result may cause an SFI to be opened to determine whether the anomaly indicates a safety, security, or reliability problem with a system. The assessment program utilizes the surveillance and other targeted experimental data and analyses using computational models to determine the overall health of stockpile systems and the need for modifications, alterations, or life extensions to ensure the safety, security, and reliability of the individual systems. This section discusses the assessment and surveillance activities and the recent changes made to improve the governance and management practices of NNSA’s Stockpile Surveillance Program.

NNSA’s national security laboratories,[1] with support from the nuclear weapons production facilities,[2] review historical design, performance, and production data in the context of new or improved assessments (see Section 2.2.1) and surveillance evaluations (see Section 2.2.2) to assure the state of the stockpile is well understood, identified issues are being addressed, and key performance parameters are being evaluated. **Figure 2–1** schematically portrays the activities conducted to assess the stockpile. These fall within the scope of both Stockpile Management (as discussed in this chapter) and ST&E (as discussed in Chapter 3).

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[1] *The national security laboratories are Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Sandia National Laboratories.*
[2] *The nuclear weapons production facilities are the Pantex Plant, Y-12 National Security Complex, Kansas City Plant, and Savannah River Site. Some components are also produced at Los Alamos National Laboratory and Sandia National Laboratories.*

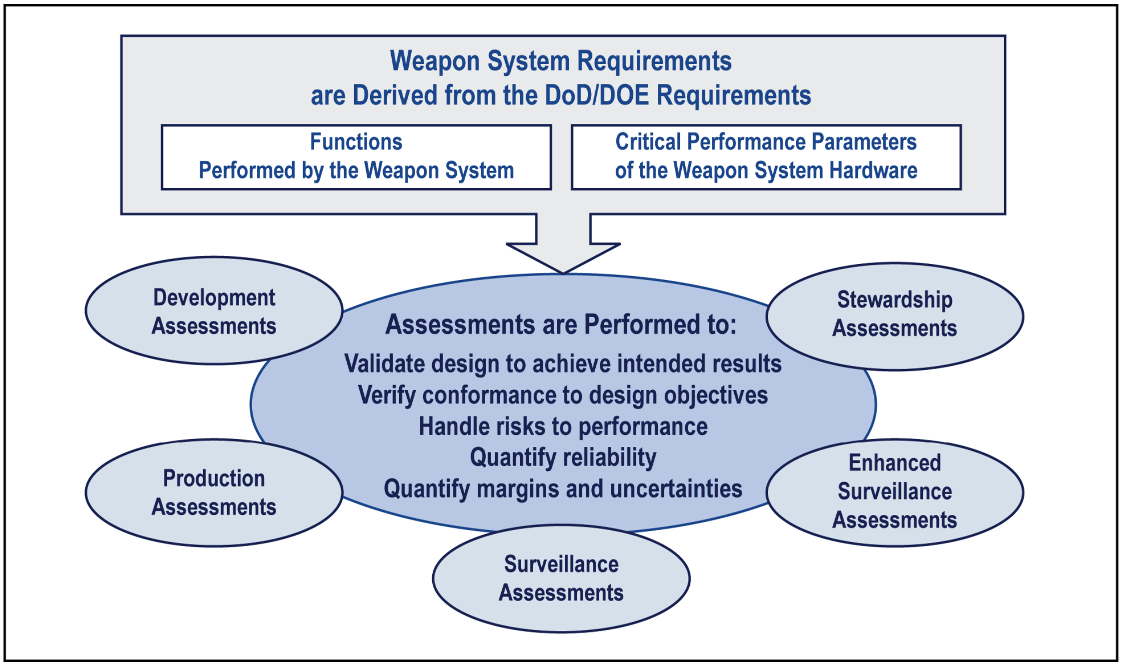

Figure 2–1. Activities conducted to assure a specific weapon system continues to meet performance requirements within a sufficient margin

2.2.1 Weapon Assessments

Warheads were originally designed to be robust and to meet all deployment requirements for their intended lifetime. However, three changes have occurred to this original design intent over the years. First, the stockpile life is now many years beyond the design lifetime, which has led to age-related degradation of many components. Second, scientific understanding and modeling, simulation, and computational capabilities have increased our ability to identify and quantify risks associated with particular weapon types. Third, surety expectations covering safety, security, and use control have increased. Together, these changes create a difficult assessment challenge. Today, assessments of specific weapons systems must advance understanding and identify technical knowledge gaps by:

- Evaluating identified performance and surety risks
- Quantifying performance thresholds, uncertainties, and margins
- Estimating performance degradation caused by stockpile aging

Weapon assessments encompass a broad spectrum of activities, including the following:

- Component and material testing over the stockpile-to-target-sequence environments[3]
- Fundamental material behavior (*e.g.*, equations of state)
- Analyses and simulations related to component qualifications and systems certifications
- Environmental effects
- Aging of materials and components
- Performance and safety sensitivity and thresholds

These assessments are also supported by new data that are gathered annually through Surveillance Program evaluations, as discussed below.

[3] *The stockpile-to-target sequence environments define the normal, hostile, and abnormal environments to which the warhead may be exposed during its life cycle.*

The activities depicted in Figure 2–1 cover a broad range of analytical and experimental needs. The stockpile management elements are conducted on a warhead-by-warhead basis to address specific concerns (*e.g.*, a required safety analysis, a spurious test result, or an identified risk area) using established test and analysis processes. Current assessments are based primarily on surveillance data and computational baseline models of the weapon system. These assessments complement the stockpile stewardship ST&E assessments described in Chapter 3, Section 3.3, which are of a more encompassing nature. The stockpile stewardship assessments generally support multiple systems and often require new or improved computational codes and models with increasing predictive capabilities as a goal, as well as major experiment activities at NNSA facilities to understand the underlying scientific basis for component and system performance.

Long-term and ongoing activities related to weapon assessments include the following:

- Updating system reliability estimates and issuing a Weapons Reliability Report on a semiannual basis (May and November)
- Fulfilling the annual assessment reporting requirements to the President (described in Section 2.3)
- Developing and improving the aging models for all major materials and components identified as "at risk" (a joint effort with the Surveillance Program) and moving toward a high-fidelity predictive assessment capability
- Quantifying margins and uncertainties[4] related to critical features, components, and system performance using computational baseline models

Key activities and milestones in weapon assessments are shown in Figure 2–14 in Section 2.9.2.

2.2.2 Weapon Surveillance

NNSA's Surveillance Program provides critical data to evaluate the condition of the active and inactive stockpile in support of decisions regarding weapon alterations, weapon modifications, repairs and rebuilds, life extensions, and assessments of reliability, safety, security, and performance. The Surveillance Program has the following goals:

- Identify defects (*e.g.*, birth defects) that affect safety, security, performance, and reliability.
- Establish margins between design requirements and performance at the component and material level.
- Identify changes and aging trends at a component and material level.
- Develop the capability for predictive assessments of stockpile components and materials.

The first two goals are primarily focused on understanding the current state of the stockpile, whereas the last two are focused on understanding how the stockpile changes with age and predicting the future state of the stockpile. The underlying objective is to ensure that precursors of aging issues are uncovered early enough to implement corrective actions before safety, security, reliability, or performance are affected.

The Surveillance Program is comprised of two elements: the Stockpile Evaluation Program and the Enhanced Surveillance subprogram within the Engineering Campaign. The Stockpile Evaluation Program is funded within the DSW program by both Stockpile Systems and Stockpile Services. It conducts

[4] *See Chapter 3, Section 3.3.1.2 for a discussion on margins and uncertainties.*

surveillance evaluations of the active and inactive stockpile and new production units. The Enhanced Surveillance subprogram provides diagnostics, methodologies, and other tools to the Stockpile Evaluation Program to enable the prediction and detection of birth or age-related defects and the accurate estimation of component or system lifetimes. These two program elements work closely together to develop and implement new surveillance capabilities across both system-level (*i.e.*, system flight tests and system laboratory tests) and component- and material-level tests.

Stockpile surveillance is performed on a random sampling of weapons drawn from both production lines and the stockpile,[5] with a focus on as-built design and manufacturing defects, as well as on aging and deployment issues. Surveillance is performed at various levels of a weapon system, from the full-up system to the major assemblies and components (*e.g.*, pits, canned subassemblies [CSAs], detonators, firing sets, gas transfer systems, and neutron generators) and, ultimately, to the materials that compose the components (*e.g.*, metals, plastics, ceramics, foams, and explosives). This process enables detection and evaluation of aging trends and anomalous changes at the component or material level.

The elements of stockpile surveillance involve a breadth of test and evaluation approaches:

- **Disassembly and inspection**. Weapons sampled from the production lines or returned from DoD are disassembled and inspected during disassembly. Weapon disassembly is performed in a controlled manner to identify any abnormal conditions and preserve the components for subsequent evaluations. Visual inspections during dismantlements also sometimes provide state of health information.
- **Flight testing.** After disassembly and inspection, selected weapons are reconfigured for flight testing. Flight test units, referred to as Joint Test Assemblies, are rebuilt to represent the original build to the extent possible. However, all special nuclear material components are replaced with either surrogate materials or instrumentation. The Joint Test Assembly units are flight-tested by the DoD operational command responsible for the system. Joint Test Assembly configurations vary from high-fidelity units that essentially have no onboard diagnostics to fully instrumented units that provide detailed information on component and subsystem performance.
- **System laboratory testing.** Test bed configurations are built to enable prescribed function testing of single parts or subsystems using parent unit[6] hardware from stockpile weapon returns. The majority of this testing occurs at the Weapons Evaluation Test Laboratory, which is operated by Sandia National Laboratories (SNL), at the Pantex Plant and involves electrical testing of the systems. The Air Force's Joint Interface Laboratory Test facility at Hill Air Force Base in Utah also conducts evaluations of joint test beds to obtain information regarding delivery platform-weapon interfaces.
- **Component testing and material evaluation.** Components and materials from the disassembly and inspection process undergo further evaluations to assess component functionality, performance margins and trends, material behavior, and aging characteristics. The testing can involve both nondestructive evaluation techniques (*e.g.*, radiography, ultrasonic testing, and dimensional measurements) and destructive evaluation techniques (*e.g.*, tests of material strength and explosive performance, as well as chemical assessments).

The number of disassembly and inspections and major component tests completed in FY 2012 and planned for FY 2013 are shown in **Table 2–2.**

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[5] *Stockpile weapons drawn for surveillance may be active or inactive weapons. In addition, some retired weapons may be drawn for surveillance to support certain evaluations.*

[6] *In some instances, Joint Test Assemblies and test beds will employ components from stockpile stores to allow the "stockpile return" components to be used in other evaluations.*

Table 2–2. Fiscal year 2012 actual and fiscal year 2013 projected major Directed Stockpile Work program stockpile evaluation activities (as of January 31, 2013)

Warheads	D&Is		JTA Flights		Test Bed Evaluations		Pit NDE		Pit D-Tests		CSA NDE		CSA D-Tests		GTS Tests		DCA Tests		Program Totals	
	Fiscal Year																			
	12	13	12	13	12	13	12	13	12	13	12	13	12	13	12	13	12	13	12	13
B61	14	13	6	9	4	6	42	30	1	1	6	11	3	0	8	10	24	21	108	101
W76-0	7	0	3	3	8	4	11	0	0	0	7	0	1	0	16	1	11	7	64	15
W76-1	13	19	4	3	14	13	35	45	1	1	2	9	2	2	9	12	10	18	90	122
W78	16	1	0	3	3	6	24	31	1	2	8	9	2	2	19	8	8	9	81	71
W80-1	8	9	4	4	0	4	26	24	0	1	1	0	1	1	11	10	17	0	68	53
B83	5	5	3	3	2	0	18	17	0	2	0	0	1	1	3	8	8	0	40	36
W84 [a]	1	0					0	0	0	0	0	0	2	0			0	0	3	0
W87	7	8	1	2	10	0	22	8	0	0	1	0	1	0	8	4	5	4	55	26
W88	6	7	4	3	6	4	8	9	0	1	1	0	1	0	37	0	0	14	63	38
Totals	**77**	**62**	**25**	**30**	**47**	**37**	**186**	**164**	**3**	**8**	**26**	**29**	**14**	**6**	**111**	**53**	**83**	**73**	**572**	**462**

CSA = canned subassembly
D&I = disassembly and inspection
DCA = detonator cable assembly
D-tests = destructive tests
GTS = gas transfer system
JTA = Joint Test Assembly
NDE = nondestructive evaluation

[a] Although the W84 is no longer deployed, limited surveillance is being conducted to ensure its continued safety.

Table 2–3 shows the planned DSW stockpile evaluation activities for FY 2013 through FY 2018. This table is based on the assessment requirements of the stockpile today and will evolve as updated information is processed and new diagnostics are deployed.

Table 2–3. Major surveillance evaluations completed in fiscal year 2012 and planned for fiscal year 2013, as well as planning requirements for the Future Years Nuclear Security Program (fiscal year 2014 through fiscal year 2018) (as of January 31, 2013)

Major Activity	FY 2012 Actual	FY 2013 Plan	FY 2014 Requirements	FY 2015 Requirements	FY 2016 Requirements	FY 2017 Requirements	FY 2018 Requirements	FYNSP Total
D&I	77	62	84	82	78	77	73	**456**
JTA Flight	25	30	36	28	33	27	28	**182**
Test Bed Evaluation	47	37	59	55	46	49	47	**293**
Pit NDE	186	164	171	169	167	164	166	**1,001**
Pit D-Test	3	8	10	7	10	9	7	**51**
CSA NDE	26	29	46	44	38	50	39	**246**
CSA D-Tests	14	6	17	15	14	14	14	**80**
DCA Test	83	73	75	80	80	80	79	**467**
GTS Tests	111	53	103	80	81	84	83	**484**
TOTALS	**572**	**462**	**601**	**560**	**547**	**554**	**536**	**3,260**

CSA = canned subassembly
D&I = disassembly and inspection
DCA = detonator cable assembly
D-Tests = destructive tests
FY = fiscal year
FYNSP = Future Years Nuclear Security Program
GTS = gas transfer system
JTA = Joint Test Assembly
NDE = nondestructive evaluation

Note: FYNSP forecasted quantities do not reflect reductions which may result from the lowering of stockpile readiness proposed for certain weapons.

Surveillance requirements, as determined by the national security laboratories for the weapon systems along with Air Force and Navy elements, identify the experiments needed to generate the information to support program deliverables, including annual assessments, semiannual *Weapons Reliability Reports*, and plans for life extension options. These requirements are continually refined, based on new surveillance information, annual assessment findings, and analysis (or reanalysis) of historical information (*e.g.*, development, production, and early experiment data) using modern assessment methodologies and computational tools. An agile and continuous cycle of surveillance, as depicted in **Figure 2–2**, provides flexibility for adjusting program priorities to address critical issues. Key deliverables of this process include collection of data needed to quantify performance margins, identification of knowledge gaps that impede the understanding of stockpile health, updates of technologies to keep up with the need for improved data, setting of priorities among competing surveillance activities, and continual improvement.

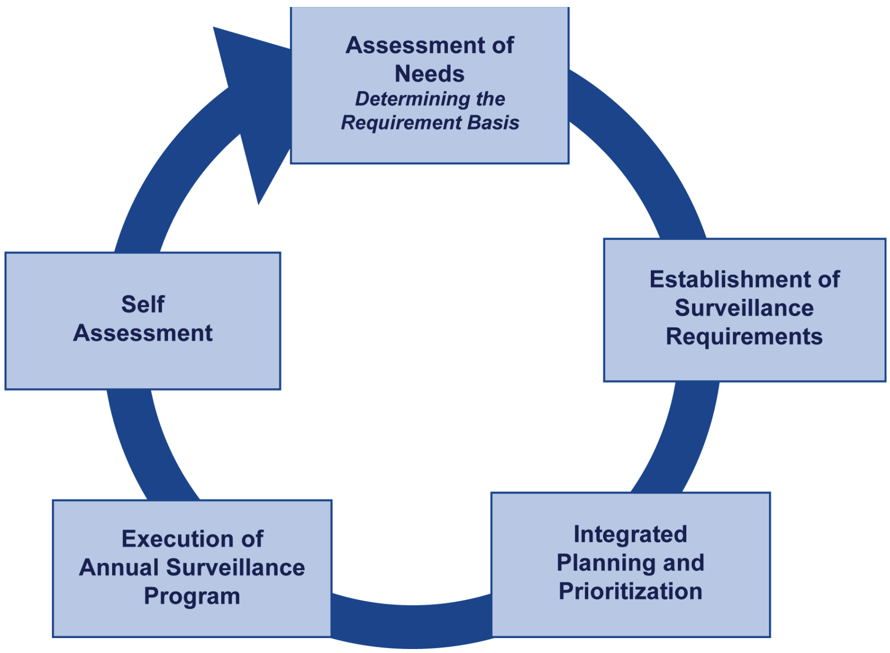

Figure 2–2. Continuous cycle of Surveillance Program activities

NNSA instituted a new surveillance governance model in FY 2011 to ensure rigor in planning and execution (see **Figure 2–3**). Under this new governance model, a Senior Technical Advisor for Surveillance, reporting directly to the Assistant Deputy Administrator for Stockpile Management, manages and integrates all elements of the Surveillance Program. Key activities are coordinated to assure that the most appropriate diagnostics are developed and used for surveillance evaluations, system-specific surveillance requirements are up to date and achieve a balance in priorities, and all systems requirements are integrated into an executable plan primarily performed at the national security laboratories of the nuclear security enterprise.

An annual surveillance schedule ensures that requirements are defined and communicated to the nuclear weapons production facilities, appropriate diagnostic capabilities are available and authorized for use, and planned activities are funded, scheduled, and completed. This schedule addresses planning for the next fiscal year, as well as planning throughout the FYNSP. Furthermore, the integration of all surveillance elements ensures that emerging issues and aging characterization will be addressed using the most cost-efficient and effective diagnostics.

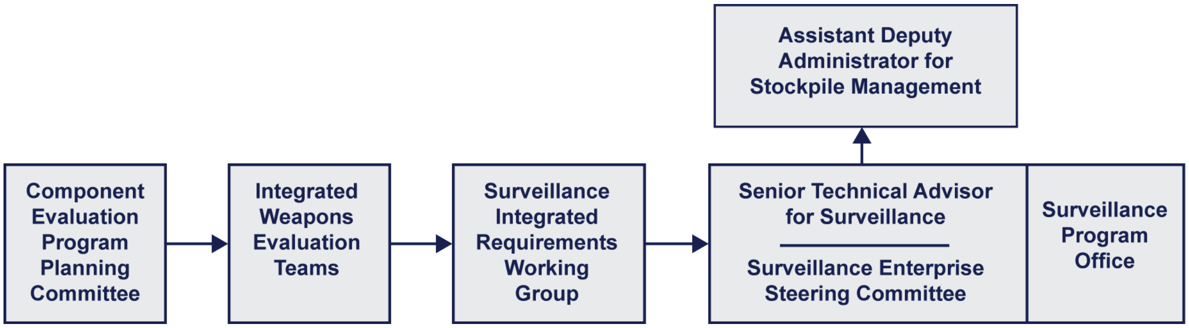

Figure 2–3. Nuclear weapons stockpile surveillance governance model

The balanced approach to detecting as-built design and manufacturing defects, assessing the performance of non-nuclear components, and identifying and understanding system aging issues of the nuclear components will support Surveillance Program objectives over the long term. NNSA will continue to assign high priority to surveillance assessments of weapon materials, components, and assemblies while eliminating or reducing lower-priority surveillance activities. In addition, a focused effort over the next few years will augment performance testing by conducting in-depth component and material evaluations of major non-nuclear components and assemblies. Ultimately, some evaluations will be transitioned to the Stockpile Evaluation Program.

Near-term surveillance activities include the following:

- Continue to employ new and improved component and material evaluation tests as part of the Stockpile Evaluation Program.
- Develop and deploy methods to make surveillance data available online for national security laboratories and nuclear weapons production facility stakeholders.
- Initiate improvements identified by the Surveillance Process Improvement Initiative to realize improved surveillance process efficiencies.
- Begin to implement surveillance metrics that assess the state of the Surveillance Program and identify and prioritize the additional information needed to address shortcomings.

Long-term and ongoing activities related to surveillance include the following:

- Meet priority stockpile surveillance commitments.
- Continue to assess both recent and historical test data to compare the state of each stockpile weapon with its original certified design and to inform future surveillance and LEP planning.
- Develop aging models for all major materials and components at risk.
- Develop and deploy improved surveillance diagnostics, with a focus on advanced nondestructive evaluation techniques to replace and augment more invasive and costly destructive techniques.
- Adjust program to handle stockpile commonality and develop capabilities to augment and later reduce reliance on flight testing.

Key activities and milestones in weapon surveillance are shown in Figure 2–14 in Section 2.9.2.

2.2.3 Significant Finding Investigations

SFIs are conducted when specific issues arise during surveillance or are identified during weapons production, DoD operations, reacceptance and rebuild, and dismantlement. The SFI process includes an evaluation of the impact on weapon system performance, reliability, security, and safety. A tracking and reporting system monitors progress from the initial discovery of an issue through its closure report. The closure report identifies the assessed impacts, if any, and provides follow-on recommendations for remediation or additional monitoring of the phenomena. In addition, a prioritization process ensures that the most serious and oldest SFIs are receiving appropriate resources. Depending on the nature of an SFI, it may be resolved solely as part of Stockpile Management, or a broader evaluation scope may be required that includes critical experiments, advanced code analysis, *etc.,* as well as the participation of ST&E experts from the Campaigns (*e.g.*, Science, Advanced Simulation and Computing [ASC], and Engineering). Most SFIs are closed out without impact to the stockpile. Some impacts involve only a subpopulation of a particular stockpile system, which may result in a minor reliability reduction. If the finding has a significant impact, it can result in the issuance of an exception to the Major Assembly Release until appropriate remedial action, such as an alteration (Alt), modification (Mod), or LEP can be undertaken.

Figure 2–4 shows the total number of SFIs opened and closed during calendar years 2001 – 2012 and the number that resulted in a significant impact to the stockpile. The variation in the number of SFIs opened during these years is a result of many factors including, for instance, the number of surveillance evaluations conducted, the pending LEP activities in which additional warheads were evaluated, and the use of improved diagnostics to identify additional areas of concern. To ensure that any issue that may affect system performance, reliability, security, or safety is identified, the threshold for the initial assessment of an anomalous observation is set intentionally low. Once notified of an anomaly by the production agency, the national security laboratory has 15 days to disposition (close or promote) the anomaly. If promoted, a Significant Finding Notification is issued, and the national security laboratories have 60 days to close out the anomaly or open a formal SFI. The relatively high number of SFIs opened, compared to the low number that were closed with a resultant impact to the stockpile, is a reflection of the conservative level that NNSA's national security laboratories and nuclear weapons production facilities set for initiating an investigation.

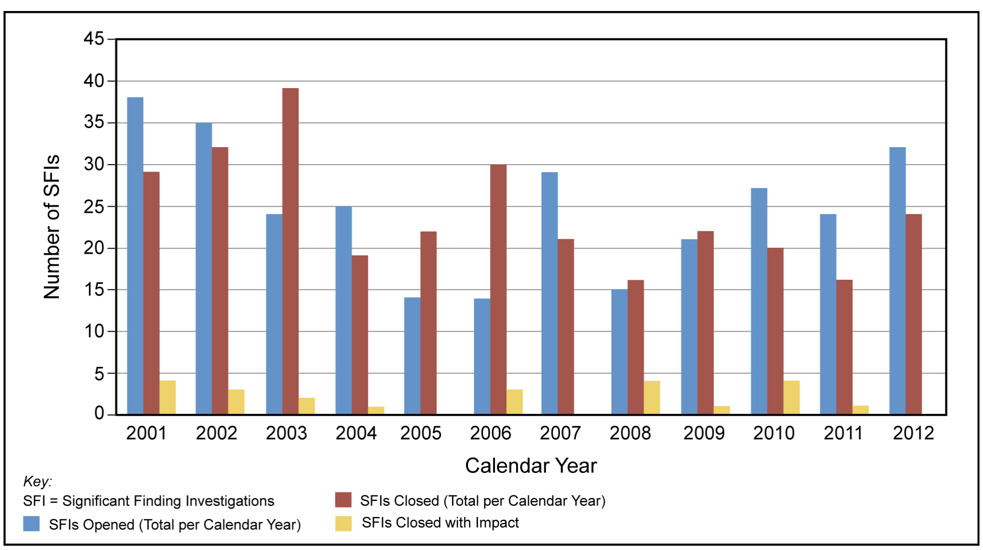

Figure 2–4. Historical number of Significant Finding Investigations opened and closed during calendar years 2001 to 2012 and the number that resulted in an impact to the stockpile

2.3 Annual Assessment Report to the President

2.3.1 Annual Assessment Requirements

President Clinton established an annual stockpile assessment requirement in 1995. The annual assessment requirement was first codified under the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (now 50 U.S.C. § 2525). The requirement directs the NNSA Nuclear Security Laboratory[7] Directors and the Commander of the U.S. Strategic Command to conduct an annual assessment of the safety, security, reliability, performance, and military effectiveness of the nuclear weapons stockpile.

The assessment process culminates in the delivery of the *Report on Stockpile Assessments* to the President via a memorandum signed jointly by the Secretaries of Energy and Defense. The individual reports of the three Laboratory Directors and the Commander of the United States Strategic Command are also forwarded to the President without change.

2.3.2 Annual Assessment Process

Each of the Laboratory Directors' Annual Assessment Reports builds on continuing experience with each weapon system and incorporates new information from stockpile maintenance, surveillance, experiments, simulations, and other sources to enhance the technical basis of each weapon. The overall assessment philosophy and approach involves quantification of weapon characteristics and the rigorous review of the results and certification basis by teams of weapons scientists and engineers. The laboratory teams responsible for each weapon type and its assessment include individuals with extensive weapons experience and access to both the historical and new data. The assessments and conclusions in the Annual Assessment Reports are reviewed by independent peers, Red Teams,[8] program managers, senior laboratory management, and the laboratory directors. Each year since the reporting process began, the laboratory directors have concluded there is no current requirement to conduct an underground nuclear test to maintain certification of any nuclear warhead. Specific results and concerns related to the stockpile systems in the latest *Report on Stockpile Assessments* are discussed in the classified Annex. **Figure 2–5** describes the overall flow of activities leading to the release of the *Report on Stockpile Assessments*.

In March 2009, the Secretary of Energy issued direction to establish a full and ongoing *independent* review of each warhead: "…an independent assessment of warhead condition relative to its system requirements be made by a laboratory challenge team not responsible for fielding the warhead." All warhead information is provided to both the home and challenge teams, and each team maintains its own computational baseline for warhead performance and reports to the laboratory director responsible for that system. As defined, the challenge team model is focused on nuclear performance. LANL and Lawrence Livermore National Laboratory (LLNL) have implemented their respective challenge teams, and evaluations are well under way for the selected systems. This joint LANL and LLNL activity is referred to as the Independent Nuclear Weapon Assessment Process. At SNL, the challenge team has been implemented in a somewhat different manner. Independence for the SNL assessments is achieved

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7 The nuclear security laboratories, as referred to in legal documents associated with the Annual Assessment process, are Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Sandia National Laboratories. Elsewhere in this SSMP, these three laboratories are collectively referred to as the "national security laboratories" – a term used for many years to describe the Nation's three nuclear weapons laboratories.

8 A Red Team is a group of subject matter experts that provides an independent mindset (that is, acts as a "devil's advocate" and challenges established thinking) in analyzing plans, strategies, or processes.

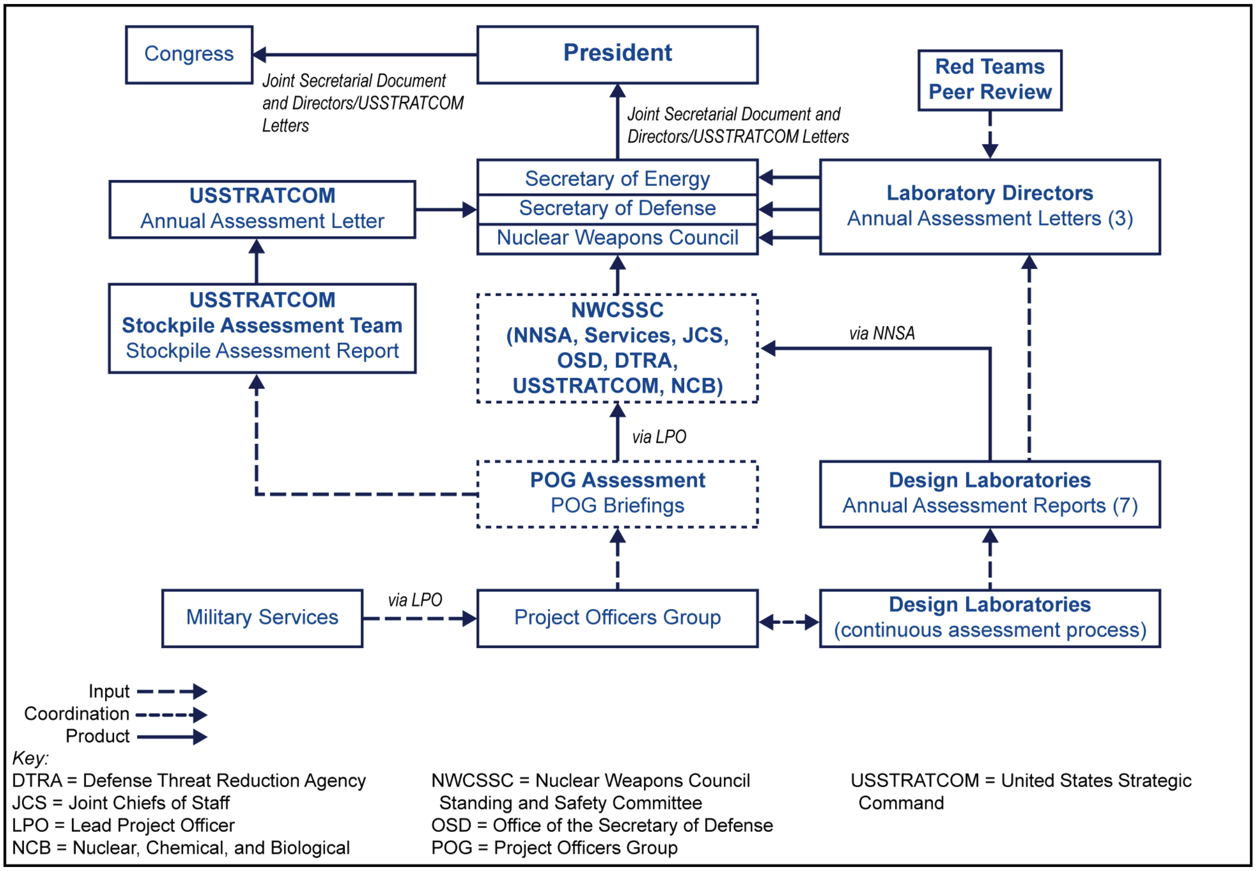

Figure 2–5. Schematic of the annual assessment process culminating in the *Report on Stockpile Assessment* and informing the Secretaries of Defense and Energy, the President, and Congress

using members of the Sandia Independent Assessment organization (which is organizationally and programmatically separate from the weapon system engineering groups) as the challenge team leads. SNL's Director has provided the assessment scope requirements to the Independent Assessment challenge team leads for both the California-based (LLNL and SNL) and the New Mexico-based (LANL and SNL) warheads. The SNL Independent Assessment challenge team also includes LANL and LLNL representatives who are engaged in assessing other laboratories' warheads. These assessments are similarly under way.

2.4 Maintenance of the Stockpile

A number of nuclear warhead components have limited lifetimes and require periodic replacement to sustain system functionality. Tritium gas transfer systems, neutron generators, and power sources deteriorate with age and must be replaced. NNSA and DoD jointly manage deliveries and installation of these replacements before warhead performance or personnel safety is adversely affected. Typically, gas transfer systems are replaced in the field at the respective DoD weapon maintenance facility; however, more invasive LLC exchanges may require returning the warhead to the Pantex Plant to complete maintenance activities.

In addition to LLC exchanges, maintenance includes certain minor alterations to stockpile weapons to address specific concerns that do not rise to the level of a system modification or an LEP activity. These alterations generally are not planned far in advance, but rather respond to an emerging issue and are addressed on a priority basis, depending on stockpile impact. Alterations of this type are completed at the Pantex Plant or at military bases by NNSA or DoD personnel, depending on the level of complexity.

Near-term maintenance activities include the following:

- Support neutron generator production at a rate of 700 to 800 components per year from FY 2014 to FY 2018.
- Support ongoing neutron generator replacements on the W76-0/1 and W78 warheads, as well as planned replacements on the W87, W80-1, and W88 warheads and B61 bombs. (The neutron generator production schedule is provided in the classified Annex, Chapter 2, Section 2.4.2, Figure 2–5.)
- Complete the first production unit for the W87 gas transfer system by FY 2019.
- Mature the technologies to support on-time delivery of LLCs (*e.g.*, gas transfer systems and electronic neutron generators) for all LLC exchanges.

Key activities and milestones in weapon maintenance are shown in Figure 2–15 in Section 2.9.2.

2.5 Stockpile Services Subprogram

The Stockpile Services subprogram in the Defense Programs Office of Nuclear Weapon Stockpile provides the enabling elements that are essential for research, development, and production capability and capacity within the nuclear security enterprise. Stockpile Services are required by multiple weapon systems and provide the capability basis to conduct system-specific weapon work. These services include diverse activities such as providing the containers for component shipments, maintaining production and surveillance capabilities (*e.g.*, calibration and repair), conducting technology, experimental science, and engineering research and development (R&D) to support assessments and certifications, and facility operations to support DSW program mission activities. Stockpile Services R&D provides weapon system component development, including technology maturation for neutron generators, gas transfer systems, and arming, fuzing, and firing devices. R&D services also include subcritical experiments to obtain data on plutonium and hydro-dynamic experiments to understand implosion behavior.

Stockpile Services provides the backbone for stockpile manufacturing to assure that shop floor factory technicians have the tools, working equipment, and safe manufacturing processes to deliver quality products. The subprogram elements include providing the engineering and manufacturing support for all weapon operations (for instance, the W76-1 LEP, weapon dismantlement, and neutron generator production), maintaining calibrated and process-controlled production equipment, managing the material supply chain, and executing continuous process improvements for efficiency and safety and to promote integration across the nuclear security enterprise. **Figure 2–6** illustrates the breadth of activities that are supported.

Improvement and modernization projects include the Product Realization Integrated Digital Enterprise (PRIDE) to modernize data integration and access information across the nuclear security enterprise. The Enterprise Modeling Consortium provides a broad range of decision support by analyzing nuclear weapons stockpile management capabilities and capacities, infrastructure life cycle planning, and essential skills projections.

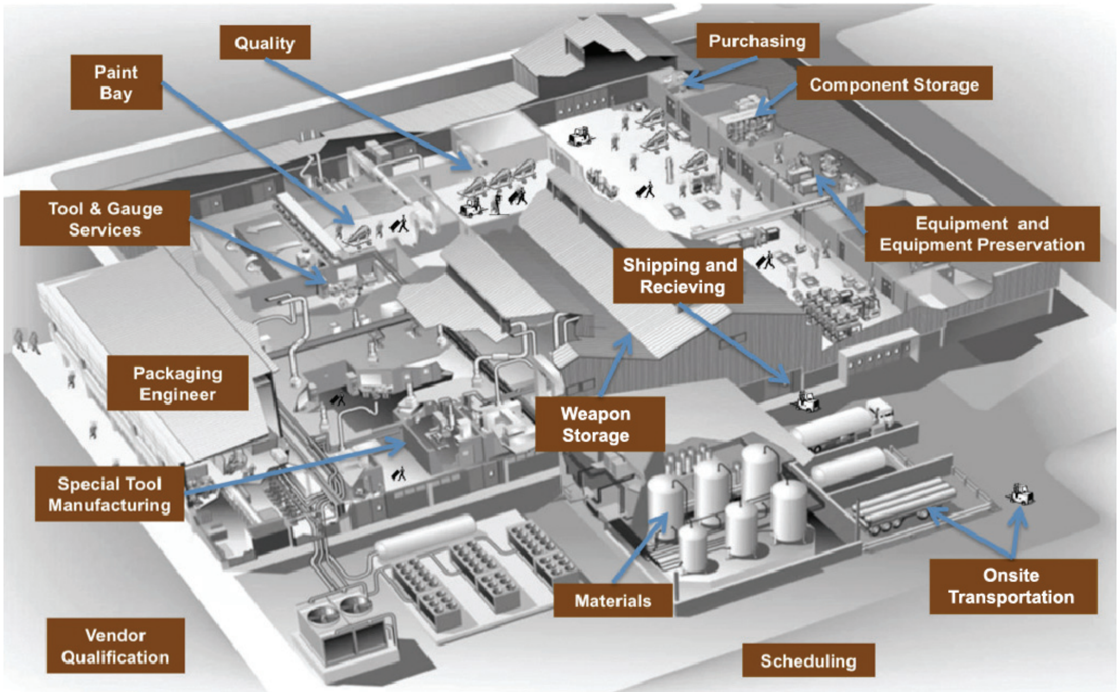

Figure 2–6. The Stockpile Services subprogram provides critical enabling capabilities to conduct the production mission

2.6 Sustaining the Stockpile through Life Extension Plans

Weapon systems in the stockpile are being sustained beyond their original design lifetime. As these systems age, NNSA continues to detect issues that may ultimately degrade the performance of some nuclear weapons to unacceptable levels. These issues require resolution. LEPs modify weapons to enhance margins against failure, increase safety, improve security, extend LLC life cycles, and address identified defects and component obsolescence. For example, when feasible, insensitive high explosives (IHE) will replace conventional high explosives (CHE) in the main charges, and new use control features will enhance the security of the weapon. Components and materials with known compatibility and aging issues or manufacturability problems will be replaced with alternatives that address the deficiency. A well-planned and well-executed stockpile life extension strategy will improve safety and security while enabling DoD to implement a deployment and hedge strategy consistent with the Administration's goal of a smaller, yet still effective, deterrent.

The drivers for life extension activities are addressing aging and performance issues, enhancing safety features, improving security, and reducing stockpile size while meeting strategic deterrence requirements. Consistent with a smaller stockpile, improvements in reliability and performance margins are desired. Additional goals are to eliminate, to the extent possible, materials that are hazardous, costly to manufacture, degrade prematurely, or react with other materials in a manner that affects performance, safety, or security. Also, because of production constraints, the future stockpile requires both refurbished and reused components[9] from legacy systems, as described in the *Nuclear Posture Review Report* (DoD 2010). Changing materials, using components from legacy systems in new LEPs, and

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[9] *Refurbished nuclear components use designs produced for that warhead type. Reuse of nuclear components utilizes designs currently or previously in the stockpile but from different warhead types. Either component approach may use existing or remanufactured assets.*

remanufacturing legacy component designs present significant challenges to today's stockpile stewards, as outlined below.

- **System Certification.** To meet weapon production requirements for the planned LEPs, NNSA will evaluate the use of refurbished and reuse pits and CSAs. Historically, such changes required nuclear testing for certification. In the absence of nuclear testing, detailed understanding of the nuclear process and the sensitivities to small changes in design attributes are essential. The Predictive Capability Framework of the science-based Stockpile Stewardship Program will enable certification of refurbished and reused nuclear components by combining full-scale experiments with surrogate materials, sub-scale experiments with plutonium, high-fidelity simulations, expert judgment, and in-depth peer reviews. This is discussed further in Chapter 3, Section 3.5.3.

- **Nuclear components – Pits and CSAs**. Conceptual designs to modernize the stockpile include refurbished and reused pits and CSAs and smaller and lighter components to improve safety and security while meeting deterrence requirements. However, weapon performance relies on an intimate relationship between the performance of the primary and secondary and the materials in the NEP. This complex interrelationship of the key subsystems and the properties of materials must be confirmed for any modified configuration. In the past, this was verified by nuclear testing. Fundamental understanding of the physical processes and system interactions has significantly improved over the last decade because of greater computing power, advanced simulations, and enhanced laboratory experiments; NNSA can now assess and certify integrated designs to improve safety and security without underground nuclear testing. These capabilities allow NNSA to consider a much broader range of options than previously possible. See Chapter 3 for further details on the scientific and technical underpinning of these advanced assessment processes for primaries (Section 3.3.2.1) and secondaries (Section 3.3.2.2).

- **Materials for the NEP**. Operation of the NEP requires a wide variety of very specialized materials. While primarily chosen to enable nuclear performance of the weapon, these materials and components must also address structural, thermal, and survivability requirements, as well as Military Characteristics requirements. To achieve the yield and weight requirements of the legacy stockpile, NEP designs have used materials and components that have degraded over time, were costly to manufacture, were hazardous to produce, and have become obsolete. Advances in understanding of the fundamental nuclear explosive process, along with technological advances in subsystem components, will enable NNSA to replace these materials and components through the LEP process with those that are longer-lived, non-hazardous, less costly, and commercially available. Chapter 3, Section 3.3 focuses on the advances in materials science and technology that enable many of these replacements.

- **Non-Nuclear Components**. Many non-nuclear components in today's systems use legacy technologies that are more than 35 years old and have not been supported for many years. Moreover, future LEPs must address new safety and security requirements that are not achievable or provided in many older designs because of component size and weight restrictions. Using the Component Maturation Framework, NNSA has identified the key technologies and components required to transform the stockpile over two decades. NNSA is establishing plans to mature these technologies sufficiently in advance of the planned insertion points to minimize risk to the extent possible. The Component Maturation Framework provides the path to address the issues identified in the TBSTP, as discussed in Chapter 3, Section 3.3.5.

2.6.1 Life Extension Program Planning and Execution Process

LEP planning is a complex NNSA and DoD process to balance a number of goals, objectives, and constraints. The key to this process is preventing any operational gaps in the Nation's nuclear deterrence while enhancing the safety, security, use control, and reliability of the stockpile by selectively integrating new, appropriately mature, and cost effective technologies. Furthermore, consistent with the *Nuclear Posture Review Report* (DoD 2010), LEP activities support the goal to reduce the number of warhead types and the stockpile size by formulating options for interoperable warheads[10] that could be flexibly deployed across different delivery platforms along with balancing the number of warheads carried on each of the ballistic missile systems. The objectives essential to the long-term sustainability of the nuclear security enterprise include the following:

- Sustain a highly specialized nuclear warhead design and manufacturing workforce.
- Mature and insert modern technologies more frequently to improve safety and security.
- Maintain a robust supply chain.
- Improve responsiveness.
- Enable multiple concurrent design and manufacturing LEP activities through sustainable steady state operations.

In addition to these goals and objectives, the following critical constraints must be addressed:

- Execute LEPs within the FYNSP funding by balancing scope expectations with affordability.
- Manage production capabilities, primarily related to pits and CSAs, while undergoing significant facility revitalization and meeting DoD requirements for first production units and operational capability.
- Maintain a robust ST&E program to ensure the availability of capabilities to certify the aging stockpile without nuclear testing and to mature new technologies and components for insertion into the stockpile.

NNSA manages the LEP planning and execution process by implementing the *NNSA Development and Production Manual, 56XB*. The Phase *6.x Process* described in Chapter 3, Section 3.2 is based on the original seven-phase Joint Nuclear Weapons Life Cycle Process covering phases of a weapon's life from initial feasibility studies through development, production, deployment, and retirement. Phase 6 of the life cycle encompasses production, maintenance, and evaluation of the stockpile. The 6.x phases (*i.e.,* Phases 6.1 through 6.6) are "mirror images" of Phases 1 through 6 and are conducted for a warhead or bomb in Phase 6 of its life cycle. The Phase *6.x Process* is focused on life extension of the system and improvements to safety, security, and use control.

To improve implementation of the Phase *6.x Process*, NNSA is developing the *Product Realization Process,* which is based on a systems engineering, risk informed approach. The *Product Realization Process* uses integrated phase gates, which are a standard set of deliverables and reviews required to advance to the next stage of product development. This process ensures that issues and risks are addressed at the earliest possible time and that all key product stakeholders agree to proceed to the next stage of LEP development. Creating standard gate checklists also provides a roadmap for future generations to follow in the product development life cycle. *Product Realization Process* requirements overlay on the LEP

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[10] *Interoperable warheads are warheads with a common NEP integrated with non-nuclear systems that maximize the use of common and adaptable components. Interoperable warheads can be deployed on multiple delivery platforms.*

planning and execution activities. **Figure 2–7** shows the integration of the *6.x Process* with the major gate reviews required by the *Product Realization Process* through Phase 6.5. Subsequently, the LEP system enters full-scale production (Phase 6.6). A revised *6.x Process* with updated gate reviews is in development to refine the process further and improve the alignment of deliverables to the various gates.

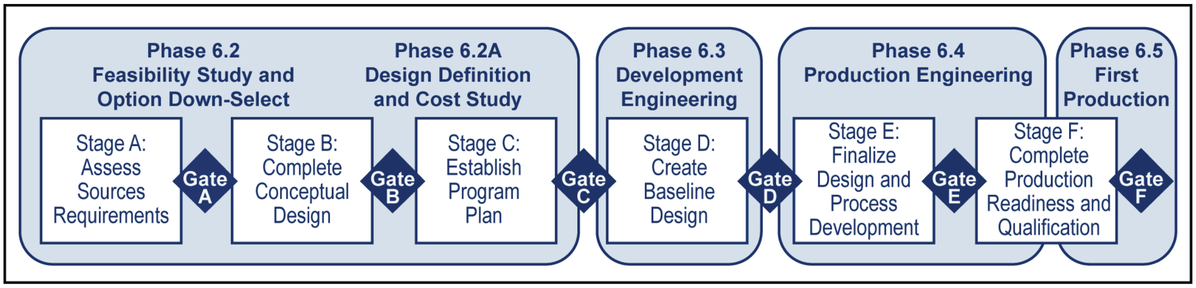

Figure 2–7. Schematic of *6.x Process* integrated with key gate reviews required by the *Product Realization Process*

2.6.2 Baseline Life Extension Program Plan

In November 2012, the Nuclear Weapons Council selected a baseline stockpile life extension plan that implements the "3+2" vision. The baseline plan was detailed in a Nuclear Weapons Council memorandum dated January 15, 2013. This plan, developed by the joint DoD/NNSA Enterprise Planning Working Group, incorporates significant changes from previous plans to:

- Align the LEP schedules with DoD delivery platform upgrades,
- Provide a long-term vision of the stockpile to reduce the total number of systems by incorporating interoperable warheads (IWs),
- Enable a reduction of the number of warheads required in the technical hedge by balancing the deployments in the submarine-launched ballistic missile and intercontinental ballistic missile legs,
- Stay within NNSA's planned production capabilities and capacities, and
- Balance the workload across the nuclear security enterprise.

NNSA life extension activities to implement the Nuclear Weapons Council plan are shown in **Figure 2–8.**

The Nuclear Weapons Council plan establishes the framework to develop more detailed implementation plans for deployment of interoperable warheads. The first interoperable warhead, IW-1, is planned to be the W78/88-1 life-extended warhead. The second and third interoperable warheads have not been specifically determined by the Nuclear Weapons Council, but the joint DoD/NNSA Enterprise Planning Working Group projects them to be the W87/88 and W76-1 life extensions, respectively. The Nuclear Weapons Council plan also includes additional information on management of the hedge stockpile, incorporation of reuse or remanufactured nuclear components, use of common non-nuclear components, improvement in safety and security, and evaluation of affordability.

Currently, most of the stockpile is in various stages of life extension activities beyond Phase 6.1. The W76-1 is in Phase 6.6 (Full-scale Production), the B61-12 is in Phase 6.3 (Development Engineering), the W78/88-1 is in Phase 6.2 (Feasibility Study and Option Downselect) and the W88 Alt 370 is in Phase 6.3 (Development Engineering). Following closely behind these activities, NNSA is working with DoD to define alternatives for the warhead to be deployed in a cruise missile. Additional details of these activities are described below and in the classified Annex.

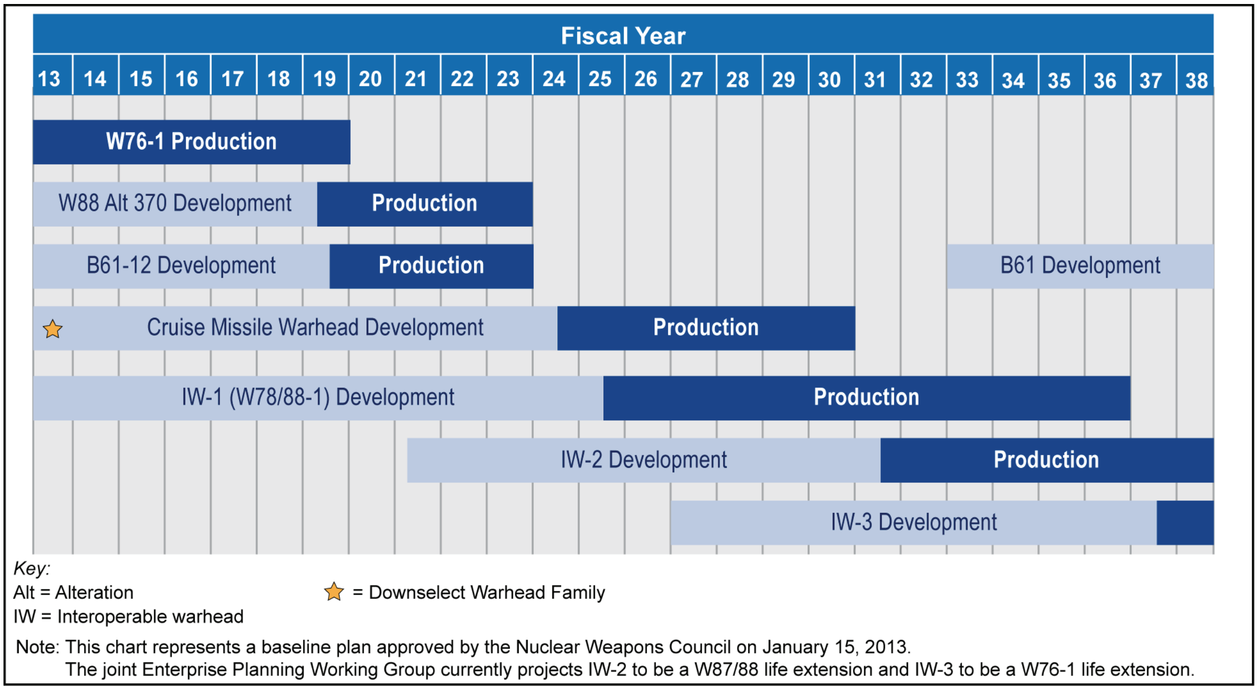

Figure 2–8. National Nuclear Security Administration life extension activities

W76-1 LEP

The W76-1 is in full scale production at the NNSA Pantex Plant. DoD has recently updated its assessment of the number of W76-1 warheads that need to be produced. NNSA plans on meeting this requirement and completing production by FY 2019. All production challenges have been successfully met.

W88 Alt 370

Engineering development for an alteration to the W88, the W88 Alt 370, is underway. This Alt will address certain lifetime requirements by modernizing the AF&F system and improving surety by incorporating a lightning arrestor connector. It will also provide additional logistical spares for the life of the system. The W88 Alt 370, the neutron generator replacement, and gas reservoir replacement will be completed at the same time. The first production unit is planned for December 2018.

B61-12 LEP

On February 27, 2012, the Nuclear Weapons Council authorized Phase 6.3 (Development Engineering) for the B61-12 LEP. This LEP will address multiple components that are nearing end of life. NNSA, in coordination with the Air Force, studied a number of design alternatives to address the military's requirements, ranging from component replacement alterations to full-scope nuclear and non-nuclear refurbishments. The joint effort also included a separate study to assess the schedule and detailed costs for each alternative. The selected option includes refurbishment of both nuclear and non-nuclear components to address aging, assure extended service life, and improve the safety, reliability, and security of the bomb. With these upgrades and the addition of new Air Force components, the B61-12 will consolidate and replace the B61-3, -4, -7, and -10 bombs. This reduction in the number of systems is consistent with *Nuclear Posture Review Report* (DoD 2010) objectives. The scope incorporates component reuse where possible and omits higher-risk technologies to reduce costs and schedule risks. The first production unit is planned for FY 2019.

In support of the B61-12 LEP, the NNSA Readiness Campaign is providing critical support for the maturation of technologies and development of manufacturing capabilities necessary to deploy neutron generators, tritium reservoirs, detonators, and other non-nuclear components. These capability development activities will also benefit future LEPs, alterations, modifications, and maintenance of the stockpile. In addition, the Science, ASC and Engineering Campaigns are providing the experimental and scientific computing capabilities to support the component qualification and system design, and qualification (see Chapter 3).

W78/88-1 (IW-1) LEP

In June 2012, the Nuclear Weapons Council authorized a Phase 6.2 study for a W78/88-1 interoperable warhead. The LEP will address aging components, improve system safety and security, replace CHE with IHE, and potentially add detonator safing features. The goal of the LEP is to develop a single NEP that will be used in both Air Force and Navy aeroshells. Currently, the W78 is integrated into the Mk12A aeroshell; however, a recent Air Force assessment has concluded that the Mk21 aeroshell offers more performance and security enhancement options than the Mk12A aeroshell. The Nuclear Weapons Council subsequently approved use of the Mk21 aeroshell for the ICBM deployment of the W78/88-1 LEP warhead. The Navy plans to incorporate the life-extended W78/88-1 warhead into the Mk5 aeroshell.

Cruise Missile Warhead

NNSA is supporting the Analysis of Alternatives study for an Air Force cruise missile warhead. This study will consider various warhead options based on reuse, refurbishment, and replacement of nuclear and non-nuclear components. NNSA commissioned a 90-day conceptual design study in October 2012 to inform NNSA and the Air Force of potential cruise missile warhead options for consideration in LEPs. Participants in this study include LANL, LLNL, SNL, and the Air Force. Key design requirements established for this tasking include the following:

- Using IHE for all primaries.
- Maximizing use of common non-nuclear components, including common approaches for LEP designs (*e.g.*, the B61-12, W76-1, and W78/88-1).
- Exploring options for enhanced surety (intrinsic and external).
- Complying with the 2010 *Nuclear Posture Review Report*.

The information from the 90-day study will be used by NNSA to downselect to a warhead family in FY 2013. Variants within the selected family will be developed for further consideration. In addition, NNSA and the Air Force will be better positioned to move expeditiously into the Phase 6.2 feasibility studies and option downselect.

NNSA Study on Interoperable Warheads

To assess the potential for deploying life-extended weapons on multiple platforms, in accordance with the 2010 *Nuclear Posture Review Report* (DoD 2010), NNSA recently completed a scoping study (the "120-Day Study") to evaluate the use of common NEPs and common and adaptable non-nuclear components in Air Force and Navy ballistic missile systems. Specific to this tasking was the development of interoperable warhead concepts that can be deployed in both the Mk5 and the Mk21 reentry aeroshells. The options focused on developing two unique NEPs, one incorporating reuse pits and one using remanufactured pits. Each NEP would be integrated with a warhead electrical system that leverages the use of common components to the extent possible while addressing the unique characteristics of the Air Force and Navy delivery system platform requirements. Key to this effort is the development of forward-compatible architectures that will enable system enhancements to improve reliability, safety, and security as technologies and components mature. The results of this study were very encouraging in providing concepts for evaluation in the W78/88-1 LEP Phase 6.2, Feasibility and Option Downselect Study.

With the development of warhead NEPs that are deployable on multiple platforms and the use of common non-nuclear components to the extent possible, the ballistic missile stockpile will ultimately be comprised of three unique warheads. These three unique warheads are planned to be deployed on both Air Force and Navy missiles. For this stockpile transformation model to be most effective, the Phase 6.2 Study of the W78/88-1 warhead must be coordinated with the study of the second interoperable warhead (*i.e.*, IW-2 in Figure 2–8). This coordinated feasibility and option downselect study will provide two key benefits:

1. It will ensure the maximum use of common components where appropriate while ensuring essential diversity where needed, and
2. It will provide for advanced technology and component maturation planning by coordinating potential improvements in the second interoperable warhead with future improvements in the first interoperable warhead.

In summary, the LEP and Alt plans endorsed by the Nuclear Weapons Council include the following:

- W76-1 LEP
  - Complete production by the end of FY 2019.
- W88 Alt 370
  - Complete development to support a first production unit no later than December 2018.
  - Complete production no later than the end of FY 2023.
- B61-12 LEP
  - Complete Phases 6.3 through 6.5 to support a first production unit planned for FY 2019.
  - Complete production no later than the end of FY 2023.
- Cruise Missile Warhead
  - Participate with DoD in an Analysis of Alternatives study for the air-launched cruise missile.
  - Complete Phases 6.1 through 6.5 to support a first production unit no earlier than FY 2024, pending the results of a 90-day, NNSA conceptual design study and subsequent decisions by the Nuclear Weapons Council.
- W78/88-1 (IW-1) LEP
  - Complete Phase 6.2/6.2A study of a W78/88-1 interoperable warhead compatible with the Mk 21 and the Mk 5 as soon as practicable; completion is currently projected in FY 2016.
  - Complete Phases 6.3 through 6.5 to support a first production unit by FY 2025.
  - Complete production by FY 2036.

Key activities and milestones in LEP planning and execution are shown in Figure 2–15 in Section 2.9.2 of this chapter. Additional details on the LEP and Alts scope and plans can be found in the classified Annex, Chapter 2, Section 2.6.

The following near-term activities support LEPs and weapons alterations:

- Update key planning documents to reflect the revised baseline, including the Nuclear Weapons Council Requirements and Planning Document and the NNSA Production and Planning Directive.
- Address technology and component maturation and the production readiness requirements scope associated with the selection of technologies in support of the B61-12 LEP and, for the longer term, to support the W78/88-1 and cruise missile warheads.
- Continue activities on a feasibility study and options downselect (Phase 6.2) study of the W78/88-1 warhead in a manner that accounts for potential commonalities, adaptability, and interoperability between Air Force and Navy ballistic missile systems.
- Continue development of an AF&F component assembly for the W88 Alt 370. In response to a request from DoD, leverage this work with existing Air Force-funded fuze work on the W87 to develop an adaptable AF&F component for the W78/88-1 LEP. NNSA will collaborate with the United Kingdom during this development.

2.6.3 Improving the Approach to Life Extension Program Planning and Execution

Over the next two decades, the nuclear security enterprise will execute a tremendous workload to extend the life of the stockpile, as described above. This workload presents a resource and production throughput challenge for NNSA that requires improvements in LEP planning and execution.

NNSA is evaluating LEP implementation approaches to shorten the design and production cycle. This transition will build on the plans described in the previous section. Central to this approach is the move to fewer types of warheads in the stockpile. These life-extended warheads will incorporate forward-compatible architectures to enable more timely and cost-effective upgrades. Where appropriate, the stockpile will transition to using more common (or similar) non-nuclear components and common NEPs on multiple delivery platforms (*e.g.*, the SLBM D5 missile and the ICBM Minuteman III missile). This closely follows both military and commercial approaches for addressing product improvements and technology obsolescence. Furthermore, this approach will increase the opportunities to incorporate modern safety and use control technology.

In addition, this approach to stockpile management will lead to a more consistent flow of relevant work that uses and continuously refreshes the critical skill sets needed in the nuclear security enterprise. Establishing a continuous technology and component maturation process, supported by a robust science-based qualification and certification capability, should further motivate the workforce and enable improved and cost-effective insertion of new technologies and components into the U.S. nuclear weapons stockpile.[11]

To focus system scopes on future system life extension activities (beyond those discussed in the previous section), the following priorities have been established:

1. Address identified performance and reliability issues and component end-of-life replacements.
2. Update system architectures to be forward compatible, which will enable future upgrades with a minimum of system changes.

[11] *These elements of the SSMP are discussed in detail in Chapter 3, Section 3.4.5.*

3. Upgrade safety, security, and use control features.
4. Incorporate features to enhance the ability to assess the system condition.

Long-term and ongoing activities planned in development and technology maturation include the following:

- Pursue continued development of new technologies to improve the safety and security of the stockpile. Address the inability to remanufacture existing weapons components caused by the obsolescence of as-built manufacturing processes. Develop alternatives to the use of certain hazardous materials and materials that are prone to excessive aging. (A more-detailed discussion of this topic is in Chapter 3, Section 3.4.)
- Apply the full spectrum of ST&E capabilities to certify the performance of the U.S. nuclear weapons stockpile and to design, qualify, and manufacture all chosen life extension alternatives. Use ST&E experimental facilities to (1) develop, improve, and validate physics-based models based on fundamental science, component, and system-scale experiments, (2) assess weapon responses to the conditions outlined in the stockpile-to-target sequences, and (3) qualify, certify, and deploy safety, security, and reliability upgrades to the stockpile. (See the more detailed discussions of these topics in Chapter 3, Section 3.5.1.)

2.6.4 Modernizing the Production Capabilities and Capacities

Maintaining the stockpile while implementing proposed improvements in safety, security, and reliability depends on the continued availability of essential production capabilities and capacities within the nuclear security enterprise. Over the next several decades, NNSA will address manufacturing capability and capacity challenges to manage the current and projected workload plan while concurrently completing significant infrastructure revitalization. These physical infrastructure improvements are discussed in more detail in Chapter 5 and Appendix D.

2.6.4.1 Readiness Campaign

This campaign provides production process development investments across the nuclear security enterprise that are crucial to the LEPs and Alts of multiple weapons systems. For instance, while the B61-12 LEP directly funds system-specific development of the components and subsystems that will make up the B61-12 bombs, that LEP relies substantially on the Readiness Campaign to fund the development of key production processes that will serve multiple systems, beginning with the B61-12. Specifically, for the B61-12 LEP to be successful, the Pantex Plant must redevelop IHE manufacturing capabilities that have not been used in volume for decades. In addition, the Kansas City Plant is relying on the Readiness Campaign to help re-establish high-precision specialized production processes for safety, radar, and other unique non-nuclear components. The Readiness Campaign also operates the capability to produce tritium to maintain the national inventory needed for the stockpile.

2.6.4.2 Plutonium Sustainment and Pit Production

The FY 2014 Plutonium Sustainment Program plan aligns with the pit production goals of the Nuclear Weapons Council baseline plan discussed in Section 2.6.2. The Plutonium Sustainment Program balances requirements with plutonium capabilities to meet national policy goals, stockpile requirements, and LEP planning. Execution of this program is dependent upon infrastructure activities described in Chapter 5, Section 5.3.1.

The Plutonium Sustainment Program for the FY 2014 FYNSP includes the following major activities:

- Continue to acquire and install pit production equipment that replaces old, end-of-service-life machines as well as additional equipment required to increase production capacity from approximately 10 pits per year to 30 pits per year.
- Continue the process development to manufacture the W87 pit, a candidate for future stockpile needs. Multiple development W87 pits were built in FY 2013.
- Build 8 to 10 developmental pits per year over the FYNSP to facilitate the transition to war reserve production through qualification and certification.
- Perform engineering and physics evaluations on the developmental builds for war reserve pit qualification and certification.
- Complete the reconstitution of a power supply production capability.

The first war reserve W87 pit is planned in FY 2019, with a ramp up in production to 30 pits per year by FY 2021. The pit development timeline is shown in **Table 2–4** below.

Table 2–4. Pit development timeline

<table>
<tr><th rowspan="2">Type</th><th colspan="8">Fiscal Year</th></tr>
<tr><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td>Pit Production Series</td><td colspan="2">Development Builds</td><td colspan="2">Process Prove-In Builds</td><td>Qualification Builds</td><td>W87-like WR Builds</td><td>W87-like WR Builds</td><td>W87-like WR Builds</td></tr>
<tr><td>Number of Builds</td><td colspan="2">8-10</td><td colspan="2">8-10</td><td>10</td><td>10</td><td>20</td><td>30</td></tr>
</table>

WR = war reserve

Preliminary plans call for pit production of potentially up to 80 pits per year starting as early as FY 2030. NNSA continues to develop options to achieve a higher production rate as part of the plutonium strategy.

The FY 2014 Plutonium Sustainment FYNSP also provides the resources to establish a pit reuse capability up to a potential capacity of 90 pits per year, in conjunction with a newly manufactured pit capability by FY 2021. The investments planned over the FYNSP in pit manufacturing equipment provide the foundation for pit reuse capability when combined with an increased workforce to process the reused pits. Until a pit reuse design and approach is formally documented and planned for stockpile use, the specific equipment and process development estimates cannot be prepared.

Pit manufacturing relies on analytical chemistry and materials characterization analyses to produce war reserve pits. Without the CMRR-NF or alternative, a production capability of 30 pits per year is only achievable through several approaches that are not mutually exclusive, including additional shift work, additional use of space in the Plutonium Facility (PF-4) at LANL, and use of offsite laboratories that require leveraging resources that are outside the Plutonium Sustainment Program.

2.6.4.3 Canned Subassembly Production

The transition of the CSA manufacturing mission from the existing Y-12 buildings, particularly Building 9212, to the Uranium Processing Facility (as part of the Uranium Capabilities Replacement Project[12]) is vital to modernizing the infrastructure of the nuclear security enterprise. This transition is

[12] *The National Defense Authorization Act for Fiscal Year 2013 refers to this project as the Uranium Capabilities Replacement Project. NNSA has previously used the term Uranium Processing Facility to describe this project in planning documents. Despite the name difference, this is the same project.*

critical to LEPs, including manufacturing new CSAs or requalifying existing CSAs. It is also critical to other defense-related missions such as surveillance and dismantlement of CSAs, nonproliferation missions that involve disposition of enriched uranium materials, delivery of fuel feedstock to the Navy, and supply of defense-related reactor fuels. Execution of this program is dependent upon infrastructure activities describe in Chapter 5, Section 5.3.1.

2.6.4.4 Tritium Supply

Tritium is an integral component of nuclear weapons. An assured supply must be available to meet the requirements of the nuclear weapons stockpile. Tritium, a radioactive material with a half-life of 12.3 years, must be periodically replenished. One of NNSA's missions is to provide freshly filled tritium reservoirs for the stockpile to replace reservoirs that have reached their end of life.

NNSA's Tritium Readiness subprogram operates a tritium production system to maintain the required inventory by producing new tritium. Because the current inventory is larger than required, only a small amount is produced today. However, to meet future tritium inventory requirements, the rate of production must be increased.

Since 2003, tritium has been produced by irradiating lithium-aluminate pellets with neutrons in a commercial nuclear power reactor. The pellets are inserted into specially designed tritium-producing burnable absorber rods (TPBARs) that are similar in dimension to reactor fuel rods. Irradiation of the rods occurs at the Tennessee Valley Authority (TVA) Watts Bar Unit 1 reactor.

After irradiation, the TPBARs are removed from the reactor, consolidated into one or more shipping containers, and transported in secure casks to the Tritium Extraction Facility at the Savannah River Site (SRS), where the tritium is removed. Gases containing tritium are then piped to the SRS Tritium Loading and Unloading Facility, where the tritium is purified and loaded in limited-life tritium reservoirs to support the nuclear weapons stockpile. The spent TPBARs are disposed of as low-level radioactive waste.

Future tritium gas transfer systems that could be incorporated into LEP weapons will probably involve larger tritium loads than past weapons because they will be designed to last longer, thus requiring less frequent exchanges. These future gas transfer systems would result in better performance margins for the NEP and, therefore, higher confidence in the nuclear design without the need for underground nuclear tests. In addition, the TPBAR irradiation cycles, extraction, and processing will affect tritium supply requirements.

Factored into the production assessment requirements is the recovery of tritium through weapons dismantlements. Tritium reservoirs are removed from all inactive weapons, as well as those that have been retired and are awaiting dismantlement. The reservoirs are returned to SRS for reclamation of the tritium and disposition of the hardware. Tritium harvested from weapon dismantlements does not impact the total inventory quantities because this inventory is already considered in the supply planning. However, without adequate funding to process these tritium reservoirs, near-term requirements may not be met.

NNSA's tritium production plan is illustrated in the schedule shown in **Figure 2–9**. The major factors in tritium supply planning are defined by the demands created from the exchange of LLCs in existing weapons, the tritium requirements determined by LEPs, and the tritium production efficiency of the TPBARs in the reactor. Each horizontal bar in Figure 2–9 represents an 18-month irradiation cycle at the Watts Bar Unit 1 reactor. A total of 544 TPBARs were loaded in October 2012 in the reactor's 12th operating cycle. Cycle 13 will begin in April 2014 with 704 TPBARs and will be completed by September 2015, when the next refueling outage is scheduled.

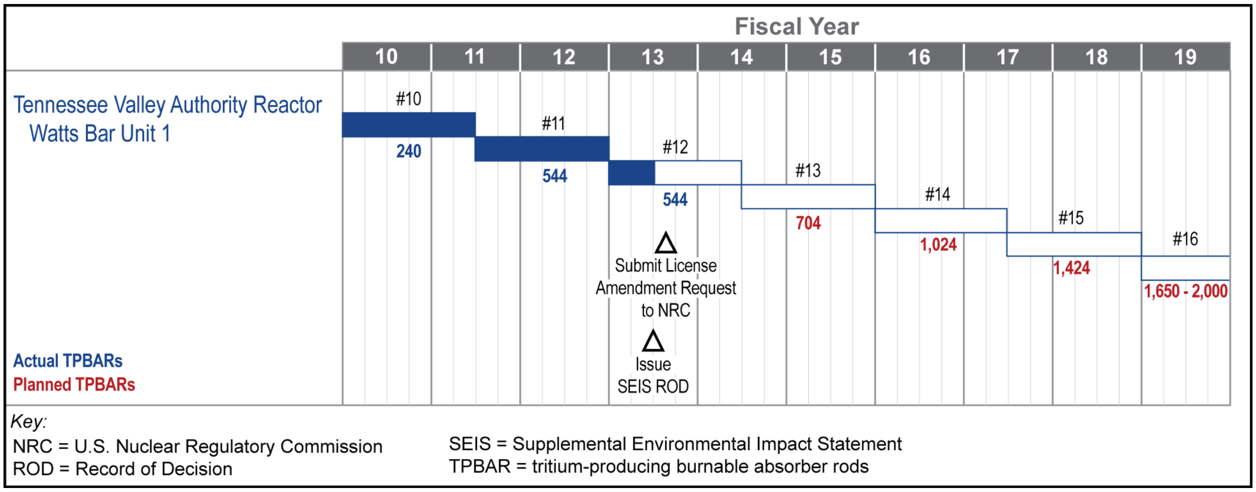

Figure 2–9. Schedule for irradiation of tritium-producing burnable absorber rods to meet post-*Nuclear Posture Review Report* requirements

To meet future requirements, the number of TPBARs must increase to approximately 1,650 to 2,000 in the FY 2019 time frame. The ramp up to higher numbers of TPBARs will commence in FY 2014. In support of this ramp up, NNSA is updating the environmental impact statement. TVA will submit a license amendment request to the Nuclear Regulatory Commission covering the increased TPBAR levels. NNSA outyear budget projections include the additional TPBARs starting in FY 2014.

An integral component of tritium production is the availability of an unobligated low-enriched uranium reactor fuel supply for use by TVA. Unobligated fuel is reactor fuel that is not restricted by peaceful use agreements. Therefore, NNSA uses this type of domestically produced and enriched fuel for tritium production for national defense purposes. Currently, the United States Enrichment Corporation (USEC) supplies unobligated reactor fuel to support tritium production through its gaseous diffusion plant in Paducah, Kentucky. USEC plans to replace this process with the American Centrifuge Project. While it is uncertain when the American Centrifuge Project will be fully operational, it is possible that one train of centrifuges (a sixth of the number that will eventually be required to provide the unobligated fuel needed to operate one reactor for tritium production) could be operational by FY 2015 if USEC, or another entity, is able to secure funding to demonstrate a capability to supply national security needs. More importantly, NNSA plans to provide unobligated fuel to the Watts Bar Unit 1 reactor through FY 2039, as shown in **Figure 2–10**.

Today, USEC is under contract to the TVA to provide approximately two more fuel reloads to the Watts Bar Unit 1 reactor. Under the Depleted Uranium Enrichment Project initiated in May 2012, TVA has transferred its contract with USEC to Energy Northwest to begin deliveries in mid-FY 2015. By the end of May 2013, USEC will have enriched 9,075 metric tons of high-assay depleted uranium for Energy Northwest, and Energy Northwest will deliver to TVA approximately nine reloads of low enriched uranium through 2022. An additional one reload may be obtained through obligation exchanges with fuel retained by Energy Northwest for its use. This total of ten reloads of unobligated low enriched uranium is twice what is needed in the delivery platform, so options are being explored to preserve the excess for future use, either through a series of obligation exchanges with available inventories or by carrying the material with the associated working capital and carrying costs.

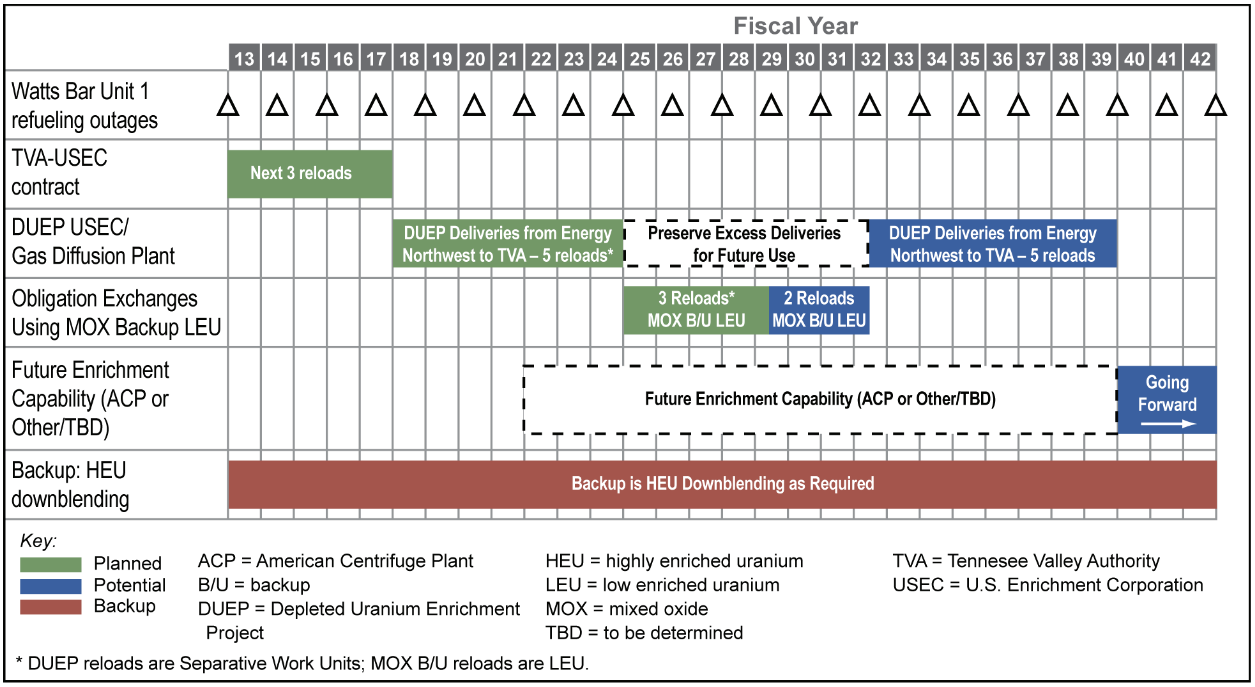

Figure 2–10. Schedule for supplying unobligated low enriched uranium fuel to the Watts Bar reactor

After 2024, obligated uranium will be exchanged using material downblended for the mixed oxide program. The Department of Energy's (DOE's) unobligated low-enriched uranium will take on obligations from low-enriched uranium that TVA will purchase from the commercial market to fuel Watts Bar Unit 1. After 2031, the remaining reloads from the Depleted Uranium Enrichment Project may be used to fuel one reactor through 2039. After that, tritium production could be supported by a new domestic enrichment capability, such as USEC's American Centrifuge Project or other initiatives like irradiation in a small modular reactor. If no other options are available, NNSA could down blend the highly enriched uranium; however, this would be an option of last resort, because the highly enriched uranium is valuable for Defense Program strategic reserves and the Naval Reactor Program. The highly enriched uranium supply is limited, and no current capability exists to produce new highly enriched uranium to replace consumed material.

2.6.4.5 Non-Nuclear Component Production

The non-nuclear components of a weapon fall into four broad technology categories: mechanical, electrical, special materials, and energetic material components. Examples of components in each of these categories include mechanical components (*e.g.*, safety mechanisms, stronglinks, and launch sensors), electrical components (*e.g.*, AF&F components, and radiation-hardened integrated circuits and transistors), special material components (*e.g.*, compression pads, cushions, radomes, desiccants, and hydrogen getters), and energetic material components (*e.g.*, thermal batteries, actuators, and impact fuzes).

In each of these component technology categories, major changes are occurring in both the manufacturing processes and the materials used. The movement of many manufacturing companies overseas has affected the size and number of suppliers willing to undertake the manufacturing of the components, given the significant quality requirements and limited quantities for these parts. As commercial industry drives the technology of the components, many of the legacy component manufacturing technologies and materials previously used to produce these components are being replaced, moved off shore, or simply made obsolete. This causes programs that require new or replacement components to identify new suppliers, train these new suppliers to operate to the necessary levels of quality for nuclear weapon components, and establish different or significantly modified manufacturing processes to realize these components. Furthermore, changes in production processes because of environmental regulations and concern about the health and safety of workers further alter the legacy manufacturing processes used for component production. Given all of these changes, it is essential that the component designers adequately characterize and model component performance, construction materials, and construction assembly and production processes to assure that the new components meet stockpile requirements related to safety, security, longevity, supply chain surety, and performance with adequate margin.

The new Component Manufacturing Development subprogram of the Readiness Campaign (that replaces the Non-nuclear Readiness subprogram) develops and deploys new or revitalized component manufacturing capabilities to support non-nuclear components required for multiple weapon system applications. Non-nuclear functions range from weapon command and control to performance assessment during deployment simulations and include various weapon-related structural features. Focusing on critical non-nuclear manufacturing technologies that will be required in 3 to 8 years ensures that the nuclear security enterprise can manufacture all components required for LEPs, LLC exchanges, alterations, and modifications.

SNL is responsible for designing and developing most non-nuclear components that are external to the NEP to support maintenance, life extension, and the safety, security, and use control modernization of the stockpile. Nuclear weapon production facility inputs are incorporated into the design and development of these components through early involvement in product realization teams. Production of non-nuclear components is done in concert with the Kansas City Plant and SNL production facilities. The Kansas City Plant has primary responsibility for providing electrical, mechanical, and special materials products that are external to the NEP while SNL production facilities provide neutron generators, the energetic material components, and microelectronics and microsystems for the nuclear security enterprise. When appropriate, non-nuclear components are also outsourced under the oversight of the responsible NNSA site.

The transfer of the Kansas City Plant's operations to its new National Security Campus (through the Kansas City Responsive Infrastructure Manufacturing and Sourcing Project) is under way and will be completed in FY 2014. To manage risks to program deliverables during the transition period, a number of mitigation options have been developed, including a build-ahead plan for producing components to support ongoing Kansas City Plant deliveries and ship schedules during the move. The Kansas City Plant and SNL have also partnered to implement a continuous-build production plan for AF&F systems that enables key operations at both Kansas City Plant locations without interrupting the production at either facility until the transition to the new National Security Campus is complete.

SNL is responsible for the design and production of neutron generators and custom radiation-hardened microelectronics. Production of neutron generators for the W76 and W78 has been successful, with historically high reliability and high manufacturing yield. The upcoming challenge will be the requirement to redesign and produce generators for the remainder of the stockpile in the next decade. Neutron generators for five systems are currently in various stages of development, with war reserve production beginning for the first of these systems (the W87) in FY 2014. Since neutron generators are LLCs, production schedules are partially driven by the requirement to replace them before their performance no longer satisfies system requirements.

The resulting overlap of both design and production deliverables across multiple systems over the next several years has driven SNL to develop and deploy several formal systems to ensure the most efficient allocation of resources for product development and physical production. The neutron generator design and production business model, in which a single organization is responsible for the entire product life cycle, has been key to bringing the necessary resources to bear on design and production problems in an efficient way via seamless integration of science and technology, design, and production assets.

The Microsystems and Engineering Sciences Applications facility at SNL produces NNSA's custom radiation-hardened microelectronics and microsystems. These components and capabilities are vitally important to the LEPs and provide a degree of supply chain security assurance that is not otherwise available. The silicon integrated circuit tool set is scheduled to be recapitalized within the next 4 years because the current generation of equipment can no longer be maintained, and replacement parts are unavailable. Integrated circuit manufacturing requires periodic tool replacement; a new building (a trusted foundry for radiation-hardened microelectronics and microsystems) will be needed in the 2020 time frame to accommodate the next recapitalization.

In addition to its manufacturing infrastructure, NNSA relies on commercial vendors from across the United States to supply critical materials, processes, services, and finished products in support of sustaining the stockpile. **Figure 2–11** provides a summary of the locations by state and number of key vendors supporting the Kansas City Plant and SNL across the country that supply critical capabilities in support of the nuclear security enterprise's manufacturing infrastructure.

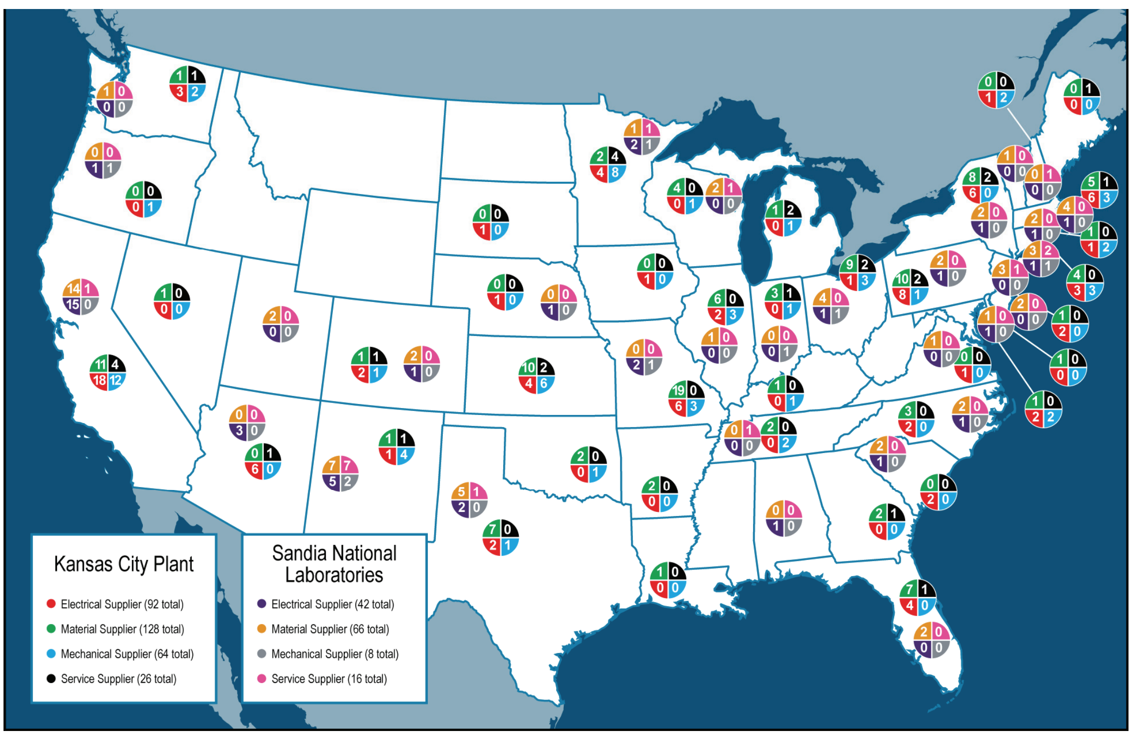

Figure 2–11. Commercial facilities from across the country provide essential capabilities to support National Nuclear Security Administration's manufacturing infrastructure

In conjunction with modernization of manufacturing capabilities, maintenance and recapitalization of other production and support activities are essential across the nuclear security enterprise. Recapitalization of major science and experimental facilities will be required to qualify and certify LEPs without returning to underground testing and to support the Surveillance Program. New explosive pressing capabilities being installed at the Pantex Plant will provide modernized equipment to support the conversion from CHE to IHE in future LEPs, as well as to consolidate operations from disparate locations at the plant. Further discussion of the facilities requiring refurbishment and recapitalization is provided in Chapter 5.

2.7 Weapons Dismantlement and Disposition

Weapons are retired from the stockpile as a result of changes in strategic requirements or surveillance evaluations. The subsequent weapons dismantlement and disposition process involves four major activities: safety analysis, disassembly, characterization, and disposition. **Figure 2–12** illustrates the processes involved in the safe dismantlement and disposition of nuclear weapons.

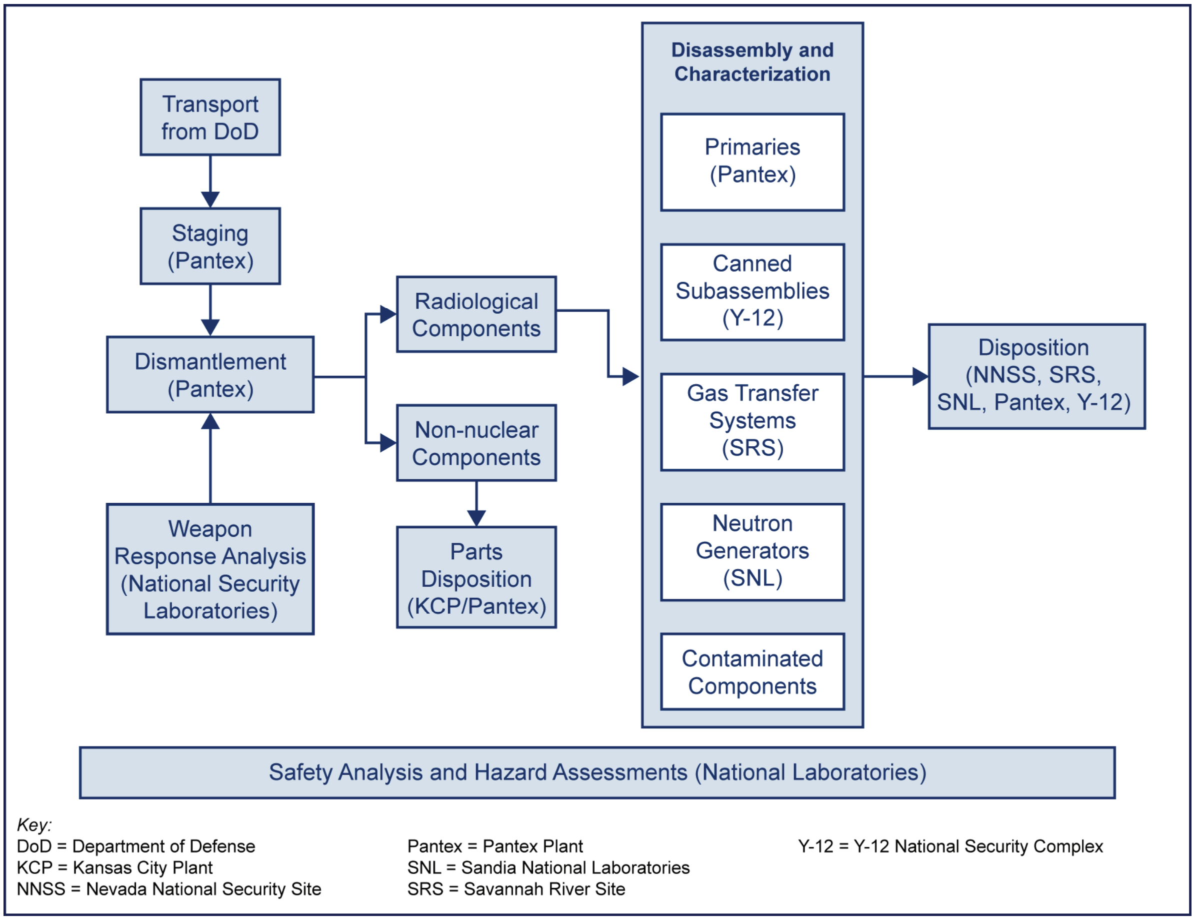

Figure 2–12. Process flow of activities involved in the safe dismantlement and disposition of nuclear warheads

A weapon-response analysis is performed prior to weapons dismantlement and disposition activities to assure that those activities are conducted in a safe manner. Planned dismantlement processes are reviewed in detail, and potential hazards are identified and assessed against potential weapon responses (*i.e.*, inadvertent nuclear detonation, high-explosive violent reaction, special nuclear material dispersal, and worker safety). Procedures and controls are developed to address the hazards prior to approval of operations to ensure that operations are conducted without adverse consequences.

Weapons and their components are characterized before dismantlement to identify their associated hazards and disposition streams. Disassembly operations separate the warhead into its major components and materials. During disposition, weapon components are earmarked for reuse, storage, recycle, surveillance, or disposal. Disposition also includes steps that demilitarize components so they cannot be used as originally intended, as well as alteration of parts to declassify them for shipment to offsite salvage locations in accordance with Federal regulations and DOE Orders. Proper characterization and disposition ensures production plants dispose of material in accordance with environmental regulations.

Many factors affect dismantlement rates, including shipping logistics, complexity of the weapon systems, and availability of qualified personnel, equipment, and facilities. A dismantlement plan[13] for FY 2011 and future years was submitted to Congress in 2008. The information in that report has been updated in the classified Annex of this SSMP. This plan accounts for additional retirements projected from the post-*Nuclear Posture Review Report* (DoD 2010) stockpile configuration. A primary goal is to take advantage of the momentum generated by the completion of safety reviews and the documented safety analyses for the handling, disassembly, and inspection of all existing weapon systems under the Seamless Safety for the 21st Century (SS-21) Initiative[14] to enable dismantlement across the entire spectrum of retired assets. The Pantex Plant has completed the SS-21 process for all weapon systems. For FY 2012, the Pantex Plant achieved 112 percent of its required weapons dismantlements and Y-12 met its CSA dismantlement requirement at 100 percent.

Near-term initiatives concerning dismantlement of retired warheads and bombs include the following:

- Complete work on the B53 CSAs scheduled at Y-12.
- Reduce the legacy material inventories at the national security laboratories and nuclear weapons production facilities.
- Dismantle W80-1 and provide parts for the W80-1 Alt 369 neutron generator replacement.
- Reduce legacy part inventories to provide additional staging capacity at the Pantex Plant.
- Continue to support the Navy's request for additional W76-0 dismantlements.

Longer-term and ongoing actions to be taken in this area include the following:

- Dismantle all nuclear weapons retired prior to 2009 no later than the end of FY 2022.
- Plan the transfer of dismantlement operations from existing facilities at Y-12 to the Uranium Processing Facility.
- Continue to support nonproliferation, LEP, and surveillance needs.

Key activities and milestones in weapon dismantlement are shown in Figure 2–14 in Section 2.9.2.

2.8 Integrated Surety Solutions for Transportation

The Integrated Surety Solutions for Transportation program will enhance NNSA transportation security through the functional integration of nuclear weapon use denial capabilities with elements of physical security. This capability was endorsed by the 2010 JASON Surety Study. By the end of FY 2011, the Surety subprogram of the Engineering Campaign had demonstrated full maturity (Technology Readiness Level 6) for all enabling technologies needed to support full stockpile implementation in the NNSA transportation venue. As depicted in **Figure 2–13**, the initial phase of implementation, which is included in the FY 2014 FYNSP request, would involve retrofitting the Safeguards Transporters with command and

[13] *National Nuclear Security Administration's Dismantlement Plan for FY 2011 and Future Years Associated with Reductions in the U.S. Nuclear Weapons Stockpile (U), submitted by the Administrator, NNSA, March 2008.*

[14] *The SS-21 program is an NNSA-wide program that enhances worker and environmental safety in the assembly, disassembly, and testing processes for nuclear weapons. The program requires the identification, evaluation, and elimination or mitigation of potential hazards.*

control subsystems to support integration of weapon use denial capabilities with Safeguards Transporter's access-delay capabilities. This phase will also include the development and production of the multi-application transportation attachment device that would complete the Safeguards Transporters/weapon interface for all warheads that already possess internal use denial subsystems. Subsequent program phases could develop external use denial subsystems for warheads which currently have no internal use denial capability. Such subsystems would be installed during transportation and interfaced to the Safeguards Transporters through the previously implemented command and control modules. Follow on activity could develop a use denial subsystem for the W88 to support return of the first Alt 370 unit to the field at the start of FY 2019, and similar programs to provide the Integrated Surety Solutions for Transportation program integration for the W76-1, W78, and W87 weapons. In FY 2013, detailed program cost estimates were developed to support implementation.

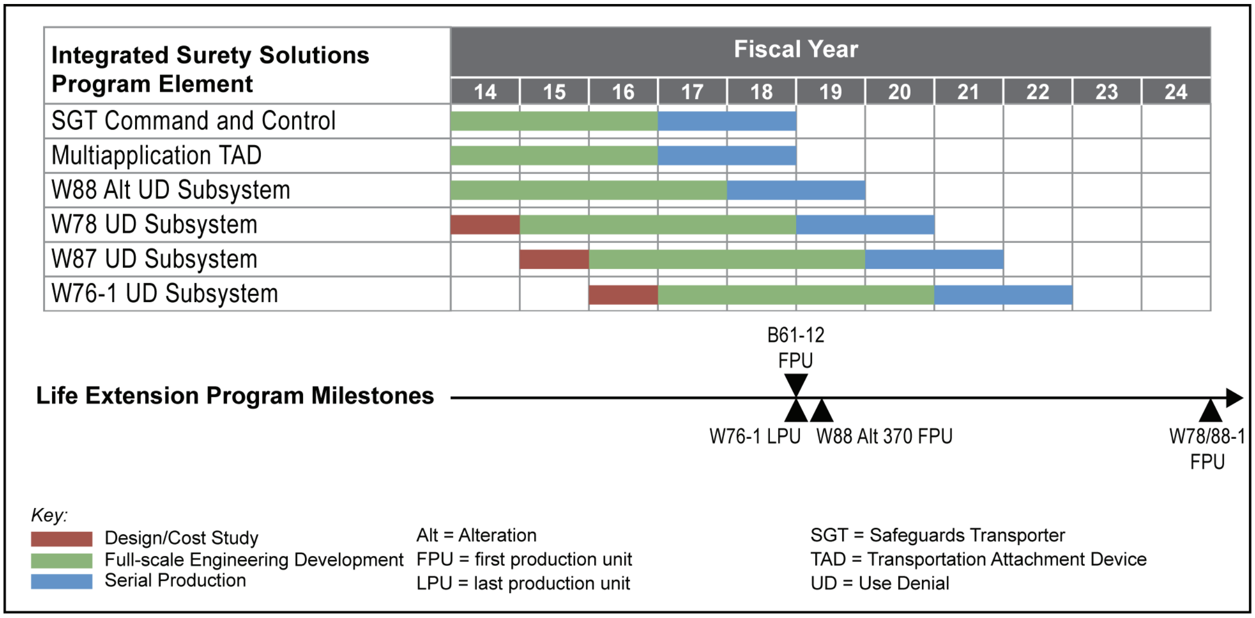

Figure 2–13. Potential schedule for Integrated Surety Solutions implementation for National Nuclear Security Administration transportation

2.9 Summary of Significant Stockpile Accomplishments and Plans

2.9.1 Recent Major Stockpile Management Accomplishments

As discussed in this chapter, significant progress has been made in virtually all elements of the Stockpile Management Program. The Nation's weapons are safe, secure, and continue to meet requirements; maintenance activities have been conducted as required; and production activities for future maintenance activities are on track. NNSA is continuing to assess weapon systems to identify areas needing more attention and has deployed a new Surveillance Program governance model to ensure that surveillance activities will be balanced across all systems in the stockpile. The Stockpile Services subprogram continues to provide enabling elements essential for weapons research, development, and production capability and capacity within the nuclear security enterprise.

Looking to the longer term, NNSA, in collaboration with DoD, is developing strategies for stockpile options that will sustain the nuclear deterrent over the long term, maintain a highly specialized technical workforce and essential infrastructure, and respond effectively to geopolitical challenges, arms control opportunities, and technological surprises.

Recent stockpile accomplishments include the following:

- Delivered all scheduled LLCs for the B61, W76, W78, W80, B83, W87, and W88, including gas transfer systems, neutron generators, and alteration kits, to DoD and the Pantex Plant to maintain the nuclear weapons stockpile.
- Conducted surveillance evaluations for all weapon systems, including flight tests, laboratory system tests, and component evaluations. Surveillance evaluations supported critical deliverables including the semiannual Weapon Reliability Reports and Annual Assessment Reports.
- Implemented a new Surveillance Program governance model to improve the planning, prioritization, and conduct of surveillance activities to best achieve program requirements.
- Completed 100 percent of FY 2012 funded scope for W76-1 LEP production and deliverables to the Navy.
- Commenced Phase 6.3, development engineering, for the B61-12 LEP.
- Commenced Phase 6.2/6.2A, feasibility studies and option downselect, for the W78/88-1 LEP.
- Commenced Phase 6.3, development engineering, for the W88 Alt 370.
- Completed 120 percent of weapon dismantlement goals in pursuit of completing the dismantlement of weapons retired prior to FY 2009 by the end of FY 2022.
- Completed construction of and began the move to the Kansas City Plant's new National Security Campus in early FY 2013.

2.9.2 Stockpile Management Activities, Milestones, and Key Annual Deliverables

To be successful in moving forward, Stockpile Management has a number of goals, milestones, and annual activities that have been discussed throughout this chapter. While the complete integrated body of work is required, the following figures graphically depict those elements that are the culmination of each of the major program elements. **Figure 2–14** shows the Stockpile Management Program's goals, planned milestones, and key annual activities through FY 2038 for its weapons assessment, surveillance, and maintenance activities. **Figure 2–15** shows the milestones set for the LEPs, major weapons component production, and weapons alteration and dismantlement activities.

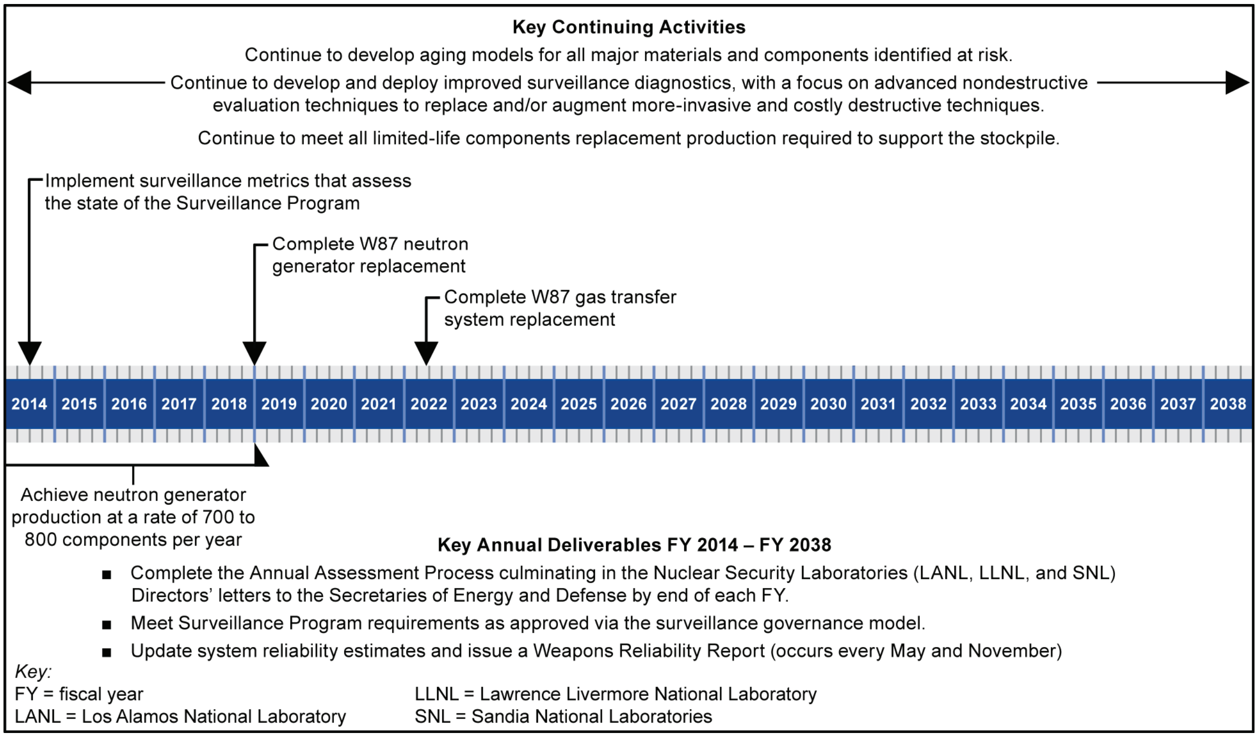

Figure 2–14. Goals, milestones, and key annual activities for weapon assessment, surveillance, and maintenance

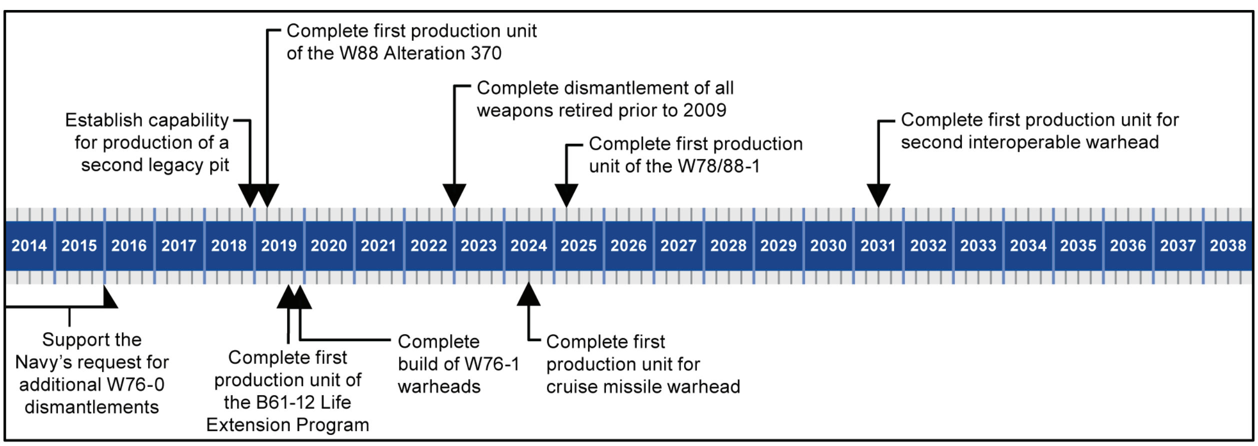

Figure 2–15. Milestones for life extension programs, major weapons component production, and weapons alteration and dismantlement

Chapter 3

Science, Technology, and Engineering: The Base of Stockpile Stewardship and Management

CHAPTER 3
SCIENCE, TECHNOLOGY, AND ENGINEERING: THE BASE OF STOCKPILE STEWARDSHIP AND MANAGEMENT

The ST&E capabilities of the nuclear security enterprise, including the suite of experimental facilities and supercomputing platforms and codes, underpin NNSA's ability to conduct annual assessment and certification of the safety, security, performance, and reliability of each weapon system without underground nuclear testing. Robust surveillance and assessment capabilities enabled by ST&E also reveal anomalies, evaluate impacts on warhead performance, and identify stockpile solutions that can be implemented via LEPs, Alterations, and Modifications. As stated in the *National Nuclear Security Administration Strategic Plan* (DOE 2011), the expertise upon which the Nation's nuclear deterrent is constructed is also applicable to other national security concerns:

> *Regardless of stockpile size, ensuring a safe, secure, and effective nuclear stockpile requires certain core capabilities and technical expertise in science, research and development, and manufacturing. The need to retain these assets across our Enterprise will only increase in importance as we work to address the nuclear security challenges of the 21st century. These assets, and the expertise of all of our people, provide the means to solve the technical challenges of verifying treaty compliance, assessing foreign nuclear weapons activities, combating nuclear terrorism and proliferation, and guarding against the threat posed by technological surprise.*

This chapter, in conjunction with the corresponding chapter and appendix in the classified Annex, provides an overview of the ST&E-based expertise and capabilities that enable accurate annual assessments, provide the means to maintain the stockpile; modernize the safety, security, and use-control features; and address broader national security requirements.

3.1 Introduction

ST&E capabilities are interwoven throughout the nuclear security enterprise, providing the fundamental basis and the supporting capabilities to accomplish the following six major efforts in stockpile stewardship and management:

- Execute annual assessments of stockpile safety, security, performance, and reliability and conduct detailed assessments of all subsystems for each weapon system.
- Perform and improve surveillance, monitoring, and analysis of the stockpile condition, including identification and resolution of SFIs.
- Analyze options to maintain and extend the life of the Nation's stockpile through LEPs.
- Develop and mature technologies to update weapons components and systems and improve safety, security, and system reliability.

- Certify that LEP products meet military requirements before entering the stockpile and ensure that capabilities are in place to enable assessment and certification of stockpile changes caused by aging or replacement of materials and manufacturing defects.
- Contribute to a diverse set of emerging national security challenges.

As described in Chapter 1 (see Figure 1–1), the flow of activities to address these key efforts is derived from documented requirements. These activities begin with the assessment of high-level strategic requirements (*e.g.*, the *Nuclear Posture Review Report* [DoD 2010], Presidential Directives, and the *FY 2011-2017 Nuclear Weapons Stockpile Plan)*, proceed to the analysis of military requirements, and ultimately culminate in stockpile sustainment assessment and certification actions to maintain a strong nuclear deterrent.

3.2 Management and Planning

The stockpile stewardship and management process consists of the following three major steps.

- **Analyze and document fundamental requirements.** This step, which is based on key planning documents, involves analyzing the requirements to assess, certify, and maintain each weapon system; documenting strategies to meet these requirements; and identifying actions to accomplish those strategies.
- **Organize, coordinate, and schedule major deliverables.** This step provides an integrated framework of activities to produce the stockpile sustainment and deterrence deliverables and is accomplished via the following three sub-elements:
  - The TBSTP document provides and prioritizes stockpile technology needs due to performance issues, aging, or needed surety enhancements (see Section 3.2.1).
  - The CMF is a planning framework to organize, coordinate, and schedule component and technology development for stockpile sustainment and modernization requirements (see Section 3.2.2).
  - The PCF is a planning framework to organize, coordinate, and schedule predictive science experimental, theoretical, and analytical activities for assessment, qualification of components, and certification and to develop solutions to address stockpile issues including improvements to safety and security (see Section 3.2.3).

  Together, the TBSTP, CMF, and PCF provide a long-term roadmap that integrates ST&E-based capabilities into DSW program activities to answer questions crucial to assessment, qualification certification, and sustainment of the stockpile. See **Figure 3–1**, which shows the integration of the TBSTP, CMF and PCF.
- **Detailed Implementation.** The implementation steps mirror the key elements of stockpile management, including assessing, sustaining, and modernizing the stockpile to assure it remains safe, secure, and reliable into the future. To accomplish these mission elements, the ST&E campaigns, the subprograms of those campaigns, and multi-campaign activities provide the necessary underlying science and engineering, develop the essential tools (*e.g.*, codes and test capabilities), and execute plans as shown in **Figure 3–2**.

These activities are the products of cooperative efforts among the campaigns and programs across NNSA sites.

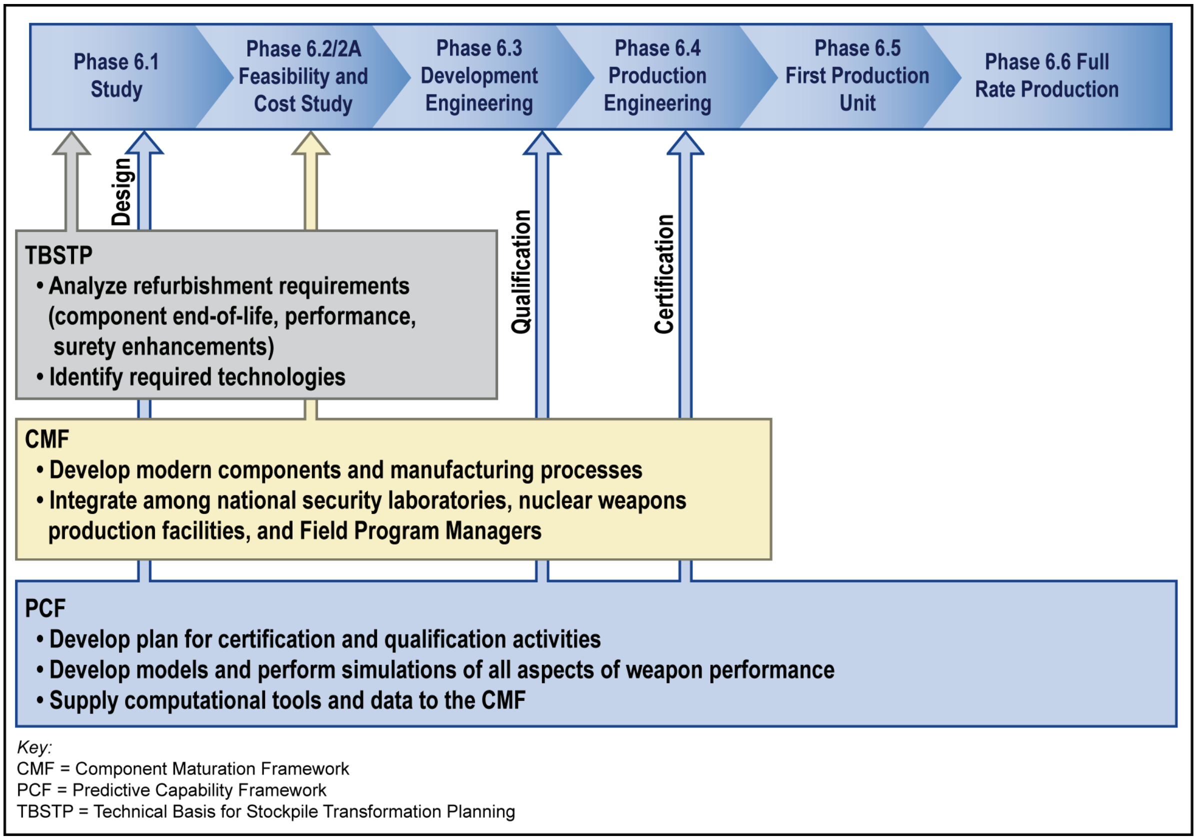

Figure 3–1. Flow of science, technology, and engineering deliverables to life extension programs

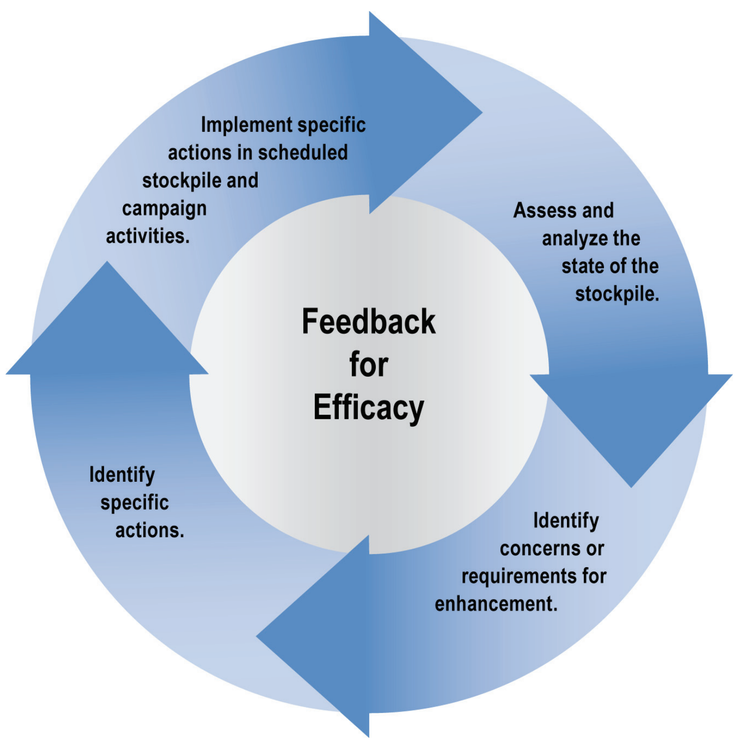

Figure 3–2. Planning and implementation process

3.2.1 Technical Basis for Stockpile Transformation Planning

The TBSTP document describes the evaluation of key issues and concerns in the deployed stockpile. It develops a prioritized list of technology needs by weapon system, based on assessments of component end of life and performance and on the need to enhance weapon safety, security, and use control. This list of technology needs provides a key driver for activities coordinated through the CMF and PCF. These activities are integrated and prioritized with the existing development, qualification, and production programs (*i.e.*, the campaigns and Stockpile Services) to achieve the desired technology and manufacturing readiness levels for implementation into the stockpile. NNSA also uses the TBSTP to communicate priorities to Congress and DoD. The TBSTP categorizes technology drivers into the three areas as shown in **Table 3–1**.

Table 3–1. Technology driver categories

Technology Investment Driver	*Description*
Potential loss of system certification from aging	Need for end-of-life replacement
Performance	Ability to achieve required yield
Enhanced surety	Safety, security, and use control upgrades

The CMF uses the TBSTP to identify, integrate, and prioritize technologies and components in various stages of development and maturity levels to address the technology drivers in Table 3–1. The PCF identifies and prioritizes both the current and projected model developments and the simulation and experimental capabilities necessary to qualify components and subassemblies and to certify systems over the 25-year planning period. Together, the TBSTP, CMF, and PCF identify the drivers (technology needs), the component developments and production activities to maintain and modernize a safe, secure, and effective nuclear deterrent, and the ST&E tools to design and qualify components. The TBSTP analysis aids NNSA in deciding which technologies and component developments to fund to ensure their maturation and timely insertion into the stockpile.

The first technology driver category, *potential loss of system certification from aging*, addresses the prediction of component end of life for stockpiled weapon systems. The TBSTP draws on experimental data and analysis conducted for a multitude of NNSA activities. Annual surveillance activities provide the most direct source of data on aging of system components and materials. In parallel, the Enhanced Surveillance subprogram of the Engineering Campaign conducts accelerated aging studies and develops predictive models of the aging process. Surveillance data, along with materials property data obtained via the Science and Engineering Campaigns, are critical to validate aging models and assess uncertainties in predicting component lifetimes and to improve and validate codes developed by the ASC Campaign. The national security laboratories use surveillance data and aging models to determine how aging impacts weapon performance. The resulting component, material, and system lifetimes, collectively referred to as predicted end of life, are reported in the TBSTP document.

The second technology driver, *performance*, captures technology needs intended to ensure that the system performance meets requirements. These needs could be driven by a variety of sources that are not associated with aging (*e.g.*, reassessment of performance based on higher fidelity models or changes in DoD requirements).

Finally, the third technology driver, *enhanced surety*, captures the technology needs associated with improvements to safety, security, and use control. These elements of stockpile sustainment are key drivers, as identified in the *Nuclear Posture Review Report* (DoD 2010). Modern technologies make these improvements possible within existing size and weight envelopes.

The national security laboratories transmit annual updates to NNSA that address the categories in Table 3–1. Based on this input, stockpile modification needs are identified for a time horizon from the near term to beyond 25 years. These drivers allow planners associated with the CMF and PCF to prioritize and schedule NNSA resources to maintain a safe, secure, and reliable stockpile. Periodic updates to the TBSTP prioritization ensure that emerging information from all relevant sources appropriately inform CMF and PCF decisions on priority and funding.

3.2.2 Component Maturation and Technology Development

Nuclear weapons are complex systems composed of thousands of nuclear and non-nuclear components. Maintenance of weapons systems by replacing aging, defective, or inadequate components requires continual technology assessments and development to model, design, manufacture, and test replacement components.

Weapon components are replaced because of design concerns or abnormalities related to aging or birth defects discovered during surveillance. Because of the age of the Nation's stockpile, like-for-like component replacement is often not possible or may be too costly. Sunset technologies, discontinued supply chain capabilities, moratoriums on the use of certain materials, improved manufacturability of alternative technologies, and improved qualification capabilities all require the development of new products for stockpile insertion. Component designs are also modified to enhance safety, security, reliability, and other requirements. These design modifications often require new manufacturing technology capabilities and component features.

The current state of technological advancement directly affects the development of new or replacement components. Hence, specialized device development capabilities must keep pace with current standards to maintain compatibility with industry tools and methods. Keeping pace with the state-of-the-art supports development, production, and maintenance efforts and enables straightforward integration of specialized and commercial devices in component design.

3.2.2.1 Component Maturation Framework Description and Purpose

The CMF is a 5- to 20-year planning framework that provides information about the status of component technology development and production activities. It provides a periodic snapshot of the status of technology development and production by focusing on activities that challenge the nuclear security enterprise's ability to meet its scope, cost, and schedule commitments to sustain the stockpile. This snapshot focuses on the Stockpile Stewardship Program activities, including the Engineering Campaign, the Readiness Campaign, the Stockpile Services subprogram, and LEPs. The CMF process facilitates dialogue among nuclear security enterprise managers. Technology maturity data are collected and integrated into a single view that crosscuts weapon systems, funding programs, and the sites. In this way, the CMF vision highlights opportunities, disconnects, and risks of technology development activities. It also promotes program funding and priority discussions to realize refurbishment designs and schedules that meet commitments to stakeholders, including more affordable costs.

Figure 3–3 illustrates the optimal point in time for subsystems (*e.g.*, firing, neutron generator, use control) to achieve the level of maturity in the product realization process that is required to meet scheduled production deliverables. This transition from component design to component manufacturing occurs when the final component design is complete, the prototype units have been demonstrated in a range of stressing operational environments, and the manufacturing processes have been defined. Based on this definition, Figure 3–3 provides the lead time necessary to achieve the first production unit and to meet the subsequent production schedule. The risk to completing the first production unit or achieving stable production is increased if the technology matures later than targeted; should this occur, risk mitigation plans will be implemented, such as the use of more mature technology or eliminating some features. The CMF defines a benchmark by which advances will be measured for a technology that is not specifically tied to a weapon system, but is being actively evaluated by the national security laboratories to address aging performance and safety and security improvements. In this manner, the nuclear security enterprise managers will have the information to assess the risk to a specific insertion opportunity. The lines represent groupings by major function or "strands" as shown on the right of the figure. The first five strands focus on technologies and the last two strands focus on activities that support or enable technology maturation.

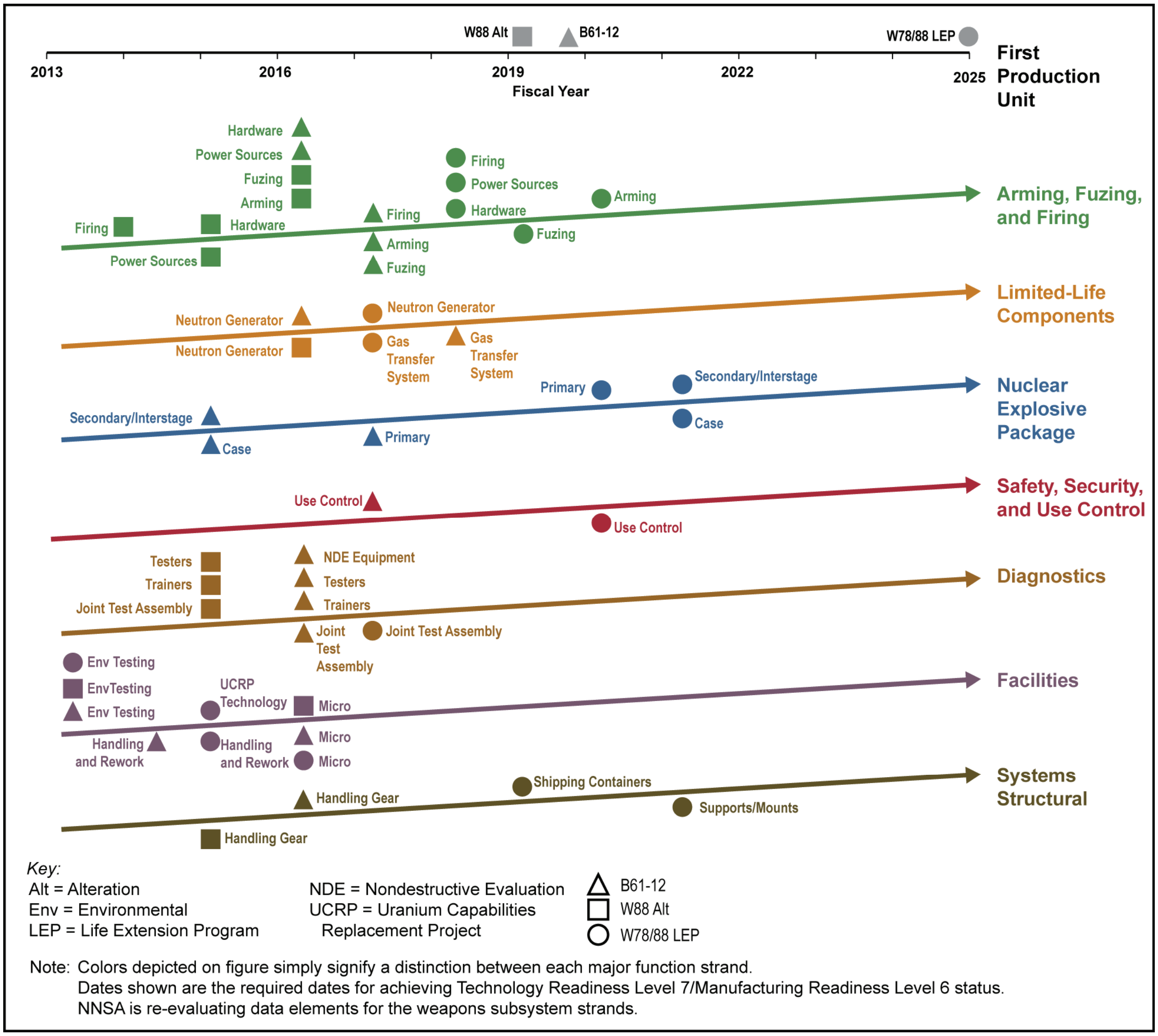

Figure 3–3. The seven current major functions, or "strands," of the Component Maturation Framework, with key components identified

3.2.2.2 Component Maturation Framework Contribution to Stockpile Sustainment Processes

The CMF contribution to stockpile sustainment processes and program relationships is illustrated in Figure 1–1 of Chapter 1. That simplified diagram illustrates the point at which the weapon functional requirements approved by the Nuclear Weapons Council and other bodies are combined with component aging and defect assessments and documented in the TBSTP. Both the TBSTP and the CMF provide critical information for planning and programming activities to conduct LEPs, weapon Alterations and Modifications, and LLC exchanges.

One goal of the CMF is to align pre-phase 6.1 technologies with identified weapon aging and other drivers outlined in the TBSTP document and to apply relevant predictive capabilities, as outlined in the PCF, to weapon components and systems associated with the evolving program of record (*i.e.*, an LEP). Another goal of the CMF is to use the established prioritization scheme provided in the TBSTP document to ensure high priority technologies are appropriately funded, through proper tracking and program integration, from conceptualization through development and finally to meet the first production unit. Figure 3–1 intentionally bears a resemblance to Figure 1–2 in Chapter 1. Both figures visibly link science and production investments to compatible scheduling and integrated development. Additionally, the TBSTP highlights gaps in understanding component lifetimes that will require new or added capabilities within the scope of the PCF.

All three planning elements (the TBSTP, PCF, and CMF) are incorporated into the planning, programming, budgeting, and evaluation process to enable an integrated approach to technology applications execution, component insertion, and assessment and certification to support stockpile stewardship and management goals and timelines.

3.2.3 General Requirements for Predictive Science Planning

In the absence of underground nuclear testing, assessment of the state of the stockpile must rely on analytic and computational evaluations, comparisons with archived data (both original and reanalyzed), and data from sophisticated new experiments. These assessments fit within the category of "predictive science," which provides the capability for improved understanding of the underlying physics of materials and components. This understanding is extrapolated through the integrated response at the engineering level to an understanding of the performance of the weapon systems to support a broad range of requirements, including qualification of LEP components, subsystems, and full-up systems.

Predictive science activities proceed from key planning documents (*e.g.*, the Primary Assessment Plan), through organization and scheduling of major deliverables based on PCF methodology, to implementation by programs and campaigns. The feedback is used to adjust planning and requirements in the PCF and other parts of the FY 2014 SSMP. This feedback establishes the resource requirements and indicates whether revision of high-level planning assumptions is required.

Predictive science provides the fundamental understanding of primary performance (Section 3.4.1.1) and secondary performance (Section 3.4.1.2). High energy density science (Section 3.4.1.3) and weapons materials (Section 3.4.1.4) are cross-cutting areas that support many elements of the stockpile, including primary and secondary assessments. Predictive Science also includes the development of the broad-based experimental and computational tools necessary to inform this fundamental understanding and to predict system performance resulting from aging, changes in manufacturing technologies, material substitutions, and insertion of modern components over a broad range of stockpile-to-target environments. In addition, robust surveillance (see Chapter 2, Section 2.2) coupled with predictive science provides the tools to reveal anomalies, evaluate their impact on warhead performance, and investigate their source and pervasiveness.

Figure 3–4 displays the current array of high-level activities formulated in the PCF. The progression of work in key groupings of ST&E-based activities is represented by five lines or "strands." Each point, or "pegpost," along these lines represents a major effort that contributes to stockpile assessment or certification. These pegposts are equivalent to the term "objectives," as used elsewhere in this SSMP. The PCF is formally managed and under change control. Before placement on the PCF diagram, each pegpost must have a management plan whereby it will evolve into a specific milestone deliverable over a 3-year horizon. All of these steps are outlined in a comprehensive PCF Management Plan under the oversight of the PCF Council. The PCF Council is composed of high-level representatives from the three national security laboratories and functions in concert with NNSA Headquarters.

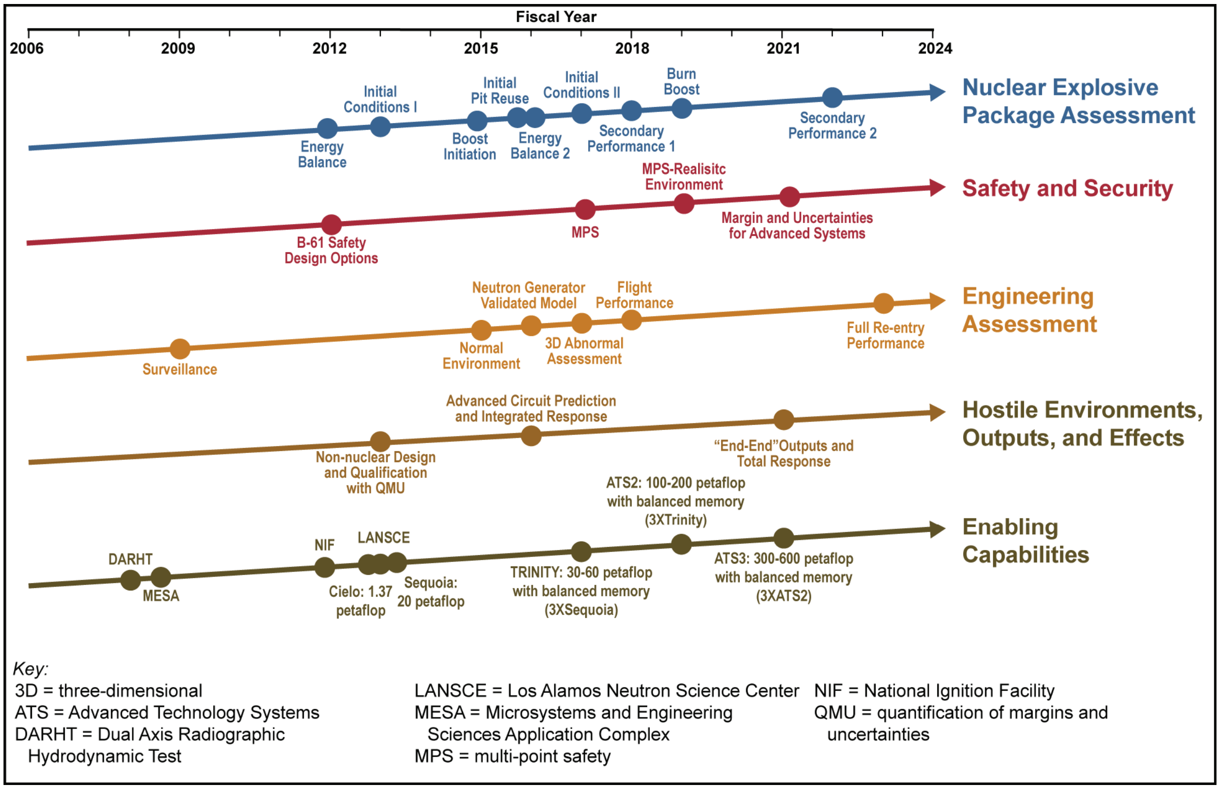

Figure 3–4. Predictive Capability Framework pegpost diagram of major efforts (strands) required to advance stockpile assessment, sustainment, and certification capabilities

An important example of pegposts is provided by the National Boost Initiative (NBI), which is focused on the thermonuclear reactions in the primary. The NBI is represented by four pegposts along the "Nuclear Explosive Package Assessment" strand: *Initial Conditions I*, *Initial Conditions II*, *Burn Initiation*, and *Burn Boost*. The first two of these four NBI pegposts are dominated by materials performance and provide detailed understanding of the initial conditions for boost. The third pegpost (*Burn Initiation*) covers nuclear reaction initiation, followed by the fourth pegpost (*Burn Boost*). Collectively, these four pegposts describe the advances in knowledge to predict nuclear primary boost performance with confidence. With the recent focus on pit reuse, the Nuclear Explosive Package Assessment strand is being modified to assure adequate focus on this important issue. A new pegpost in FY 2015 will address the immediate needs for pit reuse certification. The timing of advancements in predictive science that is necessary to address other aspects of these options may lead to additional pegposts on a 3-year cycle beyond 2015.

In the language of project management, the PCF pegpost diagram in Figure 3–4 is akin to a high-level Gantt chart – *i.e.*, it defines the array of scheduled, interlinked activities that lead to the well-established major goals of assessment and certification. These deliverables are key elements of the resource planning process. Completion of the milestones associated with each pegpost enables the assessment and certification process to sustain the stockpile and to address other national security concerns.

The management and planning tools discussed in this section will coordinate activities to assess and sustain the stockpile; evaluate LEP options; develop capabilities, technologies and components; and ultimately certify life-extended weapons. In addition, they will contribute to solving a diverse set of emerging national security challenges. The remainder of this chapter describes the program activities planned to accomplish these tasks and is divided into the following sections:

- Technology Development and Component Maturation for Stockpile Sustainment (Section 3.3)
- Predictive Science of Assessment and Certification (Section 3.4)
- Experimental and Computational Resources (Section 3.5)
- Ensuring United States Leadership in Science and Technology (Section 3.6)
- Structure of Campaigns and Programs to Meet the Requirements of Stockpile Sustainment and Deterrence (Section 3.7)
- Milestones, Objectives, and Future Planning (Section 3.8)

3.3 Technology Development and Component Maturation for Stockpile Sustainment

The legacy nuclear weapon stockpile was built during the period from the mid 1970s through the 1980s. Since this era, many of the manufacturing processes have become obsolete, and use of certain hazardous materials in these systems is no longer acceptable. Furthermore, significant progress made in understanding the aging of materials in the weapons environments has lead to better component designs. A typical weapon system will undergo an LEP no more than once every 20 to 30 years. Given the limited opportunity for upgrading components, it is imperative that technology continues to mature and be ready for insertion when the opportunity arises. Life-extended warheads can be more optimally designed to increase safety and security while meeting reliability and performance requirements. Product development and component maturation is required for stockpile refurbishment, safety and security enhancements, and replacement of components that can no longer be manufactured. This will require a healthy and robust ST&E base to underpin the design, qualification and certification.

Component and technology development and production is tracked relative to a well-defined scale that marks development progression from concept through development and ultimately to testing in relevant environments, as well as manufacturing readiness. Selected technologies are matured through a series of technology and manufacturing readiness levels (TRLs and MRLs, respectively) to meet a specific first production unit date for the first user. Each level of the TRL and MRL scale defines the maturation attributes that must be achieved before progressing to the next readiness level. Both the TRL and MRL are based on a scale of 1 through 9, where 1 reflects the earliest stages in development and 9 is a fully matured product as shown in **Figure 3–5** and **Table 3–2**.[1] A set of clearly defined requirements must be achieved to transition from one readiness level to the next. In all cases the transitions are authorized by management; in some cases a formal review may be requested. Tracking

[1] *A more complete description of the MRL states can be found in reference RMI M&O Contractor Agreement, "Conduct Manufacturing Readiness Level (MRL) Assessment," Document No. C017, June 27, 2011.*

progress to the schedule is essential to meet the first production unit date. If it is assessed to be lagging, management actions are required to address the risk, such as: (1) adding additional resources to accelerate the schedule, (2) opting for backup technology that has lower risk of achieving the delivery date, or (3) accepting the risk. Toward this end, the following sections review a sampling of components identified on the CMF chart that is being developed to achieve first production units identified on Figure 3–3 in support of the LEP plans.

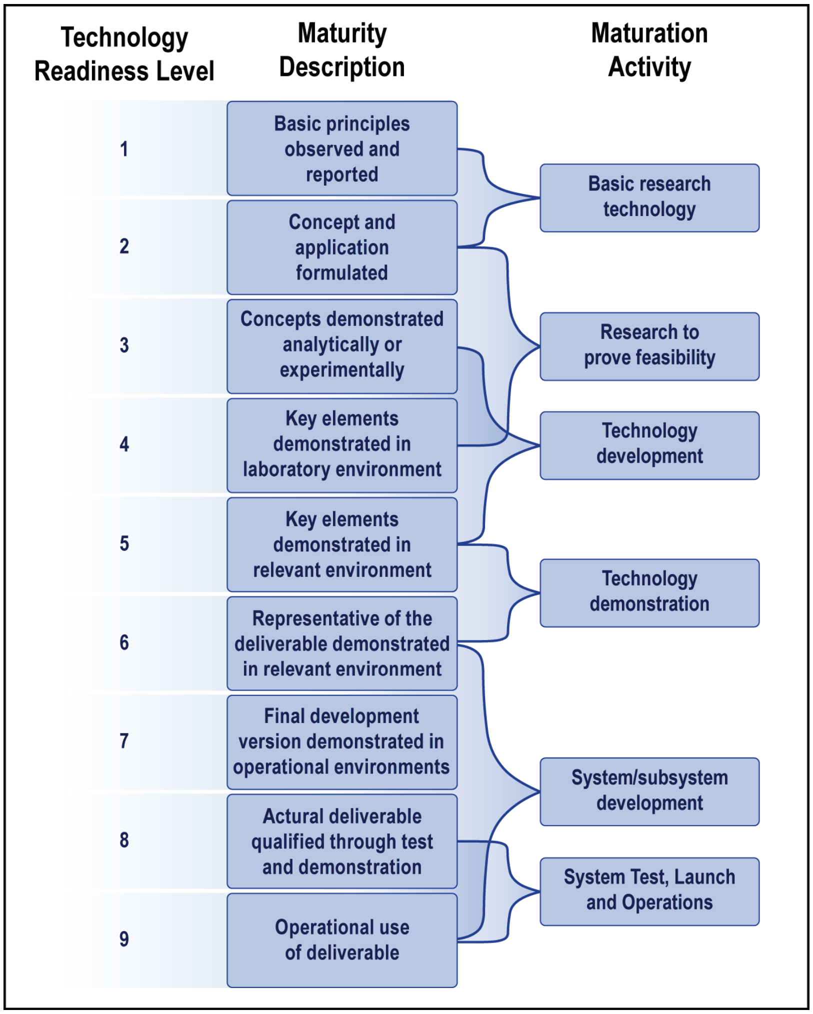

Figure 3–5. Technology readiness level

Table 3–2. Manufacturing readiness level

Manufacturing Readiness Level	*Maturation Activity*
1	Manufacturing assessment
2	Manufacturing concept formulation
3	Manufacturing concept development
4	Manufacturing capability proof-of-concept
5	Manufacturing process development
6	Manufacturing system integration
7	Manufacturing prove-in
8	Manufacturing qualification and initial production
9	Full-rate production

3.3.1 Non-Nuclear Components and Technology

Modern non-nuclear components of a weapon are essential for improving the safety, security, reliability, and performance of the stockpile. Non-nuclear components of a weapon fall into four broad categories, as described in Section 2.6.4.5 of Chapter 2 (*i.e.*, mechanical, electrical, special material, and energetic material). The business model is to have the ST&E program to fund up to TRL 6 and MRL 6; however, in some cases, there are deviations to that model. After TRL 6 and MRL 6 the technology is funded by the life extension or LLC exchange program and managed through the Product Realization Team process. Enormous changes are occurring in the manufacturing processes related to these four categories. Given these changes, extreme care is required of component designers and production engineers to characterize and model the component performance and the production processes to ensure they meet stockpile requirements. Implementation of new component technology requires the development of advanced modeling and design methods combined with sophisticated testing and continuing surveillance. Advanced modeling is also an essential element of the annual assessment of the effects of these technologies on overall nuclear system performance, safety, and reliability.

3.3.1.1 Arming, Fuzing, and Firing Systems

The AF&F systems in the nuclear stockpile are the electronic brains of the weapons. Electronics grow obsolete very quickly (over a matter of a few years); however, AF&F systems must be designed to operate flawlessly for 30 years or more. An additional challenge for the AF&F systems is the constant low-level bombardment of intrinsic radiation that electronics sustain over the life of the weapon and the required hardening to ensure the weapon can reliably operate in hostile environments. These factors drive the requirements in developing and maturing new component technologies for the AF&F systems. Component technologies include, but are not limited to, the stronglinks, pull out switch, spin rocket, fireset, cables, contact fuze, antenna, controller, electronics, batteries, programmers, packaging, connectors, aircraft/missile interfaces and sensors. Examples of technology improvement include the following:

- Fuzing radar is a component designed to provide a robust and reliable fuzing technology used to determine detonation timing by detecting the system's height relative to the ground during its trajectory. This component will replace fuzing systems that use vacuum tube technology developed in the 1960s.
- The Weapon Control Unit is the primary controller that provides information and detonation management functionality for gravity bomb application. It improves performance to both legacy System 1 and new System 2 aircraft.
- Power sources are required to enable a number of functions in the weapon systems. Advances in battery technologies, including an advanced pellet thermal battery and a thin film thermal battery, have promise to improve lifetimes, increase functionality, and facilitate fabrication.

3.3.1.2 Limited Life Components

LLCs are components that have a very well-defined and limited lifetime as a result of the function they are required to perform. Specifically, the Gas Transfer System (GTS) supplies tritium for nuclear operation; as tritium, a radioactive material that decays in time, has a relatively short half-life, the GTS must be periodically replaced with fresh gas. For an LLC such as a GTS, an LEP provides a unique opportunity to improve functionality and address DoD operational needs. Recent technology maturation has resulted in advanced gas-transfer valve technologies for enhanced functionality and new methodologies for improved gas delivery. In addition, continuous efforts and long lead times have allowed new materials for tritium storage to be qualified through rigorous aging studies. This means that NNSA can field longer-lived GTS systems with high reliability. As an additional benefit, NNSA can not only extend the life of a weapon system during an LEP, but also improve overall reliability and system performance throughout the life of the weapon.

Similarly, because the neutron generator depends on tritium to function, it is also considered an LLC. The underlying science and technology activities supporting this LLC include initial concepts, modeling, materials science, chemistry, and neutron testing. This knowledge is applied to improving unit performance through greater margins of performance (*i.e.*, increased difference between design capability and operational condition), robust neutron output at projected end of lifetime, and improved production throughput of fully tested and vetted units. Through this underlying science, future neutron generator designs will be more readily manufactured without sacrificing quality.

The TRL statuses for a number of selected non-nuclear component development activities and their system association are identified in **Table 3–3**.

Table 3–3. Selected non-nuclear component technology development

Subsystem or Category	Application	Technology	TBSTP Technology Driver	Applicable Systems: TRL
Arming fuzing and firing system	Fuzing	Radar	Performance	B61-12 LEP: TRL 4
Arming fuzing and firing system	Fuzing	Radar and JTA antenna	Performance	B61-12 LEP: TRL 4
Arming fuzing and firing system	Fuzing	Weapon control unit	Performance	B61-12 LEP: TRL 4-5
Arming Fuzing and firing system	Firing	Batteries and power sources (multiple technologies)	Performance	Future Systems: TRL 1-4
Gas Transfer System	Gas Transfer System	Tritium storage technologies, low permeation materials, advanced valve technology	Performance	W87 ALT360: TRL 5 B83 ALT353: TRL 7 Future Systems: TRL 3
Neutron generator	Neutron generator	Electronic neutron generator	Performance	B61-12 LEP: TRL 6, B61-11 Sustainment: TRL 6, B83 Sustainment: TRL 6
Neutron generator	Neutron generator	Small ferroelectric neutron generator	Performance	W80-1 Sustainment: TRL 5, W87 Sustainment: TRL 6, W88 Sustainment: TRL 4
Surety	Stronglinks	Electrical Contact Stronglink Trajectory Stronglink Magnetically Coupled Stronglink	Performance, Enhanced Surety	ECSL: B61-12 LEP and W88 ALT: TRL 5, TSL: B61-12 LEP: TRL 4, MCSL: W88 ALT: TRL 5
Surety	Processor	Validating information processor	Aging, Performance, Enhanced Surety	B61-12 LEP: TRL 5, W78/88-1 LEP: TRL 4,
Surveillance	Flight test JTA	Advanced telemetry adaptable transmitter	Aging	W88 ALT: TRL 4, W78/88-1 LEP: TRL 4,
Surveillance	Flight test JTA	Optical transduce assembly	Performance, Aging	B61-12 LEP: TRL 4 W88 ALT: TRL 4

ALT = Alteration
ECSL = Electrical Contact Stronglink
LEP = life extension program
JTA = Joint Test Assembly
MCSL = Magnetically Coupled Stronglink
TBSTP = Technical Basis for Stockpile Transformation Planning
TRL = technology readiness level
TSL = Trajectory Stronglink

3.3.2 Nuclear Explosive Package Components and Technology

Refurbishing the nuclear explosive package (NEP) via an LEP presents a number of critical challenges. The NEP is a well-integrated collection of precisely manufactured components in which very small variations in material properties or dimensions can negatively impact system performance. Unfortunately, the ability to manufacture identical assemblies can be very costly, if not impossible in today's climate (*e.g.*, use of certain hazardous materials and materials that are very difficult to replicate). Future NEP designs will rely on reuse or remanufacture of nuclear components, *i.e.*, the pit and CSA; the balance of the NEP will be largely remanufactured to address functional requirements imposed by the updated Military Characteristics and Stockpile-to-Target Sequence to address an interoperable warhead as well as safety and security updates. PCF is fully engaged in the design, qualification and certification for the proposed reuse options; in addition, CMF has a significant role as well.

Two component maturation categories include the primary explosives and support system. A large percentage of the reentry vehicle systems use conventional high explosives. Life extended systems will incorporate modifications to the primary to enable use of IHEs. Reconstituting the manufacturing capability for making IHEs is in process, and successful bench scale quantities of the previously used IHE molecule (TATB[2]) have been fabricated. Scaling up this process and synthesizing with the binder material is on track.

In addition, a new explosive molecule has been synthesized which has safety properties similar to that of an IHE (although it has not yet been certified as an IHE) but provides higher energy density, and thus higher drive to the pit. This new HE may enable pit reuse designs with higher margins than the TATB based designs and significantly improve safety over the legacy conventional high explosive designs.

The primary support system plays an important function design and operation of the primary. Materials for these supports have to be very carefully designed to address a range of requirements. In particular, the design needs enable a proper implosion while ensuring that the primary survives over the most stringent Stockpile-to-Target Sequence environments. A number of these components have very demanding properties and configurations that will benefit from advanced manufacturing techniques. One such technique is the use of additive manufacturing for specialty supports.

The TRL status for a number of selected nuclear component development activities and their system association are identified in **Table 3–4**.

3.3.3 Safety, Security, and Use Control

Enhanced surety (safety, security, use control, and use denial) is dedicated to preventing unauthorized use of our Nation's nuclear weapons stockpile. The goal of enhanced surety is to anticipate potential threats, understanding that adversary capabilities to subvert nuclear weapons surety will undoubtedly increase in capability over time; and to realize "the high standard for the safety and security of the U.S. nuclear weapons," as stated in the *Nuclear Posture Review Report* [DoD 2010]. Enhanced surety creates, develops and matures advanced safety, security, and use control and use denial technologies for stockpile insertion opportunities, including LEPs. These technologies include minimizing the probability of an accidental nuclear explosion and, in the unlikely event that unauthorized access is gained, driving the risk of an unauthorized nuclear yield to the lowest possible level. Activities in support of enhanced surety seek advances to leading-edge technology in these broad areas.

[2] *TATB stands for triaminotrinitrobenzene.*

Table 3–4. Selected nuclear explosive package component technology development

Application	Technology	TBSTP Technology Driver	Applicable Systems: TRL
Main Charge HE	Higher energy density IHE	Performance, Surety	W78/88-1 LEP: TRL 2
HE	Remanufacture of TATB		B61-12 LEP: TRL 5 W78/88-1 LEP: 4
HE Booster	Robust IHE Booster	Performance, Surety	B61-12 LEP: TRL 4 W78/88-1: TRL 4
Initiation system	Direct Optical Initiation	Performance, Surety	B61-12 LEP: 4 W78/88-1 LEP: 5
Detonator	Electrical-Mechanical Safe and Arm Device	Performance, Surety	W78/88-1: TRL 5
Pit	Pit remanufacture	Aging, Performance	W78/88-1: TRL 2
Pit	Reuse	Aging, Performance	B61-12 LEP: TRL 5 W78/88-1: TRL 3
Ancillary parts	Materials and remanufacture	Performance	W78/88-1: TRL 2
CSA	Reuse	Aging, Performance	B61-12 LEP: TRL 5 W78/88-1: TRL 2
Case	Alternate material and processing	Manufacturing [a]	W78/88-1: TRL 4
Case	Joints		W78/88-1: TRL 2
Case	Recertification and reuse	Performance	B61-12 LEP: 4
NEP support structures	Primary NEP mounts	Performance	W78/88-1: TRL 3
NEP support structures	Secondary NEP mounts	Performance	W78/88-1: TRL 3
Flight test JTA	High fidelity JTA NEP	Performance	W78/88-1: TRL 3
Flight test JTA	Instrumented JTA NEP	Performance	W78/88-1: TRL 3
Flight test JTA	Telemetry package	Performance	B61-12 LEP: 4 W78/88-1 LEP: 3 W88 ALT: 3
Flight test JTA	Robust monitors	Performance	B61-12 LEP: TRL 4 W78/88-1: TRL 3
Detonator	Performance diagnostics	Performance	W78/88-1 LEP: 3
CSA	Gas diagnostics	Performance	W78/88-1: TRL 2
Embedded sensors	Key subassembly and system diagnostics	Performance	W78/88-1: TRL 2

ALT = Alteration
CSA = canned subassembly
HE = high explosive
IHE = insensitive high explosive
LEP = life extension program
JTA = Joint Test Assembly
NEP = nuclear explosive package
TATB = triaminotrinitrobenzene
TBSTP = Technical Basis for Stockpile Transformation Planning
TRL = technology readiness level

[a] Manufacturing is not one of the TBSTP drivers, but is included in this case since it is a cost saving measure.

Additionally, efforts to identify the best solutions to improving surety have generated a systematic approach to identifying the most cost-effective applications of these surety technologies, using the Joint Integrated Lifecycle Surety risk assessment capability in collaboration with DoD. This tool allows program and weapon system managers to make better-informed implementation decisions regarding stockpile surety improvement options. Enhanced surety develops advanced initiation and use control and use denial options, as well as Integrated Surety Solutions to achieve new, improved levels of control and denial of unauthorized use. It also integrates these modern technology advancements within the scope of nuclear weapons safety and security, thus better protecting the American people from hostile nuclear weapon use.

3.3.4 Diagnostics

The Diagnostics strand in the CMF (see Figure 3–3) addresses the component and technology needs for both surveillance and trainers. These are discussed in Sections 3.3.4.1 and 3.3.4.2, respectively.

3.3.4.1 Supporting Surveillance

The focus of surveillance development is on improving surveillance diagnostics (*e.g.*, relevance, quality, and sufficiency of data) as applied to both laboratory and flight testing. In addition, improvements in and broader use of nondestructive techniques enable NNSA to preserve assets while acquiring critical surveillance information.

Whereas Core Surveillance subprogram activities establish the current condition of the stockpile, the Enhanced Surveillance subprogram is charged with developing predictive capabilities for early identification of stockpile concerns, establishing component lifetimes in the existing stockpile to support refurbishment decisions, and providing information to improve the longevity and sustainability of replacement systems. Together, the Core and Enhanced Surveillance subprograms provide the necessary diagnostics and test data to accurately assess the stockpile.

New analytical methods and diagnostics are being developed, including nondestructive evaluation techniques, to achieve timely, less-invasive, and more cost-effective surveillance. Once developed and demonstrated, the hardware for these technologies (as well as the supporting documentation for operating and maintaining them) is transferred to the appropriate nuclear weapons production facility for use in core surveillance activities.

Two new diagnostics have been developed to support surveillance: the Confined Large Optical Scintillator Screen and Imaging System (CoLOSSIS), deployed at the Pantex Plant, and the CSA nondestructive laser gas sampling system, which is deployed at Y-12. CoLOSSIS is a high-resolution x-ray tomography imaging system used to evaluate pits. It is capable of providing high-resolution, three-dimensional images of the interior of pits by computationally integrating thousands of digital radiographic images. In this manner, scientists and engineers can identify anomalies such as internal gaps and defects, signs of aging, and out of specification components without damaging the pit. Having this nondestructive tool enables screening pits for potential reuse, thereby saving valuable assets and resources. The second diagnostic, CSA nondestructive laser gas sampling, was qualified and put into service in FY 2012. This diagnostic, which will eliminate some destructive testing, allows evaluation of CSAs for potential reuse based on their gas signatures. Both diagnostics substantially improve NNSA's approach to conducting surveillance.

Improving Surveillance through Nondestructive Evaluation

As the country moves to smaller stockpiles, the assets required for surveillance become an increasingly larger fraction of the required build. In addition, the need for more in-depth understanding of the performance and aging characteristics of each component further stretches surveillance resources.

Scientists and engineers in the Surveillance and Enhanced Surveillance Programs are making excellent progress to address these challenges with the development and deployment of new classes of nondestructive surveillance tools. These tools not only preserve assets, but also provide exceptional data quality and have the ability to probe deep within components – into areas that were previously inaccessible. Using these tools has improved NNSA's ability to resolve SFIs and provide primary and secondary as-built features internal to components, and has enabled pre-screening of components for reuse.

To support Stockpile Evaluation activities, advanced system test equipment and capabilities have also been developed to diagnose margins and robustness at the system level. As part of this effort, since FY 2005, new systems testers have been provided for the W88, W76-1, W78, W87, W76-0, and W80 systems at SNL's Weapons Evaluation Test Laboratory located at the Pantex Plant. New testers for the B61 and B83 systems are scheduled for completion by FY 2014. Testing capabilities for system margin and robustness are also being developed for the W80 and the W76-0.

Another surveillance area that is a focus of the CMF is the development of joint test assemblies used in flight and other system testing. A number of joint test assembly-related technology development activities are identified in Table 3–4.

Appendix B provides additional details on Enhanced Surveillance subprogram activities.

3.3.4.2 Trainers

Many weapon components are designed for one time use (*e.g.*, firesets, stronglinks) and, as such, are of limited value when repeated use is required for training activities. Trainer development is focused on component replacements that behave identically to the weapon component, but are capable of being operated many times. For instance, when a correct code is entered into a stronglink, it should enable a specific event or series of events (*e.g.*, charge the fireset); it must also provide a signal back that the correct signal was received. However, if a wrong signal is received it will prevent the event and irreversibly lock up rendering the warhead inoperable. In a trainer, identical functionality is still required (*i.e.*, it must lock up); however, there needs to be a path that it can be reset without component replacement. While this is a relatively simple example, other components, such as a fireset to initiate the main charge detonators may have a very complex voltage and current output that must be achieved across a wide spectrum of environmental conditions. In this manner, a trainer mimics the operation of the various subsystems of the actual weapon for training purposes, but by using surrogate components to meet the desired requirements. Development of these components is a complex endeavor that is specifically tailored to the weapon systems and operational procedures.

3.3.5 Major Function Enablers

The last two groups in the CMF (see Figure 3–3), Facilities and Structural Systems, are major function enablers and focus on activities or capabilities that support technology maturation. The CMF includes these enablers to facilitate programmatic integration for facility and infrastructure maintenance and upgrading of activities that are critical to the technology maturation mission.

3.3.5.1 Facilities

Technology maturation requires facilities and infrastructure to design, fabricate and test development-quality hardware and software. Current focus areas include (1) the Microsystems and Engineering Science Application Recapitalization Program, which will maintain the capability to design and fabricate state-of-the-art microelectronic components, and (2) the Special Nuclear Material Surety and Environmental Test Program, which will ensure the safe and secure fabrication of parts made from uranium and plutonium. Additional out-year needs include neutron imaging for diagnostic evaluation of nuclear components for potential reuse and a tritium reservoir research and development function test station that will improve the inspection and diagnostic testing of new gas-transfer components. Component manufacturing technologies include, but are not limited to, microwave casting, infrared heating, agile machining, and three-dimensional printing manufacturing capability. Effective programmatic integration of these activities involves the DSW program, Engineering Campaign, Readiness Campaign, ASC Campaign, and Site Stewardship Program.

3.3.5.2 Structural Systems

New or improved weapon component capabilities may require integration with external subsystems, such as weapon handling equipment and containers, weapon use control equipment or facility surveillance and security systems. The CMF identifies and tracks appropriate external subsystems to ensure interface compatibility issues do not impact maturation and insertion schedules.

3.3.6 Special Considerations for Radiation Hardening of Nuclear and Non-Nuclear Components

NNSA conducts applied physics R&D to enable stockpile design, qualification, and assessment for hostile, fratricide, space radiation, and intrinsic radiation environments. By its nature, this R&D must be highly integrated. An R&D task may involve the Engineering Campaign for experimental and theoretical discovery, the ASC Campaign to implement and validate models and codes to predict the response in radiation environments, the Site Stewardship Program to provide major experimental facilities that support technology maturation, the Inertial Confinement Fusion (ICF) for specific radiation science and sources, the DSW program to mature the technology for insertion into the stockpile, and the Science Campaign's Advanced Certification subprogram for certifying the radiation hardness of new technology. At the same time, the focus must be on maturing the knowledge, tools, and technologies to hand off the R&D results at a usable level of maturity for DSW program stockpile development and assessment applications.

3.3.7 Developing and Maintaining Manufacturing Capabilities

Nuclear weapon components and subassemblies are manufactured to precise specifications and stringent quality requirements. Even seemingly benign design or production changes can negatively impact the performance and lifetime of these products. Unique design, performance, and quality demands are made further complicated by dynamic and rapid changes in commercial production technologies and capabilities. Demanding product requirements and small production quantities often negatively impacts the interest of commercial vendors in nuclear security enterprise component production opportunities.

The long life cycle of nuclear weapons conflicts with the pace of change in manufacturing technologies and processes in the commercial industry. As weapons age and require refurbishment, technologies and manufacturing processes of the past are often obsolete and must be replaced with modern processes. To this end, the national security laboratories provide emerging design requirements to the nuclear weapons production facilities to help assess the manufacturing aspects. The early involvement of nuclear weapons production facilities personnel during the design process (through joint Product Realization Teams) has been instrumental in the incorporation of manufacturing considerations and constraints into system and component designs. The nuclear weapons production facilities provide current and updated manufacturing capabilities to the national security laboratories through support of the Product Realization Teams, as well as through "Design for Manufacturability" guides. In collaboration with the national security laboratories, the nuclear weapons production facilities identify technology and process focus areas that support multiple weapon applications and propose projects to develop these capabilities. Through this process, design requirements and the manufacturing capabilities needed to meet them are jointly matured.

3.4 Predictive Science of Assessment and Certification

Predictive science is required for component maturation by providing capabilities that support component design and qualification and system certification as aforementioned. Equally important is the role of predictive science in assessments. Over the last 20 years of the science-based Stockpile Stewardship Program, the ability to assess the deployed stockpile with a greater depth of understanding has had significant impact on the state of the stockpile. For instance, although all systems had been originally certified with the aid of relevant nuclear tests, these tests did not cover the complete range of environmental conditions in which the warheads must perform. Modern analytical and experimental assessment tools have been vital in identifying performance issues and developing solutions to maintain the effectiveness of the stockpile. These tools have also been vital in assessing the impact of surveillance findings on performance and safety and identifying solutions.

The historical approach to weapon design and development was based on a "Cold War philosophy," under which every weapon system was uniquely designed and optimized for that threat environment. As discussed in Chapter 2, Section 2.6, stockpile stewardship plays a central role in sustaining the stockpile. As a result, the historical design approach is being significantly altered by the Nation's new strategy to certify warheads that have been revitalized using refurbished and reused nuclear components, to deploy the same NEPs on multiple delivery platforms, and to use common non-nuclear components to the extent possible. Based on the advances to date, the national security laboratories have the tools necessary to design and certify the system refurbishments discussed in Section 2.6. By necessity, these refurbishments are closely tied to the nuclear test base. However, as we move further from legacy test data to address issues (*e.g.*, aging, SFIs) or to improve safety, security, and use control features, understanding the underlying basis of performance will be essential to address potentially significant changes to nuclear and non-nuclear components and systems.

3.4.1 Nuclear Explosive Package Assessment

3.4.1.1 Primary Assessment

An assessment of primary performance and reliability requires detailed understanding of a progression of complex physical processes from explosively driven implosion hydrodynamics (*i.e.*, initial conditions) to the high pressure and temperature extremes that produce thermonuclear reactions (*i.e.*, boost). Proper initiation of the primary is essential to achieving the design nuclear yield.

The development of increasingly sophisticated computational models is a key underpinning of primary assessment. These models are tested and validated by comparison with data that span a range of length scales and complexities, from small-scale, fundamental material property measurements to highly integrated primary assembly experiments. The material property data are used to develop predictive models for weapons simulation codes. The analysis of the integrated assembly experiments relies on computational models that interpret multiple diagnostic signatures in terms of the evolution of the initial conditions of the primary implosion. Prediction of this evolution also provides validation of the

Nuclear Explosive Package Assessments

In addition to providing essential analysis, modeling, and experimental capabilities to assess the stockpile on a continuing basis, nuclear explosive package assessments also enable NNSA to accomplish the following without the need for nuclear testing:

- *Modernize the stockpile to improve safety and security*
- *Convert to an all-insensitive, high-explosive stockpile*
- *Certify and deploy both remanufactured and reused nuclear components*
- *Eliminate most of the hazardous materials from the nuclear explosive package*
- *Develop interoperable warhead options that align to the Nuclear Weapons Council's "3+2" vision*

computational codes that are used to understand performance as derived by comparison to legacy underground nuclear test data. This sequence of activities provides confidence in the computational capabilities as one element in the process of assessing stockpile performance.

To further complicate the scope of primary assessments, the Stockpile Surveillance Program has identified a number of features in primaries that were not part of the original design intent and, as weapons age, subtle changes to materials within primaries have been observed. As changes become more significant, extrapolation becomes increasingly problematic without an in-depth understanding of the physical processes and an ability to calculate deviations from the original design accurately.

The primary performance can be divided into four phases – from initiation of the high-explosive main charge, through early hydrodynamic implosion, followed by primary boost, and ultimately primary nuclear yield. In addition, the primary must provide essential safety, security, and use control functions seamlessly integrated into the design. Each of these elements is described in Chapter 3 and the associated appendix of the classified Annex to this document.

The initial processes for primary operation are initiation of the high-explosive main charge and explosive driving of the metal pit assembly to high pressures. These high-explosive-driven metals flow like fluids; their behavior is modeled using equations from the field of hydrodynamics. The term "hydrotest" typically refers to integrated hydrodynamic experiments involving a full-scale nuclear weapon primary with nonfissile surrogate material to "mock up" the special nuclear material in a pit. This mock-up material has weight, density, and other metallurgical properties similar to an actual pit, but cannot undergo fission. Flash x-ray sources at the Dual Axis Radiographic Hydrodynamic Test Facility (DARHT) facility and the Contained Firing Facility capture complementary radiographic images of imploding mock pits and provide the throughput capacity required to validate computational models. These validated models improve the ability to predict weapons safety, performance, and reliability.

Hydrodynamic experiments are an important tool for evaluation of the complex interaction of the multiple subsystems and physical processes in a weapon, including firing systems, high-explosive detonation and burn, metal performance, and initial conditions for boost. These experiments are vital to supply data to improve predictive models, resolve issues observed during surveillance, evaluate new components for LEPs and advanced safety and security, establish confidence in stockpile life extension options, and test the viability and vulnerabilities of designs of interest.

While integrated experiments with surrogate materials are important, conducting experiments with plutonium to address key unknowns with respect to the nuclear process is also essential. Complex plutonium experiments performed at the U1a Complex at the Nevada National Security Site must remain "subcritical" and not produce nuclear yield; these experiments are referred to as "subcritical experiments." Subcritical experiments use reduced scale designs and/or other modifications to prevent criticality and ensure no nuclear yield can occur.

Subcritical experiments are essential for making the link between hydrodynamic tests using surrogates and the hydrodynamic behavior of plutonium. Such experiments may become more important as the stockpile ages and design options become more complex. Plutonium experiments range from relatively simple determinations of mechanical properties to complex implosions in subcritical experiments at reduced scale. The plans for these experiments are described in the classified *Dynamic Plutonium Experiments Plan*. A study by the JASON Defense Advisory Group in 2011 cited the value of that plan and recommended that it be updated regularly and fully executed.

A major scaled subcritical experiment executed in early FY 2013 produced a comprehensive data set for the initial stages of the primary implosion using plutonium. Using recent advances in diagnostics to measure the velocity of the imploding primary assembly, NNSA researchers obtained implosion details that had not been previously measured. As the analysis of this experiment is completed and the results are integrated into simulation codes, NNSA anticipates improvements in its modeling of nuclear performance. Furthermore, the more exacting manufacturing tolerances required for this test assembly and the corresponding characterization of components led to an improved understanding of the plutonium casting process and will further inform NNSA's understanding of pit manufacturing processes.

The underlying materials models derived from fundamental tests are embedded in both the development of predictive computer codes and the analysis of complex integrated experiments. Materials assessment related to the performance of the NEP is discussed in Section 3.4.1.4.

Addressing the full range of boost questions will require significant advances in diagnostics. The conditions relevant to boost and nuclear burn must be approached under controlled, simplified laboratory experiments that examine portions of the extreme conditions produced within nuclear weapons. Approaching these conditions was the principal reason for constructing the National Ignition Facility. A number of stockpile stewardship experiments have been conducted at the National Ignition Facility and will continue to be fielded. Moreover, as that facility achieves additional advances toward ignition and burn, thorough investigation of the burning plasma conditions will allow examination of key questions concerning primary performance.

As NNSA modernizes the stockpile to add safety, security, and use control features and enhances system reliability, it must both remanufacture pits and reuse pits returned from the stockpile in design configurations that have not been nuclear tested. Furthermore, other materials within the primary are likely to be updated based on modern manufacturing techniques and aging and safety concerns. These changes will require a well-focused primary assessment program that enhances the understanding of primary performance while developing and using advanced analytic and experimental tools to validate that performance based on reanalyzed legacy nuclear test data. This is an important objective of the primary assessment component of the Nuclear Explosive Package Assessment strand in the PCF diagram (see Figure 3–4).

3.4.1.2 Secondary Assessment

The objective of secondary assessment is to develop a science-based understanding of nuclear weapons secondary performance. This capability is essential both to continuing assessment of the stockpile and to certifying each life-extended weapon for which significant changes to the primary, secondary, or environment are required. The key deliverable is the replacement of present calibrated models with validated predictive models that are founded on an improved understanding of the relevant physical processes. Secondary assessment requires detailed knowledge of the radiation hydrodynamics within the specific environment of weapons systems, as well as the dynamic response of materials at extreme temperatures and pressures.

The development of such capabilities requires high-fidelity simulations (both in terms of the physics and the numerical resolution) and model validation through carefully designed and executed experiments in high energy density and other relevant regimes. There is strong programmatic interest in the health of the high energy density facilities operated by the ICF Campaign, such as the Z pulsed power facility, the Omega laser facility, and the National Ignition Facility. A national High Energy Density Council (see Section 3.4.1.3) regularly reviews experimental proposals and the progress of experiments at these facilities.

Predictive capabilities for secondary assessment are grouped into three major areas: (1) Energy Balance, (2) Secondary Performance and Potential Failure, and (3) Outputs and Environments. Each area is part of the long-term NNSA plan to develop the capabilities outlined in the PCF and is described in greater depth in Chapter 3 of the classified Annex to this document.

For much of the last decade, the Energy Balance effort focused on understanding specific processes related to secondary performance (for further details see the classified Annex). The delivery of the recent level-1[3] Energy Balance milestone (in conjunction with the Science, ASC, and ICF Campaigns and high energy density facilities) addressed many deficiencies of previous models. Modern system performance baselines rely on this new model for secondary assessment. Moreover, our improved understanding of Energy Balance will enable intelligent choices for component modernization and increase confidence in the evolving stockpile.

The Secondary Performance focus area addresses secondary assessment across the broad range of operating regimes. To broaden the applicability, both stockpile and non-stockpile systems are included in these assessments. The goal is to develop a rigorous capability to assess and quantify the performance margins and uncertainties of stockpile systems. Non-nuclear testing of weapon subprocesses, combined with computer simulations that integrate the myriad physical processes during the nuclear phase, provides the basis for stockpile confidence. This approach has guided weapon stewards on decisions related to weapon refurbishment. Some physical processes are well understood and simulated in classified weapon codes; some are not. The Secondary Performance effort strives to provide a more fundamental understanding of the physical processes involved in the function of secondaries, especially in regimes for which the fidelity of the computer models is poor in comparison to underground nuclear testing data.

The Outputs and Environments effort focuses on developing capabilities to quantify the weapon output and subsequent weapon environment. These capabilities are essential to develop refurbishment options through LEPs, as well as nuclear nonproliferation assessments, where the nuclear outputs guide the design and construction of detection systems. The ability to calculate outputs and environments accurately has a direct impact on how well the United States can define the hostile and fratricide survivability specifications and the effectiveness of a weapon. If the U.S. intelligence community is presented with an advanced nuclear weapon of previously unknown design, the ability to determine its performance, outputs, nuclear effects, and consequences of execution may be critical to understanding why and how that foreign power would use such a weapon, thus avoiding technological surprise. A more detailed description of these efforts is provided in the classified Annex.

The need to generate conditions of interest to secondary assessment requires deep understanding of the scientific discipline of high energy density physics. The following section provides a description of high energy density science as it relates to nuclear weapons.

3.4.1.3 High Energy Density Science

Figure 3–6 depicts the qualitative temporal progression of weapons operation. The shaded area represents the portion in the high energy density regime, where materials are in extreme states of temperature, density, or pressure.

[3] *A level-1 milestone is at the highest level and defines a primary objective with specific performance metrics that must be achieved to meet a goal of the Stockpile Stewardship and Stockpile Management Programs. Such a milestone has national priority and increased visibility at NNSA Headquarters. Multiple years can be required to complete a level-1 milestone.*

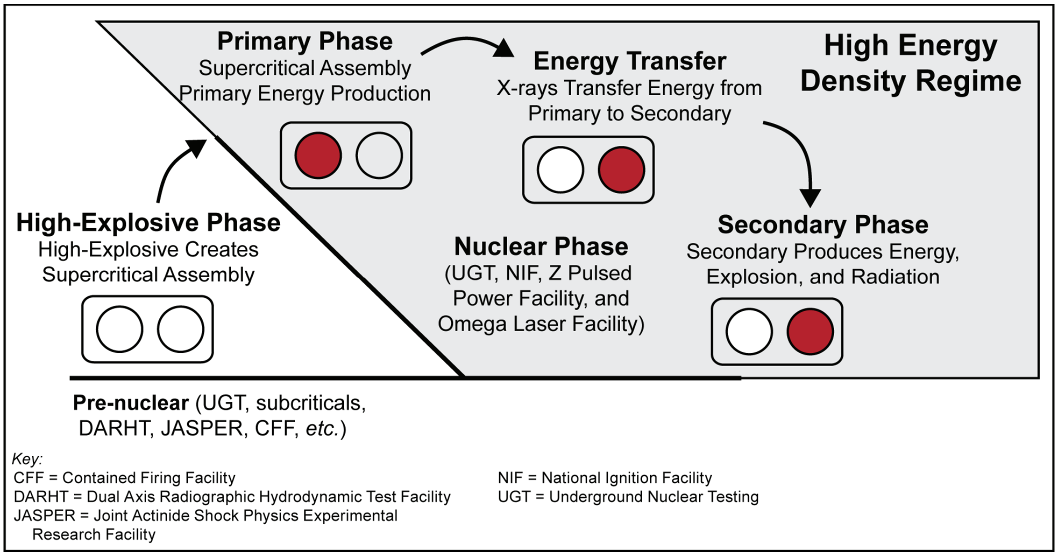

Figure 3–6. A large portion of weapons operation is in the high energy density regime

The extreme physical states encountered in nuclear weapons are difficult to replicate in the laboratory. High energy density experiments provide key data to address weapon physics issues and deliver invaluable information to validate the following weapon simulation capabilities:

- **Radiation transport.** This element is concerned with the transport of radiation through materials. High energy density facilities can create a wide range of conditions to test radiation transport models.
- **Plasma properties**. This element encompasses material properties at high temperatures and pressures, where a material is in a plasma state.
- **Material dynamics.** This element encompasses the dynamic behavior of materials at high pressures (greater than 5 megabars) in or near the solid state. Specific properties include material strength, equations of state, phase transitions, melt, and material response, such as spall and ejecta.
- **Complex Hydrodynamics.** This element encompasses the physics area of the hydrodynamic evolution of materials.
- **Burn and ignition physics.** This element concerns thermonuclear reactions. The conditions for ignition create hot, dense, radiative plasmas with high neutron flux.

In the last 2 years, a roadmap has been developed to integrate high energy density activities with DSW program activities to answer questions pertaining to secondary performance. A national High Energy Density Council regularly reviews the progress of experiments on NNSA's major high energy density facilities and experimental proposals for the out-years. This includes experiments of interest to primary assessment. Based on the reviews, the High Energy Density Council prioritizes the proposals according to an agreed set of criteria that include programmatic impact and requirements, maturity and readiness of experiments, and recent progress. Similarly, an Inertial Confinement Fusion Council, modeled after the High Energy Density Council, will be put in place this year to prioritize ignition physics experiments. The delivery of this prioritized experimental list will enable each facility to develop an optimized experimental schedule.

3.4.1.4 Weapons Materials

Although not appearing explicitly as its own strand on the PCF diagram in Figure 3–4, investigation of the properties of stockpile materials is a critical element for completing many nuclear explosive package pegposts. This section provides an overview of the ST&E strategy to obtain accurate material models.

Materials in nuclear weapons are subjected to extreme states of pressure, strain, strain rate, and temperature. Such extreme states are typically several orders of magnitude larger than those obtained under ambient conditions. Predictive capability requires a detailed understanding of the fundamental physics governing the dynamic behavior as materials are subjected to extreme temperature and pressures. The range of relevant pressures, for example, may span six orders of magnitude or more, *e.g.*, compression to megabar pressures where atmospheric pressure is 1 bar. These extreme conditions are difficult to produce in laboratory or non-nuclear explosive systems and must be probed using large facilities such as the Z pulsed power facility, DARHT, U1a Complex, and the National Ignition Facility.

Effects on a micron or even atomic scale influence the bulk (*i.e.*, macroscopic) behavior of a material. Defect generation (*e.g.*, atomic lattice dislocations, voids, or cracks), chemical composition, shock-induced chemistry, grain boundaries, grain orientation, or phase transformations often influence a material's dynamic behavior. A core part of weapons material research is to test materials at discrete states and piece together the puzzle of what governs the dynamic behavior in a fully integrated configuration.

For example, neutron-scattering techniques at the Los Alamos Neutron Science Center (LANSCE) are used to study the details of voids in a material at the submicron level. Following nucleation, such voids may grow, coalesce, and eventually cause material failure. The location of this macroscopic damage and the regions of failure are highly dependent on microstructural characteristics (*e.g.*, grain size distribution, impurity content, and grain boundary strength) and the nature of the loading (*e.g.*, time rate of loading, total strain, and maximum stress). Predicting when and where a material will fail is still one of the biggest challenges facing the materials simulation and modeling community. Data at multiple lengths and time scales from new and existing experimental capabilities are essential to characterize the state of a material and address that challenge. Fertile, active research areas include understanding how microscopic processes manifest themselves (*e.g.*, in macroscopic failure), the change in the material phase, and the degradation or improvement of material processes. Models to predict the dynamic response of a stockpile material must incorporate enough detail to represent the expected range of conditions, capture the correct material parameters, provide the appropriate functional relationships among the variables and starting conditions, and explain phenomena on time and length scales of interest. For engineering applications, it is often sufficient to include variables that represent the average behavior of a material. However, to determine how manufacturing processes impact material response, models must include variables and details that capture microscopic effects such as those related to homogeneity or crystallographic texture. Moreover, to determine the response of a material to rapid and powerful energy loads, models must include the variables and physics at microscopic scales where the response actually develops. The Science Campaign supports the experimental basis for such models. The ICF Campaign provides the advanced experimental capabilities required to study in extreme conditions. The ASC Campaign supports creation and implementation of the necessary multi-scale materials models. Experimental results from the Science and ICF Campaigns guide both theoretical model formulation and their validation.

3.4.2 Safety and Security

Predictive capabilities are essential to enable safety and security assessments, including identification of the quantification of margins (thresholds for failure) and uncertainties (QMU) of the integrated nuclear weapon system to support stockpile sustainment and qualification and certification of LEPs. Safety assessments using ASC Campaign integrated engineering codes are focused on "abnormal" environments that usually occur as the result of accidents such as a fire or a drop, where the environment is outside the bounds of normal environments. An exception is lightning, which is not the result of an accident but is considered an abnormal environment.

Safety assessments focus on the difficulty imposed by accident scenarios or abnormal environments. Specifically, engineering codes translate a scenario description into loads on the system, loads through the system, and safety component response to define a "probability of loss of assured safety" (PLOAS). The environmental space is investigated using a characterized model, and the PLOAS is estimated for each accident scenario-safety combination considered. If all PLOASs are less than 10^{-6}, the PLOAS for all other, less-stressing scenarios is also assumed to be less than 10^{-6} and the safety assertion is confirmed. For abnormal environments, PLOAS is used as the metric to assess safety. For this strategy to work, confidence in the predictive capabilities is required. External load prediction capabilities include mechanical (impact, pressure); thermal (propellant fires, hydrocarbon fuel fires, and composite material fires); and electrical and electromagnetic (lightning) environments. System response also includes mechanical (large deformation or fracture); thermal (conduction and radiation heat transfer, pressurization, thermal and mechanical failure, and energetic material response); and breakdown and electromagnetic propagation related to lightning. Coupling the activities of the ASC and Engineering Campaigns with those of the DSW program is necessary to develop, validate, and deploy these safety capabilities.

Security assessments focus on protecting nuclear assets from unauthorized use. Safety issues prohibit full-scale testing of weapons for the spectrum of security threats. To improve weapons security, predictive capabilities play a critical role in the design of advanced security systems for upcoming LEPs. The Science Campaign is developing concepts and certification paths for new security options. High-performance computing, coupled with the development of advanced physical models for blast effects and material failure validated by experiments, will lead to new predictive capabilities that allow assessment of proposed security systems.

A breadth of physics and material models and computational approaches in conjunction with experimental and surveillance data is required to support full systems safety and security assessments. The integrated engineering codes developed and applied throughout the Safety and Security strand in Figure 3–4 will provide a predictive capability:

- to support design and qualification of LEPs and alterations and the determination of the PLOAS,
- to support safety and security assertions for the annual assessment of stockpile systems, and
- to respond rapidly to SFIs.

3.4.3 Engineering Assessment

3.4.3.1 Weapon Life Cycle Engineering Assessments

Predictive computational and experimental capabilities for engineering assessments are of critical importance to address the wide variety of conditions across the nuclear weapon life cycle. These capabilities must be applicable across a breadth of weapon components, subsystems, complete weapon systems, and other supporting hardware (*e.g.*, shipping containers). At the highest level, the life cycle covers scoping studies, engineering design, manufacturing processes, qualification and certification calculations, SFI resolution, aging effects, and annual assessment activities. The engineering assessment addresses three types of environments: normal, hostile, and abnormal. Normal environments include loads associated with assembly and disassembly, transportation, and the stockpile-to-target sequence. Hostile environments include additional shock-type loads that could be imparted to a weapon by adversarial defense mechanisms during the stockpile-to-target sequence. Abnormal environments address unlikely scenarios resulting from off-normal conditions such as transportation accidents. Assessment of normal and hostile environments yields a state of stress in the weapon that is used to calculate performance yields during the nuclear explosive package assessment.

Predictive engineering assessments depend on verified and validated constitutive material models, numerical models, and computational codes. Verification is the process of determining that a model accurately represents the developer's conceptual description and its solution. This can be done by benchmarking using analytical solutions or dynamic testing of a code. Validation determines the degree to which a model accurately represents the real world from the perspective of its intended use. This is typically done by comparing the data quantitatively with a numerical model. That comparison includes fundamental material behavior such as elastic, inelastic, and dynamic responses; interaction effects such as friction; and system-level tests of joint test assemblies during flight. The ability to collect data and employ resources for these efforts is made possible by leveraging the DSW program R&D with that of the ASC, Science, and Engineering Campaigns. The PCF pegposts shown in the Engineering Assessment strand in figure 3–4 are those that drive capabilities for system, nuclear explosive package, and component needs.

An example of engineering assessment at the component level, supported by both the ASC and Engineering Campaigns, is the focused effort to develop a predictive computational capability for neutron generator performance. This effort is being conducted in concert with a parallel effort to develop advanced diagnostics to assess performance phenomena and obtain validation data.

At the system engineering level, flight test data have always been very limited, yet flight testing provides environments that in many cases cannot be readily replicated on the ground. This is especially true for reentry systems that experience stressing aerodynamic, thermal, and mechanical environments. Engineering assessments during these flights typically explore how launch and release, aeroshell performance, flight dynamics, and thermal response couple to the vehicle's mechanical response. In addition, the data often provide the boundary conditions for engineering assessments (*e.g.*, design, qualification) of internal weapon subsystems and components. The ASC Campaign and the Weapon Systems Engineering Assessment Technology subprogram of the Engineering Campaign support this effort. This work is on the critical path for a sequence of PCF pegposts from FY 2014 to FY 2023 that will culminate in a validated capability to predict full-system reentry structural dynamic loads generated by turbulent aerodynamic flows and weather. In addition, the core capability in this area is on the critical path for a similar sequence of PCF pegposts culminating in FY 2017 with a QMU prediction of gravity bomb system free-flight performance and aircraft captive-carry dynamic and mechanical response during delivery.

3.4.3.2 Aging Models Assessments

Because nuclear weapons are being retained in the stockpile well beyond their designed lifetimes, scientists and engineers in the Engineering Campaign's Enhanced Surveillance subprogram develop and maintain a fundamental understanding of stockpile aging and translate this understanding into the models and technologies needed for early identification and assessment of aging concerns. The goal is to provide sufficient lead time for NNSA to deploy its resources so that the infrastructure capability and capacity will be in place when required.

Providing tools to predict and detect the precursors of age-related degradation and estimates of component or system lifetimes based on the best available science and technology contributes to weapon safety, performance, and reliability. Assessments of the impacts of aging are conducted and reported annually. The impacts of these aging phenomena could adversely affect weapon performance, safety, or reliability with respect to component and subsystem requirements. The TBSTP document uses these lifetime predictions to inform the annual stockpile assessment process with respect to the expected future state of each weapon system and, therefore, to serve as input to the decision-making process for scheduling replacements or refurbishments.

While routine surveillance evaluates the current condition of the stockpile, the Enhanced Surveillance subprogram develops predictive capabilities for early identification of stockpile concerns, assesses component lifetimes in the existing stockpile to support refurbishment decisions, and provides information to improve the longevity and sustainability of replacement systems. New analytical methods and diagnostics, including embedded sensors and nondestructive evaluation techniques, are being developed to achieve timely, less-invasive, and more cost-effective surveillance. An example of this type of work is a new nondestructive diagnostic of detonators that can help predict performance based on detailed parameters seen in high-resolution, three-dimensional computed x-ray tomography (see Section 3.3.4 for additional information). Maximizing the use of nondestructive evaluation, in lieu of destructive evaluations, is important to preserving assets while enabling the ability to assess a larger fraction of the stockpile.

Enhanced Surveillance Accomplishments in Material and Component Aging Assessments

Predictions of the lifetime of materials and components in the stockpile are estimated using surveillance data, accelerated aging tests, and scientific analysis. The seminal work on pit aging provided the justification for extending pit lifetimes and was a key enabler for reusing previously deployed pits in life-extended weapons. The Enhanced Surveillance subprogram has broadened substantially and is now providing aging models and lifetime predictions for many of the major components and materials in the stockpile.

Developing lifetime predictions are a cornerstone of this effort. The prediction of long-term aging behavior combines tracking, trending, and modeling of core surveillance data in combination with data derived from accelerated aging studies. The challenge is to employ validated engineering codes to estimate component and system lifetimes to inform stockpile decisions.

3.4.4 Hostile Environments, Outputs, and Effects

For this fourth strand in Figure 3–4, R&D is conducted to assess and enhance the nuclear survivability and lethality of the stockpile. To this end, NNSA develops, validates, improves, and sustains experimental and computational capabilities and develops radiation-hardening technologies to support the certification and effectiveness of the evolving and aging stockpile. In collaboration with the DSW and Site Stewardship programs, the ASC, ICF, and Science Campaigns, and DoD, the capabilities and technologies developed through the Engineering Campaign support LEPs and stockpile alterations.

An integrated set of capabilities (models, simulations, experiments, testing, and analysis) focuses on developing predictive assessment of the nuclear survivability of the stockpile. The development of Qualification Alternatives to the Sandia Pulsed Reactor III will provide the capability to qualify radiation-hardened electronics in response to fast-neutron hostile environments. An integrated set of capabilities to assess other nuclear survivability issues will also be developed and deployed. These other issues encompass the electromagnetic pulse generated inside systems upon exposure to x-rays; the mechanical response of materials, components, and systems in hostile environments; and other x-ray and gamma-ray effects on electronics. In addition, inclusion of modern electronics in AF&F circuits will increase surety, improve reliability, and increase margins because of the intrinsic radiation hardness of advanced materials.

3.4.5 Enabling Capabilities

This fifth strand in Figure 3–4 includes experimental facilities and the goals for increasing the computational power. Further details regarding the experimental facilities required to meet mission commitments are provided in Section 3.5.1; the computational capabilities needed to address specific assessment and certification issues are addressed in Section 3.5.3.

3.4.5.1 Experimental Capabilities

A suite of facilities and experimental platforms exists at the national security laboratories and the Nevada National Security Site for executing experiments that provide data on weapon physics processes and on the properties of materials of weapon interest when subjected to extreme conditions. Section 3.5.1 provides an overview of the major experimental facilities at the national security laboratories and the Nevada National Security Site. Tests and experiments conducted at these facilities contribute to an enhanced understanding of weapon science and predictive capability, as discussed in Section 3.7.1 in the Science Campaign overview.

3.4.5.2 Computational Capabilities

Implementation of advanced predictive methods for stockpile assessment requires continual advances in computational science and computing power. Although great progress has been made in integrated simulations to verify the state of the stockpile, considerable additional advances are needed to meet all the challenges of an effective nuclear deterrent. For example, (1) improved resolution and geometric fidelity are needed to address the inherently three-dimensional nature of concerns such as safety and security, and (2) increased computations are needed for “sub-grid” models to implement fundamental science advances. These and other key elements of an effective predictive capability require expanded, data-intensive computing with development of new algorithms and techniques in conjunction with hardware advances to handle multi-physics, multi-scale simulations. Advances are needed in the following areas:

- Compressible hydrodynamics, including instability, mix, and turbulence
- General three-dimensional treatment of phenomena, ranging from hydrodynamics to materials behavior
- Integrated systems simulations
- “First principles” modeling of plasmas and materials using molecular dynamics methods
- Modeling of material behavior, ranging from “atomistic” to macroscopic “real world”
- More accurate “statistical” estimates of weapons behavior

A discussion on verifying and validating the assessments is included in Section 3.4.6.2.

3.4.6 Integration of Predictive Capabilities for Design, Qualification, Assessment, and Certification

Most predictive science activities are providing or developing methods for assessing, evaluating, sustaining, and certifying the stockpile. Accordingly, an effort has been established to integrate the activities in the existing strands of the PCF diagram in Figure 3–4 to develop quantitative metrics that will provide criteria for improved assessment and certification. This effort will be represented by a sixth strand that will be included in the PCF in the near future. The activities on this new strand will include the design and engineering qualification, manufacturing qualification, and physics certification of modified (life-extended) weapons. Continuous assessment is a unifying theme of both stockpile stewardship and stockpile management.

3.4.6.1 Basic Elements of Assessment

The assessment process involves the following three key steps:

- Assembly of information from surveillance, experiments, and past nuclear weapons tests
- Development of theoretical and computational tools to analyze and manipulate this information
- Application of expert judgment to analyze the results of the first two steps to inform decisions regarding the stockpile

The goal is to make the first two steps quantitative and objective enough to aid the formation of key judgments that decrease dependence on nuclear weapons test experience. Developing quantitative metrics will directly link the assessment process to significant data through verified and validated codes and make the process as transparent as possible.

3.4.6.2 Verification and Validation

An important aspect of assessment is verification and validation (V&V), *i.e.*, assuring that large numerical models are as accurate and self-consistent as possible. V&V is a scientific process to ascertain that a simulation is "right for the right reason." Verification provides evidence of the correctness of computer codes in solving pertinent equations, while validation assesses the adequacy of the physical models used to represent reality. Since weapon simulations must extrapolate far beyond available data and predict coupled, multi-scale physical phenomena are difficult to isolate in experiments, V&V is a unifying challenge for stockpile stewardship.

3.4.6.3 Stockpile Performance Metrics

Performance metrics for stockpile safety and reliability are expressed in the context of QMU, a methodology that has matured through peer reviews within NNSA, the JASON Advisory Group, and the National Academy of Sciences. QMU uses detailed analyses of weapon physics and engineering performance to establish confidence factors for performance metrics. These confidence factors are determined by the difference between the lowest end of the performance expected and the threshold for failure (the margin) divided by the sum of the uncertainties. Examples of performance metrics include measures of the integrated nuclear yield and the variability of a weapon's primary output versus the design specification.

Refinement and prioritization of assessment activities are influenced by the application of metrics and QMU assessment. For example, today nuclear explosive package assessment depends on empirical parameters that calibrate simulation codes based on prudent consideration of legacy underground nuclear test data. An aggressive program requiring a high level of ST&E is replacing these empirical parameters with fundamental data and scientifically validated physical models for predictive capability. As the stockpile ages and modernization features are included to enhance safety and security, the validity of these calibrated simulations will decrease. The decreased validity will raise the uncertainty and increase the need for predictive capability. Increased computational capability and confidence in the validity of comprehensive science-based models will allow weapons performance assessment in situations that were not directly tested. A more extensive discussion of this activity is provided in the classified Annex.

3.5 Experimental and Computational Resources

A comprehensive experimental and computational ST&E capability is needed to assess the stockpile. Today, annual assessments depend on empirical factors to calibrate simulation codes through prudent consideration of legacy underground nuclear test data. As the stockpile continues to age, identified issues are addressed, and new features are added for enhanced safety and security. These changes challenge the validity of these calibrated simulations, which increases uncertainty and the need for improving predictive capability. An aggressive program using a high level of ST&E is replacing these empirical factors with fundamental data and scientifically validated physical models. Radiochemical data and analysis capability is integral to these activities. The annual assessment activities and future LEP designs will continue to rely on updated interpretation and archival nuclear data to reduce uncertainty.

In the absence of underground nuclear testing, well-controlled experiments that isolate individual physical phenomena are generating new data on special nuclear materials and surrogates to improve models in weapons simulation codes. These models are often validated through more complex experiments that involve multiple, interdependent, physical phenomena or through highly complex, integrated experiments for which data analysis is only possible by integrating sophisticated diagnostic signatures into the simulation codes to assess system performance.

3.5.1 Experimental Resources

The following ranges of capabilities are employed to address the safety, security, and reliability of nuclear weapons systems:

- Fundamental materials experiments characterized by an isolated single variable and a simple geometry to measure properties such as materials strength
- Intermediate and focused multi-component experimental configurations to combine high explosives, metals, and increased geometrical complexity or to evaluate subsystem responses to extreme environments
- Highly integrated component experiments that use complex geometry, multi-component test articles, and dynamic inputs (*e.g.*, subcritical experiments and, with surrogate materials, hydrodynamic tests and high energy density experiments)
- Development and qualification testing of weapon hardware, including environmental testing

A number of capabilities originally designed to provide development and qualification test data for weapon hardware are now used for experimentation under the Stockpile Stewardship Program. These capabilities have become integral to providing physics data for understanding, as well as model development and validation for weapon performance assurance. While such experimental capabilities are critical for development and qualification, the test environments provide only representative, rather than comprehensive, system requirement environments. In addition, some key testing capabilities, such as underground nuclear testing or the Sandia Pulsed Reactor III fast burst reactor, are no longer available and, therefore, leave gaps in test-based qualification methodologies.

A diverse set of experimental facilities addresses assessment and certification issues and, to some extent, the breadth of these facilities mirrors the extreme environments encountered within the performance cycle of a nuclear weapon and the level of hazards associated with the testing conditions. **Table 3–5** lists major experimental capabilities with brief descriptions of the types of work performed. The classified Annex includes greater detail about these capabilities and the actual environments that would be encountered by a nuclear weapon. Examples of the subtle differences in these capabilities can be explained by noting that integrated testing with plutonium experiments are executed at the U1a Complex, while integrated experiments using surrogate materials are executed at either DARHT or the Contained Firing Facility, depending on the specific data required. The diagnostic suite that produces the pertinent data can also be a distinguishing feature, as illustrated by the multi-axis, multi-time, high-resolution x-ray imaging at DARHT versus the large-field-of-view x-ray and optical imaging at the Contained Firing Facility. Other distinguishing features can be determined by examining the environmental impact statement authorizations of facilities, for which limits on high explosives detonated in experiments are important, as exemplified by the differences between the Big Explosives Experimental Facility (BEEF) and small-scale, high-explosive R&D facilities at the national security laboratories. The amount of plutonium tested or the ultimate pressure generated in a material also produces a requirement for a suite of gas gun capabilities that cannot be satisfied by a single capability. Finally, the major environmental test and experimental capabilities are relevant examples of how environmental conditions (hostile, normal, and abnormal) drive the need for a broad array of facilities.

Table 3–5. Experimental capabilities

Facility	*Description*
Complex integrated experiments	
Dual Axis Radiographic Hydrodynamic Test (DARHT) facility	DARHT captures high-resolution images of non-special nuclear materials weapon assemblies at multiple times and along two viewing axes.
Contained Firing Facility (CFF)	The CFF provides a single high-resolution x-ray image with large fields-of-view and multi-time optical images of non-special nuclear materials weapons assemblies. Containment provides capabilities for hydrotests with a variety of hazardous materials.
U1a Complex Subcritical Experiments Facility	The U1a Complex provides material and system response data on Security Category II subcritical physics experiments. The facility includes the dual-axis Cygnus radiography system, which produces x-ray images of dynamic materials. Additional diagnostics include over 100 channels of velocimetry and a suite of imaging and hydro diagnostics.
Focused experimental capabilities	
Proton Radiography (pRad)	pRad uses protons from the Los Alamos Neutron Science Center (LANSCE) accelerator for radiography of static and dynamic materials experiments.
Omega laser facility	The Omega laser facility provides data on the fundamental properties of high energy density material, plasma, inertial confinement fusion, and radiation, as well as development of targets, diagnostics, and experimental platforms for the National Ignition Facility.

Facility	Description
National Ignition Facility	The National Ignition Facility provides data on the fundamental properties of high energy density material, plasma, radiation, fusion ignition, and thermonuclear burn at temperatures and pressures approaching those in a nuclear weapon.
Z pulsed power facility	The Z pulsed power facility provides data on the fundamental properties of high energy density materials (including plutonium and uranium), plasma, and radiation, as well as the effects of radiation on electronics. Z pulsed power facility also evaluates electromagnetic, shock, and structural effects.
High Explosives Applications Facility (HEAF)	HEAF provides indoor experimental capabilities with up to 10 kilograms of explosives in the high explosive research and development mission areas of synthesis, formulation, pressing, characterization, prototyping, performance testing and surveillance of energetic materials, components, and subassemblies.
Big Explosives Experimental Facility (BEEF)	BEEF conducts outdoor detonations of complex experiments with quantities of high explosives that cannot be contained.
National Criticality Experiments Research Center (NCERC)	NCERC (formerly the Criticality Experiments Facility) is within the Device Assembly Facility. It provides four independent, solid-fueled criticality machines to conduct Safeguards Category I criticality experiments, as well as to support of the Nuclear Criticality Safety Program.
Fundamental property capabilities	
Joint Actinide Shock Physics Experimental Research (JASPER) facility	The JASPER two-stage gas gun provides data on the properties of metals (including plutonium) at high shock pressures, temperatures, and strain rates.
Technical Area 55 (TA-55)	TA-55 provides several platforms to investigate the properties of metals, including plutonium, at high shock pressures, temperatures, and strain rates.
Los Alamos Neutron Science Center (LANSCE)	LANSCE is a linear accelerator that uses neutrons to study fundamental nuclear and material properties. The LANSCE Lujan Center conducts materials research and nuclear physics using low-energy neutrons. The Weapons Neutron Research facility conducts nuclear physics research.
Materials Testing at LANL Material Science Laboratory, Sigma building, and Firing Site complex	Bench-scale experimental capabilities are conducted for non-explosive materials and explosive-based experimental research.
Major environment test and experiment – normal environments	
Centrifuge Facility	This facility provides combined acceleration, rotation, and vibration environments to test full systems in delivery environments.
Rocket Sled Track and Aerial Cable Facilities	These facilities provide full-system testing of acceleration environments and impact phenomena (*e.g.*, ground impact for a gravity weapon).
Large-Scale Vibration and Shock Facilities	These facilities provide component, subsystem, and full-system testing of the vibration and shock environments experienced during patrol, flight, and delivery.
Environmental Testing Complex at LLNL Site 300	This complex provides test and evaluation capabilities for full-scale nuclear explosive package or sub-assemblies with full high explosive charges and surrogate pit under dynamic conditions subjected to thermal and mechanical insults simulating stockpile-to-target-sequence conditions
Pit subassembly testing at LLNL Superblock	Testing includes the thermomechanical, dynamic, and jerk testing of war reserved pits and subassemblies with mock high explosive (requires special security accommodations).
Surety efficacy testing at LLNL Superblock	This facility provides functional testing of special nuclear explosive package components as needed.

Facility	Description
Major environment test and experiment – abnormal environments	
Thermal Test Complex, Burn Site Facilities	These facilities provide radiant heat and fire (*e.g.*, controlled flame, cross-wind flame, and enveloping flame) environments for tests up to full-system level and for experiments to assure safety in abnormal (*e.g.*, accidental) scenarios.
Lightning Test Facility	This facility conducts tests and experiments to assure safety in the event of direct or nearby lightning strikes.
Drop Test Facilities	These facilities conduct tests and experiments to assure safety in the event of an unintended weapon drop during handling.
Major environment test and experiment – hostile environments	
Saturn	Saturn tests electronic subsystems in representative x-ray environments and conducts experiments to validate radiation-hardening technology and evaluate electronic subsystems, non-nuclear material properties, and electromagnetic effects.
HERMES III	HERMES III tests electronic subsystems in representative prompt gamma-ray environments and conducts experiments to evaluate radiation-hardening technology.
Annular Core Research Reactor (ACRR)	ACRR provides mixed neutron-gamma environments similar to those from an endoatmospheric burst to test electrical, mechanical, and thermal effects in components and subsystems.
Ion Beam Laboratory (IBL)	IBL provides environments at the microelectronic device level to evaluate mixed neutron and gamma-ray effects similar to those from an exoatmospheric burst to evaluate radiation-hardening technology for which integrated test capabilities are no longer available (*e.g.,* the SPR III reactor).
Light-Initiated High Explosive	Light-initiated high explosive tests the full-warhead response to x-ray-induced mechanical impulses.
Electromagnetic Environment Simulator (EMES)	EMES tests the full-warhead response to electromagnetic pulse environments.

3.5.2 Facility and Infrastructure Planning

Experimental facilities are an essential part of the nuclear security enterprise. NNSA has made substantial investments in large experimental facilities. These facilities, which include LANSCE, DARHT, the National Ignition Facility, the Z pulsed power facility, and the U1a Complex, have had considerable impact on NNSA's ability to meet national security challenges, attract and retain a premier workforce, and maintain the preeminence of its laboratories as world leaders in science.

Nevertheless, as the stockpile ages and the demands of the nuclear deterrent become more complex, NNSA's facilities and infrastructure must improve and evolve. Over the next decade, to meet the challenge of ensuring the safety, security, and reliability of the stockpile, NNSA must build on the experimental capabilities in Table 3–5 and invest in new capabilities. For more information on NNSA's strategy to revitalize its physical infrastructure, see Chapter 5 and the accompanying Appendix D.

Because of the importance and magnitude of decisions about flagship experimental ST&E facilities, NNSA created a systematic process to evaluate current and future experimental facility needs and asked the three laboratory directors to develop a strategy for major future investments in such facilities. Consistent with the data provided in the *NNSA Strategic Plan* (NNSA 2011) and the need to maintain the technical excellence of the national security laboratories, this strategy for flagship experimental facilities will accomplish the following.

- Shape the infrastructure to assure the 21st century nuclear security enterprise has the core science and technology capabilities to execute NNSA and broader national security mission responsibilities.
- Advance the fundamental based capabilities that are the foundation of NNSA's national security mission and the technical leadership of its laboratories.
- Contribute to attracting, training, and retaining the next-generation ST&E capable workforce.
- Exemplify responsible stewardship of public resources.

To provide the basis for an enduring NNSA facility strategy, the three national security laboratories prepared an integrated tri-laboratory facility roadmap. Each laboratory developed proposals for flagship ST&E facilities with expected construction costs exceeding $100 million. These proposals are consistent with the tri-laboratory facilities roadmap. An independent panel of experts reviewed the roadmap and the individual facility proposals. The Matter-Radiation Interactions in Extremes (MaRIE) advanced materials science facility, proposed by LANL, was chosen for the next phase of evaluation. The tri-laboratory roadmap will be briefed to Congress and included in the next revision of the SSMP. The full MaRIE proposal will be considered for Critical Decision 0, which is currently planned for FY 2013.

3.5.3 Computational Resources

To assess the Nation's stockpile, the nuclear security enterprise depends on accurate physical models and the ability to simulate the performance of full weapons systems by integrating material and component information into advanced computer simulation codes that run effectively on some of the world's most capable supercomputers. High-fidelity, two-dimensional and three-dimensional simulations are surpassing the capabilities of the one- and two-dimensional, legacy code simulations that designed the current stockpile. Moreover, advanced supercomputers have enabled the progression to simulations that can characterize weapon systems and their performance more accurately.

The ASC Campaign is responsible for providing computational capabilities to meet nuclear deterrence needs. In this context, "capabilities" encompasses computational platforms; mathematical algorithms and computational codes; and data management, storage, and analysis. The ASC Campaign supplies this computing capability via national user facilities that are accessible Nuclear Security Enterprise-wide to address the most challenging and pertinent weapons program issues. This user facility model ensures that the computing capabilities are delivered in the most cost-effective and resource-efficient manner, with an emphasis on maintaining productivity to address weapon assessments and predictive capability goals.

Three categories of ASC Campaign platforms are currently used for these simulations: Capability, Capacity, and Advanced Architecture. Starting in late FY 2013 The ASC Campaign will procure two classes of systems, Commodity Technology Systems and Advanced Technology Systems, to better support technology trends and improve cost effectiveness. The Commodity Technology systems in the future will provide computing power to a large percentage of the design and analysis community by leveraging predominantly commodity hardware and software. The goal of these systems is to minimize software changes and maximize availability to end-users. In contrast, the Advanced Technology systems will be the vanguards of the high performance computing platform market and incorporate features that, if successful, will become future commodity technologies. These large, first- of-a-kind systems will require application software modifications in order to take full advantage of exceptional capabilities offered by new technology.

Table 3–6 details current computational capabilities, based on historical platform classes and describes the purpose of each platform.

Table 3–6. ASC Computing capabilities (based on the historical platform classes)

System Name	System Type*	Site	Peak Performance (Teraflops)	Purpose
Dawn	Advanced Architecture	LLNL	500	Code porting and scaling in preparation for Sequoia; weapons design and analysis
Sequoia	Advanced Architecture	LLNL	20,000	Weapons design and analysis; UQ [uncertainty quantification] simulation
Cielo	Capability	LANL/SNL	1,370	Design and analysis of weapons and experiments, dedicated to very large simulation runs
Inca	Capacity	LLNL	13	Design and analysis of weapons and experiments
Typhoon	Capacity	LANL	106	Design and analysis of weapons and experiments
Hype	Capacity	LLNL	50	Tri-Lab TLCC system development and test platform
Zin	Capacity	LLNL	900	Design and analysis of weapons and experiments
Luna	Capacity	LANL	513	Design and analysis of weapons and experiments
Dark Bridge	Capacity	SNL	300	Design and analysis of weapons
Chama	Capacity	SNL	400	Design and analysis of weapons and experiments
Pecos	Capacity	SNL	400	Design and analysis of weapons and experiments
Glory	Capacity (U)	SNL	38	Unclassified stockpile science
Dawn-dev	Capacity (U)	LLNL	14	Unclassified code porting and preparation for Sequoia
Cielito	Capacity (U)	LANL	11	Unclassified code porting and preparation for Cielo
Mapache	Capacity (U)	LANL	50	Unclassified stockpile science
Moonlight	Capacity (U)	LANL	488	Unclassified stockpile science
Graph	Specialty	LLNL	111	Visualization
Cielo del Sur	Specialty	SNL	86	Design and analysis of weapons
Muir	Specialty	LLNL	174	Visualization platform for Sequoia

(U) = denotes an unclassified system. These are required to perform analysis of unclassified data and to collaborate with the open science community.

** System Type Definitions:*

Advanced Architecture: machines targeted at advancing the state of the art in order to address problems intractable at current scales, requiring burn-in time to stabilize. Past scientific advances have included plutonium aging and plasma interactions. Future advances will include plutonium equation-of-state and electronics in hostile environments.

Capability: stable machines dedicated to large-scale runs where two users capitalize most of the system resources at any time. By design, there is a single capability machine in the nuclear security enterprise run as a National User Facility. Advances towards solving the Energy Balance knob and advanced security in transporting nuclear weapons are two examples enabled by past ASC Capability systems.

Capacity: less costly machines with reliable throughput used for the bulk of day-to-day calculations. Most of these machines are procured and configured using the TriLab Linux Capacity Cluster (TLCC) standards adopted by ASC for the nuclear security enterprise mission.

Specialty: capacity machines optimized for memory intensive applications, primarily graphics.

Teraflop: measure of maximum machine speed. A teraflop is 1012 FLOPS (FLoating point OPerationS), which is more than a thousand times faster than the original Cray-1 supercomputer of the 1970s. A thousand teraflops is called a "petaflop."

Notes:

Capacity systems are purchased through a consolidated procurement via the TriLab Linux Capacity Cluster-2 (TLCC2) contract.

ACES (the Alliance for Computing at Extreme Scale) is a formal alliance between the Sandia and Los Alamos National Laboratories for designing, acquiring and operating supercomputing for the nuclear security enterprise.

3.6 Ensuring United States Leadership in Science and Technology for NNSA and Broader National Security Missions

The scientific and technological challenges posed by the evolving national security landscape require a workforce with broad technical capabilities and concomitant facilities. Chapter 6 discusses the general requirements for the nuclear security enterprise workforce. Chapter 3 of the classified 2014 SSMP focuses on the broader national security missions, whereas this section focuses on leadership in science and technology. Some details of workforce development that are driven by specific demands that require a high level ST&E capability are also discussed here.

Historically, a broad array of scientific advances in weapons technologies has been a significant force in shaping the nuclear security landscape. Examples include discoveries leading to the first fission weapons, detailed scientific understanding enabling modern secondaries, and technological solutions for missile defense. While some future challenges can be anticipated, the greatest challenges are often unanticipated. The strategic emphasis in academic areas congruent to the anticipated application areas is an element of NNSA workforce planning.

Collaboration is a key element of the strategy for preserving ST&E strength. Collaboration internally amplifies effectiveness; ensures access to ideas, techniques, and innovations; and supports training of the next generation of stockpile stewards. External collaboration provides a recruitment pipeline for a workforce skilled in areas of strategic importance to the national security mission. To that end, NNSA and its contractors have created academic programs (see Chapter 6) to support research that is of direct interest to the NNSA mission and has the collateral benefit of producing students with the skills needed to fill the pipeline. The Stockpile Stewardship Graduate Fellowship provides financial benefits and professional development opportunities to students pursuing a Ph.D. in fields of study that solve complex science and engineering problems critical to stewardship science. The Stewardship Science Academic Alliances Program funds academic research relevant to NNSA's mission. The goal of the program is to create opportunities for scientists who are underfunded by other government agencies but whose research is important to NNSA missions. An important focus is training students who will contribute to scientific discovery in these subject areas and who will potentially be employed at one of the NNSA sites. Currently, the Academic Alliances Program funds four Centers of Excellence, which are operated under cooperative agreements, and approximately 31 grants. In addition, NNSA and the DOE Office of Science have established a joint program in High Energy Density Laboratory Plasmas.

3.7 Structure of Campaigns and Programs to Meet the Requirements of Stockpile Sustainment and Deterrence

The ST&E-based activities outlined in this SSMP are executed by an array of programs, campaigns, and subprograms. These activities address a broader range of nuclear security enterprise issues, as described in Chapter 2. The information in this section provides important linkage with the budget formulation process because the programs, campaigns, and subprograms are frequently referred to in the description of appropriations.

3.7.1 Science Campaign

As the nuclear stockpile ages beyond its original design lifetime, it is imperative that the Science Campaign provides the critical capabilities to ensure weapons continue to meet military specifications.

Models of performance, benchmarked using underground nuclear testing data, must be replaced with physical models validated with modern experimental data. These physical models will enable understanding of aging, advance the understanding of surety mechanisms and their impact on assessment and certification, assess the impact of varying manufacturing techniques and processes, and provide tools to anticipate and avoid technological surprise. In particular, advances in predictive science necessary to address specific aspects of LEP pit reuse options have been identified and will be a focus of the out-year activity in the Science Campaign.

The Science Campaign supports (1) annual stockpile assessments; (2) certification statements for LEPs and weapon modifications; (3) prompt resolution of stockpile issues (*e.g.*, SFIs, including aging issues); (4) certification of warhead replacement components; (5) development of improved predictive capabilities in conjunction with the ASC Campaign; and (6) maintenance of nuclear test readiness capabilities through experiments and assessments. In supporting these activities, the Science Campaign leverages the investments made in the ASC and ICF Campaigns.

The Science Campaign aims to understand through experimentation the complexities associated with the extreme temperatures, stresses, strains, and strain rates experienced during a nuclear explosion. One grand challenge is to improve physical models for primary boost. Through the National Boost Initiative, the Science Campaign is increasing its efforts to understand this phenomenon, from the initial conditions required for boost to the subsequent dynamics.

The experimental programs at the national security laboratories and the Nevada National Security Site are designed to improve understanding of the physics associated with nuclear weapon safety, security, and effectiveness by acquiring, analyzing, and incorporating data into physics-based computer models. Through highly integrated multi-year and multi-decade efforts, those models will ultimately mature as predictive capabilities for weapon performance. The Science Campaign either manages or significantly contributes to these efforts, which are the cornerstone of modern stockpile stewardship.

Each subprogram of the Science Campaign also contributes to development and academic training of the future workforce at the national security laboratories through the Stewardship Science Academic Alliances, which is administered by the Office of Stockpile Stewardship. The core areas supported by the Stewardship Science Academic Alliances include materials under dynamic conditions and in extreme environments, hydrodynamics, low-energy nuclear science, radiochemistry, and high energy density science.

The five subprograms of the Science Campaign are displayed in **Figure 3–7** and are described in more detail in Appendix B.

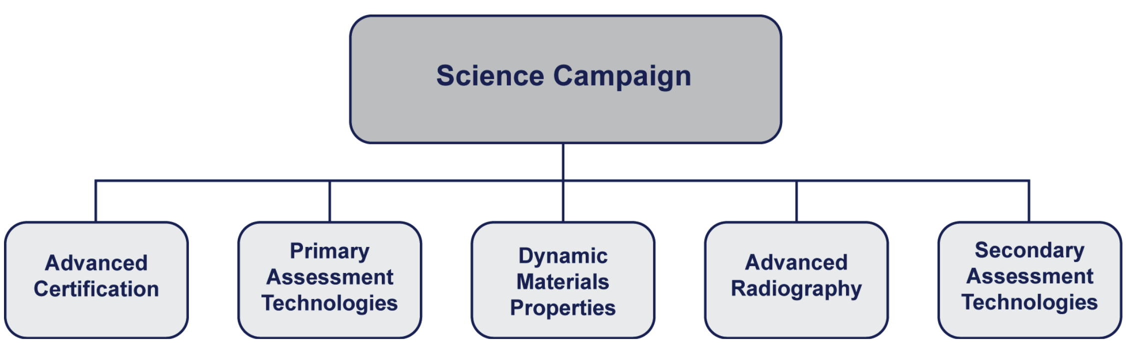

Figure 3–7. Subprograms of the Science Campaign in fiscal year 2013

3.7.1.1 FY 2012 Accomplishments of the Science Campaign

- Conducted hydrotests at LANL's DARHT and Contained Firing Facility to evaluate proposed surety concepts and assess the model for IHE
- Developed new experimental capabilities, including an all-optical probe dome, 128-channel Multiplexed Photon Doppler Velocimetry, and a refurbished and optimized Cygnus pulse power system for radiography, at the U1a Complex, as well as at hydrotest firing sites at DARHT and the Contained Firing Facility. Conducted the first targeted subcritical experiments at the U1a Complex in early FY 2013.
- Completed a Level-1 milestone on the initial condition for boost. This was a joint LLNL-LANL milestone that completed the first of a series of four boost pegposts under the Predictive Capability Framework. The laboratory teams used state-of-the-art science-based models and cutting-edge UQ [uncertainty quantification] methods to assess the quality of early phase hydrodynamic models and to make a prediction, with quantified uncertainties, of a LANL hydrodynamic experiment.
- Executed 10 experiments at the Joint Actinide Shock Physics Experimental Research (JASPER) facility at the Nevada National Security Site, including the 100th shot. The goal of these experiments was to develop the platform and deliver the materials property data to study both plutonium and surrogate materials in support of national security goals
- Executed planned high-energy-density physics experiments at the National Ignition Facility, Omega Laser Facility, and the Z pulsed power facility. Key experimental campaigns conducted included the study of weapon-relevant materials properties under high-pressure, high-temperature, and/or complex shock environments; radiation transport; complex radiation hydrodynamics; and mix/turbulent plasma conditions.
- Executed two mini-G shots and four flat plate shots as part of the Phoenix Project at LLNL's Site 300. The mini-G shots successfully demonstrated improved powerflow design with greater margin against breakdown, significantly continuing the development of an explosive pulsed-power driven platform for isentropic compression experiments. Experiments involved various materials including copper at a ramp compression of about 2 megabar. Flat plate work in FY 2012 contributed to FY 2013 plans for EOS accuracy assessments, as well as potential FY 2015 U1a Complex experiments

Additionally, the accomplishments of the Stewardship Science Academic Alliances Program have been substantial. Since 2002, the program has supported greater than 440 post-doctoral students, 290 graduate students, and over 600 university professors, as well as the development of nearly 3,000 publications and a number of invited talks. Of the post-doctoral and graduate students, NNSA has hired at least 90 to work in its laboratories.

3.7.2 Advanced Simulation and Computing Campaign

The ASC Campaign provides leading-edge simulation capabilities to support stockpile certification. The ASC Campaign's high-performance computing technology investments allow an unprecedented level of computing capability and advanced weapons codes in support of the NNSA mission.

The ASC Campaign serves as the computational surrogate for nuclear testing to predict weapon behavior. The ASC Campaign and other campaigns are integrated through the PCF (see Section 3.2.3).

The ASC Campaign's collaboration with other campaigns, the DSW program, and DOE's Office of Science is instrumental in increasing predictive capabilities for the nuclear security enterprise.

Considerable progress has been made in establishing two user facilities for production computing for the nuclear security enterprise. One facility is at LLNL, and the other has been established between SNL and LANL through the Alliance for Computing at Extreme Scales. These two centers facilitate a synergistic approach to providing high-performance computing. The ASC Campaign's simulation tools also address areas of national security beyond the U.S. nuclear stockpile. Through coordination with other Government agencies, the ASC Campaign plays an important role in supporting nonproliferation, emergency response, nuclear forensics, and attribution activities. Resources have been used to characterize special nuclear materials and devices via post-detonation analysis, and ASC Campaign simulation capabilities have been used to assess security-related mitigation strategies.

The five subprograms of the ASC Campaign are displayed in **Figure 3–8** and described in more detail in Appendix B.

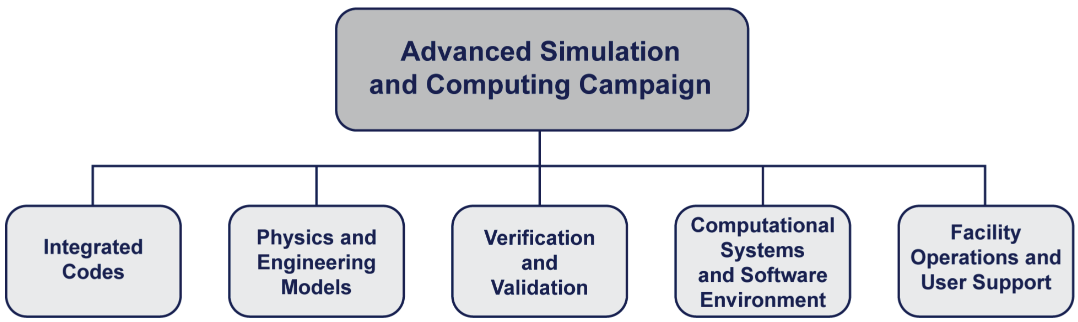

Figure 3–8. Subprograms of the Advanced Simulation and Computing Campaign in fiscal year 2013

3.7.2.1 FY 2012 Accomplishments of the Advanced Simulation and Computing Campaign

- Enabled closure of the Energy Balance Level-1 milestone, PCF pegpost through enhanced full-system simulations.
- Continued investment in a common computing environment across the nuclear security laboratories.
- Made an initial investment in the proposed joint DOE Office of Science/NNSA Exascale Initiative.
- Achieved closer coupling of DSW program deliverables with the PCF.

3.7.3 Engineering Campaign

The goal of the Engineering Campaign is to develop capabilities to assess and improve the safety, security, effectiveness, and performance of the nuclear explosive package and non-nuclear components throughout a weapon's lifetime without further underground nuclear testing. The purpose is to ensure confidence in the design of all components and subsystems and increase the ability to predict their response to external stimuli (*i.e.*, large thermal, mechanical, and combined forces and extremely high radiation fields) and aging effects and to develop essential engineering capabilities and infrastructure.

The Engineering Campaign also provides a sustained basis for certification and assessment throughout the life cycle of each weapon. The improved capability for weapon design and engineering assessment enables specific campaign objectives including the following:

- Incorporation of enhanced surety features, independent of any threat scenario, that meet the requirements of National Security Presidential Directive 28 (June 2003)
- QMU, using state-of-the-art design and assessment tools that rely on ASC Campaign codes and ST&E experimental facilities
- Establishment of a predictive capability to gauge the effect of aging on performance and lifetime assessments
- Consolidation of Security Category I and II special nuclear materials via alternative capabilities and tools
- Continuation of the Qualification Alternatives to the Sandia Pulsed Reactor Project to evaluate threats or vulnerabilities more responsively than via traditional radiation testing
- Establishment of responsive life cycle engineering at demonstrated lower costs
- Preservation of a world-class staff and program in engineering science R&D

The four subprograms of the Engineering Campaign are displayed in **Figure 3–9** and are described in more detail in Appendix B.

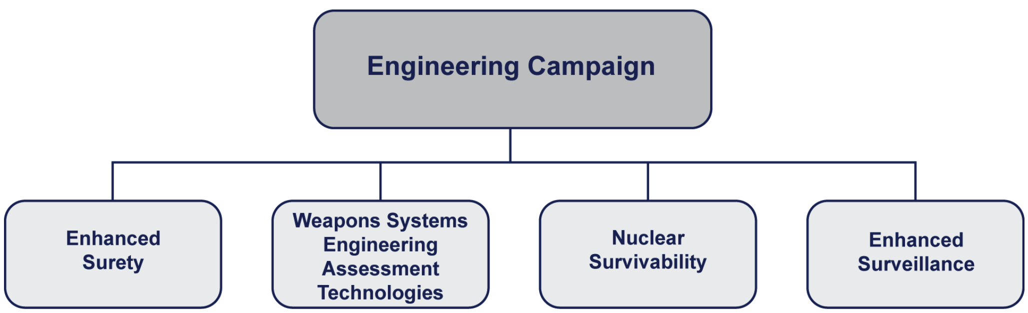

Figure 3–9. Subprograms of the Engineering Campaign in fiscal year 2013

3.7.3.1 FY 2012 Accomplishments of the Engineering Campaign

- Developed advanced safety, security, and use control and denial technologies for stockpile insertion
- Studied organic decomposition and breach of safety-related sealed exclusion regions in abnormal thermal environments
- Evaluated the equivalency of ion irradiations to simulate neutron damage in relevant III-V[4] compound semiconductor electronics for the Qualification Alternatives to the Sandia Pulsed Reactor Project
- Characterized the aging behavior of legacy and new materials and components in the stockpile

[4] *III-V refers to the columns in the periodic table in which the materials in this class of semiconductor appear.*

3.7.4 Inertial Confinement Fusion Ignition and High Yield Campaign

Demonstration and application of ignition and thermonuclear burn in the laboratory are the most important components of the ICF Campaign and remain major goals for NNSA and DOE. Science-based weapons assessments and certification require advanced experimental capabilities that can create and study matter under extreme conditions approaching the high energy density environments found in a nuclear explosion. The ICF Campaign provides these capabilities through development and use of advanced experimental and theoretical tools and techniques, including state-of-the-art laser and pulsed power facilities for both ignition and non-ignition high energy density research and advanced simulation codes. Because ignition was not achieved in FY 2012, NNSA will now emphasize non-ignition stockpile stewardship activities at the National Ignition Facility while supporting a reduced scientific effort to understand why ignition was not achieved and to continue pursuing the demonstration of ignition, including the investigation of one or more alternate ignition concepts.

Virtually all of the energy from a nuclear weapon is generated while in the high energy density state. High energy density physics experiments in ICF Campaign facilities validate the advanced theoretical models used to assess and certify the stockpile without underground nuclear testing. The National Ignition Facility will extend high energy density physics experiments to thermonuclear burn conditions in the laboratory, a unique and unprecedented scientific achievement.

The six subprograms of the ICF Campaign are displayed in **Figure 3–10** and described in more detail in Appendix B.

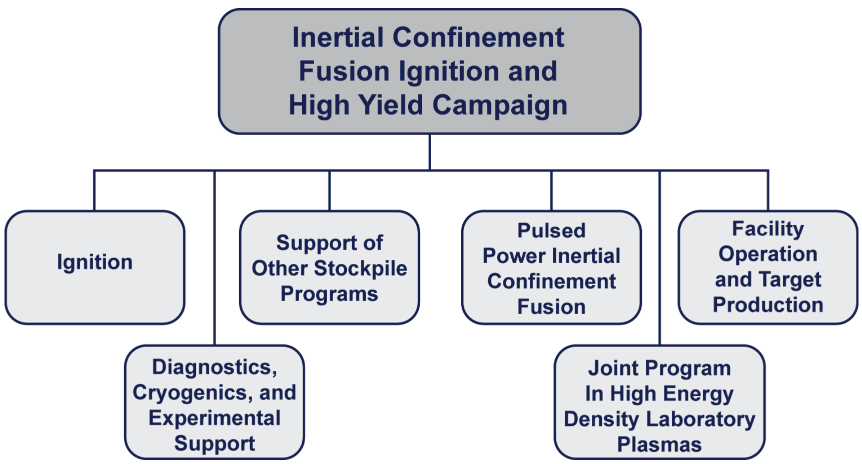

Figure 3–10. Subprograms of the Inertial Confinement Fusion Ignition and High Yield Campaign in fiscal year 2013

3.7.4.1 FY 2012 Accomplishments of the Inertial Confinement Fusion Ignition and High Yield Campaign

- Developed and submitted to Congress the "Path Forward Plan to Achieving Ignition in the ICF Campaign."
- Transitioned the National Ignition Facility to routine operations as a user facility, with laser energy up 1.8 megajoules demonstrated in the ultraviolet.
- Continued to field advanced diagnostic capabilities, including LANL's neutron imager at the National Ignition Facility, which measures both primary and down scattered neutrons.
- Demonstrated improved performance in magnetically driven implosions at the Z pulsed power facility by imploding a beryllium liner and producing an x-ray yield of 2.6 megajoule.

3.8 Milestones, Objectives, and Future Planning

Milestones and objectives for development of ST&E capabilities in FY 2014 and the out-years are shown in **Figures 3–11, 3–12**, **3–13**, and **3–14**. The basis for these milestones and objectives originates with the TBSTP, PCF, and CMF tools (see Section 3.2). The computational science effort represented by the milestones and objectives in Figure 3–11 is led by the ASC Campaign, and the experimental science effort represented by the milestones and objectives in Figure 3–12 is led by the Science Campaign. Extending out to 2038, ST&E-based campaigns, will support the stockpile assessment and certification process and the capability to address SFIs. Continuing confidence in the stockpile as it evolves to address issues and improve safety and security strongly depends on advancing the QMU methodology for reliability assessments and high-fidelity, three-dimensional predictive simulations. Both advances are directly coupled to a V&V process backed by quantitative experiments and simulation advances. Methods for advanced certification and assessment will also be extended to regimes that are relevant to analysis of proliferant technical capabilities and other factors of broader national nuclear security interest.

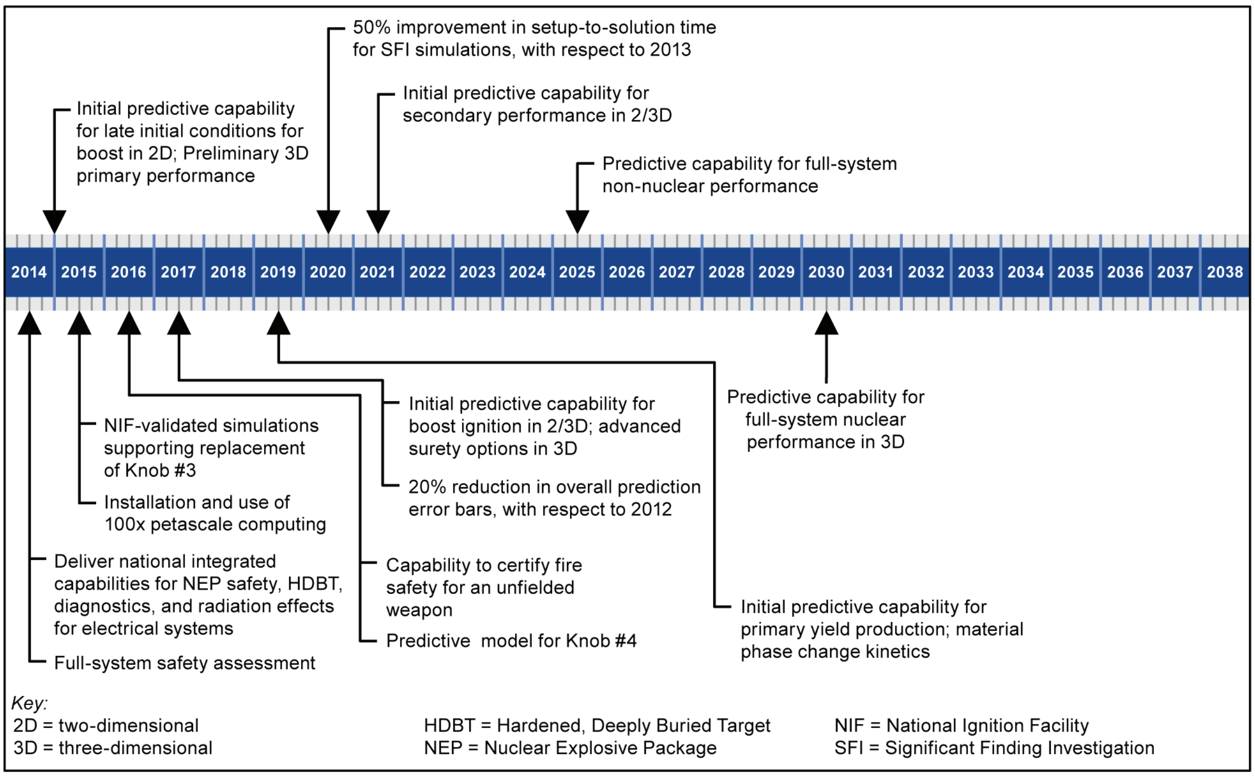

Figure 3–11. Computational milestones and objectives led by the Advanced Simulation and Computing Campaign

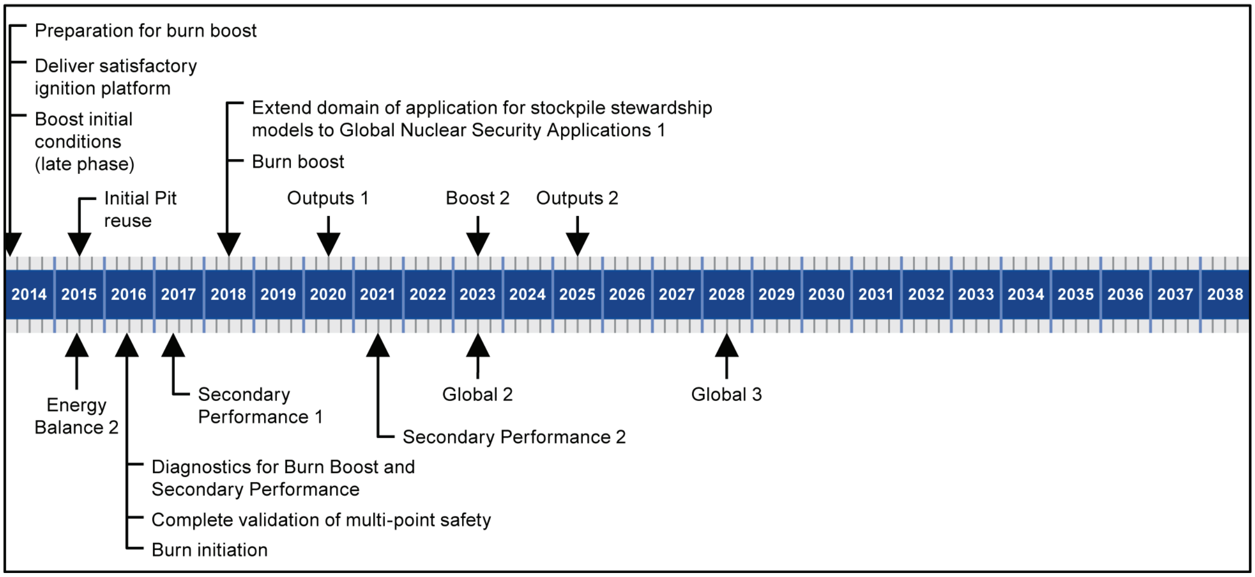

Figure 3–12. Experimental and analysis milestones and objectives led by the Science Campaign

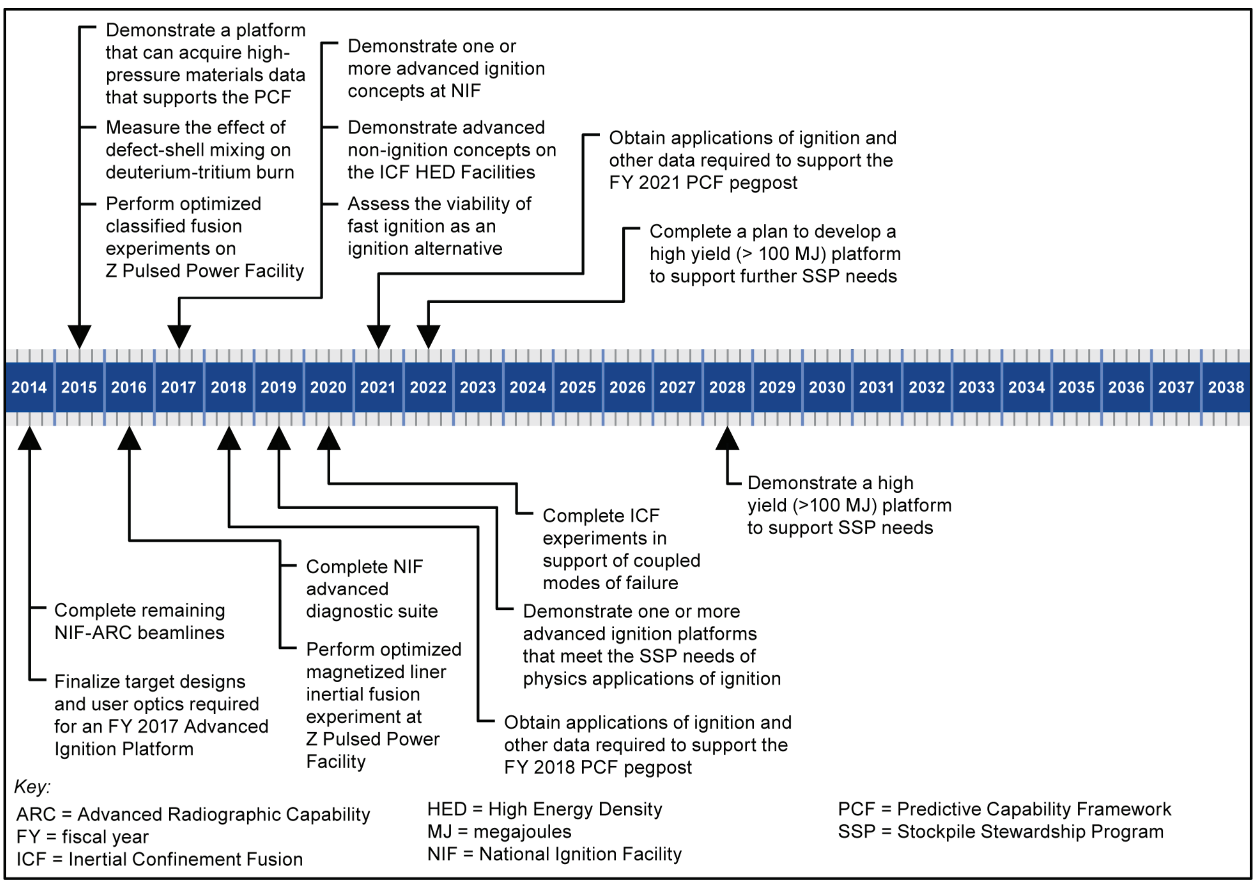

Figure 3–13. Milestones and objectives based on experiments on NNSA's high energy density facilities and led by the Inertial Confinement Fusion Ignition and High Yield Campaign

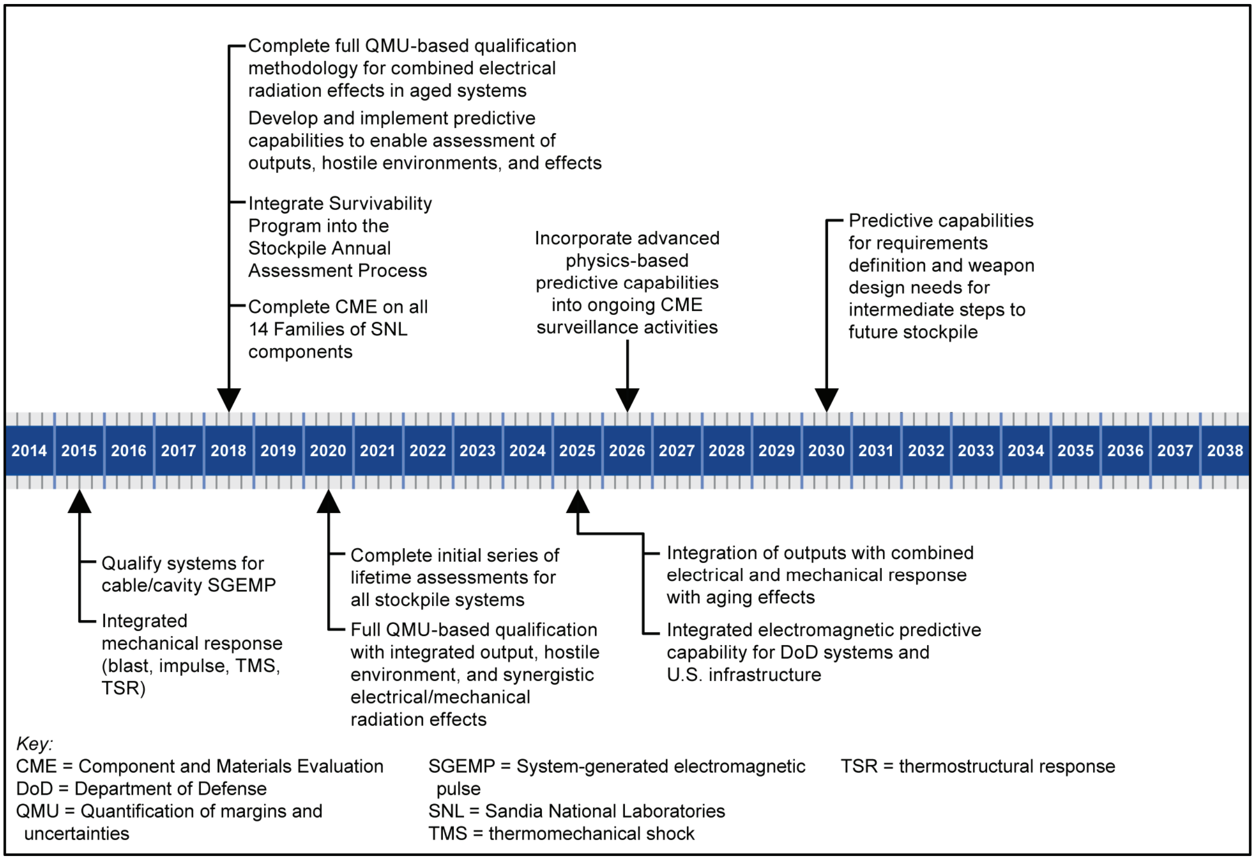

Figure 3–14. Engineering and technological milestones and objectives led by the Engineering Campaign

Figures 3–11 through 3–14 illustrate the cooperative, cross-campaign nature of the computational and experimental science efforts to resolve the challenges associated with boost. For example, the experimental tests of the late phase of boost initial conditions in 2014 will benchmark and improve the boost computational modeling. These cooperative efforts between the ASC and Science Campaigns will fulfill the 2016 PCF Initial Condition II pegpost. A similar cooperative effort is projected for boost ignition experiments and related computational development. In addition, the ICF Campaign will support burn initiation and burn boost in 2016 and 2018, respectively. The ASC Campaign uses the data and analysis from the Science Campaign to construct models of weapons materials properties, multi-phase equations of state, and constitutive properties. The milestones and objectives of the Engineering Campaign, in collaboration with the ASC, Science, and ICF Campaigns, are focused on qualifying new technologies, tools, and manufacturing processes and on surety and surveillance activities to support LEPs, Alterations, and Modifications.

In addition to the predictive assessment and certification of weapons systems, maintenance of reliable, modern technology production methods and systems engineering is essential to sustain the stockpile. The Engineering Campaign, in cooperation with the ASC, Science, and ICF Campaigns, supplies many aspects of this process. Engineering efforts are focused on surety and surveillance activities to support future LEPs, Alterations, and Modifications. Out-year priorities include R&D in nuclear survivability to develop and quantify the technologies, tools, and materials to ensure that capabilities and design options are available when required. The Engineering Campaign will continue to transform surveillance, including the methodology to detect aging signatures through advanced diagnostics. The near focus of the Enhanced Surety effort is on the following four multi-site development efforts:

- Mature use control options to deliver a near-term solution
- Produce prototypical hardware
- Mature integrated surety solutions to integrate physical security elements with a weapon's use denial systems
- Develop, in cooperation with the UK Atomic Weapons Establishment, multi-point safety options for the next insertion opportunity

A more complete description of the projected advances in assessment and the further elaboration of cooperative, cross-campaign efforts can be found in Chapter 3 of the classified Annex.

3.8.1 Projection of Some Key Weapons Issues beyond 2020

The CMF and PCF have developed well-defined, integrated plans to 2020 (see Figures 3–3 and 3–4); the CMF and PCF methods are being used to estimate requirements out to 2038. The projections from 2020 to 2038, as shown in Figures 3–10 to 3–13, identify key areas where scientific and technological advances will enhance the assessment, certification, surveillance, and provide options for sustaining the stockpile and improving safety and security features. Moreover, the limits imposed by near-term computing power are being carefully considered, using the PCF process, in making these projections.

The list below describes some of the key issues to be addressed in out-year planning beyond 2020. Each item is followed with the projected planning response out to 2038.

- **Weapons materials aging and replacement material qualification.** As materials age and require replacement, more sophisticated methods are needed to predict their behavior under weapons conditions. In addition, as unavoidable changes in the stockpile occur, models for materials behavior must be more closely related to fundamental thermodynamic and physical properties (*i.e.*, to "first principles").
  - *Out-year planning response*. Characterize the dynamic and aged properties of weapons materials using advanced diagnostic and analysis tools and experiments to inform and validate new higher-fidelity models.
- **Accurate prediction of the boost phase of primary performance.** The National Boost Initiative will produce valuable results by 2018 that will greatly enhance the predictive capability for certification. The National Boost Initiative is unlikely, however, to settle all issues associated with the complex phenomena of boost cavity formation, boundary turbulence, and mix.
  - *Out-year planning response*. Emphasize three-dimensional simulations of boost cavity formation to provide enhanced confidence in primary performance. In addition, conduct a thorough investigation of burning plasma conditions at the National Ignition Facility. This effort may discover new coupled effects and thus indicate the need for high-gain experiments. After 2020, consideration of upgrades to igniting plasma systems using lasers or pulsed power drivers may be needed to meet the postulated weapons requirements.

- **Continuing value of large-scale, integrated hydrodynamic experiments**. These experiments, which test many aspects of the early phase of weapons operation, can be performed at DARHT, the Contained Firing Facility, and the U1a Complex. Such experiments are essential to simulation code validation, SFI resolution, annual stockpile assessment and certification, and component performance assessments, as well as to establishing confidence in stockpile options. Equally important, these tests provide the means to train and evaluate the capabilities of the scientists and engineers that make the certification and assessment judgments. Experiments that include special nuclear materials have become more important as aging continues and design options become more complex. Advances in experimental diagnostics will likely be needed. Subcritical and other plutonium experiments are a key element in materials science and predictive capability. A series of out-year experiments have been defined, along with a suite of diagnostics to provide data essential for enhancing modeling capability.
  - *Out-year planning response*. Make advances in diagnostic instruments and techniques to provide accurate data for large-scale integrated hydrodynamic experiments involving special nuclear materials and their surrogates and for subcritical experiments involving scaling and surrogacy. This effort will also play an important role in maintaining stewardship skills and weapons readiness.
- **Accurate prediction for secondary performance.** Deliver predictive capabilities to assess the overall weapon performance in delivering the militarily effective yield with an aging and evolving stockpile. Work on certification of the overall weapon systems is ongoing, with the first production unit of two LEPs expected in the 2020s. NNSA will deliver QMU-based assessments based on validated physics-based models and codes, including full utilization of three-dimensional simulation capabilities and full suite of uncertainty quantification assessments.
  - *Out-year planning response*. Utilize a broader range of experimental capabilities, including the possible application of an ignition platform to access regimes previously inaccessible; the experimental campaign will include material properties, nuclear properties (cross section), and integrated performance.
- **Accurate prediction for weapons output, environment, and effects.** The main context here is to utilize all the predictive, physics based capabilities to deliver assessment of the consequence of execution for both potential application to the U.S. stockpile and assessment of potential foreign threats.
  - *Out-year planning response*. Develop and utilize full physics capabilities to assess the weapon output, the coupling of the radiation with surrounding environments, and the assessment of the effectiveness and consequence of the weapon output. Such assessments will utilize modern physics models and capabilities, validated by new experimental data and applied to a broad suite of scenarios to enable decision-making.
- **Transforming surveillance capabilities to better predict materials aging and coupled effects resulting from actual weapons environments.** As the stockpile continues to age and materials must be replaced, the need for accurate monitoring of the physical state of the stockpile will increase significantly. Surveillance will move away from observing defects introduced by manufacturing to production of quantitative data that can be used to identify aging changes.
  - *Out-year planning response*. Continue to develop new diagnostic tools for enhanced surveillance and mature new techniques and migrate them to the Stockpile Evaluation Program. Place more emphasis on quantitative measurements and nondestructive techniques to ensure stockpile reliability in the future.

- **Maintaining weapons design, engineering, and key manufacturing capabilities in the 40 years beyond the last nuclear test.** By 2025 no personnel with actual underground nuclear test design and operation expertise will likely remain at the nuclear security laboratories.
  - *Out-year planning response.* To ensure confidence in the nuclear weapon stockpile and meet the challenges of the broader nuclear security enterprise, establish the needed training and competency for the future contractor workforce through the requisite computer simulation capabilities, coupled with increasingly complex experimental science.

The influence of advanced ST&E can only be realized when viewed through the perspective of the broader national security mission. This mission applies to the breadth of research that spans fundamental scientific discoveries associated with exploring thermonuclear burn and other complex phenomena; such research can be applied to the challenges of detection of improvised explosive devices and modeling global climate. Over the past 5 years, NNSA has demonstrated great success in responding to challenges from the national security and deterrence landscape. Advances have been made in nuclear forensics that aid in attribution, development of render-safe technologies, assessment of foreign weapons, development of DoD-requested conventional munitions (currently in theater), and detection of clandestine weapons materials. The response to these emerging challenges has been rapid and efficient, in large part because of the existence of the workforce and nuclear materials infrastructure. Additional budgetary support from these activities directly adds to the capabilities of the nuclear security enterprise. Plans to enhance the broader nuclear security enterprise are being developed, and these plans are being further enabled by increased collaboration among NNSA's nuclear weapons and nonproliferation programs, as well as with the intelligence community.

Chapter 4

Nuclear Test Readiness

CHAPTER 4
NUCLEAR TEST READINESS

The United States continues to observe the 1992 nuclear test moratorium. NNSA has maintained a readiness to conduct an underground nuclear test if required to ensure the safety and reliability of the stockpile or, if otherwise directed by the President, for policy reasons. DOE/NNSA has maintained a 24- to 36-month nuclear test readiness posture (response time) pursuant to Presidential Decision Directive 15 (1993) during a period when readiness to test was funded as an active program. NNSA's evaluation of test readiness response time has changed over the years, and the fundamental approach taken to achieve test readiness has also changed.

4.1 The NNSA Approach to Test Readiness

Under NNSA policy, for a given test readiness posture, a single underground nuclear test would be conducted within the specified period. In establishing its posture for test readiness, NNSA focused principally on a scenario in which a test would be needed to resolve a complex technical issue discovered in the stockpile. Such a test would have to be highly diagnosed and would fulfill all of the same requirements in place in 1993. Aside from the uncertainty of these assumptions, only one test might be needed to address and resolve a performance or safety issue with a U.S. nuclear weapon; however, it is more likely that a series of tests would be needed to isolate and resolve a specific issue. It is expected that the additional tests would be completed in 1 to 2 years. NNSA does not have, or plan to acquire, the capability to resume a continuous, open-ended nuclear test program such as that conducted prior to the 1992 moratorium. It has also become increasingly clear that this open-ended scenario is unlikely, and it is unrealistic to maintain such conditions in order to conduct a test if called upon to do so by the President. Some tests with simple scenarios and minimal diagnostics could be conducted in much shorter times. In contrast, some types of tests could not be conducted in less than 36 months from inception, even prior to the test moratorium.

The NNSA strategy to remain ready for nuclear testing has been to maintain the unique sites, facilities, equipment, and competencies of personnel primarily through their use in the Stockpile Stewardship and Stockpile Management Programs and other national security initiatives. The ability to conduct nuclear tests draws on the broad range of skills and capabilities at the Nevada National Security Site and the national security laboratories. Test readiness presumes the continuation of a robust Stockpile Stewardship Program, including dynamic plutonium experiments (*e.g.*, subcritical experiments at the Nevada National Security Site), other high-explosive-driven experiments, and high energy density experiments conducted at laser and pulsed-power facilities. In addition, it also presumes the maintenance of competencies in a number of operational capabilities (*e.g.*, underground operations and mining) and scientific equities *(e.g.*, diagnostic development, data acquisition, and analysis).

However, a number of technologies unique to underground tests are not exercised by stockpile stewardship; these were discussed in detail in the 2009 version of the test readiness report submitted to Congress. Since that time, most equipment unique to test readiness has remained in storage with minimal resources devoted to maintenance, and the number of key[1] and critical[2] personnel available to execute an underground test has continued to decline, with no funded program in place to train their replacements (see Appendix C).

Of the experimental activities relevant to test readiness, subcritical experiments that are compliant with a zero yield policy most closely resemble nuclear tests in their operational aspects. Twenty-seven subcritical experiments have been conducted since 1997 (not counting confirmatory, or non-nuclear, experiments, which also contribute to technical competency and formality of operations). These subcritical experiments have provided data on the dynamic behavior of plutonium that enhance our ability to evaluate the safety and reliability of the stockpile.

In FY 2012 and early FY 2013, NNSA executed the first in a series of “scaled” subcritical plutonium experiments at the Nevada National Security Site. These convergent geometry experiments are designed to reach pressures approaching those in a weapon primary. The skills required to manufacture, assemble, and field these experiments are similar to those required to build and field a nuclear test.

These and other experiments at the national security laboratories, such as the complementary hydrodynamic experiments at the DARHT facility using surrogates, help maintain the essential skills needed to conduct a nuclear test. However, the primary goal of such hydrodynamic and subcritical experiments is to provide data for stockpile stewardship; the benefit to test readiness is secondary. In addition, efforts to plan and prepare life extension and modernization programs for major weapons systems and to conduct production, maintenance, and surveillance operations at nuclear weapons production facilities have been important for maintaining the skills and facilities to handle and modify a nuclear device for testing, if needed.

Any capability for a nuclear test that is not used in other program work and could not be reconstituted and implemented within the readiness response time window must also be maintained. Since the early 1990s, some facilities and equipment unique to nuclear testing have not been maintained, based on the expectation they could be reconstituted within the mandated time for test resumption.

With respect to personnel, in addition to on-the-job mentoring opportunities, current staff have access to active and retired personnel with underground nuclear test-specific skills and expertise, should the need arise. However, this pool of experienced personnel is rapidly diminishing. Over the past decade, exercises have been conducted, sometimes in conjunction with non-nuclear experiments, in an effort to refresh expertise in some of the nuclear test-unique areas.

Moreover, some activities are conducted to maintain the physical infrastructure and experimental support at the Nevada National Security Site and North Las Vegas Facility, such as the Device Assembly Facility; various equipment storage and staging sites; communications; security; and environmental, health, and safety personnel. Such assets will be important if a nuclear test must be conducted.

The Nuclear Posture Review Report (DoD 2010) reaffirmed and strengthened the U.S. commitment to maintain the nuclear deterrent capability without nuclear testing unless an unforeseen critical technical issue with the stockpile is discovered or as a response to another Nation engaging in nuclear testing. These scenarios are among those considered in the table prepared by the Strategic Advisory Group Special Task Force (see Table C–1 of Appendix C).

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[1] *Key personnel are those who fill positions defined as necessary to the preparation for or conduct of an underground test in NSO M 450.X2-1 – Underground Nuclear Testing, Test Readiness, and Threshold Test Ban Treaty Verification.*

[2] *Critical personnel are those who fill positions defined as vital to the safe accomplishment of an underground test in NSO M 450.X2-1 – Underground Nuclear Testing, Test Readiness, and Threshold Test Ban Treaty Verification.*

4.2 Capability to Respond in 24 to 36 Months

As indicated in the introduction to this chapter, NNSA maintains a nuclear test readiness posture in which an underground test could be conducted within 24 to 36 months of a directive from the President. A complex test[3] might take 36 months to field and conduct, while a simpler test might be possible in a 24-month or shorter time interval.

In the years soon after nuclear testing ended in 1992, personnel, facilities, and equipment were still in place and active, so confidence in asserting a 24- to 36-month test readiness posture was high. Subsequently, several reviews were conducted to evaluate the 24- to 36-month test readiness posture. These are cited and discussed in the 2003 edition of the *Nuclear Posture Review Report*. Recent reviews concluded that, because of a loss of expertise (through personnel attrition) and degradation of specific capabilities, the United States would likely require 36 months to test, with less confidence in the ability to achieve a 24-month response time, even for a test that was technically relatively simple. It was believed that, as time passed, the 36-month posture would be increasingly difficult to achieve. Also of significance was the premise that test-experienced personnel, who had retired or moved to other fields, would be available for recall if required. While this was a reasonable planning basis a decade ago, the pool of available test-qualified personnel continues to diminish and, if a return to testing were required, would need to be replenished by hiring and training new personnel, preferably through other Stockpile Stewardship Program activities.

Beginning in 2003, NNSA began to address the issues identified above with funds provided by Congress. For example, NNSA made efforts to update test plans and procedures, including work to bring safety analyses up to date to meet new safety standards. Neutron generators that would be needed for nuclear testing were fabricated to replace old units whose shelf lives had expired. Significant work was done to restore and update diagnostic instrumentation and renew the skills of the scientists and technicians needed to use them.

In July 2006, NNSA conducted the Unicorn subcritical experiment. Like previous subcritical experiments, Unicorn helped renew nuclear test-related skills. This particular experiment was the first conducted in a vertical geometry and hence was more comparable to the emplacement of a nuclear test. In addition, many issues came to light and important lessons were learned that would be valuable in the event that a nuclear test were necessary someday. This work allowed NNSA, by FY 2006, to regain a quicker readiness capability and a potentially shorter response time for a technically simpler test.

Since FY 2006, test readiness funding has decreased significantly. Beginning in FY 2011, test readiness is no longer funded as a separate program, and all test-readiness-related activities are funded either under the Site Stewardship Program (or its predecessor, the Readiness in Technical Base and Facilities Program) or are supported by the programmatic work conducted under the DSW Program or the Science Campaign. Nearly all activities implemented over the past decade purely for test readiness have been eliminated.

NNSA continues to identify the funding required to implement appropriate infrastructure closure processes and make strategic decisions to integrate activities supporting test readiness into the overall Stockpile Stewardship Program at the Nevada National Security Site.

[3] *A "complex test" is a fully-diagnosed test that fulfills all of the technical requirements of a pre-1993 test.*

4.3 Capability to Respond in 6 to 10 Months

Nuclear test readiness policy has consistently been based on readiness to respond to a technical issue with a stockpile weapon. The Strategic Advisory Group Special Task Force, which included all three NNSA national security laboratory directors, concluded in March 2010 that a very limited test to signal the readiness of the U.S. nuclear deterrent or to respond to another Nation's test could be conducted in 6 to 10 months, but such a test is not a component of stockpile stewardship.

Historically, when the United States was engaged in a sustained nuclear testing program, it would normally take about 18 months to develop and field a nuclear test to obtain technical data. In many cases, particularly when a test had complex technical objectives, the time from test conception to execution could be much longer than 18 months. A test could be fielded in a shorter time interval only by interrupting and modifying a test already in process to fit a new set of technical objectives.

A test readiness posture as short as 6 months is substantially different in nature from an 18-month or 36-month readiness posture. A 6-month readiness scenario would be most relevant if the President directed testing to resume for policy reasons, as President Kennedy did in 1961.

4.4 Conclusion

While DOE/NNSA can meet the essential requirements for test readiness, a number of elements on the critical path timeline to conduct a weapons physics test have eroded since 1992. However, stockpile stewardship capabilities have improved significantly in the same time period.

Nevertheless, test readiness is no longer considered the backbone of stockpile stewardship. Recognizing the limited resources available for test readiness, a reduced set of capabilities is now considered in this analysis. In particular, the current assessment of test readiness assumes limited diagnostics. The current status also differs from previous years because of a change in the underlying assumptions of the analysis; a return to testing is a low-probability event that would only occur following a Presidential decree of a national emergency. Testing would have to be conducted pursuant to waivers of certain Federal laws and regulations, the compliance with which could affect the desired schedule. The analysis now assumes these waivers are in place when making estimates of "readiness." Test readiness capability is, therefore, determined solely on the basis of technical ability and not on statutory and regulatory compliance.

CHAPTER 5

Revitalize Physical Infrastructure

CHAPTER 5
REVITALIZE PHYSICAL INFRASTRUCTURE

The *Nuclear Posture Review Report* (DoD 2010) concluded that, "*Increased investments in the nuclear infrastructure are needed to ensure the long-term safety, security, and effectiveness of our nuclear arsenal.*" While some NNSA facilities are in good condition, others date to the Manhattan Project and are costly to maintain and may present operational risks. This chapter describes the plan to maintain, sustain, refurbish, and replace the physical infrastructure to support the Nation's stockpile and modernize the nuclear security enterprise. Safety, security, environmental, and technological obsolescence issues are the key drivers of increased maintenance and operational costs. The plan to revitalize the physical infrastructure in support of the *Nuclear Posture Review Report* (DoD 2010) is provided in this chapter.[1]

NNSA works with its national security laboratories, the Nevada National Security Site, nuclear weapons production facilities, and DoD to identify the best path to ensure the continued availability of its experimental, computational, and manufacturing facilities to accomplish the stockpile mission. A balanced approach is required to sustain the existing infrastructure, replace or refurbish inefficient and unreliable facilities, and dispose of excess facilities and infrastructure.

> ***Nuclear Weapons Council Infrastructure Direction***
>
> *The Nuclear Weapons Council recently adopted the large infrastructure continuity of capability strategy for plutonium and uranium:*
>
> - *Defer construction of the Chemistry and Metallurgy Research Replacement Nuclear Facility for at least 5 years and execute a plutonium strategy that achieves a 30-pit-per-year capacity by 2021.*
> - *Modify the plans for the Uranium Capabilities Replacement Project to accelerate construction and modify the priorities to equip the new facility in Phase I with Building 9212 capabilities. Plan, design, and prioritize the installation of equipment for uranium operations associated with Buildings 9215 and 9998 in Phase II and with Building 9204–2E in Phase III.*

NNSA has refocused management of its physical infrastructure. In the FY 2014 budget, NNSA eliminated the Readiness in Technical Base and Facilities Program and redistributed these functions. Under the new NNSA organization, the Office of Defense Programs manages the areas of the former Readiness in Technical Base and Facilities Program that specifically addressed continuity of weapons-related capabilities. Nuclear Programs, newly created within Defense Programs now includes Nuclear Operations Capabilities subprogram, a Construction subprogram, as well as a Capabilities Based Investments subprogram that focus and collaborate on investments in support of the core programmatic requirements of Defense Programs. The new Office of Infrastructure and Operations manages the facility operations portion of the former Readiness in Technical Base and Facilities Program, including landlord responsibilities under the existing Site Stewardship Program. The Site Stewardship Program provides a well-integrated organization with focused support on site operations, site support, sustainment, and disposition of facilities and infrastructure. This new office works from a corporate perspective in partnership with the

[1] *The physical infrastructure information presented here does not reflect all activities required to deliver major facility renovations or new facilities. NNSA infrastructure improvements must adhere to applicable DOE Orders and other legislative, statutory, and Executive Order requirements, including but not limited to the National Environmental Policy Act, the Energy Policy Act, and the Energy Independence and Security Act.*

program offices. This chapter also identifies infrastructure and security contributions from other programs, *e.g.*, Safeguards and Security.

5.1 Capability-Based Approach to Infrastructure Investment

An NNSA goal is to provide a capability-based infrastructure that is responsive to future stockpile scenarios and represents an appropriate balance between risk and cost. Regardless of stockpile size or composition, certain facilities and operations must be available to manufacture, certify, maintain, and assess the nuclear weapon stockpile.

This capability-based infrastructure approach involves prioritizing investments that support program and mission objectives while minimizing technical risks, costs, and environmental impacts. These investments include overhauling and extending the life of facilities or replacing such assets with new construction. NNSA also leverages needed capabilities through agreements with external organizations for the use of their highly specialized facilities. While the overall number of specialized facilities (*e.g.*, the TVA reactors) is small in comparison with the nuclear security enterprise, their contributions to the mission are very important.

The NNSA infrastructure that directly supports weapons design, production, qualification, and assessment is summarized in **Table 5–1**. This table provides the links between mission capabilities and the current condition of the supporting facilities and infrastructure. Table 5–1 also identifies the assets that represent the current highest priority risks to the mission and the mitigation strategies to alleviate these risks. Color codes highlight the capabilities at risk.

5.2 Sustainment of Existing Facilities and Infrastructure

NNSA has implemented management strategies, including improved energy sustainability, to ensure that existing facilities and infrastructure are sustained and managed safely, efficiently, and reliably. The Site Stewardship Program funds and supports the operation and maintenance of the overall facilities and infrastructure for the nuclear security enterprise. Individual programs invest in sustaining particular capabilities and infrastructure, such as dedicated equipment and specially designed machinery, for their own programmatic use. These investments, for the most part, are not addressed in this chapter unless sustainment of the capability is at risk.

The *Nuclear Posture Review Report* (DoD 2010), the *National Nuclear Security Administration Strategic Plan* (DOE 2011), environmental Records of Decisions, the Congressional Budget Request, and statutory and regulatory requirements are key drivers of the nuclear security enterprise portfolio. Many factors are considered when setting priorities, including the risk to mission deliverables, worker and public safety, support of national energy sustainability goals, and footprint reduction. NNSA identifies functions at risk, proposes mitigating actions, and recommends remedies that are incorporated into portfolio planning. Each site reviews the condition of its facilities and infrastructure and plans improvements, especially if the condition of these assets poses an unacceptable risk. The program balances the condition of assets with the urgency for the use of the core capabilities that those assets support. NNSA prioritizes the infrastructure using a defined set of facility classifications, namely Mission Critical (MC), Mission Dependent Not Critical (MDNC), and Not Mission Dependent (NMD). NNSA evaluates risks by applying industry standards, such as Facility Condition Index (FCI) goals, and determines the priorities for infrastructure recapitalization and refurbishment accordingly.

Table 5–1. Infrastructure management strategy to sustain National Nuclear Security Administration functions and mission capabilities [a]

(green) Existing infrastructure is estimated to be sufficient for post-*Nuclear Posture Review Report* (DoD 2010) mission capabilities.
(yellow) Existing infrastructure may not be sufficient or is inefficient or unreliable for post-*Nuclear Posture Review Report* (DoD 2010) mission capabilities.
(red) Existing infrastructure is not sufficient for post-*Nuclear Posture Review Report* (DoD 2010) mission capabilities.

Function	*Mission Capability*	*Current Limitation of Capability*	*Capability Requirement*	*Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability*
Plutonium	R&D	Aged, seismically deficient, and inefficient facility	Modernize and sustain existing facilities	• Complete NNSA program operations in CMR Building in 2019 • Optimize use of RLUOB for plutonium analytical chemistry • Consider CMRR-NF construction or alternative in 5 years
	Manufacturing	< 10 pits per year	Up to 80 pits per year	• Implement PF-4 plutonium investments to achieve 30 pits per year production by FY 2021 • Plan to support up to 80 pits per year as early as 2030 • Implement planned TRP Phase II and Phase III upgrades • Evaluate design options to build a tunnel between PF-4 and the RLUOB
	Storage	Insufficient capacity, dispersed locations	Consolidate and sustain existing facilities	• Accelerate disposition of excess materials from PF-4 vault • Consider staging options at the Device Assembly Facility for bulk quantities of plutonium with defined future use • Consider viable storage alternatives jointly with DoD, including new Material Staging Facility at Pantex
	Radioactive waste disposition	Consent agreement to close one location and upgrade waste processing system	Sustain existing facilities with some new construction	• Construct TRU Waste Project and close TA-54, Area G • Construct RLWTF facility upgrade
Uranium	HEU and CSA R&D	Aged, Inefficient and dispersed facilities	Efficient R&D facility	Implement investments in existing buildings (9202, 9203, and 9731) until options are evaluated for the proposed new Applied Technology Laboratory
	CSA manufacturing	160 CSAs per year and aged, fragile and or inefficient facilities	Approximately 80 CSAs per year	• Construct and operate Phase I and plan construction of Phases II and III of the UCRP • Complete NFRR to keep Building 9212 and 9204-2E viable; make necessary investments for continued operation of Buildings 9204-2E, 9215, and 9988 until UCRP Phases II and III are complete • Design and construct lithium production facility
	Storage	Satisfactory	Sustain HEUMF	No new construction
	Radioactive waste disposition	Satisfactory	Sustain existing facilities	No new construction

Function	Mission Capability	Current Limitation of Capability	Capability Requirement	Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability
Tritium	R&D	Satisfactory	Sustain existing facilities	No new construction
	Manufacturing	Satisfactory; TVA reactors sufficient through FY 2030	940 metric tons of unrestricted and unobligated LEU for one reactor	No change in infrastructure; implement plan to outsource acquisition of LEU
		544 TPBARs per cycle sufficient through FY 2015	1,700 to 2,500 TPBARs per reactor per cycle by 2019	No change in infrastructure; complete Supplemental Environmental Impact Statement to support Nuclear Regulatory Commission by FY 2015 and approval of TVA license amendment to increase production to required levels
		Aged and inefficient facilities	Consolidate operations into existing newer facilities	Implement TRIM projects at SRS through combination of expense and capital improvement
	Storage	Satisfactory	Sustain existing facilities	No new construction
High Explosives	R&D	Aged and inefficient facilities	Modernize and consolidate	• Design and construct Energetic Materials Characterization at LANL • Consider proposals for energetic materials R&D, characterization and new high explosive qualification capabilities at LLNL • Continue consolidation of the LANL firing sites for broader class of storage
	Production	1,000 pounds per year	Up to 2,500 pounds per year	• Complete construction of HE Pressing Facility • Consider proposals for new HE Formulation Facility • Design and construct new HE Component Fabrication and Qualification Facility and new related Science, Technology, and Engineering Facility
		600 hemispheres per year – fragile and inefficient facilities	Up to 600 hemispheres per year – modernize and consolidate facilities	
	Storage	Satisfactory	Sustain existing facilities	Repurpose existing facilities for a broader classification of storage at LANL
	Disposition	Satisfactory	Sustain existing facilities	No new construction
Weapons Assembly and Disassembly	Assembly cells and bays, weapon surveillance, NDE operations	Obsolete and aged cell and bay operational subsystems	Sufficient cells and bays to support all LEPs	• Consider proposals for Fire Protection Building Lead-Ins • Evaluate and implement upgrades to ultraviolet flame detector and air monitoring systems (expense funded)
Nonnuclear Components	R&D	Microelectronics for LEPs	Keep equipment and tooling close enough to industry to maintain capability	Evaluate microfabrication recapitalization; implement recapitalization of silicon fabrication (operations funded)
	Production	Satisfactory facilities at laboratories	2 to 3 phased LEPs	No new construction
		Aged and inefficient facilities at production plant		• KCPNSC facility lease with GSA executed in November 2012 • Complete personnel and equipment relocation and installation from the Kansas City Bannister Plant to KCRIMS at KCPNSC in FY 2014

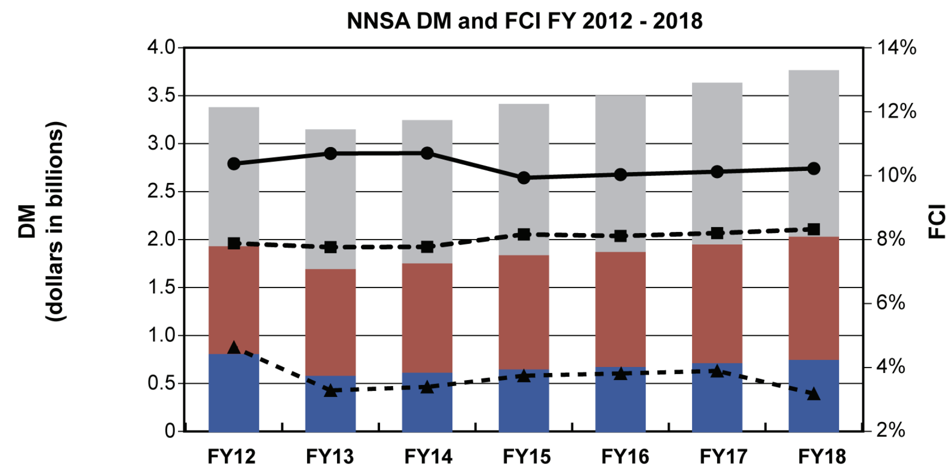
Function	Mission Capability	Current Limitation of Capability	Capability Requirement	Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability
Special Nuclear Material	Transportation	Satisfactory	Sustain existing facilities	No new construction
	Security protection and storage	Plutonium: TA-55 PIDAS old and reached end of design life	Sustain new PIDAS	Complete construction of NMSSUP Phase II PIDAS
		Plutonium: Superblock supported at Security CAT III	SNM supported at Security Category III	No new construction
		SNM staging and DAF storage	Sustain existing infrastructure	Consider DAF Lead-in Piping project (operations funded)
		Security protection and staging for Zones 4 & 12 approaching end of life	Efficient and right-sized PIDAS	• Consider proposals to refurbish, consolidate, or eliminate Zone 4 in conjunction with alternatives analysis for material staging • Consider proposals for refurbishment of Zone 12 security • Consider Protective Force Portal Upgrade and Enhancement project
		PIDAS for uranium is old, and inefficient and reaching end of design life.	20-acre PIDAS campus	• Complete construction on Security Improvement Project • Execute interim West-end Protected Area Reduction as early subproject of UCRP Phase I (reduce 150 to 80 acres) • Execute UCRP Phases II and III coupled with the three security projects listed below to reduce PIDAS from 80 to 20 acres • Consider Central Alarm Station Relocation project • Consider PIDAS Sensor Modernization project • Consider Entry Control Facilities project
Design, Certification, Experiments, and Surveillance	Life extension design support	1 LEP	Design support for 2 to 3 LEPs	• Sustain and modernize ST&E capabilities and phasing of LEP activities at the national security laboratories, the nuclear weapons production facilities, and the Nevada National Security Site • Sustain and modernize LEP and Warhead Assessment Revitalization (capital equipment) • Consider proposals for Weapons Manufacturing Support Facility
	Certifications, surveillance, and assessments of warheads	Up to 7 warheads types	Assessment of up to 7 warhead types	• Consider proposals for MaRIE • Provide stable support for the Nevada National Security Site and for ST&E capabilities at the national security laboratories
	Computational science	Inadequate infrastructure to support more than petaflops	Sustain infrastructure support for exaflops	Implement infrastructure modernization for exascale computing as part of ASC

Function	Mission Capability	Current Limitation of Capability	Capability Requirement	Near Term Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability
Design, Certification, Experiments, and Surveillance (cont'd)	Testing and experiments to support stockpile certification and surveillance	Aging environmental testing and experimental equipment and infrastructure for LEPs	Sustain stockpile certification and surveillance test capabilities	• Complete Phase II Test Capabilities Revitalization construction • Continue refurbishment of Tonopah Test Range (operations funded) • Sustain environmental test and experimental capabilities • Consider proposals for Site 300 capabilities • Design and construct Weapons Engineering Facility
		Inadequate radiography for larger scale subcritical experiments at the Nevada National Security Site	Sustain radiography infrastructure, including equipment to support hydrodynamic experiments	Consider proposals for upgrading or enhancing underground radiography capability, including equipment instrumentation, diagnostic, and imaging system replacement for hydrodynamic experiments
Enabling Infrastructure	Utility services including HVAC, electrical, fire main, *etc.*	Inadequate electrical services and distribution systems, old and inefficient operations centers, fire protection, seismic upgrades, and support facilities	Upgrade and sustain utilities and infrastructure for modern capabilities	• Construct Electric Reliability & Distribution project (LLNL) • Construct LANL Electrical Infrastructure project • Design and construct Fire Station project at Y-12 • Design and construct Emergency Operations Center projects (LLNL, SNL, and Y-12) • Consider proposals for Zone 11 High Pressure Fire Loop project (Pantex)

ASC = Advanced Simulation and Computing Campaign
CMR = Chemistry and Metallurgy Research
CSA = canned subassembly
DAF = Device Assembly Facility
DoD = U.S. Department of Defense
FY = fiscal year
GSA = General Services Administration
HE = high explosive
HEU = highly enriched uranium
HEUMF = Highly Enriched Uranium Materials Facility
HVAC = heating, ventilation, air conditioning
KCPNSC = Kansas City Plant National Security Campus
KCRIMS = Kansas City Responsive Infrastructure Manufacturing and Sourcing
LANL = Los Alamos National Laboratory
LEP = life extension program
LEU = low-enriched uranium
LLNL = Lawrence Livermore National Laboratory
MaRIE = Matter-Radiation Interaction in Extremes
NDE = nondestructive evaluation
NFRR = Nuclear Facility Risk Reduction
NMSSUP Phase II = Nuclear Materials Safeguard and Security Upgrade Project Phase II
NNSA = National Nuclear Security Administration
Pantex = Pantex Plant
PF-4 = Plutonium Facility
PIDAS = Perimeter Intrusion Detection and Assessment System
R&D = research and development
RLUOB = Radiological Laboratory Utility Office Building
RLWTF = Radiological Liquid Waste Treatment Facility
SNL = Sandia National Laboratories
SRS = Savannah River Site
SNM = special nuclear material
ST&E = science, technology, and engineering
TA = Technical Area
TPBARs = tritium-producing burnable absorber rods
TRIM = Tritium Responsive Infrastructure Modifications
TRP = TA-55 Reinvestment Project
TRU = transuranic
TVA = Tennessee Valley Authority
UCRP = Uranium Capabilities Replacement Project
Y-12 = Y-12 National Security Complex

[a] The infrastructure projects in the column entitled "Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability" represent the highest priority projects on the Integrated Priority List as shown in Figure 5.2.

NNSA collects data that links the facilities and enabling infrastructure to core capabilities for the mission. NNSA aims to provide the highest level of sustainment and maintenance for the MC facilities with a graded approach applied to the rest of the facilities and infrastructure portfolio. This strategy allows NNSA to plan for and allocate appropriate resources to the most critical needs. **Figure 5–1** projects the Deferred Maintenance (DM) and FCI for FY 2012 through FY 2018. As currently projected, the condition of MC facilities will improve with the FCI decreasing from 5 percent in FY 2012 to approximately 3 percent in FY 2018. The condition of MDNC facilities degrades slightly, but overall the projections are approximately 8 percent. The FCI of NMD facilities are projected to stay at approximately 10 percent. The decreasing FCI for MC facilities and stable FCIs for MDNC and NMD facilities indicate that the increasing level of DM does not increase risks. NNSA continues to manage its maintenance funds to sustain progress in reducing risk in MC facilities while accepting a greater, but stable, level of risk in its MDNC and NMD facilities.



	FY12	FY13	FY14	FY15	FY16	FY17	FY18
DM (not mission dependent)	1.451	1.458	1.495	1.578	1.631	1.687	1.737
DM (mission dependent)	1.124	1.112	1.139	1.190	1.197	1.238	1.284
DM (mission critical)	0.815	0.588	0.621	0.655	0.683	0.720	0.754
FCI (not mission dependent)	10.42%	10.72%	10.73%	9.96%	10.06%	10.15%	10.25%
FCI (mission dependent)	7.91%	7.79%	7.80%	8.19%	8.14%	8.23%	8.35%
FCI (mission critical)	4.66%	3.31%	3.42%	3.77%	3.84%	3.92%	3.21%

FCI = (cost of deferred maintenance)/(replacement plant value), where:
FCI ≤ 2%, Excellent 2% < FCI ≤ 5%, Good 5% < FCI ≤ 10%, Adequate 10% < FCI ≤ 25%, Fair FCI > 25%, Poor

Key:
DM = Deferred Maintenance
FCI = Facility Condition Index
FIMS = Facilities Information Management System
FY = fiscal year

Note: FY 2012 - FIMS Snapshot; NNSA 8 Sites; FY 2013-2018 NNSA Infrastructure Data Analysis Center (IDAC).

Figure 5–1. Facility Condition Index measurements and Deferred Maintenance

Funding for the Facilities and Infrastructure Recapitalization Program was last requested in FY 2012; however, projects will continue to be executed until all funds are expended. The Facilities and Infrastructure Recapitalization Program has attained approximately 98 percent of its $900 million deferred maintenance reduction goal. In FY 2013, funds were redirected to a new capability-based investment initiative. Going forward, NNSA will focus on discrete facilities and infrastructure investments to sustain capabilities.

5.3 Construction

Nuclear Programs' Construction subprogram provides line-item projects that support weapons activities using a defined review, prioritization, and decision approval process. The Site Stewardship Construction subprogram provides general purpose and multi-user facilities and infrastructure upgrades and replacements that are integrated into this single prioritization process. The Defense Nuclear Security program also uses a similar process for rating and ranking their proposed projects. To plan for the 25-year period from FY 2014 to FY 2038, the NNSA sites have submitted proposed projects that address known infrastructure risks. These projects are needed to revitalize, modernize, and replace aged and inefficient assets. All mission gaps are evaluated by infrastructure experts, ranked by program sponsors, and consolidated into a NNSA nuclear security enterprise-wide priority list of approved and proposed projects. The result is the approved Integrated Priority List of capital construction proposals in the FYNSP and post-FYNSP periods, as presented in **Figure 5–2** in Section 5.3.1. Near-term projects are of the highest priority and are usually in more-advanced stages of development, in accord with DOE Order 413.3B. The proposed post-FYNSP projects are constrained by budget assumptions and do not yet have an NNSA-approved mission need justification (Critical Decision [CD]-0). Project activities will be funded from the priority list based on the resources available. The scheduled milestones and cost ranges shown are "rough order of magnitude," for the unapproved projects because they are preconceptual and not fully scoped. General scope descriptions for the proposed projects are provided in Appendix D. Projects that have been deleted because of changes in priority are also noted in Appendix D.

5.3.1 Approved and Proposed Line-Item Construction Projects

NNSA is committed to ensuring the continuity of capability and mission functions for the nuclear security enterprise. Given the fiscal realities of the Budget Control Act, NNSA has determined that the Uranium Capabilities Replacement Project (UCRP), formerly referred to as Uranium Processing Facility[2] (UPF) and CMRR-NF Projects cannot proceed simultaneously. Based on an independent review, Building 9212 at Y-12 was determined to present the highest programmatic and operational risk. Therefore, CMRR-NF construction was deferred for at least 5-years. The UCRP Project Execution Plan has been revised to prioritize the replacement of the highest-risk uranium processing operations in Building 9212 first.

The UCRP is the highest-priority construction project and a key objective in Figure 5–6 in Section 5.8. The following adjustments have recently been made to the project execution plan to support a phased implementation approach:

- Begin site preparation activities in FY 2013 in anticipation of the start of nuclear facility construction. Continue design development based on prioritization of capabilities required to support Phase I.
- Set the Phase I performance baseline in FY 2014. Construct the main UPF structure within the UCRP and associated support systems, and begin transition of Building 9212 capabilities to the new UPF by 2019.
- Perform highly enriched uranium processing operations, which are presently executed in Building 9212, in the new UPF by 2025.
- Complete the design and prioritize installation into the UCRP of all other highly enriched uranium processing capabilities for Phase II (associated with Buildings 9215 and 9998) and for Phase III (associated with Building 9204–2E). Install the highest priority of these capabilities with the remaining funds in Phase I or as subsequent line-item projects. The transition of the highly enriched uranium processes from Buildings 9204-2E, 9215, and 9998 will continue until all these processes are fully operational in the UPF within the UCRP. UPF manufacturing capacity will be at

[2] *In the FY 2013 National Defense Authorization Act, the Uranium Processing Facility (UPF) Project was broken into three phases and renamed the Uranium Capabilities Replacement Project (UCRP) for budget authorization.*

approximately 80 CSAs per year when all process operations from 9212 (Phase I), 9215, and 9998 (Phase II, and 9204-2E (Phase III) are fully operational in the UPF.

- Implement the plans for incremental investments that are needed until the UCRP is fully operational for facility risk reduction in Buildings 9204-2E, 9215, and 9998.

The President's FY 2013 budget request deferred CMRR-NF construction. NNSA plans to phase in capabilities sooner than planned for CMRR-NF by adding equipment in existing infrastructure. NNSA is also evaluating the feasibility of constructing small laboratory modules connected to existing nuclear facilities that could accommodate higher risk plutonium operations in more modern space. The following steps are being taken as part of a plutonium strategy to maintain uninterrupted plutonium operations, in light of the 5-year deferral of construction of the CMRR-NF. The sum of these efforts will ensure the continuity of Defense Programs' plutonium manufacturing and support capabilities to meet currently identified program needs.

- Implement strategies to provide analytical chemistry, material characterization, and storage capabilities using existing facilities until the CMRR-NF is operational.
- Continue the planned orderly phase out of activities in the Chemistry and Metallurgy Research (CMR) Building until approximately 2019.
- Implement plutonium strategy plans to optimize use of the Radiological Laboratory Utility Office Building (RLUOB) for analytical chemistry capabilities. The plan supports a CMR Building exit strategy and relocation of analytical chemistry functions.
- Continue to implement plans to process, package, and ship excess special nuclear material in PF-4. Consider proposals for material staging options at other sites for bulk quantities of plutonium with defined future use.
- Continue to execute a plutonium strategy that achieves manufacturing capacities of 10 pits per year by 2019 and 30 pits per year by 2021.
- Complete examination of alternatives for the construction of the CMRR-NF, or an alternative to its construction, as part of the plutonium strategy to support potentially up to 80 pits per year manufacturing capability in Technical Area 55 (TA-55) starting as early as FY 2030. NNSA will continue to develop options to achieve the higher production rate as part of the plutonium strategy.
- Evaluate design options to build a tunnel that would optimize program operations between RLUOB and PF-4.

In addition to the UCRP construction, NNSA is committed to the following high-priority capital-line-item infrastructure projects that have funding in the FY 2014 budget:

- Certify and stage transuranic waste for shipment off site via the Transuranic Waste Facility Project as part of a comprehensive, long-term strategy to consolidate hazardous and radioactive waste operations and comply with New Mexico Consent Order requirements.
- Upgrade PF-4 to address safety and security concerns through Phase II of the TA-55 Reinvestment Project.
- Upgrade the LANL radioactive liquid waste treatment capability, which is expensive to maintain and has become unreliable, with the Radioactive Liquid Waste Treatment Facility Project.
- Complete transition to the recently constructed Kansas City Responsive Infrastructure Manufacturing and Sourcing (KCRIMS) that is part of the Kansas City Plant National Security Campus (KCPNSC). The equipment relocation and installation activities are under way from the 3.0-million-square-feet Bannister Federal Complex to the 20-year-leased, 1.5-million-square-feet KCPNSC. Buildings at the KCPNSC are Leadership in Energy and Environmental Design (LEED) Gold certified, and on schedule with full occupancy projected for FY 2014.

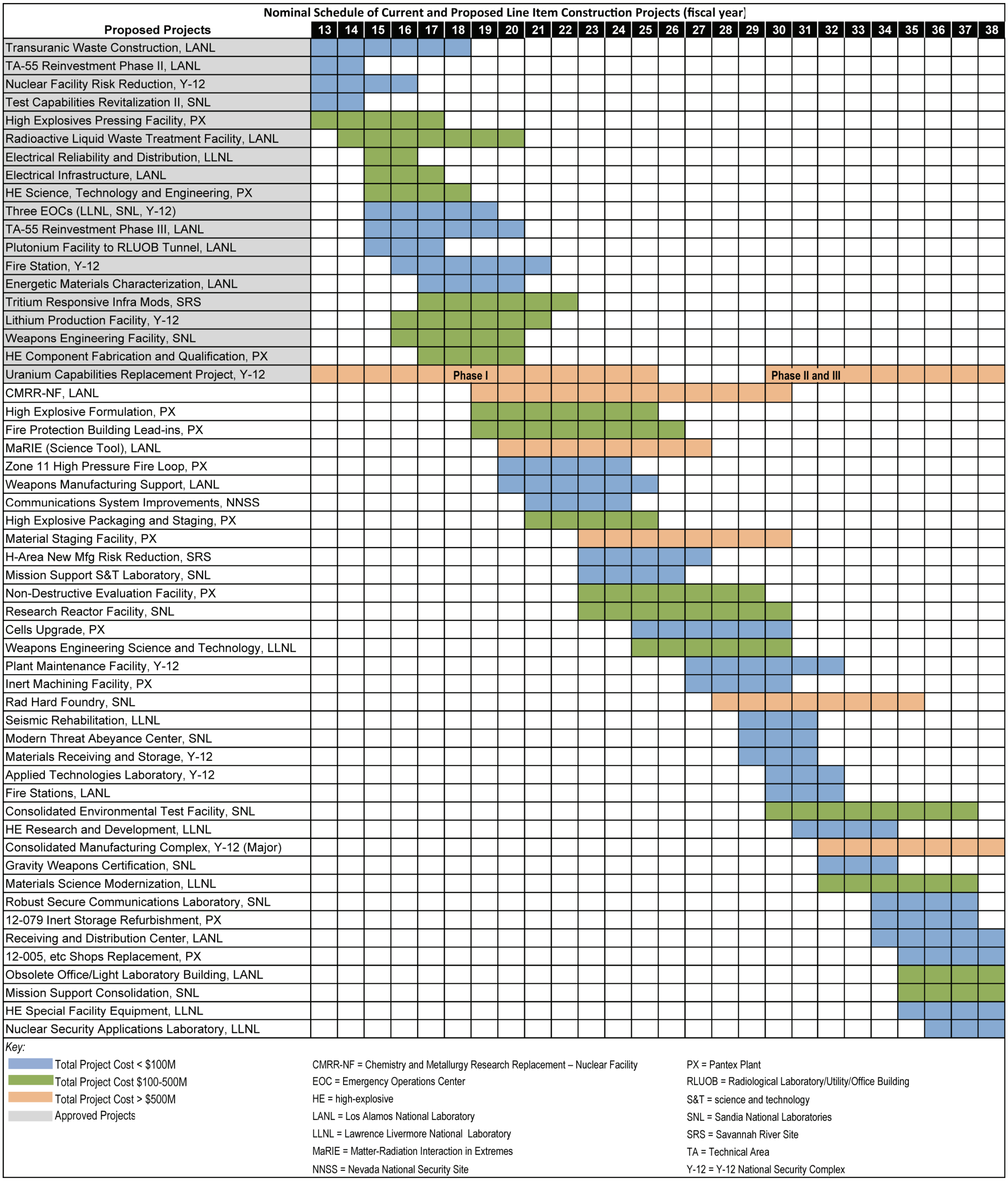


Figure 5–2. NNSA Integrated Priority List of capital construction projects

5.3.2 Approved and Proposed Security and Capital Equipment Projects

Figures 5–3 and **5–4**, respectively, list the security and capital equipment projects proposed to meet the needs of specific NNSA programs. The descriptions for these projects are provided in Appendix D. The projects proposed by the Defense Nuclear Security program, as shown in Figure 5–3, include four Y-12 projects that support right sizing and efficiency by reducing the PIDAS and adding Argus infrastructure. The Security Improvement Project will implement the Argus security system, an interconnected, computer-based personnel access system adopted by DOE and NNSA as the standard security technology for the nuclear security enterprise. Other Y-12 projects include PIDAS Sensor Modernization, Central Alarm Station Relocation, and Entry Control Facilities. Security fence projects at other sites include the Nuclear Materials Safeguard and Security Upgrade Project Phase II under construction at LANL, the new Device Assembly Facility Argus project, and the Zones 4 and 12 PIDAS Refurbishment and the Protective Force Portal Upgrade and Enhancement Projects at the Pantex Plant. The capital equipment projects in Figure 5–4 include the Exascale Computing Project at multiple sites, the Silicon Fabrication Recapitalization Project at SNL, the Enhanced Radiography Equipment Project at the Nevada National Security Site, and the LEP and Warhead Assessment Revitalization at LLNL.

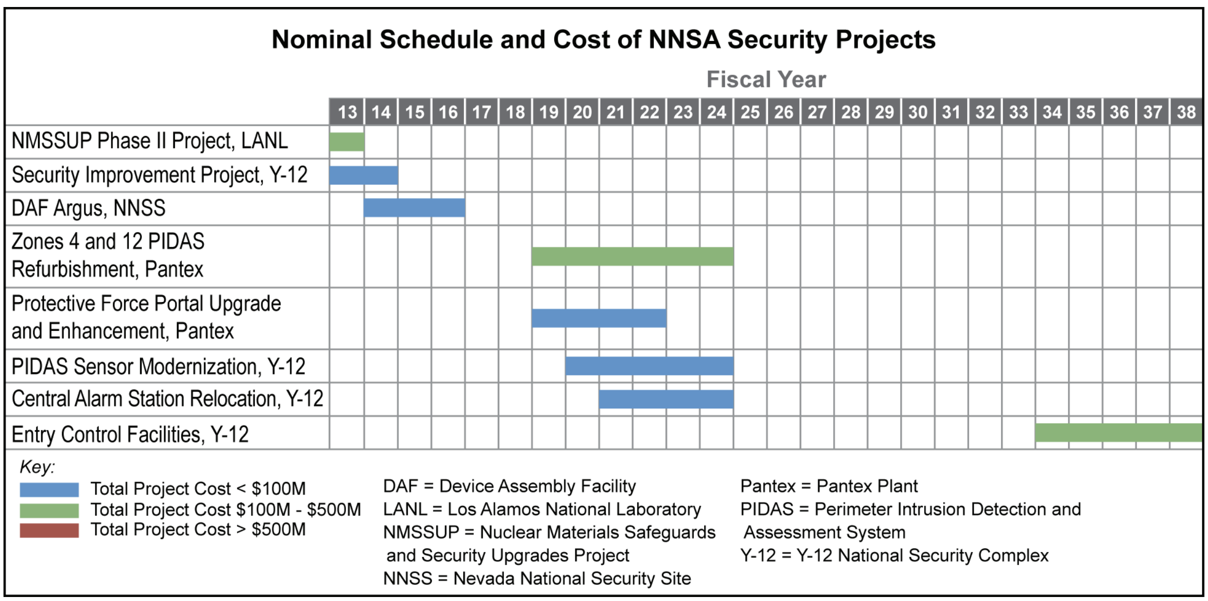


Figure 5–3. Nominal schedule and cost of security projects

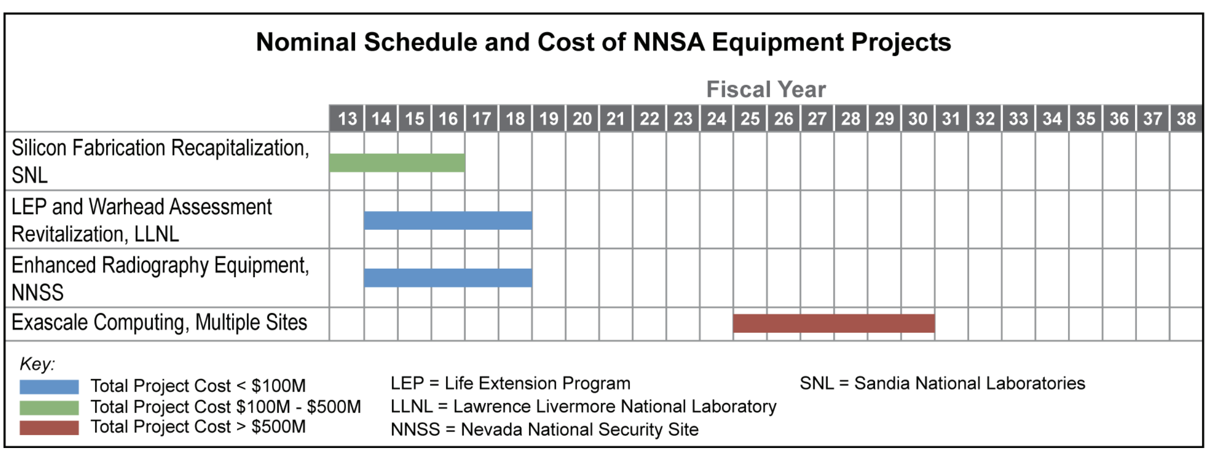


Figure 5–4. Nominal schedule and cost of capital equipment projects

Reductions in high-security fenced areas will contribute to facility modernization and consolidation of special nuclear material. The total net high security fence reduction is estimated at 134 acres and **Figure 5–6**, in Section 5.8, identifies the schedule to achieve the PIDAS reduction.

The LLNL PIDAS reduction transitioned Building 332 (Superblock) to Security Category III status at the end of FY 2012. LLNL support of LEPs may require special security accommodations on a periodic basis to support stockpile stewardship. LLNL is exploring options to use Superblock and other facilities for limited periods to support LEPs.

> ***High Security Fence Reduction***
>
> *A nuclear security enterprise-wide net reduction of about 25 percent of the high-security fenced acreage will be possible after consolidation and completion of a few projects. The net security fence reduction:*
>
> | | |
> |---|---|
> | – *NMSSUP Phase II, LANL* | *+6 acres* |
> | – *Superblock Deinventory, LLNL* | *-10 acres* |
> | – *West-end Protected Area Reduction, Y-12* | *-70 acres* |
> | – *Central Alarm Station Relocation, Y-12; PIDAS Sensor Modifications, Y-12; and Entry Control Facilities, Y-12* | *-60 acres* |
> | – ***Total net high security fence reduction*** | ***-134 acres*** |

The West-end Protected Area Reduction is an early subproject of the UCRP that, when completed, will reduce the protected area from 150 acres to about 80 acres. Because it is an interim PIDAS reduction and part of the UCRP scope, this subproject is not in Figure 5–3. UCRP construction will include building infrastructure and phased installation of the processing equipment. Therefore, the three security projects[3] funded by the Defense Nuclear Security program and the final PIDAS reduction from 80 acres to 20 acres depend on completion of all three phases of the UCRP.

5.4 Reliance on Non-DOE-Owned Facilities and Infrastructure

NNSA owns the majority of the real property facilities and infrastructure that support the nuclear deterrence mission. However, for greater efficiency, NNSA uses a combination of owned, leased, permitted (licensed), commercial, and partner facilities to execute its mission. Examples of these unique property assets include the TVA reactors, the University of Rochester's Omega laser facility, and the Holston Army Ammunition Plant. NNSA leverages the cost savings and benefits of time-sharing and collaboration against the risk of unplanned termination of the capabilities by owners of these facilities. This approach allows NNSA to focus resources on sustaining and modernizing its own assets.

5.5 Disposition of Excess Facilities

The Facilities Disposition (FD) subprogram within Site Stewardship supports a modern and efficient nuclear security enterprise by managing the risk to the worker, public, and environment of excess facilities that have deteriorated. Process-contaminated facilities with minimal maintenance budgets and no funding for future disposition pose the greatest risk. The FD subprogram manages these risks by characterizing and removing hazardous materials to place the facilities in the lowest risk configuration. Non-process-contaminated facilities pose risks to the worker, public, and environment because of structural degradation, industrial contamination, and increased vulnerability to fire. In addition, some excess facilities may complicate a site's security response by cluttering lines of fire and offering vantage points to adversaries.

NNSA plans, prioritizes, and executes the FD subprogram at the nuclear security enterprise-level because of the uneven distribution of deteriorated facilities requires prioritization at that level. Coordination with the Office of Environmental Management is also required for the transfer and final disposition of process-contaminated facilities.

[3] *The three security projects replace the Protected Area Reduction Project that was described in the FY 2012 SSMP.*

Management of the risks created by deteriorating excess facilities, by disposition to eliminate the risk and other measures to manage the risks, is important for attaining the DOE and NNSA strategic goals and complying with Congressional and Executive mandates. The FD subprogram's management of the final stages of the facility life cycle is an essential component of NNSA's corporate facilities management. NNSA will provide Congress a separate report on the disposition program in accordance with the Conference Report 107-258, which accompanied the Energy and Water Development Appropriations Act, 2002.

Figure 5–5 below summarizes NNSA's excess facility footprint projections over the FYNSP. The planned deactivation and disposition of non-process-contaminated facilities will be prioritized within site operating resources. NNSA's FD subprogram will focus FY 2014 through FY 2018 resources on managing risk of the deteriorating process-contaminated facilities awaiting transfer to the Office of Environmental Management for disposition.

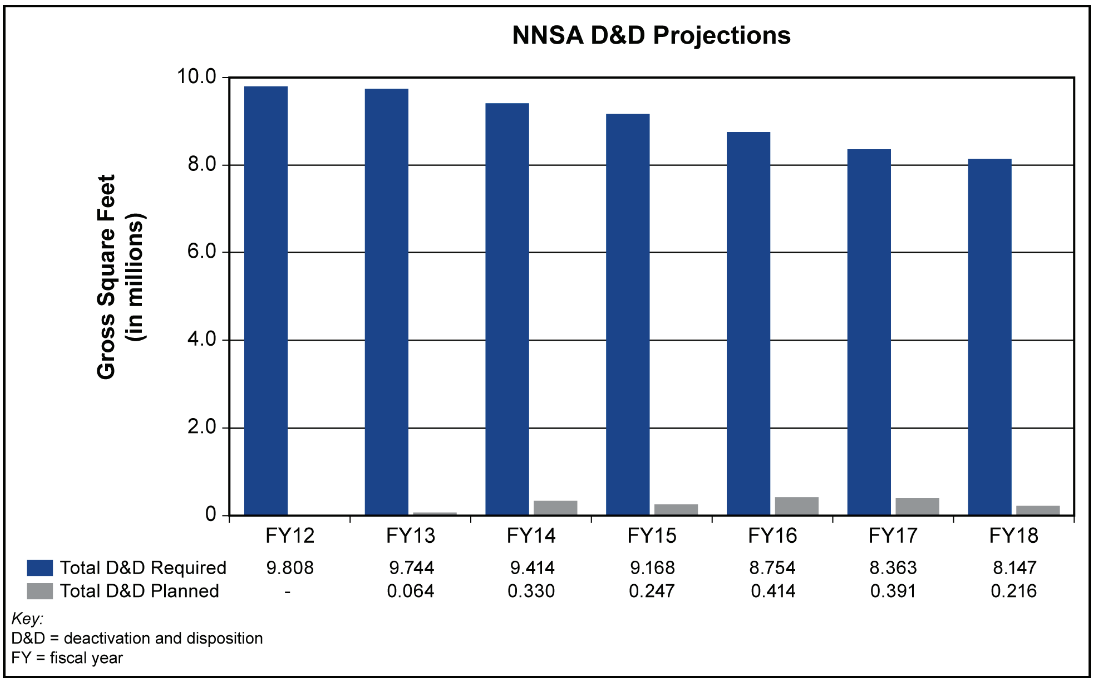


Figure 5–5. NNSA deactivation and disposition projections

5.6 Capabilities for Post-2038 Weapons Infrastructure

Table 5–2 provides a post-2038 physical infrastructure posture that supports NNSA's vision of a modern, efficient, 21st century nuclear security enterprise. Project activities will be funded from the priority list in Figure 5–2 based on the resources provided. Assuming sufficient FYNSP and post-FYNSP funding, significant change and modernization at the eight field sites will have been accomplished. Table 5–2 shows a nominally resourced program where the performance status is green (satisfactory) for most of the nuclear security enterprise's major mission functions and the known risks are mitigated in support of a post-2038 weapons programs posture. Mission functions and capabilities are listed with a satisfactory capability status. Mission functions, at risk in the post-2038 posture include plutonium manufacturing, uranium radioactive waste disposition, weapons assembly and disassembly, and non-nuclear component R&D and production.

Table 5–2. Infrastructure modernization accomplishments and post-2038 capability status

Existing infrastructure is estimated to be sufficient for post-*Nuclear Posture Review Report* (DoD 2010) mission capabilities.
Existing infrastructure may not be sufficient or is inefficient or unreliable for post-*Nuclear Posture Review Report* (DoD 2010) mission capabilities.
Existing infrastructure is not sufficient for post-*Nuclear Posture Review Report* (DoD 2010) mission capabilities.

Function	*Mission Capability*	*Post -2038 Estimated Limitation of Capability*	*Capability Requirement*	*Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability*
Plutonium	R&D	Satisfactory	Sustain existing facilities	• Discontinued CMR building operations in 2019, LANL • Optimized RLUOB operations to support plutonium analytical chemistry, LANL • Completed CMRR-NF or alternative
	Manufacturing	Up to 80 pits per year; manufacturing and plutonium facility approaching end-of-design life	Up to 80 pits per year	• Completed PF-4 Manufacturing Process Equipment Upgrades (existing line) to increase production capacity to 30 pits per year, LANL • Complete investments in TA-55 to address projected demand for plutonium manufacturing, increased pit manufacturing up to 80 ppy, and support capabilities • Constructed TRP Phases II and III upgrades, LANL • Consider proposals for PF-4 replacement, LANL
	Storage	Satisfactory, with no known storage limitation; storage adequate at PF-4 for strategic assets	Sustain existing facilities	• Deinventoried bulk plutonium in PF-4 vault; shipped strategic assets materials to storage location(s) and surplus materials to WIPP or stored at DAF or other location, LANL • Sustained material staging capability, Pantex
	Radioactive waste disposition	Satisfactory, with no known limitation	Sustain existing facilities with some new construction	• Constructed TRU Waste Facility and closed TA-54, Area G, LANL • Constructed RLWTF Upgrade, LANL
Uranium	R&D	Satisfactory, with no known limitation	Sustain new facility	Constructed Applied Technology Laboratory, Y-12
	Manufacturing	Approximately 80 CSAs per year	Sustain existing and new facilities	• Constructed and made operational the UCRP, Y-12 • Completed NFRR refurbishment, Y-12 • Constructed Lithium Production Facility, Y-12 • Initiated construction of the Consolidated Manufacturing Complex, Y-12
	Storage	Satisfactory	Sustain HEUMF	No new construction
	Radioactive waste disposition	Aged and inefficient infrastructure	Sustain existing facilities	Consider proposals to sustain radioactive waste disposition capability
Tritium	R&D	Satisfactory	Sustain existing facilities	No new construction
	Manufacturing	Satisfactory	Sustain existing facilities	• Unrestricted and unobligated LEU to be provided from down-blended HEU from dismantlements post-2030. • Maintained the U.S. Nuclear Regulatory Commission license at TVA required to support TPBAR irradiation cycles • Sustained the Tritium Extraction Facility and other support facilities, SRS • Completed the TRIM initiative (expense and capital projects), SRS • Completed the HANM Risk Reduction Project, SRS
	Storage	Satisfactory	Sustain existing facilities	No change in infrastructure

Function	Mission Capability	Post -2038 Estimated Limitation of Capability	Capability Requirement	Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability
High Explosives	R&D	Satisfactory	Sustain existing facilities	• Constructed HE R&D Facility, LLNL • Initiated HE Special Facility Equipment construction, LLNL • Sustained facilities at HEAF and Site 300, LLNL • Constructed the Energetic Materials Characterization facility, LANL • Consolidated firing site activities, LANL
	Production	Satisfactory	Sustain existing facilities	• Constructed HE Science Technology, and Engineering facility, Pantex • Constructed HE Formulation, Pantex • Completed HE Pressing Facility, Pantex • Constructed HE Science Technology and Engineering, Pantex • Constructed Inert Machining Facility, Pantex • Constructed HE Component Fabrication and Qualification Facility, Pantex
	Storage	Satisfactory	Sustain existing facilities	HE Packaging and Staging Facility constructed, Pantex
	Disposition	Satisfactory	Sustain existing facilities	No new construction
Weapons Assembly and Disassembly	Assembly cells and bays, weapon surveillance, NDE operations	Cells and bays end of design life	Sufficient cells and bays to support all LEPs	• Constructed Nondestructive Evaluation Facility, Pantex • Completed 12-44 cells 1 and 8, and 12-98 cell 4 upgrades, Pantex • Consider proposal for cells and bays refurbishment, Pantex
Nonnuclear Components	R&D	Microelectronics, trusted foundry for LEPs	Keep equipment and tooling close enough to industry to maintain capability	• Completed recapitalization of silicon micro fabrication, SNL • Constructed Research Reactor Facility, SNL • Constructed Radiation Hardened Foundry , SNL
	Production	Maintain silicon semiconductor tooling of limited life technology at laboratories	Facility and tooling modernization to support 2 to 3 phased LEPs	• Performed technology updates to maintain silicon and semiconductor production capability • Sustaining existing facilities at SNL
		Approaching end of lease period at KCPNSC		• Initial lease of KCPNSC ends in FY 2033 • Completed evaluation of non-nuclear alternatives to determine future KCPNSC operations and lease options

Function	Mission Capability	Post -2038 Estimated Limitation of Capability	Capability Requirement	Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability
Special Nuclear Material	Transportation	Satisfactory	Sustain existing facilities	No new construction required
	Security protection and Storage	TA-55 operations at LANL	Sustain new PIDAS	Completed construction of NMSSUP Phase II PIDAS, LANL
		Superblock security reduced at LNLL	Security Category III requirements	No new construction required
		DAF satisfactory at the Nevada National Security Site	Sustain existing infrastructure	No new construction required
		Zone 12 and 4 PIDAS right-sized at Pantex	Sustain right-sized PIDAS	• Funded and implemented preferred Zone 4 elimination alternative in concert with Materials Staging Facility, Pantex • Construct preferred alternative for Zone 12 PIDAS Refurbishment, Pantex • Constructed Protective Force Portal Upgrade and Enhancement, Pantex
		HEU at Y-12 is satisfactory	Sustain new 20-acre PIDAS	• Completed Security Improvement Project construction, Y-12 • Constructed Entry Control Facilities, Y-12 • Constructed Central Alarm Station Relocation, Y-12 • Constructed PIDAS Sensor Modernization, Y-12
Design, Certification, Experiments, and Surveillance	Life extension design support	2-3 LEPs	Design support for 2-3 LEPs	• Fully implemented ST&E capabilities and phasing of LEP activities, including implementation at CMF and PCF at national security laboratories, Nevada National Security Site, and nuclear weapons production facilities • Recapitalized LEP and Warhead Assessment Revitalization Project equipment, LLNL • Constructed Weapons Manufacturing Support Facility, LANL • Constructed Weapons Engineering, Science and Technology, LLNL • Constructed Mission Support Science and Technology Laboratory, SNL • Constructed Weapons Engineering Facility, SNL • Constructed Robust Secure Communications Laboratory, SNL • Constructed Modern Threat Abeyance Center, SNL • Sustained experimental and analysis capabilities
	Certifications, surveillance, and assessments of warheads	Up to 7 warheads types	Assessment of up to 7 warhead types	• Constructed MaRIE, LANL • Provide stable support for Nevada National Security Site and national security laboratories — ST&E capabilities and surveillance
	Computational science	Exaflops	Exaflops	Implemented exascale computing as part of Advanced Simulation and Computing subprogram
	Testing and experiments to support stockpile certification and surveillance	Satisfactory	Sufficient to support stockpile certification and surveillance	• Completed Phase II of Test Capabilities Revitalization • Constructed Research Reactor Facility, SNL • Refurbished Tonopah Test Range equipment and infrastructure • Consolidated major environmental test capabilities to SNL and Pantex • Constructed Gravity Weapons Certification, SNL • Constructed Environmental Test Facility , SNL
		Sufficient radiography for all Nevada National Security Site experiments	Radiography infrastructure, including equipment to support hydrodynamic experiments	Enhanced Nevada National Security Site radiography capability for hydrodynamic subcritical experiments

Function	Mission Capability	Post -2038 Estimated Limitation of Capability	Capability Requirement	Infrastructure Management Strategy to Mitigate Risk and Sustain Required Capability
Enabling Infrastructure	Utility services including HVAC, electrical, fire main, *etc.*	Electrical utility services distribution and system upgrades sufficient	• Sustain infrastructure • Support IT computing and other capacity requirements	• Completed LLNL and LANL electrical utility infrastructure • Constructed Fire Station, Y-12 • Constructed Emergency Operations Centers (LLNL, SNL, and Y-12) • Constructed Zone 11 High Pressure Fire Loop, Pantex • Constructed Fire Protection Building Lead-ins, Pantex • Constructed Communication Systems Improvements, Nevada National Security Site • Constructed Plant Maintenance Facility, Y-12 • Constructed Seismic Rehabilitation; LLNL • Constructed Fire Stations, LANL

CMF = Component Maturation Framework
CMR = Chemistry and Metallurgy Research
CMRR-NF = Chemistry and Metallurgy Research Replacement Nuclear Facility
CSA = canned subassembly
DAF = Device Assembly Facility
FY = fiscal year
HE = high explosive
HEAF = High Explosives Applications Facility
HEU = highly enriched uranium
HEUMF = Highly Enriched Uranium Materials Facility
HVAC = heating, ventilation, and air conditioning
IT = Information Technology
KCPNSC = Kansas City Plant National Security Campus
LANL = Los Alamos National Laboratory
LEP = life extension program
LEU = low-enriched uranium
LLNL = Lawrence Livermore National Laboratory
MaRIE = Matter-Radiation Interaction in Extremes
NDE = nondestructive evaluation
NFRR = Nuclear Facility Risk Reduction
NMSSUP = Nuclear Materials Safeguards and Security Upgrades Project
PCF = Predictive Capability Framework
PF-4 = Plutonium Facility
PIDAS = Perimeter Intrusion Detection and Assessment System
Pantex = Pantex Plant
R&D = research and development
RLUOB = Radiological Laboratory Utility Office Building
RLWTF = Radiological Liquid Waste Treatment Facility
SNL = Sandia National Laboratories
SRS = Savannah River Site
ST&E = science, technology, and engineering
TA = Technical Area
TRIM = Tritium Responsive Infrastructure Modifications
TRP = TA-55 Reinvestment Project
TRU = transuranic
TPBAR = tritium-producing burnable absorber rod
TVA = Tennessee Valley Authority
UCRP = Uranium Capabilities Replacement Project
WIPP = Waste Isolation Pilot Plant
Y-12 = Y-12 National Security Complex

5.7 Site Stewardship

The Site Stewardship Program within the Weapons Activities account is aligned with the DOE's *Strategic Plan* (May 2011) to ensure capabilities and resources are available to address environmental, energy, security, and management challenges. This program was restructured in FY 2014 to include a portion of activities from the Readiness in Technical Base and Facilities Program. Its four infrastructure-related subprograms support modernizing and managing the physical infrastructure: Nuclear Materials Integration, Corporate Project Management, Enterprise Infrastructure, Minority Serving Institution Partnerships Program, and Construction.

5.7.1 Nuclear Materials Integration Subprogram

The Nuclear Materials Integration subprogram focuses attention on consolidation and disposition of specific NNSA nuclear materials. This subprogram includes inactive actinides activities to ensure programmatic materials, not in active use, are properly characterized and safely packaged and that unneeded materials have an appropriate disposition path. In addition, this subprogram maintains and operates the Nuclear Materials Management and Safeguards System that is used to track and account for nuclear materials at DOE and at sites licensed by the Nuclear Regulatory Commission.

5.7.2 Corporate Project Management Subprogram

The Corporate Project Management subprogram provides centralized funding for corporate project management activities within the nuclear security enterprise, specifically: project management standardization, acquisition planning, portfolio management, data sharing and industry coordination, and quality assurance. The Corporate Project Management subprogram enhances project management practices by integrating into a single comprehensive and corporate program the project management processes currently performed by the eight NNSA M&O contractors. This subprogram provides focused management and reliable performance reporting on critical NNSA projects and assets through standardization of NNSA project management processes. This standardization will improve cost performance and eliminate management and control inefficiencies.

5.7.3 Enterprise Infrastructure Subprogram

The Enterprise Infrastructure subprogram includes Site Operations, Site Support, Sustainment, and Facility Disposition.

Site Operations supports the infrastructure investment necessary to provide a nuclear deterrent and sustain base operations within the nuclear security enterprise, including increased surveillance, the B61 LEP, and potential LEPs for the W78 and W88. Site Operations keeps NNSA-owned programmatic capabilities in a state of readiness, ensuring each capability (workforce and facility) is operationally ready to execute programmatic tasks in support of the entire nuclear security enterprise.

Site Support provides the critical cross-cutting support for programmatic functions that include nuclear research and development, nuclear criticality safety, container, waste management, and long-term stewardship activities for both the nuclear security enterprise and other DOE organizations. These support activities are regulatory driven and reduce risks to human health and the environment by (1) operating and maintaining environmental cleanup systems installed by DOE's Office of Environmental Management as part of the Legacy Environmental Cleanup projects at NNSA sites and

(2) performing long-term environmental monitoring activities and analyses in a cost-effective manner to assure compliance with Federal, state, and local requirements.

Sustainment for facilities and infrastructure includes management of maintenance costs, re-capitalization projects, other general plant projects, capital equipment projects, expenses-funded projects, Roof Asset Management Program costs, and other project costs related to line items. Sustainment includes the energy modernization and investment that implements specific sustainability and energy-savings projects across the nuclear security enterprise. Sustainment also addresses NNSA's deferred maintenance backlog. See Section 5.2 for additional information.

The Construction subprogram was previously discussed in Section 5.3. The FD subprogram is part of the Enterprise Infrastructure subprogram and was previously discussed in Section 5.5.

5.7.4 Minority Serving Institution Partnerships Program

The Minority Serving Institution Partnership Program (MSIPP) is a new subprogram that will fund research and education enhancements at under-represented colleges and universities in order to develop the needed skills and talent for NNSA's enduring technical workforce at the labs and production plants.

5.8 Key Milestones, Objectives, and Future Plans

Figure 5–6 Illustrates physical infrastructure key milestones, objectives, and future plans for revitalizing NNSA's infrastructure, assuming sufficient FYNSP and post-FYNSP funding is provided. Projects without approved baselines are not presented with the exception of the UCRP.

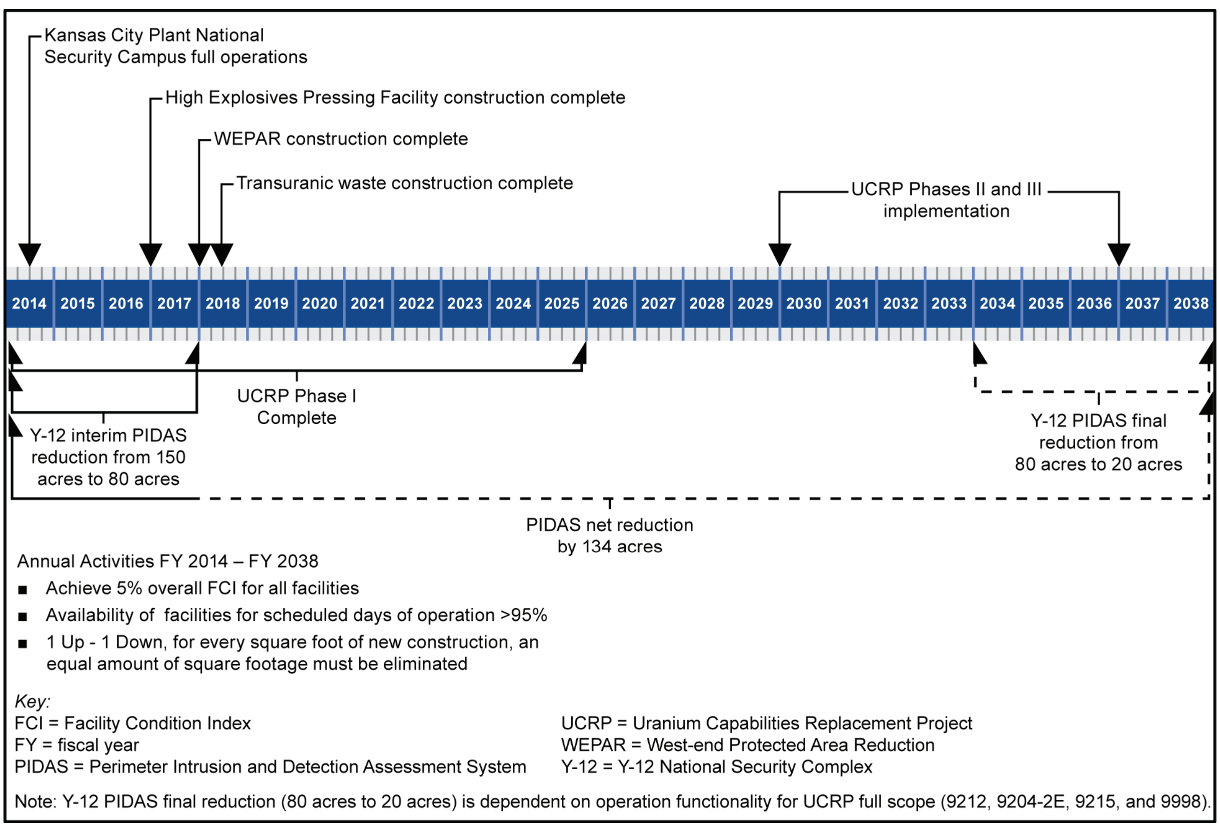


Figure 5–6. Physical infrastructure revitalization milestones, objectives, and future plans

Chapter 6

Sustaining the Workforce

CHAPTER 6
SUSTAINING THE WORKFORCE

The future of the nuclear security enterprise requires a skilled and diverse workforce with the depth of experience in areas that are essential to ensure the Nation retains a safe, secure, and effective deterrent. To ensure the existence of a capable workforce, NNSA must develop and retain sufficient workers with the requisite skills, experience, certifications, and proficiency, especially in the science, engineering, and manufacturing disciplines. In addition, proficiency is required in maintenance, safety, logistics, security, acquisition, program management, and applied skills. Furthermore, the capability to develop and maintain the right skills and to refresh those skills regularly is required.

NNSA faces challenges that are inherent in most Federal agencies, such as an aging workforce, budgetary restrictions and, most importantly, competition for the human talent to accomplish its missions. Looking toward the future, an improved economy may lead NNSA and M&O contractor employees to retire earlier or employees may leave for positions that afford greater monetary gain and career advancement. An improved economy may also create new challenges by driving the demand for essential skills.[1] As a result, NNSA recognizes the need to develop and implement a forward-looking strategy to retain or refresh both its Federal and M&O contractor workforce. Moreover, as new programmatic and business challenges arise, such as increased life extension activity, continued aging of the stockpile, new construction, and new contract models, NNSA must develop new and innovative strategies to sustain its workforce.

6.1 The Nuclear Security Enterprise Workforce

As illustrated in **Figure 6–1**, the nuclear security enterprise workforce consists of three distinct but related components: (1) the Federal workforce, which is primarily civilian but includes key participation by the military services, (2) the M&O contractor workforce, and (3) the non-M&O contractor workforce. Each component has a unique role and purpose.

The Federal workforce plans, manages, and oversees the nuclear security enterprise and is ultimately accountable to the President, Congress, and the public. It performs key planning functions such as integrating DoD requirements and conducts planning and programming. In addition, the Federal workforce provides program and project management, risk management, and acquisition and contract management. Finally, the Federal workforce oversees activity in the nuclear security enterprise through fiduciary oversight, risk acceptance, product acceptance, and environmental, safety, and health oversight.

[1] *Within this context, the term "essential skills" means skills that are required to accomplish the Defense Programs and other assigned NNSA missions indefinitely or are required at a given time to support specific, defined aspects of nuclear security enterprise activities. Such skills are related to scientific, technical, engineering, operations, business, or other professional disciplines. They are further characterized by factors such as their uniqueness, high market demand, time to acquire and maintain proficiency, and difficulty in recruiting and retaining individuals with those skills. See the text box at the end of Section 6.2.3 for examples of essential skills.*

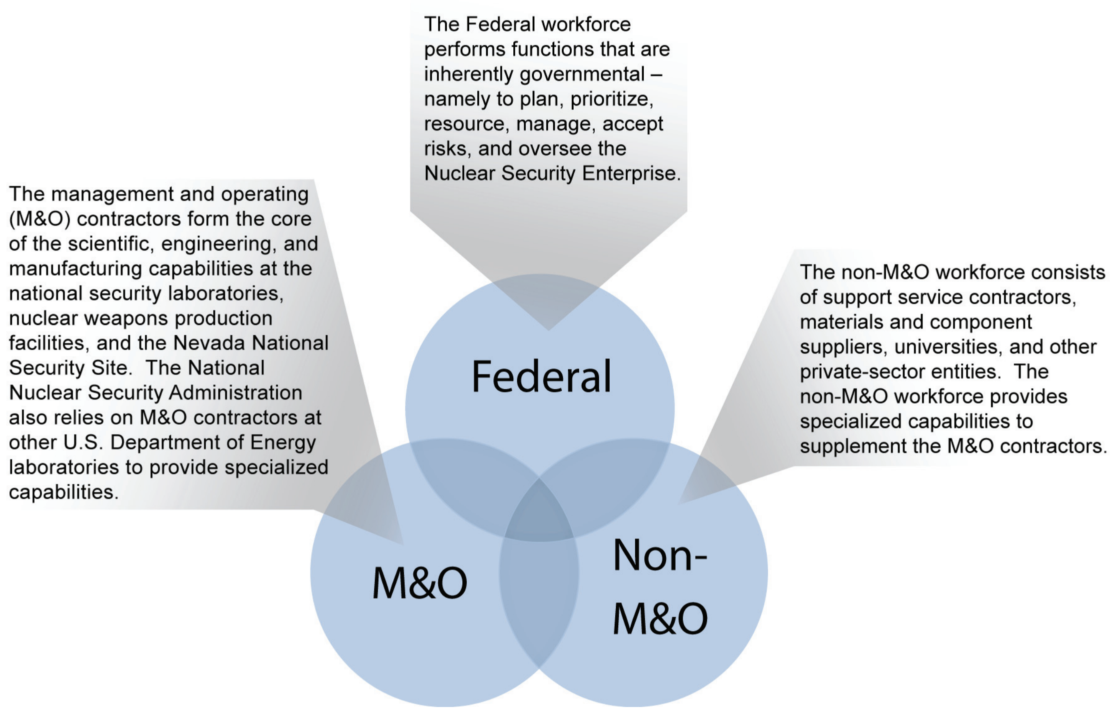


Figure 6–1. Nuclear security enterprise workforce components

In addition to the Federal civilian workforce, a cadre of military officers is routinely stationed on active duty at NNSA, primarily within Defense Programs. The senior military leader in Defense Programs is a flag officer whose position is established by the Atomic Energy Act of 1954, as amended. These officers bring a service perspective to weapons activities and return to DoD at the end of their assignment with a better understanding of NNSA, the nuclear security enterprise, and weapons activities. Overall, the Federal workforce constitutes about 10 percent of the total nuclear security enterprise workforce; the cost of this oversight and management constitutes less than 4 percent of contract expenses.

Historically, weapons activities have been implemented primarily through a Government-owned, contractor-operated, research, development, and production complex, along with a large commercial, academic, and industrial supply chain. The M&O contractors, or their equivalent within DOE, operate most of the R&D facilities. The NNSA M&O contractor workforce is principally located at the eight NNSA principal Government-owned facilities. For seven of these, NNSA is the “landlord” responsible for the overall contract arrangements under which the M&Os operate. Defense Programs is a tenant organization at SRS, for which the DOE Office of Environmental Management is the landlord. While not part of NNSA, the Office of Environmental Management reports to the Under Secretary for Nuclear Security, who also serves as the NNSA Administrator. Based on its specific needs, NNSA also obtains goods and services from other DOE national laboratories and facilities, principally those managed by the DOE Office of Science and Office of Nuclear Energy.

Personnel exchange provides a means for key interface between the Federal and M&O contractor workforce. As in other DOE program offices, under current DOE policy, M&O contractor with technical expertise are routinely assigned to NNSA Headquarters in Washington, D.C., usually for 1 to 3 years. This exchange program provides opportunities that are beneficial to both the Federal Government and its M&O contractors as it improves overall communications between the Federal and M&O workforce. From the Federal perspective, Federal program managers obtain technical expertise and advice from the national security laboratories, the Nevada National Security Site, and the nuclear weapons production facilities, often in highly specialized areas. When M&O contractors return to their home organizations, they bring back knowledge and understanding of how Federal programs are structured, managed, and operated, as well as an understanding of business drivers, policies, and practices. The exchange program also contributes to the overall decision-making process of Defense Programs and other NNSA organizations, as well as to the development of senior leadership at their home facility. In a few instances, this program has been a source of recruitment for senior technical positions in Federal programs. Improvements can result from this exchange as Federal employees use the exchange to understand better how their fiduciary responsibilities can be executed, and as they use technical training opportunities offered by M&O contractors.

NNSA's outreach for the requisite skill set goes beyond its own landlord responsibilities. In addition to having access to the expertise of M&O contractors, NNSA relies on non-M&O contractors to provide specialized services and academic institutions to develop a workforce pipeline with the best and brightest from universities around the Nation. Formal "pipeline programs" exist as well as other programs and tools to support recruitment and retention of the workforce.

6.2 Workforce Planning for the Nuclear Security Enterprise

The role of Headquarters in workforce planning is two-fold: plan for the Federal workforce and monitor the M&O contractor workforce planning. NNSA requires its M&O contractors to determine the appropriate skill mix, which could change as the mission evolves, to execute stockpile stewardship and management activities. NNSA Headquarters works jointly with its M&O contractors to collect workforce data and identify and resolve issues, particularly those affecting multiple sites.

6.2.1 Strategic Workload Drivers

Over the next 25 years, the U.S. nuclear stockpile will be sustained through vigorous surveillance, assessment, life extension, and dismantlement efforts. The nuclear security enterprise workforce will perform annual certifications and assessments of the stockpile to certify readiness of systems, extend the life-span of aging weapon systems through planned LEPs and analysis of LEP options, perform exchanges of weapons system LLCs, dismantle and retire weapons, refurbish and modernize the physical infrastructure, and develop and institute a suite of "best business practices" to improve efficiency and integration across the nuclear security enterprise. As the United States reduces the number of nuclear weapons, the reliability of the remaining weapons and the quality of the facilities to manage them will become more important. The nature of this range of activities is sufficient to exercise essential skills. However, NNSA will need to be smart about scheduling these activities to avoid significant gaps in the performance of some skills that could lead to the loss of these skills.

In the past, long periods between programmatic engagement, coupled with the demographics of the workforce (*i.e.*, an aging workforce) and the reductions in DSW program funding, have placed significant pressure and risk on the retention of knowledge and the maintenance of essential skills. The most cost-effective way to ensure sustainment of the full range essential skills and capabilities for designing and building nuclear weapons is to maintain a balanced workload of LEPs.

A highly-skilled nuclear security enterprise workforce is needed to meet specific programmatic challenges that depend on sufficient FYNSP and post-FYNSP funding levels. Most of the active stockpile will be in various stages of life extension activities in the future. The Nuclear Weapons Council has approved a baseline LEP plan; the details of that plan are in Chapter 2, Section 2.6.2 (see Figure 2–8) and in Chapter 2 of the classified Annex. Since the cessation of underground nuclear testing, there have been limited opportunities to exercise the full range of weapon design and production skills. Coupled with the aging workforce, unacceptable pressure and risk on the retention of knowledge and the maintenance of essential skills has occurred. The balanced workload of LEPs provides an opportunity to ensure the sustainment of essential skills and capabilities for designing and building nuclear weapons.

6.2.2 Federal Workforce Planning

In December 2010, at the direction of the Deputy Administrator, Defense Programs completed an internal analysis of its Federal staff requirements at Headquarters and the seven field offices. As a result of this effort, Defense Programs has (1) a current baseline for Federal staffing, by function, at NNSA Headquarters and its seven field offices, (2) a projection of staff requirements to FY 2016, and (3) strategies and other follow-on actions. A broader NNSA Federal Baseline Staffing Analysis was commissioned by the Principal Deputy Administrator in March 2011. That analysis captured information that NNSA can use to help determine its future staffing requirements.

Until an NNSA action plan is developed to support the Federal study, the Defense Programs study will serve as the informative workforce data for this document. *The National Defense Authorization Act for Fiscal Year 2013* capped the NNSA Federal staffing ceiling at 1,825 by October 1, 2014. This reduction from the previous ceiling of 1,910 represents a constraint as well as an opportunity to reshape the workforce.

The retirement rate may be slightly higher than average in the future. This presents a unique opportunity to reshape the workforce with a more diverse staff who are trained and positioned to address nuclear security challenges with new technologies. To address retirement challenges, NNSA will use knowledge-capture techniques and processes to record, understand, and transfer the invaluable experience and knowledge of the aging workforce. To meet these challenges, NNSA will emphasize effective leadership, performance measures, management consistency, increased focus on training at all levels, increased flexibility and adaptability of the staff, and the need for aggressive program knowledge transfer.

For NNSA staffing, **Figure 6–2** shows the FY 2013 composition of the Federal workforce in the Office of the Administrator, Office of Secure Transportation Asset including the NNSA field offices by occupational series functions. Figure 6–2 shows that 63 percent of the Federal workforce is included in the occupational series functions of engineers, program and administrative management, and safety and security. It is this workforce that is responsible for the Federal management and oversight functions of NNSA.

Overall, the workforce distribution by occupational series functions should not change dramatically in the next 5 years. Several initiatives designed to improve performance, operations, and business practices are discussed in detail in Chapter 8, Section 8.10. As these initiatives mature, the Federal workforce will evolve.

One initiative that has come to fruition is the consolidation of the Pantex Plant and Y-12 field offices into the NNSA Production Office. This consolidation is expected to yield staff savings in the long term. The NNSA Production Office is responsible for the transition to, and execution of, the new consolidated M&O contract at Y-12 and the Pantex Plant. Over time, the NNSA Production Office may be responsible for other NNSA production activities, such as the tritium operations at the Savannah River Site. The NNSA Production Office will continue contract management and oversight of the existing M&O, Security, and Support Service contracts at Y-12 and the Pantex Plant through the transition to and execution of the new contract. The NNSA Production Office will also be responsible for timely closure of expired contracts at both sites.

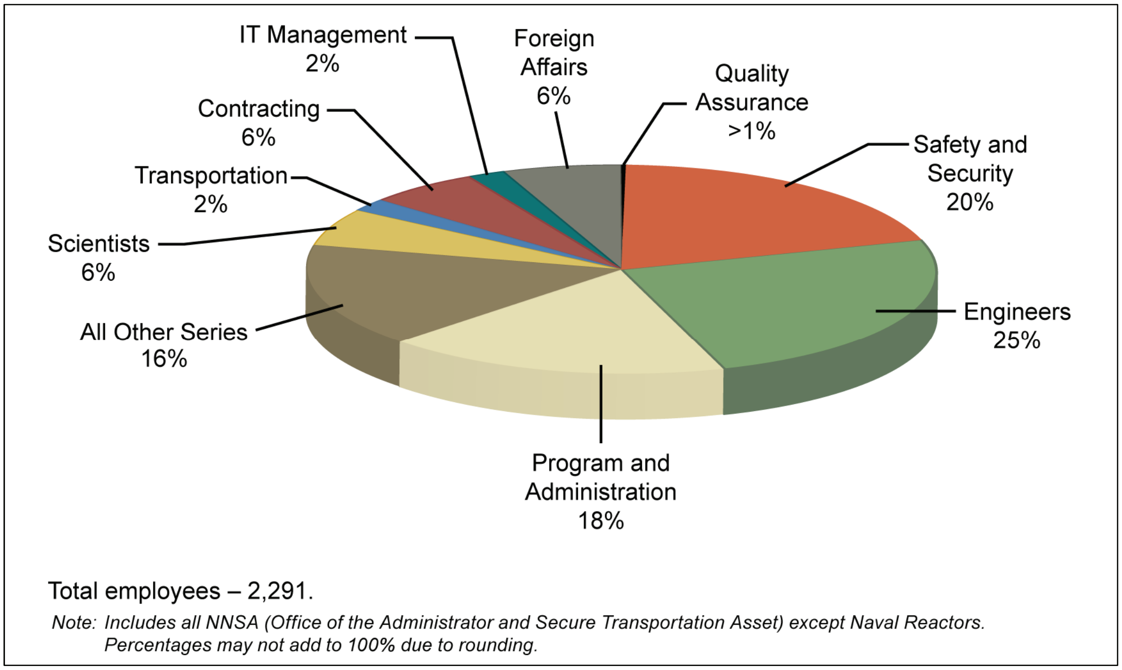


Figure 6–2. NNSA workforce by occupational series functions (excludes Naval Reactors)

The NNSA Production Office is organized with geographically distributed functional leads in order to not require relocations and to facilitate teaming and consolidation where appropriate. The NNSA Production Office will operate in a geographically neutral manner; the organization is flatter than the other models considered. Over time, a single process will cover both sites. Efficiencies are expected through natural attrition; when a vacancy is available, an evaluation will be conducted to determine if the position needs to be at one site or at another or, perhaps, is needed at both. These efficiencies will translate into a smaller Federal footprint.

In addition to cost savings, NNSA anticipates a combination of staff savings, skill-mix changes, and redistribution of staffing resources in the Federal workforce across the nuclear security enterprise.

6.2.3 Management and Operating Contractor Workforce Planning

NNSA's M&O contractors have, by direction, developed and implemented effective workforce planning capabilities for their respective organizations. In addition, the U.S. Government Accountability Office has determined that each contractor has implemented strategies and programs to recruit, hire, and retain the essential skills needed.[2]

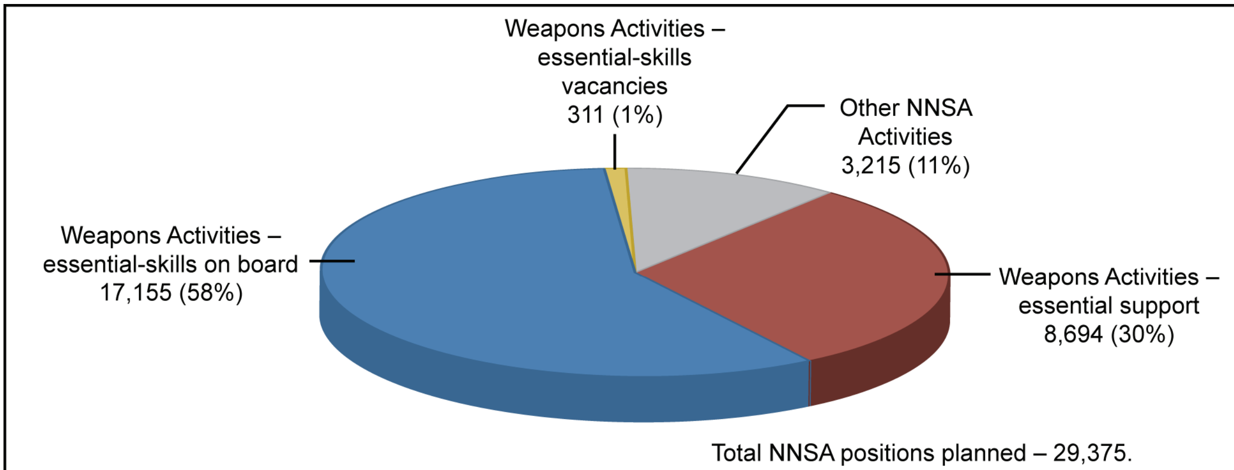
As the responsible Federal oversight agency, NNSA recognizes the need for a comprehensive review and corporate outlook regarding the M&O contractor workforce, particularly the essential skills to ensure that strategies are in place to meet mission requirements. To maintain essential skills and work variety, NNSA conducts Work for Others (WFO) that also represents a unique opportunity to leverage personnel

[2] *In its February 2005 Report, entitled* National Nuclear Security Administration: Contractor's Strategies to Recruit and Retain a Critically Skilled Workforce are Generally Effective, *the General Accounting Office (now called the Government Accountability Office found that all of the M&O contractors have developed and implemented effective recruiting and retention strategies, have maintained the critically skilled workforce needed to fulfill their current missions, and are using effective principles essential for strategic workforce planning. Furthermore, the report found that NNSA supported these strategies by providing additional funding and monitoring and evaluating the contractor progress in meeting critical workforce needs.*

and facilities to provide capabilities to other Federal agencies, private industry, and universities and colleges.

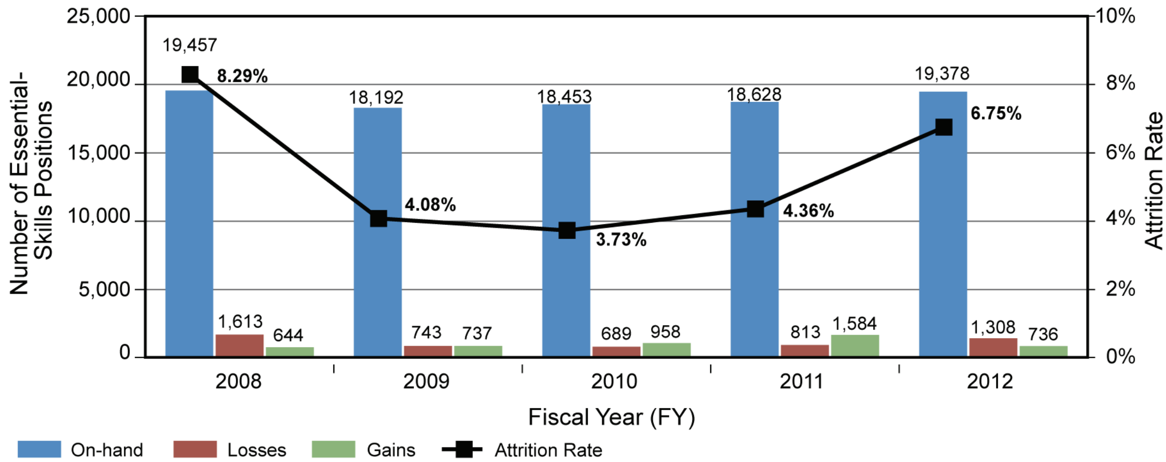
NNSA developed a standardized approach to gather, analyze, and report data on the M&O contractor workforce making use of the Common Occupational Classification System to provide a standard characterization of the workforce, as illustrated in this chapter. This was needed because each M&O contractor uses a different system and terminology to characterize its respective workforce. As a result, NNSA has a corporate baseline and reporting capability regarding its M&O contractor workforce. This capability is being used to verify the workforce on hand and assure that its M&O contractors are adequately planning to meet workforce requirements to accomplish assigned missions.

In collaboration with the M&O contractors, Defense Programs developed an initial baseline for each M&O contractor workforce. **Figures 6–3, 6–4** and **6–5** reflect the consolidated M&O contractor workforce. Figure 6–3 illustrates the end of FY 2012 total M&O workforce, including total NNSA positions, weapon and non-weapon positions, and positions that require essential skills and essential support for weapons activities. Figure 6–4 provides the M&O workforce gains and losses and the attrition rates for positions that required essential skills for the last 5 years. Figure 6–5 illustrates the overall M&O workforce projections through FY 2038 for essential skills, by occupational series. DoD and NNSA are conducting workforce prioritization studies to determine if higher staffing levels can be achieved. The dashed line in Figure 6–5 represents staffing levels if workforce prioritization goals cannot be achieved (see Chapter 8).



- Almost 26,000 positions, 88 percent of the workforce support Defense Programs Weapons Activities.
- Approximately 11 percent of the workforce support other NNSA Activities such as direct or indirect support of other programs.

Figure 6–3. National Nuclear Security Administration management and operating contractor workforce



- Essential-skills workforce positions have increased over the past 4 years by about 1,186 positions.
- Attrition rates have increased in the past 2 years; however attrition rates have averaged 4.7 percent over the past 4 years.
- Attrition rates for the scientific and engineering workforce are consistent with the overall workforce.
- Over the past 3 years, there has been acceleration in hiring scientists and engineers, from a low point of 7,707 positions in FY 2010 to 8,679 in FY 2012, which indicates an ability to recruit, maintain, and replenish the workforce.

Note: Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure 6–4. NNSA consolidated management and operating contractor gains and losses in essential-skills positions over the last 5 years

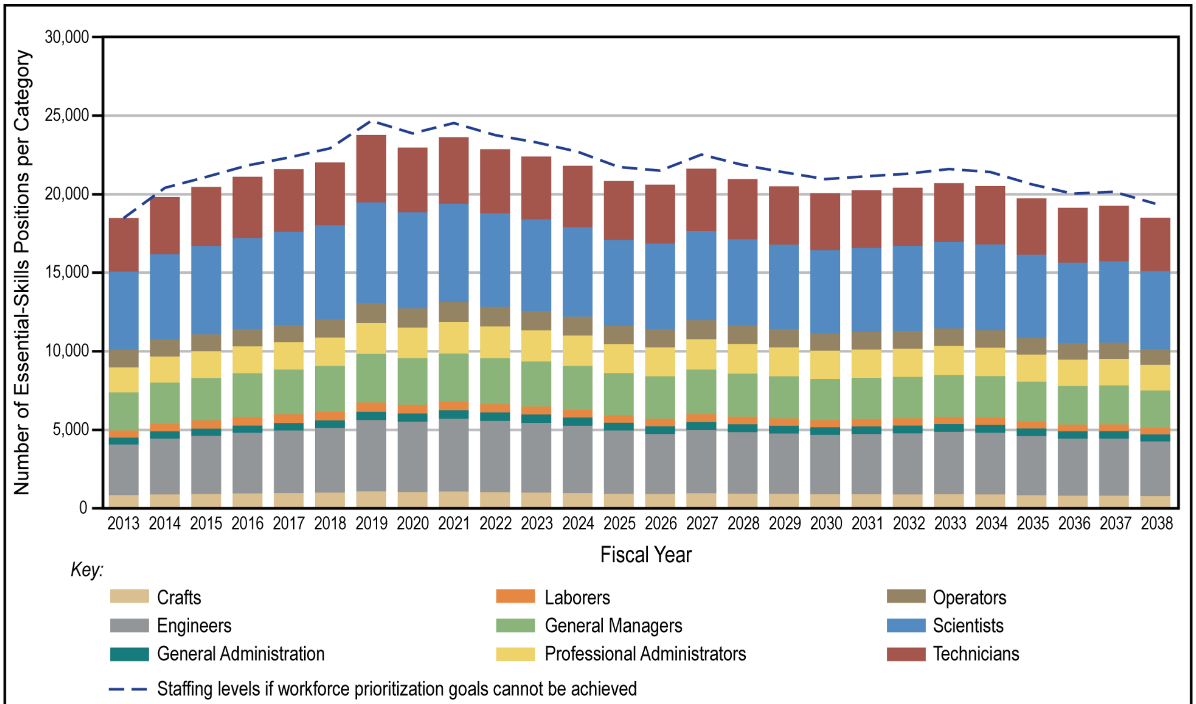


Figure 6–5. National Nuclear Security Administration management and operating workforce projections for essential skills

A separate summary baseline for each individual M&O contractor is provided in Appendix E. Each summary provides a brief narrative outlook and discusses the current workforce; the gains, losses, and attrition rates for positions that require essential skills; and the workforce projections for essential skills through FY 2018.

The present NNSA M&O contractor workforce is described by the following:

- 29,375 total positions are planned to support NNSA programs in FY 2013.
- Nearly 25,800 (88 percent) of the workforce support weapons activities.
- Of those supporting weapons activities, 58 percent have essential skills.

The overall M&O essential skills workforce is expected to increase by 3,500 positions through 2018. M&O contractors have to date been able to recruit and replenish the workforce to maintain the skills considered essential to the weapons activities. They express optimism in Appendix E that this trend is expected to continue. However, the recent NNSA-DoD Joint study expressed some concern over this and is the subject of a workforce study to be conducted over the next several months.

Essential Skills

National security laboratories and Nevada National Security Site

- *Nuclear design and evaluation – primary and secondary design*
- *Nuclear design code development*
- *Physics – atomic and plasma (high energy density)*
- *Computing and simulation*
- *Engineering design and evaluation – all phases*
- *Manufacturing and fabrication*
- *Lasers, pulsed power, accelerators, and gas guns*
- *Diagnostics and instrumentation systems*
- *Quality assurance*

Nuclear weapons production facilities

- *Engineering – electrical, mechanical, and materials*
- *Nuclear criticality safety engineering*
- *Fire protection engineering*
- *Project management and project controls*
- *Reservoir engineering*
- *Radioactive material process engineering*
- *Operational and craft skills*
- *Engineering – welding, radar, and optics*
- *Quality assurance*

6.2.4 The Non-Management and Operating Contractor Workforce

Through academic alliances or long-term vendor relationships, NNSA also seeks to maintain a skilled, versatile, knowledgeable, and experienced workforce to supplement the Federal and M&O contractor workforce. The firms that fabricate TPBARs and the Laboratory for Laser Energetics at the University of Rochester are examples of external workforce providers needed by NNSA. NNSA continues to monitor the numbers, skills, experience levels, and availability of such contractors and will identify additional suppliers to reduce the risk of relying on single-source providers.

6.3 Workforce Sustainment Programs and Strategies

In addition to its Federal and M&O contractor workforce planning initiatives, NNSA recognizes the need to develop and institute forward-looking strategies to refresh both the Federal and M&O contractor workforce. NNSA will continue to employ strategies that have proven successful and to make improvements as necessary. NNSA must develop new and innovative strategies for workforce sustainment to meet the programmatic and business challenges described in this SSMP. Core competencies such as cost analysis are also particularly important.

NNSA's challenge is to attract and retain a high percentage of its employees on a long-term basis and to maintain a high level of proficiency among its staff. By retaining a high percentage of employees, proficiency levels would be maintained, and replacement costs and the exposure of sensitive information would be reduced. However, infusion of new talent is also beneficial in developing new technologies, approaches, and processes. To attract external talent, NNSA must maintain a competitive position with respect to total benefits, including salary.

Even though NNSA is a public entity and its M&O contractors are private-sector entities, NNSA and its contractors use similar strategies and tools to recruit, sustain, and reshape their respective workforce. However, as private-sector employers, the M&O contractors may have more flexibility in recruitment, salary and benefit structure, and workforce mobility.

Some of the more important and successful strategies to recruit, develop, and retain the workforce, along with some of the challenges NNSA and its M&O contractors face, are highlighted in Sections 6.3.1 and 6.3.2 below.

6.3.1 Recruiting Programs

A number of workforce initiative programs assure success in attracting and retaining talented, career-oriented workers. These programs are summarized below.

- **Pathways Program.** Based on the annual assessment to determine the qualifications, educational backgrounds, and special skills that are needed, NNSA will recruit candidates with the right skills and qualifications to meet the long-term strategies of the nuclear security enterprise.
  - **NNSA Graduates Program.** This program, which consolidates the former Nonproliferation Graduate Fellowship Program and the Future Leaders Program, is open to students who have completed academic requirements within the last 2 years in a variety of programs. Participants must complete a 1-year Developmental Program and 40 hours of formal training. Participants receive training and coaching, rotational assignments, and opportunities to work with senior-level and peer-level mentors to develop technical and leadership skills.
  - **Interns Program.** This program consolidates the former Student Career Experience Program and the Student Temporary Employment Program. It is open to students who are pursuing a high school diploma, college degree, or post-graduate degree and are seeking exposure to a wide range of administrative, professional, and technical experiences.
- **Minority Serving Institutions Partnerships Program.** This program supports a number of activities, including internships designed to create a diverse pool of potential employees who have had meaningful work experiences and consider NNSA to be a serious career choice. Each year over 5,000 students participate in various activities across the NNSA field offices, national security laboratories, nuclear weapons production facilities, and the Nevada National Security Sites through agreements with 29 minority serving institutions. The research and faculty support at minority serving institutions is directly related to NNSA missions.
- **Apprenticeship Programs.** These programs address recruitment and retention of craft workers with various skills at the respective NNSA sites.
- **University Partnerships.** These partnerships provide high school through postdoctoral programs to Federal and M&O contractor employees. Such partnering promotes student work programs, helps recruit graduates, and makes it possible to tailor degree programs and curriculum content to meet NNSA's needs.

- **Recruiting and Collaboration Forums.** The objective of these forums is to develop shared recruiting strategies for essential skills, including applicant pools, contacts, and networks, and to provide a coordinated presence at professional association and campus job events.
- **Stewardship Science Academic Alliances and Post-Doctoral Degree Programs.** The national security laboratories will continue to use these programs to recruit a workforce of high-quality scientists.
- **Predictive Science Academic Alliance Program.** This program engages the academic community in advances in predictive modeling and simulation technologies. NNSA and the DOE Office of Science also sponsor a DOE Computational Science Graduate Fellowship for students pursuing doctoral degrees in fields that use high performance computing to solve complex science and engineering problems.
- **Outreach Programs.** These programs emphasize taking an active role in local communities through outreach to teachers and students at middle, secondary, and post-secondary levels that focuses attention on the importance of science and technology. Demonstration programs, speaking events, science bowls, career fairs, and college nights are a few of the tools that NNSA Federal and M&O contractor managers use to engage the public and the academic community.

6.3.2 Development Programs

- **Leadership Development.** NNSA has embarked on a robust, cohesive leadership and career management program to provide the Federal workforce with the tools and resources to do their jobs better. NNSA is unifying its leadership, development, training, and student programs into a single integrated program that is changing the leadership and career management culture. This effort addresses employees at entry, middle, and executive levels. It serves new employees during their first year in NNSA, mid-level employees interested in professional and leadership development, and executive-level employees by providing continual learning, mentoring, networking, and other developmental opportunities and ensuring that qualifications and required certifications are maintained.
- **Individual Development.** Each employee is encouraged to prepare a personal development plan. In-house continuing education and educational assistance programs are provided to promote personal development and improvement of the knowledge base. Scientists and engineers with a Bachelor of Science degree are encouraged to pursue advanced degrees. Other courses and programs are offered both on line and in a formal classroom setting, depending on the subject. Programs and courses range from entry-level studies to advanced executive studies at universities and Federal institutes.
- **Institutes for Higher Learning.** Several M&O contractors have formed institutes, usually in partnership with a university or a consortium of universities, such as the Seaborg Institute, the Engineering Institute, and the Information Science Technology Institute. These institutes serve a recruiting role in addition to providing advanced educational opportunities.
- **Cooperative Education Programs.** Cooperative education programs at several NNSA sites provide opportunities for students attending 4-year universities to alternate semesters of academic study with semesters of paid, career-related, learning experiences. The goal of these programs is to bridge the gap between academic study and its application in professional practice.

- **Technical Fellowships.** Technical Fellowship programs at the M&O sites maintain and grow core competencies to support the business while enabling employees to meet their educational development needs. Employees pursue advanced education in science or engineering areas identified as essential skills to support the nuclear weapons mission.
- **Performance Management Process.** The annual performance development process evaluates the salaried workforce and serves as an assessment and development tool at all organizational levels. The fit between talent and need is evaluated to plan for career progression and succession or to fill a key role by recruiting outside the existing workforce.

6.3.3 Compensation and Benefits

- **Federal.** Most NNSA Federal employees are under a pay-banding and pay-for-performance personnel system. NNSA has developed several broad career paths and established multi-grade pay bands, and annual pay adjustments are based on performance. The system is designed to improve recruiting, performance, and retention by allowing NNSA to compete more effectively for high-quality employees and to motivate and retain high-performing employees. NNSA also uses recruitment and retention bonus incentives on a selective basis as allowed under Federal regulations.
- **M&O Contractors.** M&O contractors must remain competitive with private industry to recruit and sustain its workforce. Toward that end, the M&O contractors offer competitive salaries, retention incentives, health and retirement benefits, performance incentives, and short- and long-term disability plans. To validate and ensure that compensation and benefits packages remain competitive and comparable to relevant labor markets, M&O contractors are required by DOE to conduct scheduled formal evaluations of their programs.

6.3.4 Challenges

NNSA and the M&O contractors face many challenges in attracting and retaining high-quality talent. These challenges include (1) the difficulty in recruiting at remote locations or small towns, (2) recruiting for certain engineering and information technology positions and those requiring shift work, (3) competing with other laboratories, academia, and high-technology firms (especially those offering significant sign-on bonuses or stock options), (4) finding meaningful work for personnel awaiting security clearances, and (5) coping with pay freezes and budget impacts. Although the economy has slowed attrition somewhat, as the economy improves, retirements are expected to increase and the recruitment of individuals with specific ST&E skills may be impeded. An improving economy will likely drive demand for employees with essential skills, thereby creating new challenges. Each M&O contractor understands the challenges unique to its organization and has taken steps to develop strategies and plans to meet those challenges.

6.4 Summary

NNSA's Federal, M&O contractor, and non-M&O workforce form the foundation of the nuclear security enterprise and enable the execution of this SSMP and other NNSA programs. NNSA's first challenge is to attract and retain a high percentage of its employees on a long-term basis and to ensure those employees maintain a high level of proficiency. Both replacement costs and the exposure of sensitive information are reduced by creating a system that retains a high percentage of employees. NNSA's second challenge is to be able to predict the essential skills required of its workforce and to develop the agility of its workforce to respond to changing needs.

The SSMP workforce planning, strategies, and tools will be nested and integrated with other program drivers within NNSA to ensure a corporate approach to workforce planning, acquisition, development, retention, knowledge transfer, and sustainment. The diverse set of capabilities and skills needed to ensure the Nation retains a safe, secure, and reliable stockpile can then be provided by combining the nuclear security enterprise’s Federal, assigned military, M&O contractor, and non-M&O workforce into an integrated staff.

CHAPTER 7

Security

CHAPTER 7
SECURITY

Assuring the security of the Nation's nuclear weapons, special nuclear material, infrastructure, and sensitive information involves three programs: the Office of Secure Transportation Asset (STA), Defense Nuclear Security program, and NNSA Chief Information Officer Activities. The STA program ensures safe and secure transport of the Nation's nuclear assets. The Defense Nuclear Security program ensures protection, control, and accountability of nuclear materials, and physical and personnel security at [NNSA Headquarters], the national security laboratories, the Nevada National Security Site, and the nuclear weapons production facilities. The NNSA Chief Information Officer Activities Program protects information assets by providing information technology systems and information management security safeguards.

7.1 Secure Transportation Asset Program

Nuclear weapon LEPs, LLC exchanges, surveillance, dismantlement, nonproliferation initiatives, and experimental programs rely on transport of nuclear weapons, components, and special nuclear material on schedule and in a safe and secure manner. The STA program safely and securely transports nuclear weapons, weapons components, and special nuclear materials to meet projected DOE, DoD, and other customer requirements. The STA program supports the DOE goal to reduce the dangers and environmental risks of domestic transport of nuclear cargo and the initiative to consolidate storage of nuclear material, as shown in **Table 7–1**, and provides secure transport for several DOE programs and the National Aeronautics and Space Administration. Because of the control and coordination required and the potential national security consequences, the STA program is a Government-owned, Government-operated program managed and executed by Federal personnel with contractor support. As required, the STA Program Advisory Board prioritizes shipments based on customer input.

Table 7–1. Agencies, DOE/NNSA offices, and programs supported by the Secure Transportation Asset program

Agency, DOE/NNSA Office, or Program	*Type of Shipment or Service*
NNSA Nuclear Counterterrorism and Incident Response Program	Emergency airlift, Office of Secure Transportation personnel and equipment
NNSA Office of Naval Reactors	Reactor fuel replacements, HEU oxides and metals
NNSA Directed Stockpile Work program	Weapons, joint test assemblies, component subassemblies, tritium gas transfer systems, tritium gas generators, uranium solids
NNSA Office of Defense Nuclear Nonproliferation	HEU metals and oxides, plutonium metals and oxides, mixed oxides
NNSA Office of Nonproliferation and International Security	Training events with nuclear transport elements of foreign nations
DOE Office of Nuclear Energy	HEU metals
U.S. National Aeronautics and Space Administration	Radioisotope thermoelectric generators
DOE Secretary, Deputy Secretary, and NNSA Administrator	Executive protection, stateside and overseas, as required
DOE Environmental Management	Hazardous surplus strategic material, site de-inventory movements
DOE Office of Science	HEU metal and oxides
DOE Emergency Management	Alternate NNSA Emergency Operations Center

HEU = highly enriched uranium

7.1.1 Core Components of the Secure Transportation Asset Program

7.1.1.1 Federal Agent Force

Federal agents undergo a rigorous selection process and intensive training to master a unique set of skills in order to defend a shipment from theft, hijacking, or an armed attack. They must respond to unpredictable situations, including non-hostile emergencies, without endangering the public or the cargo.

7.1.1.2 Specialized Vehicle Fleet

The STA program maintains a variety of escort vehicles and armored tractors for convoy operations. A methodical engineering process ensures safety, security, quality control, and configuration management of the vehicles. A vehicle remains in operation according to a "reliability life cycle" that is based on the vehicle maintenance history and life expectancy of mechanical systems, rather than on age or mileage. To ensure a vehicle performs as intended, rigorous maintenance is integrated into every mission. Each vehicle and its communication systems are inspected, tested, and serviced before use. The maintenance required is three to four times that of a commercial vehicle.

To introduce a new vehicle into operation, various platforms are evaluated against mission requirements and long-term costs. Once a prototype is produced and thoroughly tested, commercial vehicles and components are procured and provided to the modification facility for production. The production process includes provision for occupant protection, reconfiguration for a Federal agent team, and installation of new electrical systems and wiring, equipment compartments, and communications systems.

7.1.1.3 Specialized Trailers

With their design, engineering, testing, production, and use spanning several decades, specialized trailers are the most critical capital assets of the program. Their design and construction addresses public safety, unique cargo configurations, and protection systems. The Safeguards Transporter is the second generation of trailers used for nuclear warheads and weapons-grade material. These trailers are certified for 20 years by SNL; the first production units begin to expire in FY 2018. Design studies have been initiated for the third generation of trailers, the Mobile Guardian Transporter. Safety and security subsystems design, coupled with startup and production of this third-generation trailer, will be challenging during the FYNSP.

7.1.1.4 Transportation Command and Control System

This component provides multiple communications channels; capabilities for redundant, automated asset tracking; and robust data storage and processing. The essential elements are the primary and alternate Transportation Emergency Communications and Control facilities, relay stations with satellite services, and an overlapping, integrated series of secure communication networks. The primary Transportation Emergency Communications and Control facility operates 24 hours a day to control and monitor convoys; alternate facilities are maintained for special contingencies and natural disasters.

7.1.1.5 Geographically Situated Facilities

The STA program maintains over 68 distinct facilities supporting communications, training, logistics, mission operations, and management oversight in many states (*e.g.*, New Mexico, Texas, Tennessee, Maryland, Missouri, Idaho, and Arkansas). Three Federal agent commands with vehicle maintenance facilities are in Albuquerque, New Mexico; Amarillo, Texas; and Oak Ridge, Tennessee. Fort Chaffee, Arkansas, has centralized training facilities and an academy.

7.1.2 Major Organizational Efforts of the Secure Transportation Asset Program

7.1.2.1 Liaison and Domain Awareness

A rigorous liaison program is maintained with agencies and organizations that may come in contact with a convoy or have to respond to an emergency. This interface extends across the 48 continental states, but is particularly focused on primary and secondary routes of convoy operations. The scope of the liaison includes Federal, state, tribal, and local agencies and involves interactions with law enforcement officers, firefighters, emergency and hazardous materials responders, dispatchers, and military personnel. The STA program also provides emergency response information to law enforcement associations, governors' associations (specifically on the transport of hazardous materials), and governors' representatives.

The STA program developed an Active Security Doctrine that is operationally focused, intelligence driven, and emphasizes realistic threat scenarios, specific environments, and the routes traveled by convoys. That doctrine provides options to adjust protection levels commensurate with real-time conditions and the technology to enhance domain awareness along transportation corridors. The program relies on extensive coordination and established data-sharing relationships with the DOE Office of Intelligence and Counterintelligence, the United States Northern Command, Department of Homeland Security, and the Federal Bureau of Investigation. Implementation of doctrine, intelligence, reconnaissance, and liaison efforts better enable the STA to evaluate mission options and mitigate risks.

7.1.2.2 Training

Federal agents are trained in full-scale emergency and tactical operations scenarios, tactical driving techniques, and a variety of weapons and explosives. Each agent command has facilities and staff to refresh primary skill sets and accomplish most qualification training. At Fort Chaffee, Arkansas, a Training Command with permanent facilities and billets supports special weapons, tactical scenarios, general agent training, and the Agent Candidate Training Academy. A special fleet is maintained to support training realism.

7.1.2.3 Safety and Security

An aggressive program is maintained to review and test safety and security methods and equipment. All new equipment, munitions, vehicles, and methods of transport undergo testing and safety evaluation. Once selected, the intended improvement or benefit must be validated. Safety and security principles also guide the formulation of strict accountability procedures, radiological screening, and information control. Force-on-force validation exercises are the primary means to test all convoy systems, identify vulnerabilities, and ensure implementation of the Active Security Doctrine. These exercises are designed by the safety and security staff, executed by the training and logistical staff, and integrated with the emergency command and control elements of the STA program to provide the most realistic convoy scenarios possible.

7.1.2.4 Aviation Services

The fleet of Government-owned aircraft provides efficient and flexible airlift of LLCs, nuclear incident response elements, Federal agents, joint test assemblies, and training assemblies, and personnel responding to emergencies and disasters. Special requirements when transporting Federal agents preclude the use of commercial airlines for practical, regulatory, and budgetary purposes. The STA program maintains the capability to respond immediately to any nuclear incident or accident within the continental United States. The STA program is also prepared to support the evacuation and relocation of key personnel to maintain the continuity of governmental operations.

7.1.3 Secure Transportation Asset Program Goals

The overall goal is to be sized efficiently to support the projected workload with sufficient flexibility to adjust to unforeseen requirements and changes in the security posture, while maintaining a workforce and vehicle fleet capable of responding to the full security continuum.

The annual STA program goals are:

- Maintain five fully operational units.
- Develop and execute a mission calendar with prioritized capabilities.
- Maintain a validated Site Safeguards Security Plan that meets the requirements of the DOE Graded Security Protection Policy and ensures integration of vulnerability assessments for all threats.
- Maintain a tested and fully functional Emergency Operations Center to respond to any national incident.
- Validate the integration of various response elements (Radiological Assistance Program, Crisis Support Team, and Accident Response Group).
- Conduct validation force-on-force exercise to test the effectiveness of the security system.
- Conduct surveys, assessments, and independent audits to ensure mission, training, and operations are executed safely and securely.
- Maintain a continuous emergency airlift capability to support the Nuclear Counterterrorism and Incident Response Program mission.
- Review and update the over-the-road Documented Safety Analysis and the Integrated Safety Management System description.
- Support nuclear nonproliferation and nuclear security by providing training and expertise to foreign Nations.

The long-term STA program goals are:

- Complete production and fielding of the Replacement Armored Tractor by FY 2019.
- Upgrade and replace aging vehicles on a continuous basis.
- Design, test, and begin producing the Mobile Guardian Transporter by FY 2018.
- Upgrade the vehicle network system with the Advanced Radio Enterprise System.
- Develop security strategies based on intelligence assessments and risk mitigation and management.
- Modernize and maintain facilities and infrastructure.

With the completion of a major aircraft life cycle replacement, the STA program is now focused on replacing end-of-life communications systems for its vehicle fleet, replacing its armored tractors, and preparing for the retirement of the Safeguards Transporter trailers.

To meet changing customer needs, within budget constraints, and to account for emerging threats, the STA program has developed an integrated, long-term plan to maintain, refurbish, and modernize its critical assets, eliminate outdated ones, and procure new ones. The life cycles of these assets require substantial investment and deliberate effort spanning decades.

7.1.4 Secure Transportation Asset Program Strategy

7.1.4.1 Program Planning and Management

The STA program capacity will be maintained to support the workload associated with Defense Programs' dismantlement and maintenance of the nuclear weapons stockpile and the initiative to consolidate the storage of nuclear material. The uncertain threat environment necessitates the implementation of both force multiplier technologies and operational enhancements for domain awareness analysis. The STA Program continues to implement an operationally-focused and intelligence-driven operation concentrated on the detection, deterrence, and disruption of potential threats while sustaining capabilities to defend, recapture, and recover nuclear weapons, special nuclear materials, and weapons components.

7.1.4.2 Strategic Management

The STA Program will provide safe and secure transportation of nuclear weapons, nuclear weapon components, and special nuclear materials in support of national security. The following external factors have the strongest impact on the achievement of that primary strategic goal:

- Effect of de-inventory and special nuclear material consolidation campaigns on life span of vehicle fleet and capacity requirements
- Stabilized vendor fleet replacement schedules
- Uncertain threat environment
- Highly trained agents sought by other Federal law enforcement agencies
- Ability to train agents in realistic over-the-road environments

7.1.4.3 Major out-year Priorities and Assumptions

The STA Program has identified the following four key strategies to guide the Office of Secure Transportation over the next 5 to 10 years. These strategies are in line with and support the NNSA Administrator's key goals as identified in the *NNSA Strategic Plan* (NNSA 2011) and the Secretary of Energy's goals as identified in the *DOE Strategic Plan* (DOE 2011).

7.1.4.4 Modernization of Mission Assets and Infrastructure

The STA program must maintain assets to support current and future missions based on changing customer needs, budgets, and threats. These assets include vehicles (tractors, trailers, and escort vehicles), facilities, and aircraft. Modernizing and sustaining these assets requires an integrated, long-term strategy and a substantial investment. The STA strategy includes eliminating outdated assets, refurbishing existing assets to extend their useful life, and procuring new assets.

7.1.4.5 Improvement of Workforce Capability and Performance

Although assets and infrastructure are essential for successful mission implementation, the workforce is the STA program's most valuable and important resource. The skill and talent base required to support the mission must be continuously replenished, developed, and maintained. This includes everyone in the organization, from Federal agents to senior management. Programs for initial and continuing training and development will ensure the staff is competent and proficient in their current positions. The program will recruit highly experienced and innovative personnel, retain experienced personnel, and develop succession plans to ensure vacancies can be filled with little or no impact on the mission.

7.1.4.6 Strengthening of Mission Support Systems

Mission support systems provide the critical information and system redundancy to ensure mission success. This includes information obtained, analyzed, and disseminated prior to the mission; continuous monitoring of that information to ensure it is accurate and valid; and frequent communication within the mission teams and among the teams and NNSA Headquarters. All of this must be accomplished seamlessly in real time while balancing the evolving requirements of cyber security to ensure system reliability and integrity. In addition, the STA program will leverage other information technology systems that support business processes and operations to improve the efficiency and effectiveness of its mission.

7.1.4.7 Driving an Integrated and Effective Organization

The STA program will continuously monitor, evaluate, and improve operations to ensure the mission is achievable in a changing operational environment. This includes activities that are directly related to the mission, such as safeguards and security requirements and the business process operations in the organization. The program will always strive to eliminate redundancies, improve performance and efficiency, and streamline operations.

Key STA program milestones, objectives, and future plans are displayed in **Figure 7–2** of Section 7.4.1.

7.1.5 Secure Transportation Asset Program Challenges

Challenges that the STA program must meet to accomplish its missions are:

- **Stable and Balanced Vehicle Production.** In the past, vehicle replacements were based on bulk purchases and accelerated production. As the program transitions to stable procurement and production, vehicles at their end of life must be replaced without a surge in production. Some must undergo extensive refurbishment for establishment of a steady production.
- **Sunset Technology.** The best technology that is both reliable and has the greatest life expectancy must be determined. Without that balance, large capital investments will be unusable because a supporting system can no longer be serviced.
- **Forecasting and Meeting Future Workload.** A major challenge is anticipating the future workload, which depends on NNSA and DOE shipping requirements, consolidation of requests, synchronization of site activities, duration windows for various weapon activities, and handling or delivery requirements for specific cargo.
- **Retention of Federal Agents.** Federal agents are recruited from the same pool as other law enforcement agencies. Career progression, job enrichment, and quality of life must be provided to retain agents for 20 to 25 years. The separation from family, long travel hours, and acute stress of the mission pose unique difficulties for retention. The program must adhere to a predictable schedule that balances training and mission weeks so agents can plan personal time and know which weeks they will be away from their families. Greater emphasis on the accuracy of customer forecasts is therefore required.
- **Facilities.** The program is challenged each year in allocating funds for construction projects, life cycle replacements, and repairs, including deferred maintenance.

7.2 Defense Nuclear Security Program

The Defense Nuclear Security program establishes the security requirements and policies of the nuclear security enterprise and verifies their effective implementation through assessments. It also provides unique knowledge and expertise for a broader set of national security needs, such as nuclear nonproliferation, homeland security, and intelligence. The program is comprised of subject matter experts in physical security, protective forces, nuclear materials control and accountability, personnel security, nuclear material integration, classified and sensitive information protection, and technical security programs.

The Defense Nuclear Security program's organizational structure and channels for mission execution were significantly revised because of the security breach at Y-12. In the early morning hours of Saturday, July 28, 2012, three individuals trespassed into a high security area at Y-12 and defaced an exterior wall of the Highly Enriched Uranium Materials Facility. This one event precipitated numerous and dramatic changes in the roles, responsibilities, and organizational structure of the Defense Nuclear Security program. The adopted plan is titled "Assessment of NNSA Federal Organization and Oversight of Security Operations" (November 2012). The result is an organization with clearer lines of authority and greater operational oversight and performance assurance. The principles of the security program remain fundamentally sound and are unchanged. The changes in the conduct of oversight and performance assurance give Defense Nuclear Security greater confidence in the execution of the NNSA security mission.

With the reorganization of the Defense Nuclear Security program to focus on policy, training, and performance assessment, the responsibility for the execution of the security mission has been moved to the newly established NNSA Office of the Associate Administrator for Infrastructure and Operations. A new security organization within the Office of the Associate Administrator for Infrastructure and Operations will ensure that policies provided by Defense Nuclear Security staff are executed effectively at the national security laboratories, the nuclear weapons production facilities, and the Nevada National Security Site. This office will be responsible for operational security direction and program management to include prioritizing resources, evaluating programs, and allocating funds. It will ensure standardization of security procedures across the NNSA field offices and will also execute the mission and security training requirements. In addition, an expanded intelligence and counterintelligence liaison will ensure that Federal security managers receive needed information and have appropriate ties to law enforcement and intelligence-related agencies. While this new security organization within the Office of the Associate Administrator for Infrastructure and Operations is outside of Defense Nuclear Security, it will be the strategic partner between the program and the Office of the Associate Administrator for Infrastructure and Operations that provides NNSA Headquarters involvement in the security activities at each of the eight NNSA sites.

7.2.1 Offices of the Defense Nuclear Security Program

The Office of the Associate Administrator for Defense Nuclear Security program is now structured so that it serves solely as a staff organization at the strategic level. The four security offices under the former structure are being functionally realigned, with responsibilities spread across five offices. The five offices are Performance Assessment, Strategic Requirements (*i.e.*, policy development, planning and requirements, and training and career development), Nuclear Materials Integration, Personnel and Facility Clearances, and Mission Support (*i.e.*, resource management, NNSA Headquarters security operations, classification and controlled information, and human capital). The Office of Nuclear Material Integration and the Office of Personnel and Facility Clearances were added to the Defense

Nuclear Security program in calendar year 2011. The roles and responsibilities of these two offices are unchanged by this latest reorganization.

7.2.1.1 Office of Performance Assessment

The Office of Performance Assessment is now responsible for assessing contractor and Federal field office performance, including no-notice and short-notice assessments. It will also evaluate training effectiveness, policy implementation, and vulnerability assessments. The Chief of Defense Nuclear Security program will use this new entity to verify that security programs are properly implemented.

7.2.1.2 Office of Strategic Requirements

The Office of Strategic Requirements is responsible for determining security requirements and the NNSA security policy process (whether to write new policy or to interpret and amplify existing DOE policy). It will also establish training requirements and develop standards and criteria for security programs. The training policy and career development function is being enhanced to ensure Federal security professional development.

7.2.1.3 Office of Nuclear Materials Integration

The Office of Nuclear Materials Integration focuses on stabilization, consolidation, disposition, and management support for specific nuclear materials. It coordinates and integrates multi-program initiatives to consolidate and dispose of materials through the Nuclear Materials Advisory Board, which includes senior-level representatives from the DOE Headquarters organizations that manage accountable nuclear materials.

7.2.1.4 Office of Personnel and Facility Clearances

The Office of Personnel and Facility Clearances provides direction, support, and guidance on personnel security policy and manages the access authorization portion of the personnel security program in support of approximately 50,000 cleared Federal and contractor personnel at NNSA sites, NNSA Headquarters, and some DOE elements. It ensures that individuals meet the personnel security requirements before accessing special nuclear materials or classified and sensitive information.

7.2.1.5 Office of Mission Support

The Office of Mission Support retains the existing Defense Nuclear Security functions of NNSA Headquarters security operations for administration and certification of classified and controlled information, as well as policies to govern their proper handling. The office implements certain activities within the NNSA Headquarters' security program, including protection and control of classified information, management of foreign visits and assignments, processing of visit requests, and handling access control requests for NNSA Headquarters' designated areas. It also manages the Defense Nuclear Security program direction budget, establishes internal controls, develops and implements office protocols, and oversees records management.

7.2.2 Defense Nuclear Security Program Goals

The overall goal is to safeguard the physical facilities, materials, information assets, and the nuclear security enterprise workforce. Specific goals are summarized below.

- Establish a performance assessment program to ensure effective security operations through monitoring, tracking, and analysis. The information gathered during assessments is used for assessing implementation of DOE NNSA policies and requirements; identifying site-specific issues within the security arena; determining potential trends requiring closer analysis and/or intervention; and improving federal and contractor performance.
- Support the nuclear security enterprise by establishing a life cycle planning process for the Planning, Programming, Budgeting, and Evaluation cycle, increasing communications with stakeholders and agencies, strengthening critical partnerships through improved collaboration, establishing security-focused incentives for performance, and developing feedback mechanisms that include standardized metrics.
- Ensure a functional and sustainable workforce by identifying and addressing current skill gaps, recruiting a motivated and innovative workforce, retaining experienced personnel, and developing succession plans.
- Finalize and publish the National Strategic Plan for Nuclear Materials Management and update that plan at least every 3 years. Ensure consistent, agency-wide management and integration of production and utilization of accountable nuclear materials. Ensure integration of characterization, safe and secure packaging, storage, stabilization, consolidation, and disposition of those materials. Integrate anticipated needs for nuclear materials and increase the effectiveness of their use across the nuclear security enterprise. Integrate consolidation and disposition plans, metrics, and budget support.

7.2.3 Defense Nuclear Security Program Strategy

Defense Nuclear Security is responsible for the overall policy direction and assessment of security programs at the NNSA. This will consist of developing NNSA strategic-level policy guidance, requirements determination, and conducting performance assessments. The Defense Nuclear Security program will implement a strategy to comply with safeguards and security requirements and eliminate or mitigate identified problem areas across the nuclear security enterprise. This strategy will include providing additional training of protective forces, acquiring updated weapon systems and support equipment, improving and modernizing security systems infrastructure, improving physical barrier systems and standoff distances, and reducing the number of locations identified as “targets of interest.” In addition, as a result of the Y-12 event, the Defense Nuclear Security program will take a more active role in assessing the protection effectiveness at each of the NNSA sites. This assessment capability will consist of a team of subject matter experts that will conduct performance assurance reviews sufficient to measure the program’s effectiveness in protecting NNSA assets from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts that may impact national security, program continuity, and the security of employees and the public.

The key milestones, objectives, and future plans are provided in **Figure 7–3** in Section 7.4.2; ongoing activities and projects are listed in Section 7.4.2.1.

7.2.4 Defense Nuclear Security Program Challenges

Specific Defense Nuclear Security program challenges are summarized below.

The challenges of Performance Assurance in Defense Nuclear Security are:

- Ensure that the Office of Defense Nuclear Security has complete situational awareness of each site's implementation of the DOE Safeguards and Security Program.
- Conduct on-the-ground assessments of each site office and the contractor's performance in executing the safeguards and security mission.
- Coordinate assessments with other offices to ensure that redundant and overlapping security reviews and audits of Federal and contractor facilities are minimized.

The challenges of Strategic Requirements in Defense Nuclear Security are:

- Ensure the establishment of clear safeguards and security requirements for all of the safeguards and security subprograms (Protective Forces, Physical Security, Information Protection, Personnel Security, and Material Control and Accountability).
- Ensure that the requirements are consistent with DOE-established safeguards and security policy and programs.
- Establish standards and inspection criteria used in the evaluation of each site's implementation of safeguards and security policies.
- Establish definitive training requirements in support of the DOE Safeguards and Security Program.

The challenges of Nuclear Material Integration in Defense Nuclear Security are:

- Implement projects to stabilize, consolidate, and dispose of excess nuclear materials at LANL, Y-12, Idaho National Laboratory, and Oak Ridge National Laboratory.
- Develop plans to consolidate and dispose of materials at DOE and other sites (*e.g.*, universities and industry) that have "no defined use."
- Develop integrated material plans to increase standardization and efficiency.

The challenges of Personnel Security and Facility Clearance in Defense Nuclear Security are:

- Continue to improve the quality, efficiency, and effectiveness of personnel security activities using more technology, increased training, and improved quality assurance.

The challenges of Mission Support in Defense Nuclear Security are:

- Ensure that security operations at NNSA Headquarters are effective in protection of personnel, information, and property.
- Ensure all NNSA Headquarters employees understand and implement security practices within the NNSA Headquarters environment.
- Ensure that the NNSA classification and controlled information program provides clear programmatic requirements to maintain the classification of NNSA information.

7.3 NNSA Chief Information Officer Activities Program

Beginning in FY 2013, the existing Cyber Security Program is being deleted and consolidated with the Information Technology (IT) program under a new program entitled NNSA Chief Information Officer Activities. This change will provide better alignment of resources to reduce the threats to and vulnerabilities of information and information systems. NNSA is pursuing an aggressive IT and cyber security transformation strategy to lower costs, improve security, and enable collaboration solutions. The strategy is driven by Government-wide mandates, including the Office of Management and Budget's *25 Point Implementation Plan to Reform Federal Information Technology Management* and Executive Order 13576, *Delivering an Efficient, Effective, and Accountable Government*. The Office of the Chief Information Officer (OCIO) is responsible for fostering a culture to ensure IT systems and projects are coordinated across NNSA, have the necessary cyber security protection, and are aligned with the *NNSA Strategic Plan* (NNSA 2011) and DOE requirements and objectives.

Because of the highly complex and global nature of the stockpile stewardship mission, electronic information and information assets must be managed and protected using a risk management approach. All information collected, created, processed, transmitted, stored, or disseminated by or on behalf of NNSA on automated information systems requires a level of protection commensurate with the risk to the information and to associated information-processing systems. Moreover, because of the geographically diverse nature of the nuclear security enterprise, the risk management approach must be flexible, comprehensive, coordinated, and cost effective to ensure that security considerations are fully integrated into the architecture of the nuclear security enterprise and NNSA business processes.

7.3.1 Information Technology

The OCIO focus for the next 5 years is to transform the computing environment in support of the Administrator's OneNNSA[1] vision via three objectives: the NNSA Network Vision (2NV), the Joint Cybersecurity Coordination Center (JC3), and the Cyber Sciences Laboratory (CSL). 2NV will provide a secure, mobile, agile, and adaptive IT infrastructure. JC3 will provide understanding of the "health" of that computing environment from a cyber security and network operations perspective. CSL will provide IT research and development capability to support the NNSA mission.

The future IT infrastructure will be smaller and deliver more value as NNSA transitions to an integrated and secure "cloud" architecture. In accordance with the *NNSA Strategic Plan* (NNSA 2011), the OCIO will employ "a management approach that integrates leadership, people, and processes to better accomplish our goals as a unified nuclear security enterprise." Nuclear security enterprise governance, enabled by 2NV, JC3, and CSL, will advance the OneNNSA vision by eliminating internal "stove pipes" and identifying risks using holistic measures and risk-informed models.

7.3.2 NNSA Network Vision

2NV will enhance and modernize the IT environment to allow the workforce to perform duties from any approved device anywhere, at anytime. The cloud architecture will provide common services so that NNSA Headquarters, field sites, national security laboratories, Nevada National Security Site, and nuclear weapons production facilities can utilize common services such as email, web conferencing, collaboration, emergency response management, records management, and facilities management.

[1] *A smaller, safer, more secure, and less expensive nuclear security enterprise that leverages the scientific and technical capabilities of the workforce to meet all NNSA national security requirements.*

Collaborative behavior, a core value of the OneNNSA vision, will be necessary to achieve excellence for mission success in a safe, secure, and efficient manner. NNSA will achieve the "We operate jointly" culture needed to support governance policy to optimize success and excel at what it does. In particular, the collaborative culture will enable more-efficient use of IT investments and more-rapid access to IT services. The greater coordination and collaboration in information management policy and technology deployment will result in greater productivity and reduced costs. At the same time, a reduction in the redundancy of applications, networks, and services will increase effectiveness and security.

7.3.3 Transformation of Information Technology Architecture

During FY 2013, the NNSA is focused on delivering three distinct new capabilities that will provide the underlying architectural tools for future transformation of the nuclear security enterprise:

- YOURcloud is a secure, community cloud-services broker powered by Infrastructure on Demand (IoD) that will enable a state-of-the-art multi-tenant, multi-cloud platform for secure application hosting, data center consolidation, and shared services hosting. IoD was developed by LANL provides a management and security control panel for managing a diverse set of cloud environments while respecting site autonomy for managing their discrete workloads.
- OneNNSA Network is a secure wide area network connecting all NNSA sites to the cloud. All traffic will be encrypted with FIPS 140-2 compliant algorithms to protect the confidentiality of NNSA information. In addition, the network will provide federated Identity Management services for single-sign-on to the cloud and a base foundation for HSPD-12 implementation.
- ONEvoice is an agency wide unified communications solution providing desktop video, web conferencing, instant messaging, presence, and voice for all NNSA employees (both Federal employees and M&O contractors). This solution will be integrated with an agency wide social network to provide enhanced features for collaboration, document sharing, crowd sourcing, and knowledge retention.

These capabilities will be delivered as an integrated set of solutions under the DOE's RightPath initiative in partnership with the DOE Chief Information Officer. In particular, these NNSA investments will leverage new circuits, infrastructure, and endpoints that are procured using DOE's innovative Energy Savings Performance Contract. When combined, these capabilities will provide a first of its kind agency-wide transformation centered on improved collaboration, world class security, enhanced energy savings, and ultimately will significantly lower costs.

7.3.4 Joint Cybersecurity Coordination Center

Incident management reform is a key element of the Secretary of Energy's Management Excellence Initiatives. In spring 2010, DOE assessed its Incident Management Program and identified the need to (1) provide agile, robust, transparent, and integrated capabilities for the DOE front-line cyber security operations; (2) use the collective DOE expertise; and (3) meet Federal requirements for incident management and response. JC3 was formed in 2011 to achieve these objectives. JC3, which includes NNSA engagement, will allow DOE to understand the "health" of its computing environment from a cyber security and network operations perspective. JC3 is responsible for consolidating the cyber security incident management capability and governance processes into a single comprehensive unit, and for streamlining information sharing, reporting, and access to technical resources (24 hours a day, 7 days a week), while preserving an individual organization's unique requirements and information.

7.3.5 Cyber Sciences Laboratory

The CSL is a virtual cyber defense R&D capability that combines the top researchers from nine national laboratories, academia, and industry to provide game changing new capabilities for securing DOE/NNSA operational networks, nuclear-weapons-related information systems, and the electrical grid. During the last year, CSL has made substantial progress towards institutionalizing a robust cyber defense R&D program. Accomplishments include establishing a formal governance process, publishing a research vision and roadmap, and becoming the recognized third pillar of modernization.

In the upcoming fiscal year, CSL will execute an ambitious R&D portfolio that pools efforts from across the enterprise, academia, and industry to focus on three signature programs: Scalable Testing of System Cyber Dynamics, Resilience and Assurance, Big Data and Behavioral Cyber Analytics. The successful outcome of this research will ensure that (1) new capabilities are rolled into the JC3, (2) scientific foundations for cyber security can be established in nascent and emerging areas, and (3) the overall risk related to nuclear weapons information, the electrical grid, and sensitive data on our operational networks can be significantly reduced. Over time, the products of CSL will increase the cost of attack for an adversary, improve the economics of defense, and provide higher assurance that the systems and networks supporting the DOE/NNSA mission can be operated at a higher level of assurance. In addition, sharing information with other Government agencies and transitioning tools to practice within industry will further magnify the effects of this R&D capability outside DOE/NNSA.

7.3.6 Subprograms of NNSA Chief Information Officer Activities

The three subprograms to be created in FY 2013 are summarized below. As part of consolidating cyber security and IT activities, the Technology Application Development subprogram that was part of the Cyber Security Program in FY 2011 and FY 2012 is being realigned to the Infrastructure subprogram, and a new subprogram, Federal Unclassified Information Technology, is being created.

7.3.6.1 Infrastructure Subprogram

This subprogram supports cyber security operations and activities at all NNSA sites. A risk-based “defense-in-depth” approach will be used to achieve cyber security in a highly networked environment by balancing protection capability and cost, performance, and operational considerations. The defense-in-depth approach, a combination of known best practices and a cost strategy that relies on intelligent application of techniques and technologies, has three components: personnel, technology, and operations. This approach will provide the personnel and technology to maintain a cyber security posture that complies with Federal and DOE/NNSA policies and processes while addressing the increased number and complexity of threats, vulnerabilities, and risks via multiple security techniques.

7.3.6.2 Enterprise Secure Computing Subprogram

This subprogram provides a state-of-the-art, classified, computing infrastructure to enable collaboration and information-sharing in a secure environment by focusing on daily operations, infrastructure enhancements, and application deployment.

7.3.6.3 Federal Unclassified Information Technology Subprogram

This subprogram develops and advances policies and initiatives in support of solutions to specific cyber security needs at NNSA Headquarters and sites. Efforts are focused on emerging technologies and leveraging existing technologies to create a more secure environment. In addition, new strategies can be developed to support activities across NNSA and to foster collaboration.

7.3.7 NNSA Chief Information Officer Activities Program Goals

The overarching goal is to implement a flexible, full-life-cycle, risk-based management program that has the following characteristics:

- Provides adequate protection of NNSA information and information assets.
- Is predicated on Executive Orders; national standards, laws, regulations; and DOE/NNSA Orders, manuals, directives, and guidance; thereby resulting in a cyber security architecture that is aligned with the nuclear security enterprise architecture, has an appropriate policies and procedures framework and methodology, and follows a comprehensive management approach to ensure alignment with DOE/NNSA and OCIO strategic plans and support of NNSA's mission.
- Ensures NNSA complies with DOE's defense-in-depth cyber security strategy and the *NNSA Information Management Strategic Plan* and maintains current certification and accreditation packages, resulting in an official Authority to Operate signed by the designated authority.

The subprogram goals are:

Infrastructure

- Protect and defend NNSA information and information assets, from the perimeter to the end user, to ensure data availability, integrity, and confidentiality.
- Manage 2NV, JC3, and CSL to provide a broad, deep framework for cyber security controls.
- Initiate a site assessment visit process to assure support for the cyber security mission and future requirements. Develop and deploy a centralized management system to track cyber security assets.
- Develop and implement a career development and tracking program to provide enhanced technical and management training opportunities.

Enterprise Secure Computing

- Mitigate the risk to classified information assets via a technology design that provides effective network-level monitoring, limits an intruder's ability to traverse the network, offers the minimum level of services required, and is updated in a timely manner to lessen vulnerabilities.
- Develop enhanced information security protections and transparencies for NNSA's information systems, applications, and networks. Develop improved information security protection and accountability tools and practices in classified and unclassified environments.

Federal Unclassified Information Technology

- Improve Federal oversight and compliance assessment of the cyber security posture.
- Continue to develop NNSA policies that implement national and DOE/NNSA cyber security policies and best practices. Implement the updated certification and accreditation processes.
- Develop consolidated cyber security policy guidance to balance risk management and performance and use modern document distribution methods.

7.3.8 NNSA Chief Information Officer Activities Program Strategy

NNSA must defend against cyber threats that are increasing in number, complexity, and sophistication, while supporting the application of advanced information technologies to national security and other missions. Its sites will continue to improve the scope and quality of cyber security by implementing NNSA guidance and addressing the increased requirements. Executing the strategies and accomplishing the objectives and goals outlined in the *NNSA Information Management Strategic Plan* will result in an integrated program that balances operations, technology, and personnel to achieve defense-in-depth.

The remainder of this strategy section includes the following:

- Summaries of the five components of the long-term NNSA strategy for cyber security (planning, policy and guidance, architecture and technology, services, and performance measurement)
- General indicators to measure the success of defense-in-depth via the three key pillars (operations, technology, and people)
- A description of the risk management process for cyber security

Key milestones, objectives, and future plans are shown in **Figure 7–4** in Section 7.4.3.

7.3.8.1 Long-term Strategy for the NNSA Chief Information Officer Activities Program

Planning. A collaborative effort with the field offices is used to understand the threat landscape and identify weaknesses through process validation and performance measurement. This information is fed back to the planning component to generate a long-term strategic plan and an annual tactical plan. The planning processes and documentation include a cyber security working group, strategic and tactical plans, and a DOE threat statement and risk assessment.

Cyber security policy and guidance. The policy component is closely aligned with the DOE cyber and IT governance program and the planning component. Cyber security policies establish high-level goals and outcomes for the program. Enhanced by guidance and performance metrics, the policy is in place to drive implementation. The focus is on a top-level "thin-client policy," supported by DOE guidance, to achieve a less risk-averse cyber security component.

Architecture and technology. Installing well-defined, high-level structures, processes, and principles puts DOE/NNSA in a position to manage its IT assets. To achieve the best results and ensure a standard approach is applied across DOE/NNSA, NNSA Chief Information Officer Activities program will address architectural guidance, licensing of security tools and products, and a technology review and development process.

Services. The OCIO facilitates the adjustment of NNSA sites in adapting to new processes and policies through various services and by performing key initiatives. The aim of the services component is to develop an intelligent, proactive approach to mitigate the security threat to DOE/NNSA. Processes stemming from this component include cyber security communications, education and awareness, asset management, advice and assistance, and awards and recognition.

Performance measurement. This component provides a clear and consistent way to measure success and demonstrate results to senior management. The processes and documents from this component include compliance review and monitoring and development of performance metrics.

7.3.8.2 General Indicators for Measuring the Success of Defense-in-Depth for Cyber Security

Successful execution of the *NNSA Information Management Strategic Plan* can be gauged by evaluating the general indicators for the three key pillars of cyber security.

Operations. Success indicators in operations include the following:

- Policies, processes, and procedures will be understandable and implementable.
- Program managers, users, and support personnel will have confidence in the information and information assets used to achieve their missions.
- Decision makers will share a seamless and common view of information that spans the nuclear security enterprise, allowing joint decisions on certification and accreditation activities.
- NNSA's cyber security architecture will allow integration and implementation of products and services to enhance cyber security capabilities.
- Oversight assessments will identify security gaps, and corrective actions will be documented in a plan of action and milestones and monitored for progress.
- Missions and research activities will be completed, with security restraints.

Technology. Success indicators in technology are as follows:

- Cyber security capabilities will be dynamic, robust, agile, reconfigurable on demand, available, and consistently controlled at all points of access.
- Cutting-edge technologies will be researched to provide protection, detection, and response. After evaluation, these products will be rapidly deployed across all NNSA systems and networks.

People. Success indicators in personnel include the following:

- Cyber security personnel will be trained to ensure protection of the computing environments.
- The entire workforce will recognize the importance of cyber security and understand their roles and responsibilities.
- Certification and accreditation packages will clearly state management, operational, and technical controls, and responsible individuals will ensure adherence to these controls based on acceptable residual risks.

7.3.8.3 Risk Management Process for Cyber Security

The risk management approach defined in the *NNSA Strategic Plan* (NNSA 2011) provides the guidance to protect information assets by implementing a process to identify and evaluate potential risks and to respond intelligently and proactively to those risks to avoid damage to NNSA's mission, performance, and reputation. The risk management process is being conducted according to the sequence in **Figure 7–1**.

Figure 7–1. NNSA Chief Information Officer Activities program work flow for the risk management process

7.3.9 NNSA Chief Information Officer Activities Program Challenges

Subprogram challenges of the NNSA Chief Information Officer Activities Program are:

Infrastructure

- Some Office of Management and Budget and DOE requirements for unclassified cyber security activities are unfunded.
- A cyber security risk management approach that includes requirements and an implementation plan must be developed.
- Incident management and handling processes for cyber security are not consistent across DOE/NNSA.
- Expanded use of advanced information technology solutions is required to improve the overall computing environment and enhance user interactions.
- The cyber security infrastructure must be replaced and modernized.

Enterprise Secure Computing

- New Federal requirements for classified environments must be implemented nuclear security enterprise-wide, such as Comprehensive National Cyber Security Initiative Item #7 and network and system enhancements.
- Investment planning is needed for cyber security technologies in NNSA networks.

Federal Unclassified Information Technology

- Resources are required to research cyber security development and deployment issues that have resulted from expanded use of advanced information technologies.
- Investment planning must be implemented for cyber security technology development.

7.4 Milestones, Objectives, and Future Plans

7.4.1 Secure Transportation Asset Program Milestones, Objectives, and Future Plans

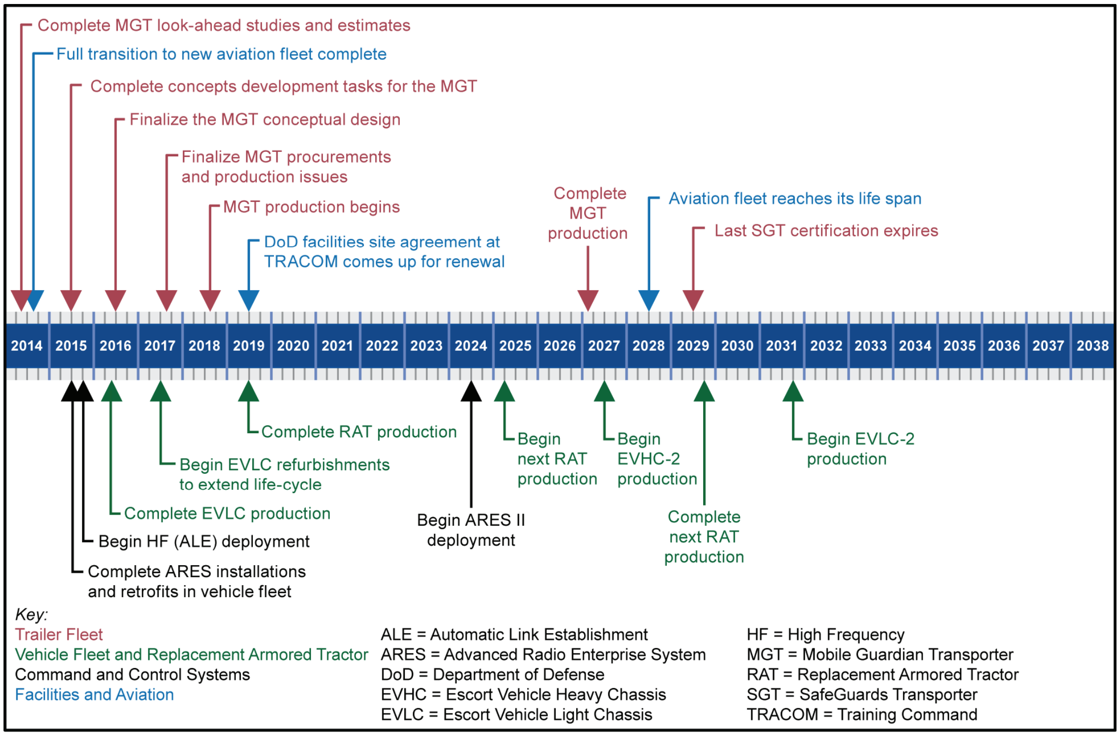


Figure 7–2. Secure Transportation Asset program milestones and objectives timeline

7.4.2 Defense Nuclear Security Program Milestones, Objectives, and Future Plans

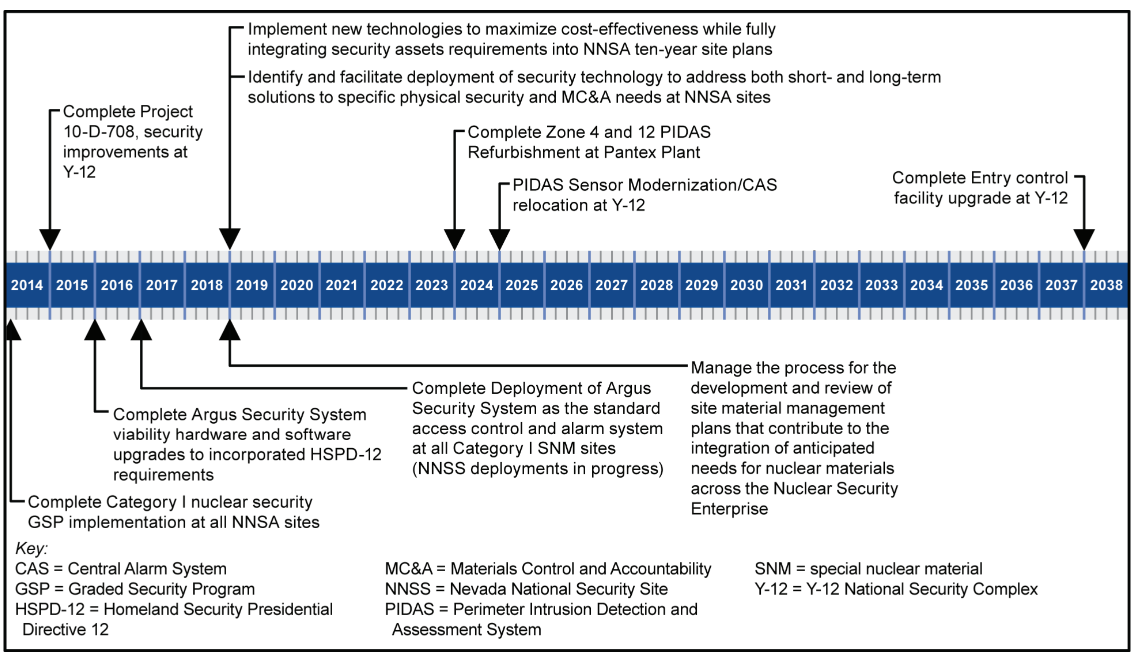


Figure 7–3. NNSA Physical Defense Nuclear Security program milestones and objectives timeline

7.4.2.1 Ongoing Activities and Projects in NNSA Safeguards and Security Defense Nuclear Security

In addition to the activities and projects in Figure 7–3, the following Defense Nuclear Security efforts are ongoing:

- Conduct Safeguards and Security effectiveness assessments across the nuclear security enterprise.
- Continue to improve the Safeguards and Security Program.
- Assess security implementation efforts by reviewing and updating security plans and performance testing, reviewing vulnerability assessments, and revising threat and vulnerability analyses.
- Transition to and implement the Joint Nuclear Security Collaboration Initiative to provide greater consistency between DOE/NNSA and DoD regarding nuclear weapons and material protection strategies and practices.
- Plan deployment of Integrated Video Assessment Systems at the Nevada National Security Site.
- Install wireless Motomesh systems at Pantex and the Nevada National Security Site.
- Complete reviews of classified and sensitive information at NNSA Headquarters and field offices.
- Focus on standardizing technologies to provide operational efficiencies for security programs.
- Upgrade security systems and reduce the Y-12 Protected Area initially by approximately 70 acres and ultimately by approximately 130 acres.

7.4.3 NNSA Chief Information Officer Activities Program Milestones, Objectives, and Future Plans

The NNSA Chief Information Officer Activities Program has begun to develop a robust set of performance metrics to better align the budget requirements with anticipated performance outcomes.

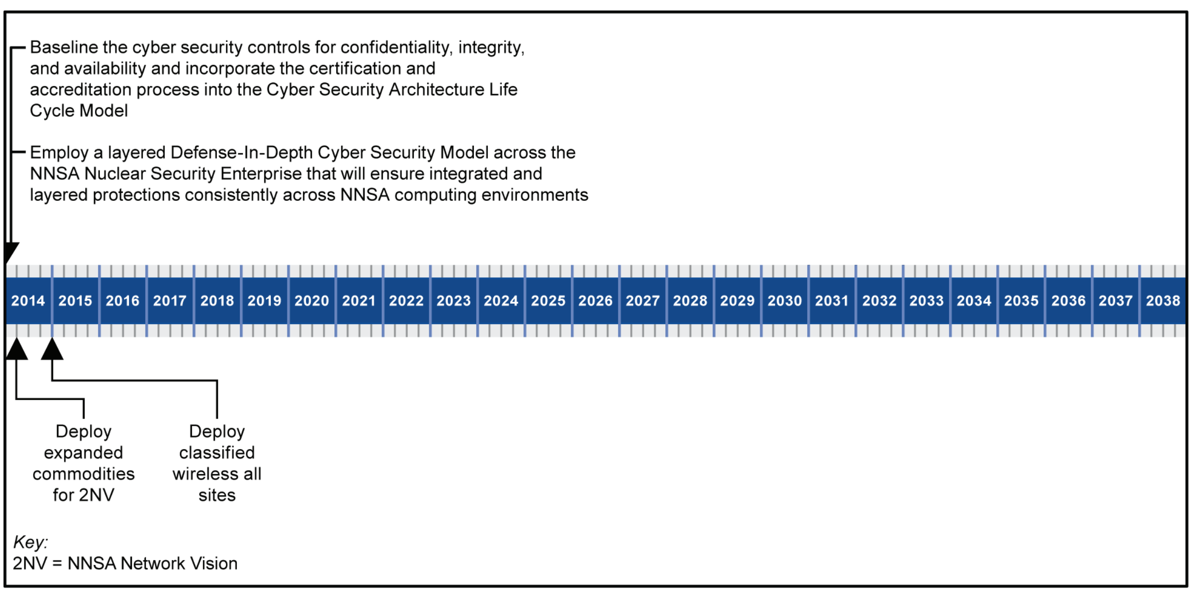


Figure 7–4. NNSA Chief Information Officer Activities program milestones and objectives timeline

Chapter 8

Future Years Nuclear Security Program Budget, Requirements Estimates, and Operations and Effective Business Practices

CHAPTER 8
FUTURE YEARS NUCLEAR SECURITY PROGRAM BUDGET, REQUIREMENTS ESTIMATES, AND OPERATIONS AND EFFECTIVE BUSINESS PRACTICES

NNSA has worked in close coordination with DoD over the past year to develop a responsible and affordable plan that ensures the safety and reliability of the stockpile and maintains the essential capabilities and infrastructure. The plan described in the FY 2014 FYNSP and in this SSMP is the result of rigorous analysis and tradeoffs between requirements and resources[1]. This joint analysis effort will continue as a multi-year, iterative process to adjust the plan to ensure it continues to reflect the best available planning data and a joint consensus on the balance between requirements and resources.

The budgetary information in this chapter of the SSMP provides an overview of the key elements in the Weapons Activities budget. This chapter also includes figures that graphically illustrate the relevant budgetary information for specific activities associated with each of these key elements. The FYNSP section is followed by a section that describes selected budget requirement estimates for 20 years beyond the FYNSP, along with the assumptions upon which these estimates are based. That section also includes past and projected weapon system life cycle costs used as part of the estimates beyond the FYNSP.

This section concludes with some of the actions NNSA is taking to improve the effectiveness and reduce the cost of its operations and business practices. These actions were being worked on prior to the recent NNSA and DOD joint study recommendation to identify Management Efficiencies and Workforce Prioritization target reductions for FY 2014 through FY 2018. To meet the *Nuclear Posture Review* (DoD 2010) goals but still stay within the tight discretionary spending caps now in place, NNSA, in coordination with DOD, is proposing to achieve savings through a strong synergy and alignment among science, engineering, technology development, and manufacturing capabilities with LEPs and by implementing several management efficiencies and reducing work on lower priority efforts.

8.1 Future Years Nuclear Security Program Budget

Table 8–1 shows the FYNSP budget for Weapons Activities. The numbers in this table for the FY 2014 FYNSP reflect the incorporation of "Workforce Prioritization" and "Management Efficiencies" savings targets generated as part of the joint study with DoD. These targets, as shown in **Table 8–2**, reflect the NNSA commitments to generate total program savings through realignment of staff via priority efforts such as LEPs, as well as the realization of efficiencies that would reduce the cost of executing stockpile

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[1] *The funding levels reflected in this chapter and the activities described throughout this document do not include the impacts of sequestration.*

stewardship and management activities. The planning to achieve these savings includes the completion of a workforce study and an analysis of options to realize particular efficiencies.

Funding for activities that formerly composed the Readiness in Technical Base and Facilities Program has now been moved to two programs. A new program, Nuclear Programs, funds strategic investments to modernize nuclear manufacturing capabilities. The Site Stewardship Program funds field infrastructure and operations that broadly support all programs within the nuclear security enterprise and NNSA.

Another change from the FY 2013 FYNSP is the transfer of activities funded under the Nuclear Counterterrorism Incident Response and National Security Applications programs to the Nuclear Nonproliferation appropriation.

Table 8–1. Overview of Future Years Nuclear Security Program budget for Weapons Activities in fiscal years 2012 through 2018 [a]

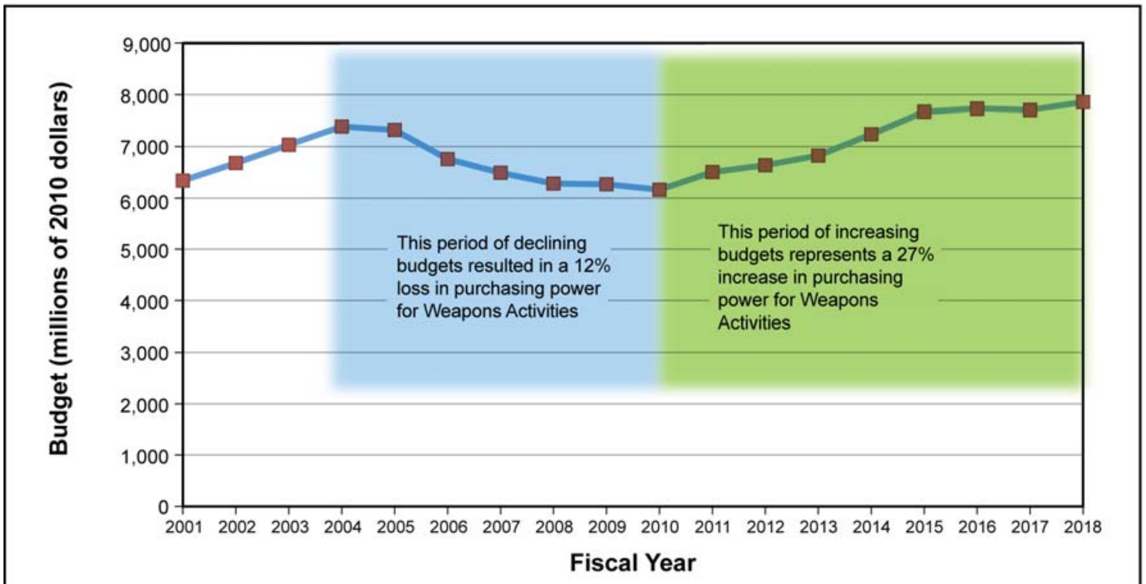
	Fiscal Year (dollars in millions)						
Activity	***2012 Current***	***2013 Annualized CR [b]***	***2014 Request***	***2015 Request***	***2016 Request***	***2017 Request***	***2018 Request***
Directed Stockpile Work	1,862.1	2,111.3	2,428.5	2,539.7	2,586.3	2,732.4	3,045.5
Science Campaign	331.9	350.1	397.9	513.6	541.9	537.2	535.2
Engineering Campaign	141.8	150.6	149.9	165.1	166.9	160.5	172.0
Inertial Confinement Fusion Ignition and High Yield Campaign	474.5	465.0	401.0	367.8	364.2	353.9	345.6
Advanced Simulation and Computing Campaign	618.0	595.0	564.3	601.1	621.0	633.9	646.7
Readiness Campaign	128.4	130.1	197.8	271.0	254.6	225.8	224.6
Secure Transportation Asset	243.1	219.4	219.2	226.1	234.1	245.5	248.2
Readiness in Technical Base and Facilities	2,013.7	2,216.8	0	0	0	0	0
Nuclear Programs	0.0	0.0	744.5	994.1	1,191.6	1,208.5	1,333.2
Site Stewardship	82.2	90.0	1,706.0	1,745.4	1,729.2	1,775.7	1,705.6
Facilities and Infrastructure Recapitalization	96.1	0	0	0	0	0	0
Nuclear Counterterrorism Incident Response	221.4	247.6	0	0	0	0	0
Defense Nuclear Security	692.1	674.5	679.0	643.7	652.8	667.3	682.2
NNSA Chief Information Officer Activities	131.4	137.0	148.4	179.8	151.7	154.4	157.0
National Security Applications	10	18.2	0	0	0	0	0
Legacy Contractor Pensions	168.2	185.0	279.6	302.3	291.1	237.6	197.0
Adjustments	0	(33.2)	(47.7)	0	0	0	0
Weapons Activities Total	***7,214.8***	***7,557.3***	***7,868.4***	***8,549.7***	***8,785.4***	***8,932.8***	***9,292.9***

[a] Totals may not add due to rounding.
[b] FY 2013 amounts shown reflect the P.L. 112-175 continuing resolution level annualized to a full year.

Table 8–2. Savings targets for workforce prioritization and management efficiencies

	Fiscal Year (dollars in millions)				
	2014	***2015***	***2016***	***2017***	***2018***
Workforce Prioritization Savings	(240.4)	(267.0)	(307.2)	(324.3)	(398.1)
Management Efficiencies Savings	(80.0)	(162.6)	(247.4)	(339.6)	(439.1)
Total	***(320.4)***	***(429.6)***	***(554.6)***	***(663.9)***	***(837.2)***

Figure 8–1 shows how this level of funding over the FYNSP compares with Weapons Activities purchasing power (in 2010 dollars) in prior years.

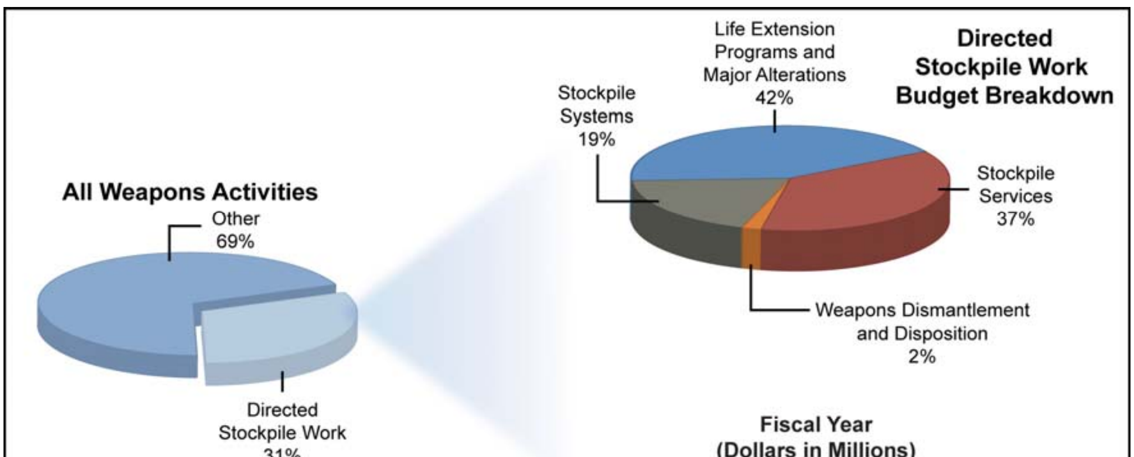


Note: Nuclear Counterterrorism Incident Response and National Security Applications funding have been removed from the Weapons Activities totals for FY 2001 – FY 2013 since they are no longer included for FY 2014 – FY 2018.

Figure 8–1. Weapons Activities historical purchasing power — fiscal years 2001 through 2018

Figures 8–2 to **8–11** display the pie charts for the FY 2014 budget and the tables that detail the FY 2014 FYNSP breakdown and the reference years FY 2012 and FY 2013.

8.2 Directed Stockpile Work Budget



Fiscal Year (Dollars in Millions)

	2012	2013	2014	2015	2016	2017	2018
Life Extension Programs and Major Alterations	379.5	566.9	1,014.6	1,072.4	1,075.5	1,102.3	1,263.5
Stockpile Systems	578.3	590.4	454.5	459.5	454.2	458.3	470.3
Weapons Dismantlement and Disposition	55.9	51.3	49.3	49.7	50.2	50.4	59.2
Stockpile Services	848.4	902.7	910.2	958.0	1,006.4	1,121.4	1,252.4
Total Directed Stockpile Work	1,862.1	2,111.3	2,428.5	2,539.7	2,586.3	2,732.4	3,045.5

Figure 8–2. Directed Stockpile Work funding schedule for fiscal years 2012 through 2018

The LEP funding line has been retitled "Life Extensions Programs and Major Alterations." This funding line includes all Phase 6.2-6.6 activities for full or partial warhead life extension efforts whose anticipated cost for research, development, test, and evaluation, or total procurement triggers a Congressional requirement to submit a Special Acquisition Report.

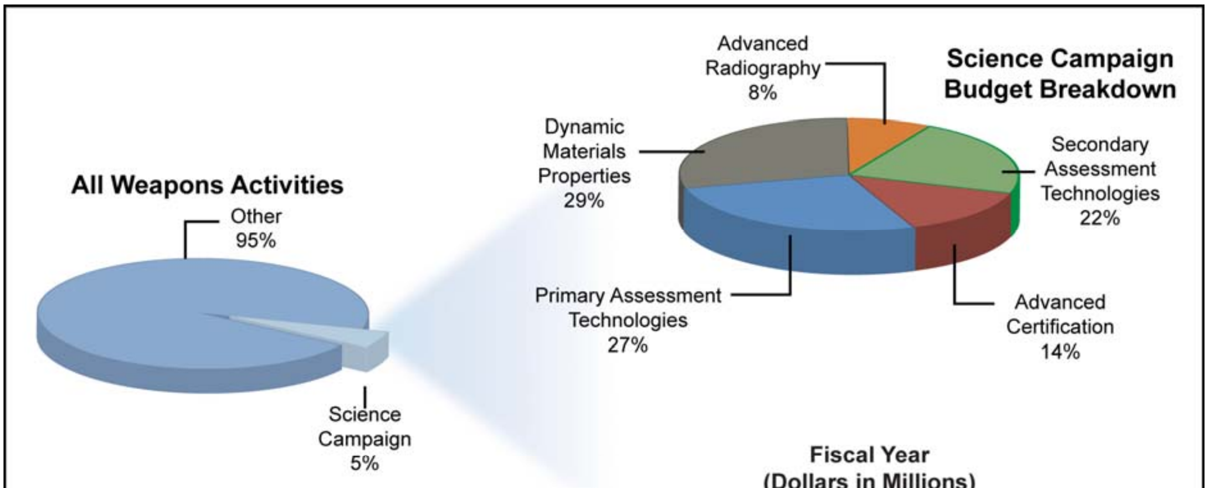
The Stockpile Systems and Stockpile Services budget lines in Figure 8–2 include Surveillance Program funding in the amounts shown for FY 2010 through 2018 in **Table 8–3**.

Table 8–3. Surveillance Program funding for fiscal years 2010 through 2018

	Fiscal Year (Dollars in Millions)								
	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
Surveillance Program Funding	181	239	239	217	225	213	219	209	214

8.3 Science, Technology, and Engineering Budget and Readiness Campaign Budget

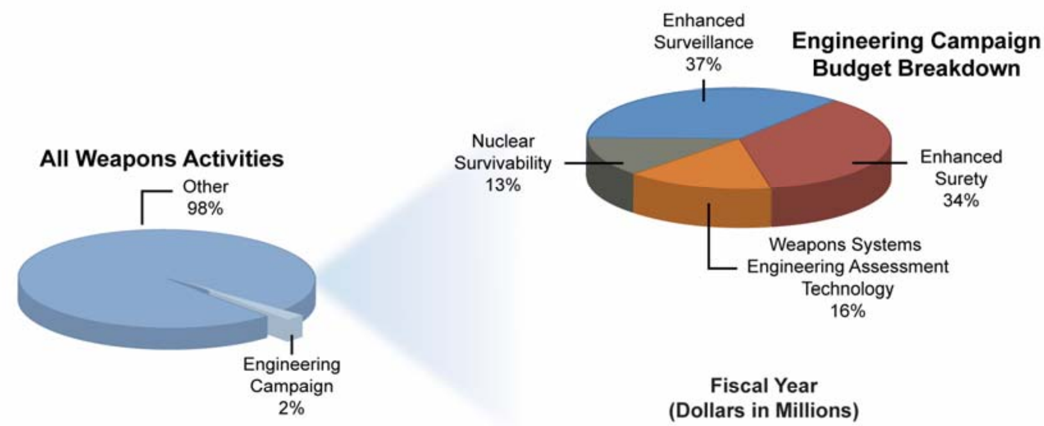
8.3.1 Science Campaign



	2012	2013	2014	2015	2016	2017	2018
Advanced Certification	39.8	44.1	54.7	71.4	73.9	73.7	65.2
Primary Assessment Technologies	85.1	94.0	109.2	140.3	140.0	137.3	141.9
Dynamic Materials Properties	96.3	97.0	117.0	135.1	147.0	150.7	151.4
Advanced Radiography	25.9	30.0	30.5	73.0	82.5	76.0	76.7
Secondary Assessment Technologies	84.7	85.0	86.5	93.8	98.5	99.6	100.0
Total Science Campaign	331.9	350.1	397.9	513.6	541.9	537.2	535.2

Figure 8–3. Science Campaign funding schedule for fiscal years 2012 through 2018

8.3.2 Engineering Campaign

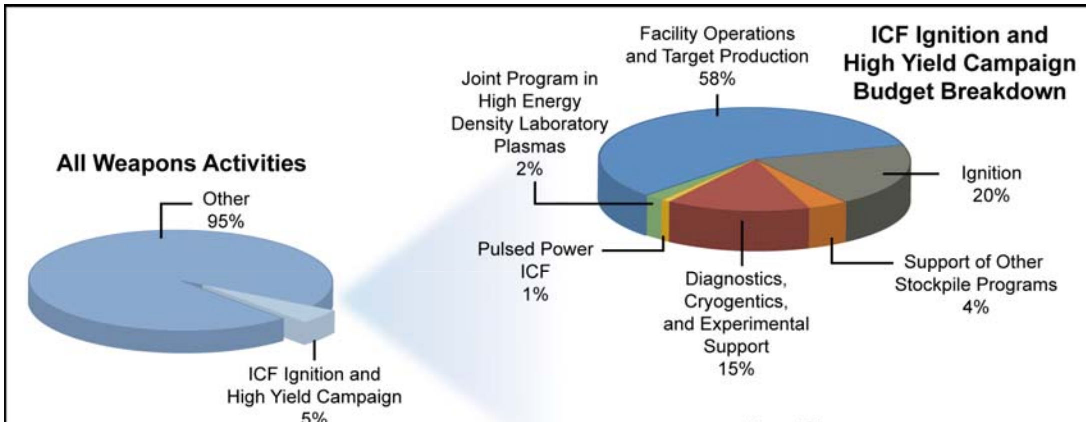


Fiscal Year (Dollars in Millions)

	2012	2013	2014	2015	2016	2017	2018
Enhanced Surety	41.5	46.4	51.8	57.0	54.5	47.9	53.9
Weapon Systems Engineering Assessment Technology	15.5	19.0	23.7	24.2	24.0	24.1	25.8
Nuclear Survivability	19.3	21.8	19.5	27.2	28.2	29.0	30.2
Enhanced Surveillance	65.6	63.4	54.9	56.7	60.1	59.5	62.1
Total Engineering Campaign	141.8	150.6	149.9	165.1	166.9	160.5	172.0

Figure 8–4. Engineering Campaign funding schedule for fiscal years 2012 through 2018

8.3.3 Inertial Confinement Fusion Ignition and High Yield Campaign



Fiscal Year (Dollars in Millions)

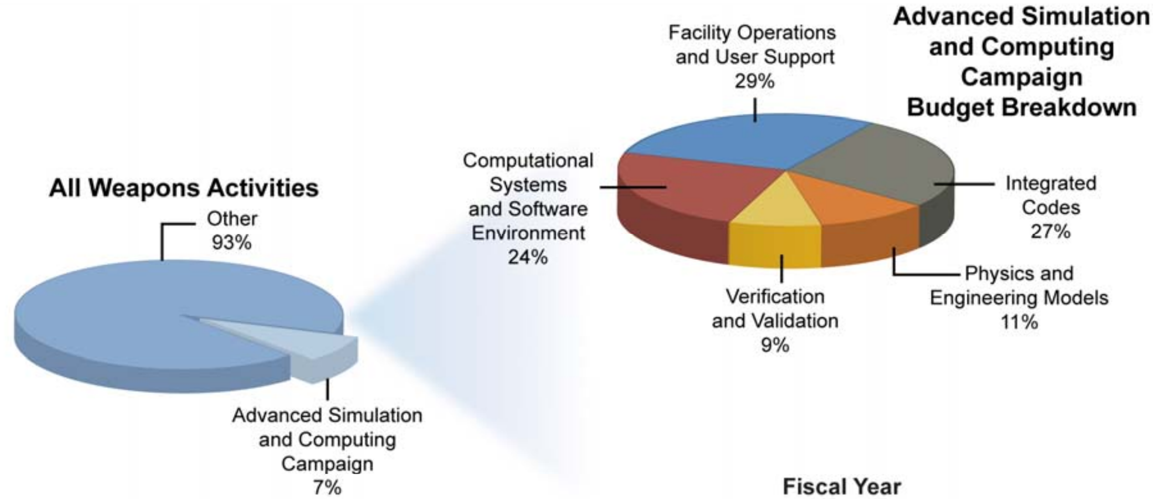
	2012	2013	2014	2015	2016	2017	2018
Diagnostics, Cryogenics, and Experimental Support	85.7	81.9	59.9	56.8	54.5	50.6	47.1
Pulsed Power ICF	5.0	6.0	5.0	5.7	5.8	5.9	6.0
Joint Program in High Energy Density Laboratory Plasmas	9.1	8.3	8.2	9.5	9.5	9.5	9.4
Facility Operations and Target Production	264.8	269.7	232.7	204.8	201.3	193.2	186.3
Ignition	109.9	84.2	80.2	73.6	75.3	76.8	78.2
Support of Other Stockpile Programs	0.0	14.8	15.0	17.4	17.7	18.0	18.5
Total ICF Ignition and High Yield Campaign*	474.5	465.0	401.0	367.8	364.2	353.9	345.6

Key:
ICF = Inertial Confinement Fusion

* Since submission of the FY 2013 Congressional Budget Request, funds from adjustments due to indirect rate changes at Lawrence Livermore National Laboratory were included for FY 2013 in Readiness in Technical Base and Facilities and for FY14 and beyond in Enterprise Infrastructure in Site Stewardship. These monies will provide a portion of base operations and maintenance for the National Ignition Facility.

Figure 8–5. Inertial Confinement Fusion Ignition and High Yield Campaign funding schedule for fiscal years 2012 through 2018

8.3.4 Advanced Simulation and Computing Campaign

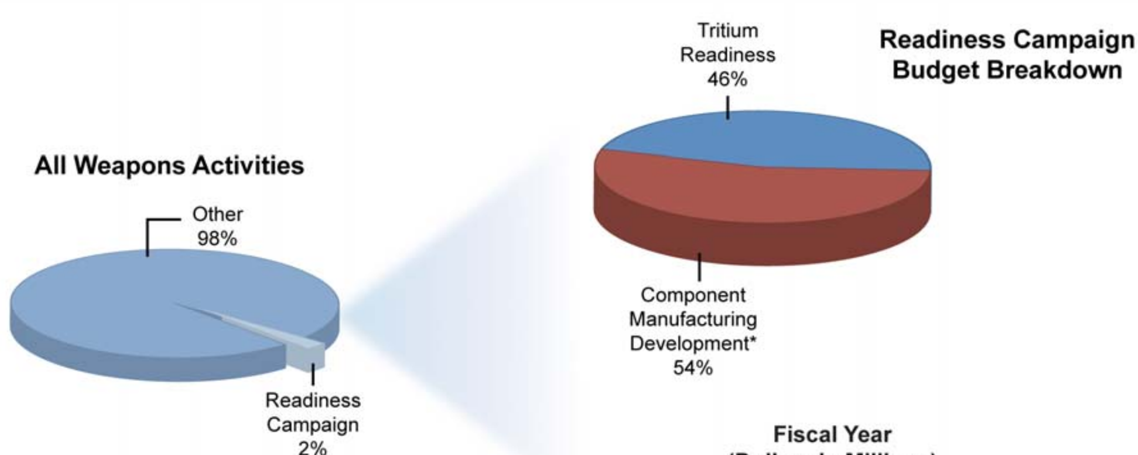


Fiscal Year (Dollars in Millions)

	2012	2013	2014	2015	2016	2017	2018
Integrated Codes	160.9	145.7	157.5	167.8	173.3	176.9	180.5
Physics and Engineering Models	69.9	68.9	63.0	67.1	69.3	70.8	72.2
Verification and Validation	46.1	56.2	52.7	56.2	58.1	59.2	60.4
Computational Systems and Software Environment	181.2	151.1	135.6	144.4	149.2	152.3	155.4
Facility Operations and User Support	159.9	173.0	155.5	165.6	171.1	174.7	178.2
Total Advanced Simulation and Computing Campaign	618.0	594.9	564.3	601.1	621.0	633.9	646.7

Figure 8–6. Advanced Simulation and Computing Campaign funding schedule for fiscal years 2012 through 2018

8.3.5 Readiness Campaign



Fiscal Year (Dollars in Millions)

	2012	2013	2014	2015	2016	2017	2018
Tritium Readiness	63.5	65.4	91.7	115.8	104.5	95.6	123.2
Component Manufacturing Development*	64.9	64.7	106.1	155.2	150.2	130.3	101.4
Total Readiness Campaign	128.4	130.1	197.8	271.0	254.6	225.8	224.6

* Formerly Nonnuclear Readiness Campaign

Figure 8–7. Readiness Campaign funding schedule for fiscal years 2012 through 2018

Table 8–4 shows the estimated costs, funded under the Tritium Readiness subprogram, to support the projected increase in tritium requirements. In 2010, the U.S. Government Accountability Office, as part of an audit of the Tritium Readiness subprogram, recommended that NNSA ensure it complies with appropriate contracting procedures and that its future budget requests account for the subprogram's large unexpended balances. Previously, NNSA provided funding to component and service suppliers to fully fund the 5-year period of their contract options. NNSA relies extensively on commercial suppliers, through multi-year contracts, to support this subprogram. This funding profile, combined with a decrease in the requirement for TPBARs manufacture and irradiation, resulted in high uncosted balances. As a result of the audit recommendations by the U.S. Government Accountability Office, NNSA undertook efforts to develop and implement an acquisition strategy that funds suppliers on a shorter time basis and now takes account of uncosted balances for future funding requests. The Tritium Readiness subprogram also terminated its out-year scope for component procurements and de-obligated funds that would have been in excess at the expiration of the period of performance for the current options. These adjustments are reflected in Table 8–4.

Table 8–4. Estimated tritium readiness resource requirements

	Fiscal Year (dollars in millions)							
	2012	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2014 – 2018***
Requirements	63.5	65.4	95.7	122	111.3	102.9	134.6	566.5
President's Budget/Future Years Nuclear Security Program	63.5	65.4	91.7	115.8	104.5	95.6	123.2	530.8
Surpluses/shortfalls [a]	0	0	(4.00)	(6.20)	(6.80)	(7.30)	(11.40)	(35.70)

[a] Shortfall arises from the general application of savings targets for Management Efficiencies and Workforce Prioritization for which studies are ongoing to determine the final allocation.

8.4 Nuclear Security Enterprise Infrastructure and Operations

As noted above, the activities formerly found in the Readiness in Technical Base and Facilities Program are now split between Nuclear Programs and the Site Stewardship Program.

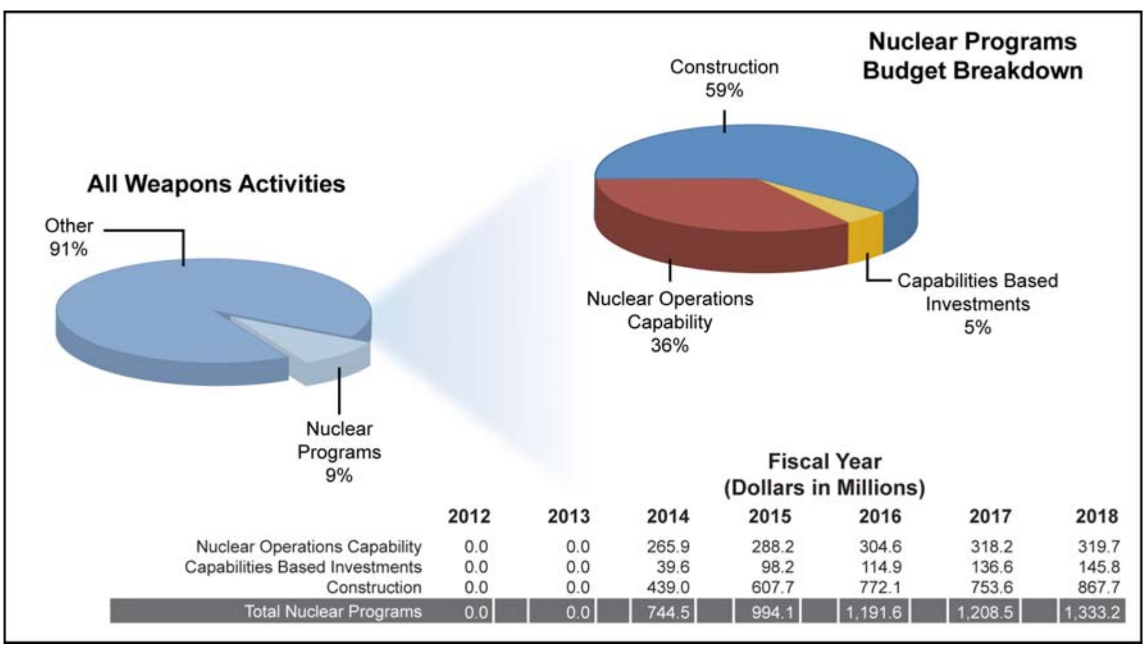
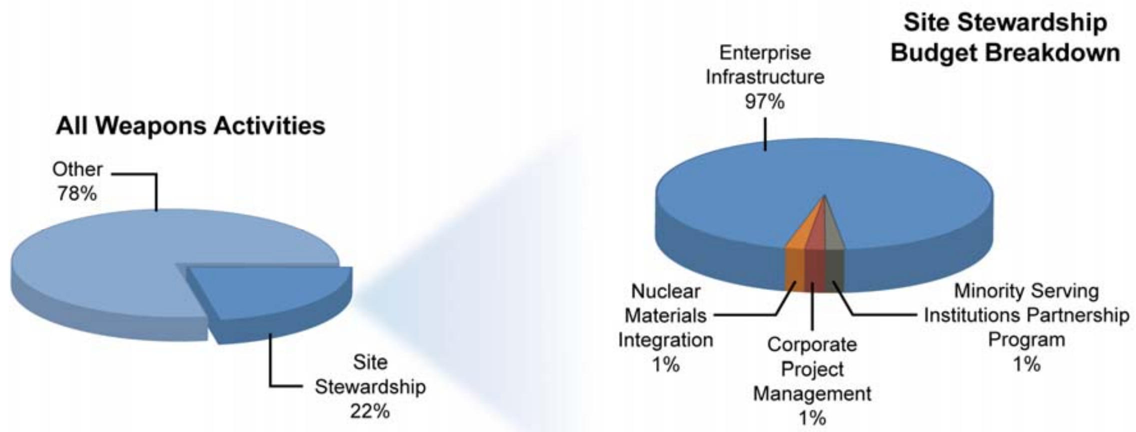


Figure 8–8. Nuclear Programs funding schedule for fiscal years 2012 through 2018



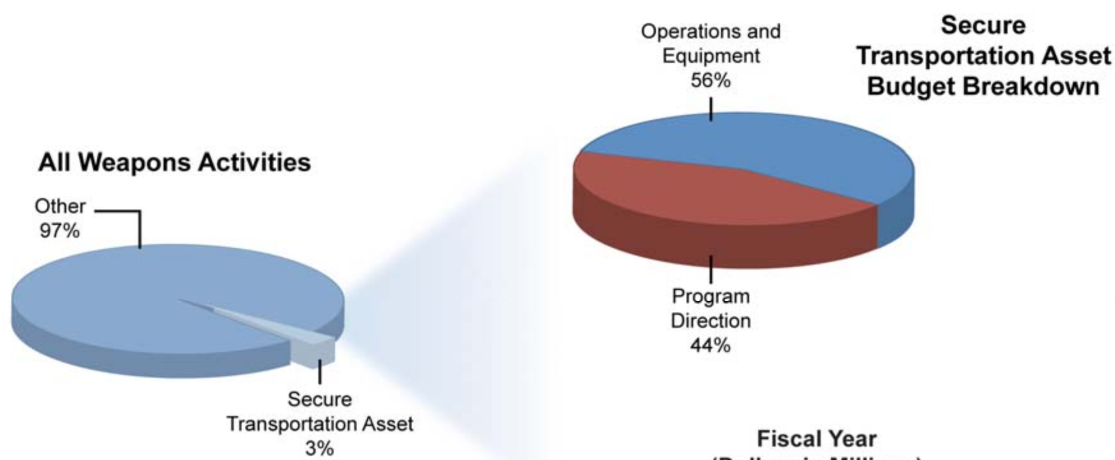
Fiscal Year (Dollars in Millions)

	2012	2013	2014	2015	2016	2017	2018
Environmental Projects and Operations*	45.2	47.0	0.0	0.0	0.0	0.0	0.0
Energy Modernization and Investment Program*	0.0	10.3	0.0	0.0	0.0	0.0	0.0
Nuclear Materials Integration	37.0	19.0	17.7	17.6	17.9	18.3	18.7
Corporate Project Management	0.0	13.8	13.0	12.8	12.1	10.1	8.2
Minority Serving Institutions Partnership Program	0.0	0.0	14.5	14.4	14.3	14.2	14.0
Enterprise Infrastructure	0.0	0.0	1,660.8	1,644.6	1,680.0	1,691.0	1,624.6
Construction	0.0	0.0	0.0	56.0	5.0	42.1	40.0
Total Site Stewardship	82.2	90.1	1,706.0	1,745.4	1,729.2	1,775.7	1,705.6

* Funding for these activities is now found in Enterprise Infrastructure

Figure 8–9. Site Stewardship funding schedule for fiscal years 2012 through 2018

8.5 Secure Transportation Asset Budget

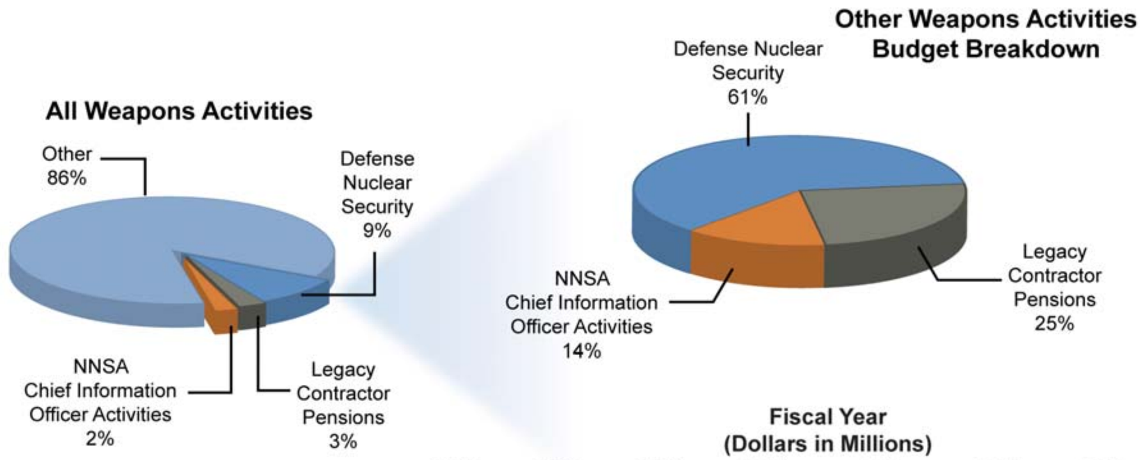


Fiscal Year (Dollars in Millions)

	2012	2013	2014	2015	2016	2017	2018
Operations and Equipment	150.0	115.0	122.1	125.8	132.2	142.8	144.4
Program Direction	93.1	104.4	97.1	100.3	101.9	102.7	103.8
Total Secure Transportation Asset	243.1	219.4	219.2	226.1	234.1	245.5	248.2

Figure 8–10. Secure Transportation Asset funding schedule for fiscal years 2012 through 2018

8.6 Other Weapons Activities Budget



Fiscal Year
(Dollars in Millions)

	2012	2013	2014	2015	2016	2017	2018
Facilities and Infrastructure Recapitalization	96.1	0.0	0.0	0.0	0.0	0.0	0.0
Nuclear Counterterrorism Incident Response*	221.4	247.6	0.0	0.0	0.0	0.0	0.0
Defense Nuclear Security	692.1	674.5	679.0	643.7	652.8	667.3	682.2
NNSA Chief Information Officer Activities	131.4	137.0	148.4	179.8	151.7	154.4	157.0
National Security Applications*	10.0	18.2	0.0	0.0	0.0	0.0	0.0
Legacy Contractor Pensions	168.2	185.0	279.6	302.3	291.1	237.6	197.0
Adjustments	0.0	(33.2)	(47.7)	0.0	0.0	0.0	0.0
Total Other Weapons Activities	1,319.2	1,229.1	1,059.3	1,125.8	1,095.6	1,059.3	1,036.2

* Nuclear Counterterrorism Incident Response and National Security Applicationshas been transferred to the Defense Nuclear Nonproliferation appropriation.

Figure 8–11. Other Weapons Activities funding schedules for fiscal years 2012 through 2018

8.7 Other Fiscal Issues

8.7.1 Pension Cost Growth and Alternative Mitigation Strategies

NNSA has a large contractor workforce, many of whom participate in employer-sponsored, defined-benefit pension plans. Pursuant to DOE/NNSA contracts with its contractors, the U.S. Government reimburses reasonable pension costs. Market downturns, interest rate decreases, and new statutory requirements have caused large increases in pension costs. The Administration is fully committed to continuing to reimburse contractors for these pension costs in accordance with their contracts. NNSA is also responsible for legacy pension costs associated with the former University of California contracts. The Administration's FY 2014 budget request will continue to cover the total pension reimbursement and legacy contractor pension costs, which are estimated to be $886.7 million for all of NNSA for FY 2014. This represents $112.4 million more than the estimated payments for FY 2013 ($774.3 million).

The Administration continues to evaluate multiple approaches to determine the best path to covering the pension plan contributions while minimizing the impact on NNSA's mission. Contractors are evaluating mitigation strategies, such as analyzing plan changes, identifying alternative funding strategies, and seeking increased participant contributions. Contractors have also been directed to look for savings in other human resource areas to fund the pension plan contributions.

8.8 Estimates of Requirements Beyond the Future Years Nuclear Security Program

Projections beyond the FYNSP are appropriately called estimates. These are snapshots in time of expected inflation and other factors, given a specific set of requirements that are themselves not fixed over a period of years. Budget estimates are evaluated each year and adjusted as necessary. For the cost projections beyond the FYNSP, an escalation of 2 percent per year is assumed after FY 2018 for those activities expected to be operating at the same levels as during the FYNSP. For some elements, such as for LEPs and other discrete projects, this estimate is not valid. In those cases, discrete estimates of the requirements have been made using currently available planning data.

Figure 8–12 shows the Weapons Activities funding contained in the FY 2014 President's Budget. Section 8.9 includes the current estimates for direct support of the stockpile for the conduct of surveillance, assessment, maintenance, and life extension activities.

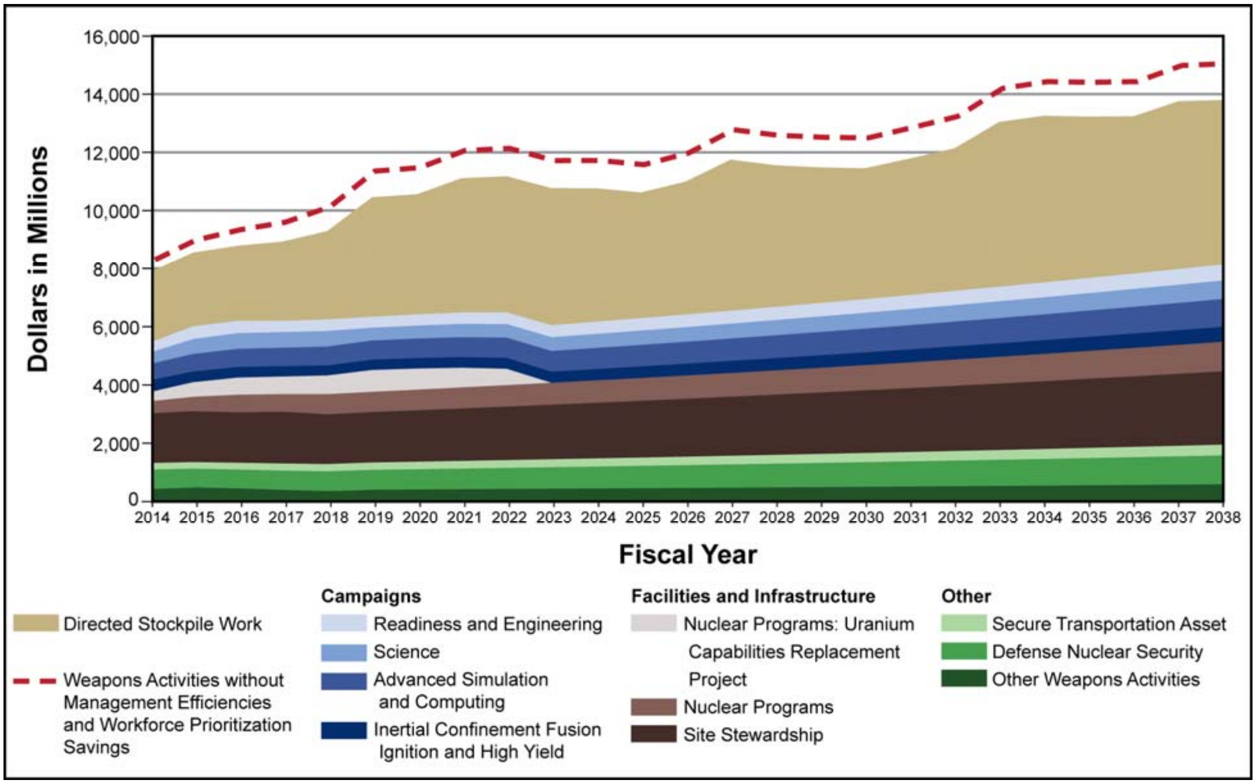


Figure 8–12. Estimate of out-year budget requirements for Weapons Activities of the NNSA in then-year dollars

NNSA has been examining alternatives to the construction of the CMRR-NF and recently briefed Congress on the plutonium strategy. The FYNSP does contain funding for elements of the strategy to achieve a 30-pits-per-year capability by FY 2021. No funding has been included in the FYNSP or beyond for construction of the CMRR-NF or the alternatives to reach potentially up to 80 pits per year capability as early as 2030 because of immaturity in the planning for the alternatives.

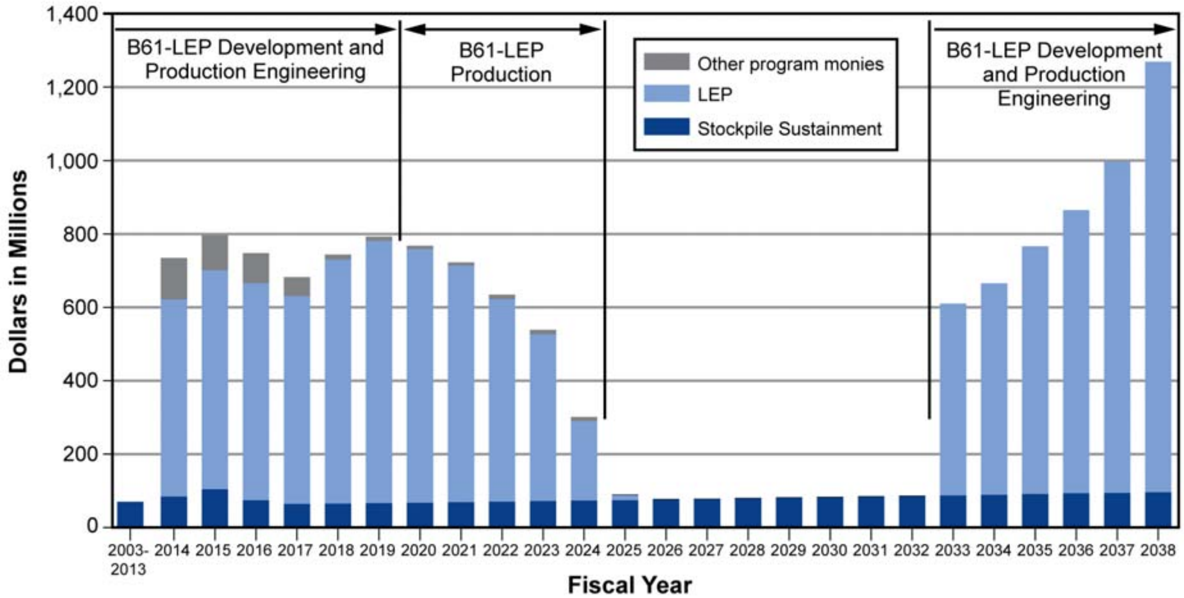
8.9 Estimates for Stockpile Management

Life cycle costs encompass all anticipated costs associated with a project or program throughout its lifetime, from pre-design, through manufacturing, to end of life. For nuclear weapons, life cycle cost analysis is useful in comparing similar weapon designs. Where systems may have the same R&D costs, one weapon design may have a lower manufacturing cost, but higher maintenance and support costs.

The design, manufacturing, and sustainment costs of the weapons in the stockpile were not reported by weapon type before FY 2003, and back calculating these costs is not feasible. At the direction of Congress, starting with the FY 2005 DOE budget request, certain stockpile sustainment costs for each weapon type within the DSW program have been reported annually. Actual sustainment funding for weapons maintenance and life extension activities has been reported as prior-year appropriations back to FY 2003. Sustainment costs include ongoing assessment activities, LLC exchanges, required and routine maintenance, safety studies, periodic repairs, resolution and timely closure of SFIs, military liaison work, and surveillance to assure the continued safety, security, and reliability of the stockpile. These costs are incurred every year that a weapon is in the active stockpile. LEPs, which are not part of stockpile sustainment, are undertaken as needed to extend the life of a warhead for an additional 20 to 30 years or more. LEP costs are incurred only for the duration of the life extension activities.

Such weapon-specific sustainment appropriations *do not* reflect the breadth of stockpile support activities in the Weapons Activities account of the NNSA budget. In fact, weapon-specific costs are only a fraction of the Weapons Activities budget or of the DSW program budget. Other costs are traceable to the Stockpile Services subprogram (under the DSW program), the ST&E campaigns, and the physical infrastructure, as well as to security and transportation, all of which make current and future weapon-specific activities possible. Further discussion of each of these Weapons Activities is in the classified Annex to this SSMP.

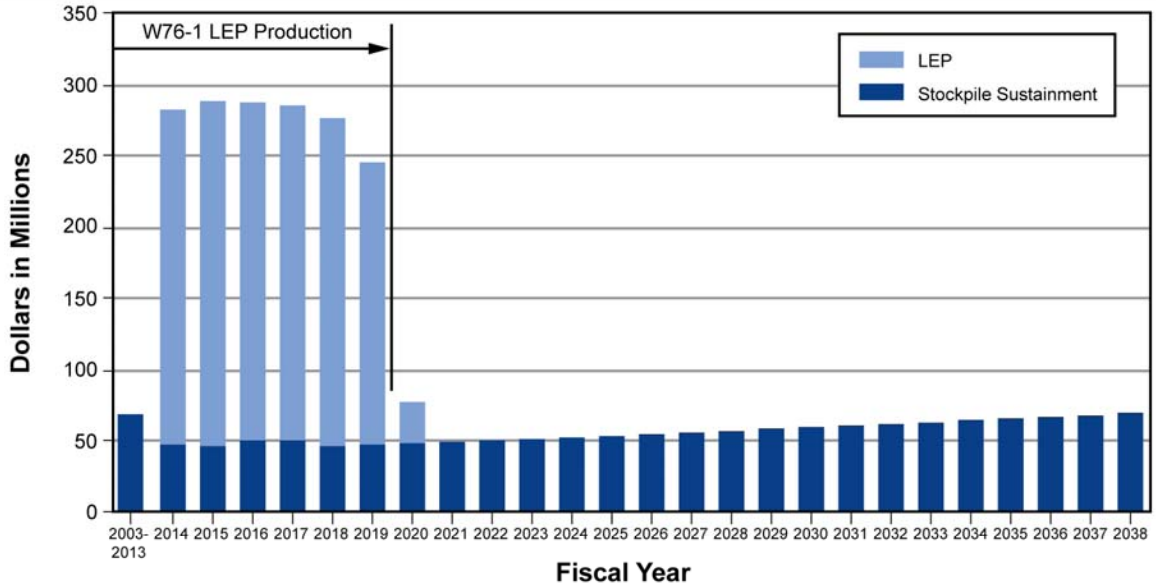
Figures 8–13 through **8–19** show the annual stockpile sustainment and life extension costs (in then-year dollars) that can be directly associated with a warhead in the active stockpile. **Figures 8–20** through **8–23** show the life extension costs (in then-year dollars) for life extension efforts that can be associated with more than one weapon system in the active stockpile. Cost estimates for future weapons programs were based on cost for the W-76-1 LEP. These preliminary estimates could be lower or higher depending on the ability to reuse components versus new components. Each of these efforts will result in a warhead that is interoperable between the platforms that currently carry the referenced warheads. The intent of the Nuclear Weapons Council's current baseline strategic plan is to replace one or more current stockpile warheads with each of the interoperable, life-extended warheads. Ultimately, the four current SLBM/ICBM warhead types will be replaced with three interoperable types. The sustainment costs for the interoperable warheads, once they enter the stockpile, have been captured in sustainment costs for existing warheads because of the classification of the transition plan. Interoperable warheads are expected to have a reduced total sustainment cost of the weapons they replace due to consolidation of warhead types. The extent of these savings, however, has not yet been determined. Details on the transition from existing warheads to interoperable ones can be found in Chapter 2 of the classified Annex.



- 2003 to 2013 average cost data for sustainment only obtained from actual prior year appropriation in DOE Congressional budget request. Prior year average LEP costs are not shown.
- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2014 to 2025 B61 LEP cost projections based on the completed Weapons Development Cost Report.
- Other program monies represent the incremental costs to other programs to execute the LEP.
- Stockpile sustainment costs refer to the stockpile systems appropriation in the Directed Stockpile Work budget without LEP 6.2-6.2A costs.
- 2019 to 2038 sustainment cost projections escalated at 2 percent per year from 2018 funding levels.
- The LEP shown starting in 2033 is a follow-on to the ongoing B61-12 LEP. Cost projections were obtained from an internal cost model based on W76 LEP actual costs, subject to change.

Key:
LEP = Life Extension Program

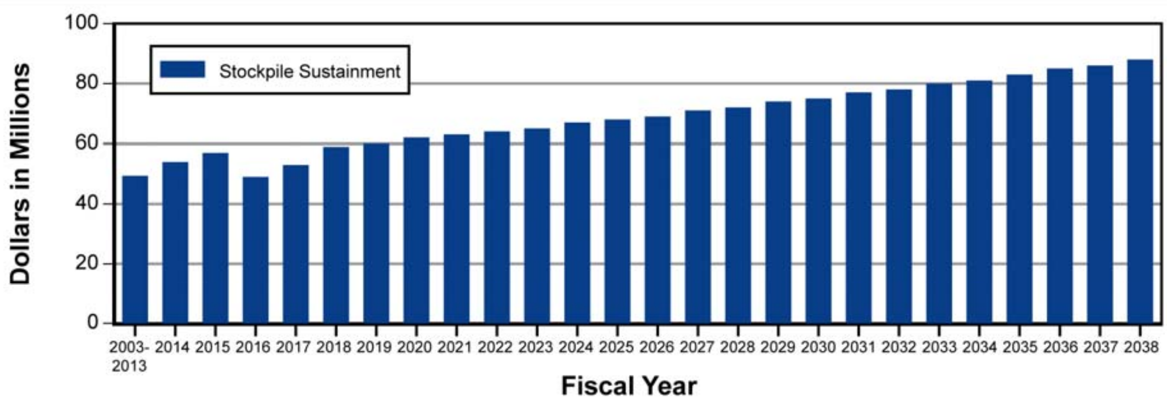
Figure 8–13. B61 gravity bomb projected costs for fiscal years 2014 through 2038



- 2003 to 2013 cost data for sustainment only obtained from actual prior year appropriation in DOE Congressional budget request. Prior year average LEP costs are not shown.
- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- Stockpile sustainment costs refer to the stockpile systems appropriation in the Directed Stockpile Work budget without LEP 6.2-6.2A costs.
- 2019 to 2038 sustainment cost projections escalated at 2 percent per year from the 2018 funding level.

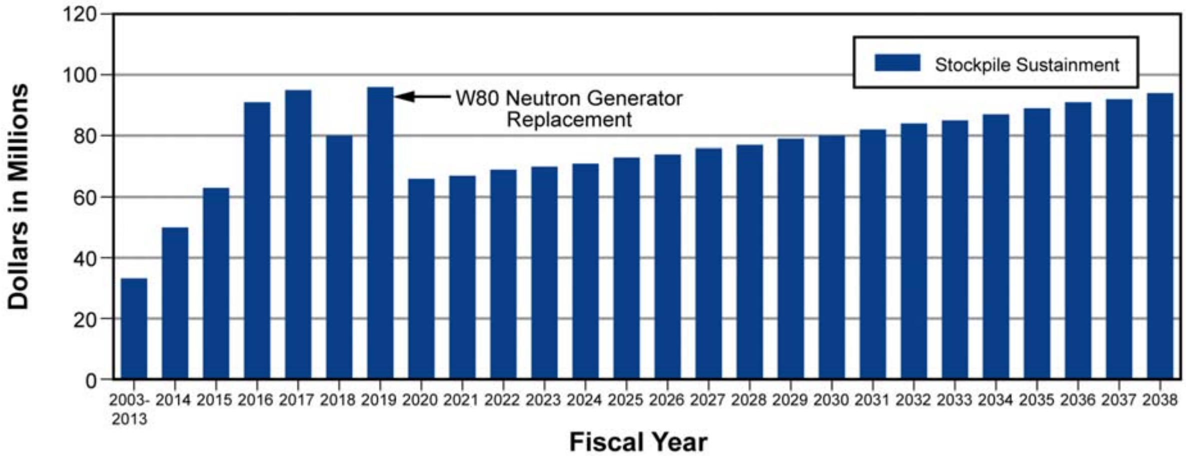
Key:
LEP = Life Extension Program

Figure 8–14. W76 nuclear warhead projected costs for fiscal years 2014 through 2038



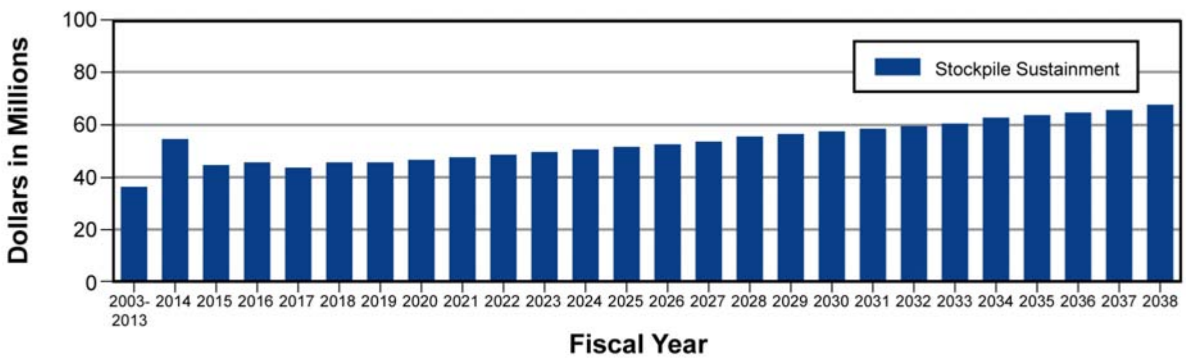
- 2003 to 2013 average cost data for sustainment obtained from actual prior year appropriation in DOE Congressional budget request.
- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2019 to 2038 sustainment cost projections escalated by 2 percent per year from the 2018 funding level.
- Stockpile sustainment costs refer to the stockpile systems appropriation in the Directed Stockpile Work budget without life extension program 6.2-6.2A costs.

Figure 8–15. W78 nuclear warhead projected costs for fiscal years 2014 through 2038



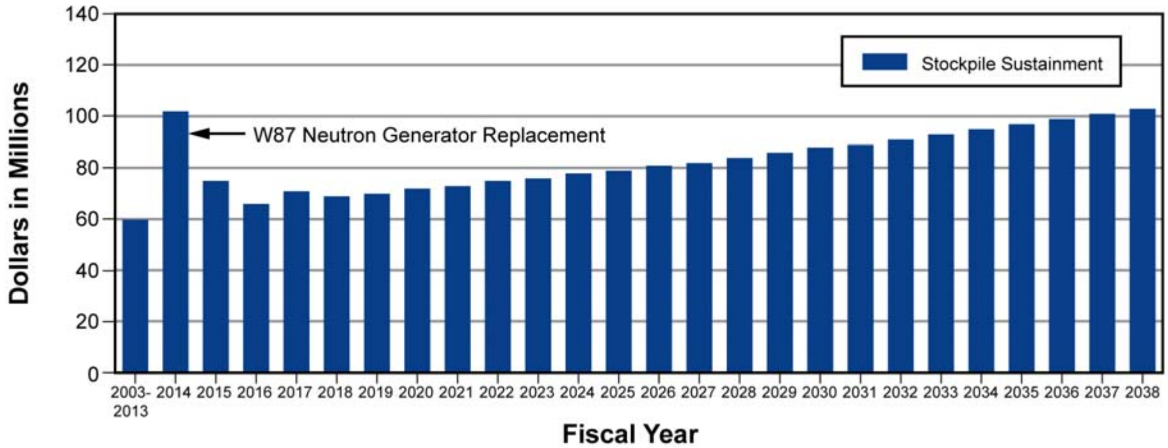
- 2003 to 2013 average cost data for sustainment obtained from actual prior year appropriation in DOE Congressional budget request.
- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2019 to 2038 sustainment cost projections escalated by 2 percent per year from the 2018 funding level.
- Stockpile sustainment costs refer to the stockpile systems appropriation in the Directed Stockpile Work budget without life extension program 6.2-6.2A costs.

Figure 8–16. W80 nuclear warhead projected costs for fiscal years 2014 through 2038



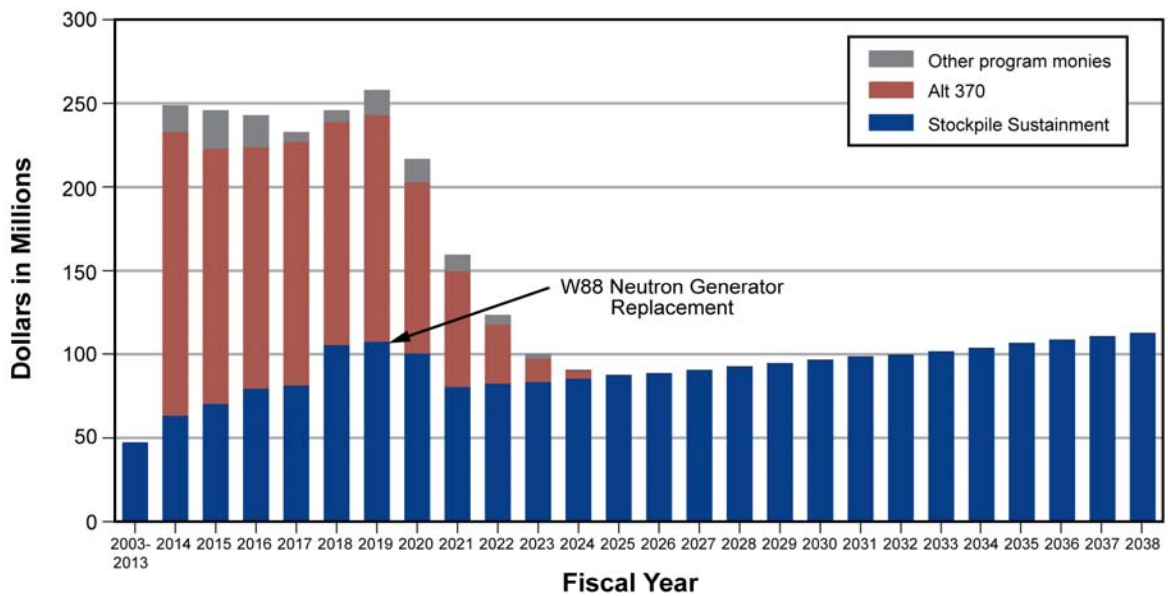
- 2003 to 2013 average cost data for sustainment obtained from actual prior year appropriation in DOE Congressional budget request.
- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2019 to 2038 sustainment cost projections escalated by 2 percent per year from the 2018 funding level.
- Stockpile sustainment costs refer to the stockpile systems appropriation in the Directed Stockpile Work budget without life extension program 6.2-6.2A costs.

Figure 8–17. B83 gravity bomb projected costs for fiscal years 2014 through 2038



- 2003 to 2013 average cost data for sustainment obtained from actual prior year appropriation in DOE Congressional budget request.
- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2019 to 2038 sustainment cost projections escalated by 2 percent per year from the 2018 funding level.
- Stockpile sustainment costs refer to the stockpile systems appropriation in the Directed Stockpile Work budget without life extension program 6.2-6.2A costs.

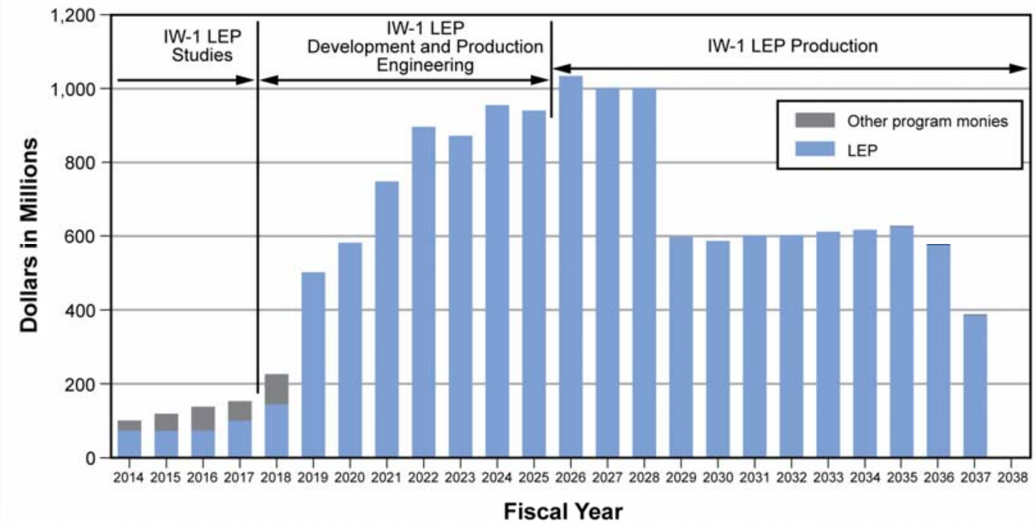
Figure 8–18. W87 nuclear warhead projected costs for fiscal years 2014 through 2038



- 2003 to 2013 average cost data for sustainment only obtained from actual prior year appropriation in DOE Congressional budget request.
- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2014 to 2024 W88 Alt 370 cost projections based on the completed Weapons Development Cost Report.
- Other program monies represent the incremental costs to other programs to execute the Alt.
- Stockpile sustainment costs refer to the stockpile systems appropriation in the Directed Stockpile Work budget without Life Extension Program 6.2-6.2A or major Alt costs.
- 2019 to 2038 sustainment cost projections escalated at 2 percent per year from 2018 funding levels.

Key:
Alt = Alteration

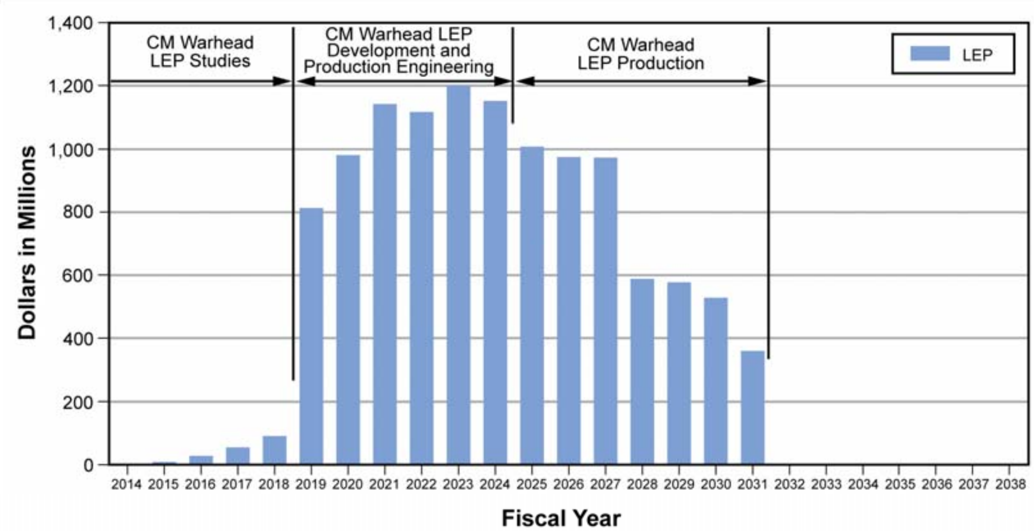
Figure 8–19. W88 nuclear warhead projected costs for fiscal years 2014 through 2038



- 2014 to 2019 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2019 to 2037 LEP cost projections obtained from internal cost model based on W76 LEP actual costs, subject to change.
- The chart above assumes a FPU in 2025 which represents a no earlier than date. The actual FPU date will be set based on the results of the 6.2-6.2A studies.
- Other program monies represent the incremental costs to other programs to execute the LEP. These have been broken out for 2014 to 2019, but are included in the LEP totals for 2019 to 2037.

Key:
FPU = First Production Unit
IW = interoperable warhead
LEP = Life Extension Program

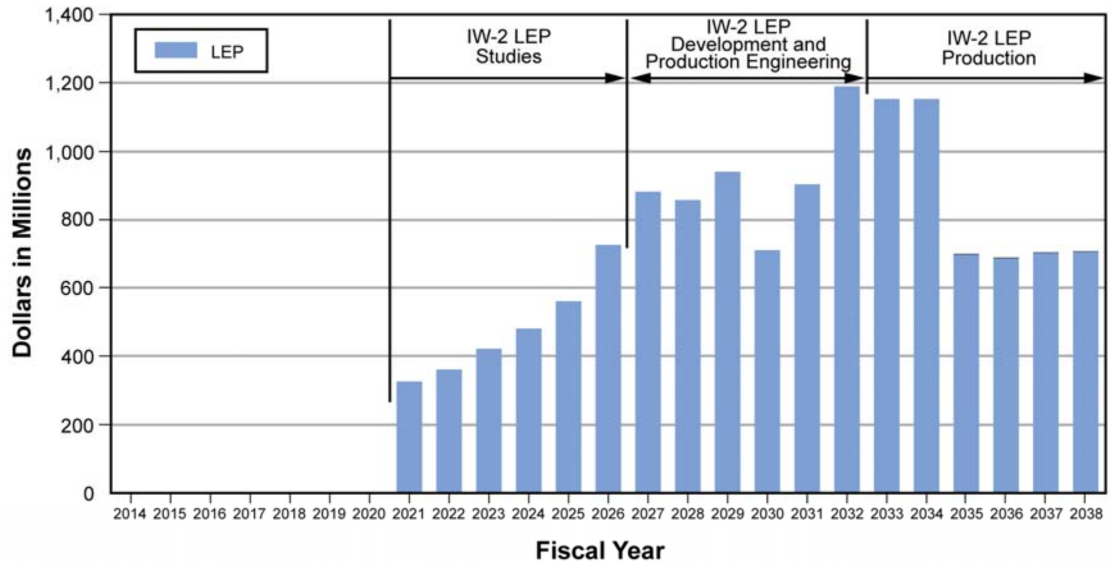
Figure 8–20. IW-1 life extension program projected costs for fiscal years 2014 through 2038



- 2014 to 2018 cost data obtained from Future Years Nuclear Security Program, DOE Congressional budget request.
- 2019 to 2037 LEP cost projections obtained from internal cost model based on W76 LEP actual costs, subject to change.
- The chart above assumes a FPU in 2024 which represents a no earlier than date. The actual FPU date will be set based on the results of the 6.2-6.2A studies.
- Other program monies have been included in the LEP total costs above.

Key:
CM = cruise missile
FPU = First Production Unit
LEP = Life Extension Program

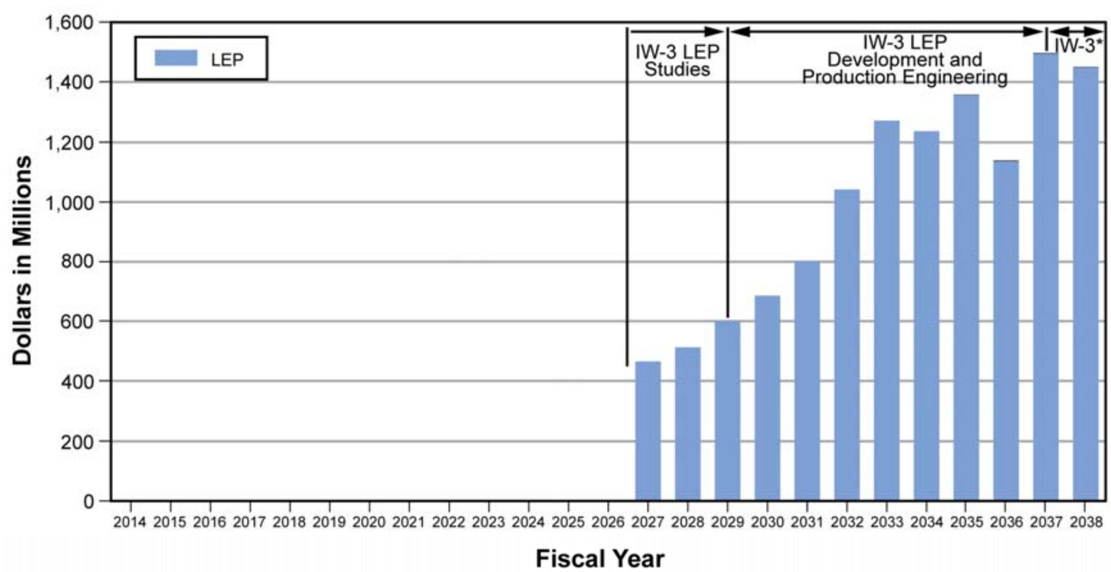
Figure 8–21. Cruise missile warhead life extension program projected costs for fiscal years 2014 through 2038



- 2021 to 2037 LEP cost projections obtained from internal cost model based on W76 LEP actual costs, subject to change.
- The chart above assumes a FPU in 2031 which represents a no earlier than date. The actual FPU date will be set based on the results of the 6.2-6.2A studies.
- Other program monies have been included in the LEP total costs above.

Key:
FPU = First Production Unit
IW = interoperable warhead
LEP = Life Extension Program

Figure 8–22. IW-2 life extension program nuclear warhead projected costs for fiscal years 2014 through 2038



- 2027 to 2038 LEP cost projections obtained from internal cost model based on W76 LEP actual costs, subject to change.
- The chart above assumes a FPU in 2037 which represents a no earlier than date. The actual FPU date will be set based on the results of the 6.2-6.2A studies.
- Other program monies have been included in the LEP total costs above.

Key:
FPU = First Production Unit
IW = interoperable warhead
LEP = Life Extension Program

* IW-3 LEP Production

Figure 8–23. IW-3 nuclear warhead projected costs for fiscal years 2014 through 2038

Total projected direct costs in then-year dollars for each weapon within the FY 2014 through FY 2038 period are provided in **Figure 8–24**. Even though those figures do not capture all of the costs incurred for each weapon, they illustrate the significance of life extensions to the life cycle cost of a weapon system. As noted above, the conduct of both sustainment and life extension activities is tremendously dependent on the capabilities, technologies, and services provided by the other elements included in the Weapons Activities account.

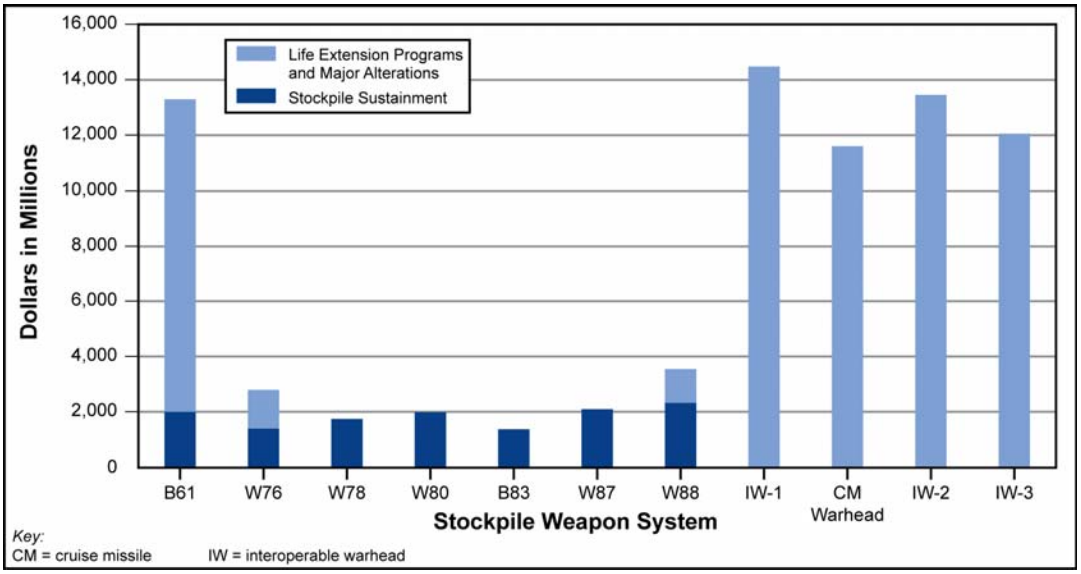


Figure 8–24. Total weapon cost projected for fiscal years 2014 through 2038

Figure 8–25 is a one-chart summary of the total projected nuclear weapons life extension costs over the period from FY 2013 through FY 2038 based on the LEP schedule reflected in Figure 2–8. The chart shows the general magnitude of costs, including both the direct LEP cost and the incremental costs (other program monies) to the routinely funded base activities. Conduct of these efforts is dependent on a base that is adequately funded.

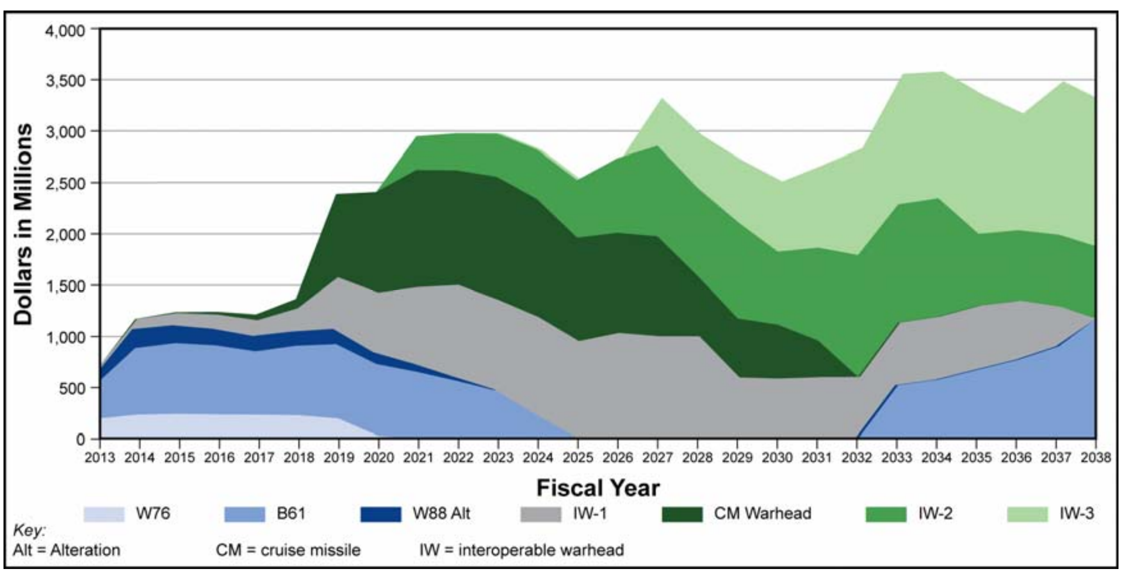


Figure 8–25. Total U.S. projected nuclear weapons life extension costs for fiscal years 2013 through 2038

8.10 Operations and Effective Business Practices

NNSA has a history of continuous improvement initiatives; it is now formalizing, prioritizing, and implementing with rigor the OneNNSA efficiencies under the Mission First umbrella. The purpose of Mission First efficiencies is to implement improved management system standards, information technology, and enhanced business and project management tools. A core objective is to reduce annual indirect and overhead costs to enable NNSA to focus more of its human and financial resources on the core missions and their delivery to customers. For example, a new acquisition strategy was developed and used to merge the Pantex Plant and Y-12 M&O contracts. Consolidation of those contracts will work seamlessly to enhance mission performance, strengthen partnerships, and improve stakeholder confidence in an era of diminishing resources. In effect, Mission First will continue to streamline the governance and NNSA organizational structure and use the existing best practices of the sites and contractors to develop new techniques that will be applied to the entire nuclear security enterprise.

The Mission First efforts identified below reflect the overall commitment of NNSA to identify savings wherever possible and are in addition to other efforts underway to identify savings consistent with the joint NNSA-DoD CAPE study. The specific Mission First efficiencies highlighted include:

- International Organization for Standardization (ISO) management systems standards: no FY 2013 target savings goal
- Governance model: no FY 2013 target savings goals
- Wireless technology: net savings of $280 million identified
- One-card access control: savings range $7,491 (high end) to $3,752 (low end) in FY 2012, dollars in thousands
- NNSA Network Vision (2NV): total net savings estimated at over $280 million
- Business Management Advisory Council: no FY 2013 target savings goal
- Defense Programs' Enterprise Portfolio Analysis Tool: no FY 2013 target savings goal
- Defense Programs' Work Breakdown Structure (WBS): no FY 2013 target savings goal

These efficiency initiatives are summarized below.

8.10.1 International Organization for Standardization Management Systems Standards

The Administrator committed to Congress and other external stakeholders that NNSA would implement an enterprise-wide management system that complies with an international consensus standard to improve overall organizational efficiency and stewardship. In support of this commitment, NNSA launched a project to build a management system compliant with ISO 9001: 2008, *Quality Management Systems*, to implement DOE Order 414.1D *Quality Assurance*, under the initiative for Federal entities. The NNSA ISO Steering Committee developed a plan in January 2012 for implementing ISO 9001. As part of this plan, an ISO Project Team began a series of activities to set the stage for implementation. This included training a significant number of staff members on the ISO Standard, selection and procurement of an ISO technical expert to provide advisory services, and performance of a number of gap analyses designed to measure current Headquarters processes against the ISO requirements. With the establishment of the Office of Infrastructure and Operations, leadership directed that implementation activities should focus on building a management system in the new organization that, from the start, would perform in conformance with ISO principles. Accordingly, leadership and staff are being trained on ISO practices, and development of the documentation is under way. At the same time, NNSA-wide procedures are being developed to execute ISO requirements for internal audits, management reviews, and corrective and preventive actions. Working from a draft quality manual, the Office of Quality Management, which is an outgrowth of the ISO Project Team, will continue to move NNSA toward full ISO implementation. In the coming months, NNSA will train additional personnel on the ISO Standard, train auditors, pursue development of the documentation, and test out a cycle of internal audits, management review, and corrective and preventive action activities.

8.10.2 Governance Model

Congress and a number of independent panels have recommended that the NNSA organization and governance model be examined and perhaps revamped. This effort has been under way, with some significant changes resulting to date. Governance is being improved on both the Federal side and the contractor side. On the Federal side, NNSA is creating the Office of the Associate Administrator for Infrastructure and Operations. This office will provide centralized and consistent policy and direction to the nuclear security enterprise field sites. NNSA has also created the Nuclear Production Office to replace the separate offices in Amarillo, Texas and Oak Ridge, Tennessee with a single production focused office. This consolidation provides a management structure that is appropriate for the forward-leaning strategy of the single contract for operating both of these nuclear weapons production facilities that was recently awarded. Because of the contract protest, implementation of this consolidated contract acquisition continues to be delayed.

These are key examples of how NNSA is streamlining its governance model. NNSA has moved from “initiatives” to actions and continuous improvement. NNSA is also responding to valuable external input in the area of effective and appropriate collaboration with M&O contractor partners. At the direction of the Principal Deputy Administrator, a team effort to improve “Governance and Collaboration” is working to develop processes that more effectively use contractor input; for example, whenever DOE Directives or Orders are changed or there is a need to work jointly on improvements to contractor-proposed business processes.

These efforts are elements of NNSA’s strategy to deal with the resource realities outlined earlier in this document. NNSA must ensure nuclear safety, nuclear security, and cyber security of the Nation’s critical stockpile assets in an environment characterized by reduced costs of operations and increased productivity.

NNSA’s contractors are responding by clarifying functions, responsibilities, and authorities, as well as by revising internal requirements for consistency with DOE management principles and NNSA operating principles. At the same time, they are implementing strong contractor assurance systems with integrated and performance-based oversight. The M&O contractors are engaged in continuous improvement of their internal management processes in response to NNSA’s expectations. Such improvements can produce business practices that will enable NNSA to increase the ratio of resources applied directly to the mission in a resource-constrained environment. **Figure 8–26** is a conceptual illustration of the governance model and the key activities that support its implementation. This governance model balances principles, requirements, measures, assessments, and oversight into an efficient operational model.

Figure 8–26. The National Nuclear Security Administration governance model

8.10.3 Wireless Technology

Deployment of wireless technology is linked and enabled by the success of the 2NV initiative that uses wireless technology as described in Section 8.10.5. A pilot "hotel style" localized wireless network was deployed at the New Hope Center at Y-12 and lessons learned are being used in the deployment phase at other locations. Standardized equipment is being purchased at a heavy discount via the negotiated contracts of NNSA's Supply Chain Management Center. NNSA has deployed wireless local area networks, based on IEEE 802.11 standards, for unclassified internet access at LANL, LLNL, the Pantex Plant, and Y-12. Additional deployments of these wireless networks are planned to enable the NNSA Network Vision strategy of wireless connectivity anywhere, anytime, on any device.

The wireless network is being managed as a programmatic-type effort, consisting of multiple small projects that are developed each year and can be quickly executed to generate an immediate return on investment. This process aligns well with the NNSA Chief Information Officer's governance reforms (see Chapter 7, Section 7.3), U.S. Office of Management and Budget guidance, and industry "best practices." Eventually, NNSA will be able to leverage wireless sensor networks to eliminate remedial tasks (*e.g.*, pressure monitoring, temperature monitoring) and to redirect resources to higher-priority, unfunded efforts such as maintenance backlogs and construction. A core element of this approach will be partnership with the National Security Agency to deliver classified wireless capabilities to support mission activities using their emerging Commercial for Classified Program.

To capture and validate cost savings, NNSA commissioned a business case analysis to be conducted by a support company. This business case was used to support the Government cost estimate for wireless technology and identify cost savings or avoidance. **Table 8–5** identifies the estimated total costs and total savings by site based on this study. The overall investment breakeven point for the NNSA program will occur in FY 2013, just 2 years into the program life cycle, although some of the larger sites achieved breakeven sooner. The quantifiable benefits for NNSA exceed the costs for the overall wireless initiative, with a positive net savings of over $280 million.

Table 8–5. Cost and savings summary for NNSA wireless technology

	Y-12	LANL	Pantex	KCP	OST	NNSS	LLNL	SRS
	Dollars in Millions							
Total Costs (5-year period)	(19,472,832)	(18,524,423)	(40,991,511)	(6,480,555)	(35,361,836)	(44,248,815)	(8,316,978)	(32,311,115)
Total Savings (5-year period)	57,619,622	88,015,737	108,545,385	14,732,115	40,567,560	122,228,582	34,049,063	56,542,407
Net Savings (present value)	34,068,558	62,383,49	60,276,498	7,062,109	4,356,602	69,190,839	23,204,078	21,175,331
Return on Investment	196%	375%	165%	127%	15%	176%	309%	75%
Breakeven Point	FY 2012	FY 2012	FY 2012	FY 2014	FY 2013	FY 2013	FY 2012	FY 2013

KCP = Kansas City Plant
LANL = Los Alamos National Laboratory
LLNL Lawrence Livermore National Laboratory
OST = Office of Secure Transportation
Pantex = Pantex Plant
NNSS = Nevada National Security Site
SRS = Savannah River Site
Y-12 = Y-12 National Security Complex

8.10.4 One Identification Access Control

One of the most obvious examples of OneNNSA success will be streamlined access to all NNSA facilities for all Federal and contractor employees within the nuclear security enterprise. This effort also has a goal of simplifying and standardizing the access control for visitors to all sites. The initiative is currently in its formative stages, and NNSA is piloting the project, known internally as OneID, to streamline access management throughout the enterprise. A general description of OneID is provided below:

> *The OneID project shall redefine "visitor" within NNSA and shall help reinforce the OneNNSA strategy and culture change necessary to transform the nuclear security enterprise. The project shall eliminate down-time for frequent travelers, provide some reduction in processing at site Visitor Centers, reduce paperwork, and implement many of the tenets of the DOE Identity, Credential, and Access Management (ICAM) framework such as interoperability, leveraging a common credential, and consistency in process. When implemented, this project shall minimize the impact of badging/processing to the end user while also enhancing security in a transparent and efficient manner.*

The requirements document for this initiative has been finalized; a prototype is under development at LLNL; and a business case has been completed (the business case is summarized in **Table 8–6**). The table illustrates the relative disparity between costs and benefits calculated in FY 2012 dollars. OneID is an initiative that directly supports the OneNNSA vision and positions the nuclear security enterprise to take advantage of capabilities for efficiency and effectiveness that are available with a relatively modest investment.

Table 8–6. OneID costs, benefits, and estimated payback

FY 2012 (dollars in thousands)	High End	Low End
Total Estimated ROM Cost	$5,449.87	$2,718.94
Total Estimated Benefits	$12,941.87	$6,470.93
Difference	$7,491.99	$3,752.00
Estimated Payback Period	23 months	18 months

ROM = rough order of magnitude

Based on the analysis of costs and benefits of the OneID initiative, it would appear that the nuclear security enterprise could potentially reap significant benefits from implementing the initiative.

8.10.5 NNSA Network Vision

The NNSA Network Vision will provide a secure, mobile, agile, and adaptive IT infrastructure. Upon completion of the 2NV deployment, NNSA will have enabled an unclassified environment to support working anywhere, anytime, on any device. This new architecture has inherent benefits from a cost perspective. To capture and validate cost savings, NNSA commissioned a business case analysis conducted by a support company. This business case was used to support the Government cost estimate for 2NV acquisitions, as well as to justify project expenses from an overall return-on-investment strategy. The business case analysis found that over $200 million in total investment costs yielded over $520 million in total savings and over $280 million in net present value savings over the 5-year program life cycle. For wireless technology, four of the field offices have a breakeven point in 1 year; three have a breakeven point in 2 years; and one has a breakeven point in 3 years. All of the field offices have a positive return on investment over the project life cycle. The 2NV savings largely fall into several general themes: decreased travel because of new wide-area collaborative technologies; decreased IT support costs in a Virtual Desktop Environment; lower device costs due to leveraging “bring your own device” strategies; zero-client personal computers in lieu of traditional desktops or laptops; lower energy consumption via zero clients; the cloud; and productivity improvements from collaborative technologies such as the social network, file-sharing, presence, desktop video, *etc*. In FY 2013, NNSA will invest roughly $17 million across four projects to deliver the new IT infrastructure. These investments are expected to generate annual returns after implementation of these new capabilities.

8.10.6 Business Management Advisory Council

The Business Management Advisory Council (BMAC) strategic objective is to transform the Federal and M&O community’s business management processes from a tactical, reactive, single-site functionality to a strategically driven, integrated, nuclear security enterprise functionality. This change will help ensure maximum value for every dollar spent directly and indirectly. Flowing from these changes will be related Federal policy, contract strategy, and administrative changes and improvements. BMAC is critical to achieving this broad transformation of NNSA’s business functions.

BMAC key objectives include the following:

- Establish nuclear security enterprise-wide, cross-functional business strategies.
- Reduce the total cost of ownership for internal assets, acquired goods and services, and all other business operational costs.
- Improve the skills of the nuclear security enterprise M&O business management community.
- Align the contracts and contract-oversight models to support BMAC initiatives and results.

BMAC applies an integrated, cross-functional, business unit analytical approach to the entire nuclear security enterprise. Using this approach, the nuclear security enterprise can begin to look for opportunities to create efficiencies and enhance cost-effectiveness in areas such as acquisition, contractor human resources (including pension and healthcare initiatives), personal property, supply chain management, and finance.

The BMAC members are the NNSA Chief Operating Officer, the Chief Operating Officer or equivalent of each M&O contractor, the NNSA Senior Procurement Executive, and the NNSA program and field office representatives. BMAC functions in a collaborative advisory manner to ensure impartiality and champion process improvements. BMAC will oversee the activities of each Functional Subgroup Team and collectively approve or disapprove the strategies of each team. Advisory members routinely inform their respective field offices of the initiatives being developed and implemented.

BMAC identified, implemented, and validated approximately $180 million in cost savings in the various functional areas of the nuclear security enterprise in FY 2010 and achieved cost savings of another $180 million for FY 2011. The FY 2012 savings goal of an additional $88 million, leveraged through the Supply Chain Management Center, was achieved.

8.10.7 Defense Programs Enterprise Portfolio Analysis Tool

The web-based application Enterprise Portfolio Analysis Tool (EPAT) was established to better oversee the management of Defense Programs. This tool was developed and implemented to streamline the planning, programming, budgeting, and evaluation ("PPBE") process in Defense Programs.

The tool uses "formulation" portfolios consistent with the Congressional base table hierarchy structure that aligns with the WBS. The WBS identifies specific organizational work scopes to allow for transparency at lower levels.

Additional enhancements instituted within EPAT are accessible across the nuclear security enterprise for Defense Programs, Federal Program Managers, and M&O contractors. These new developments facilitate data collection for use in budget formulation and execution using both the WBS and budget and reporting codes and provide budgetary transparency at the lower levels for specific organizational work scope. EPAT aligns the Defense Programs WBS and budget and reporting codes to provide a consistent framework to accomplish the PPBE of work required to execute the Defense Programs mission.

Major EPAT enhancements include the following:

- **WBS Cost Data Accounting Flexfield Reporting**. This enhancement facilitates alignment of actual costs related to reporting entity and program value at the lowest level of the WBS.
- **Tracking of Official Baseline Numbers**. This enhancement provides workflows and capture of budget formulation baselines in support of FYNSP formulation reporting.

Collection of WBS cost data will provide monthly cost reporting within EPAT at the activity level. This data can now be rolled up to DOE's Standard Accounting and Reporting System (STARS) control points. Monthly STARS totals will be pulled into EPAT to facilitate allocation of actual costs to lower level activity items. The ability to report costs at the lowest level of the WBS, while providing validation that the low-level totals summarize to equal STARS control totals, will provide better oversight for decision making in Defense Programs.

The tracking of official baseline numbers provides a method to ensure the official numbers are validated and available for reporting to specific audiences during the budget cycle. These baselines will become the official numbers for reporting purposes.

EPAT will continue to provide senior NNSA leadership with clear information that supports high-level strategic decisions. EPAT integrates and manages the data from programs composed of large, complex, and diverse portfolios of research, development, simulation, experimentation, surveillance, manufacturing, and transportation operations. EPAT provides a consistent framework for planning, programming, budgeting, and evaluating work required to execute the Defense Programs mission.

8.10.8 Defense Programs Work Breakdown Structure

The WBS identifies the entire Defense Programs work scope of products, capabilities, and services and breaks the work scope down into discrete elements, the total sum of which represents all of the work and products necessary to meet Defense Programs mission requirements. The WBS allows Defense Programs to identify resource requirements and allocate resources effectively by enabling a better understanding of the scope of work, providing a common framework for planning and control, and creating a defensible basis for the PPBE process.

The WBS is a hierarchical structure that reflects the work performed within a given program to meet objectives. Budget projections are tied to the WBS to ensure consistency with work elements. The highest levels in the WBS correspond to the budget and reporting codes established for Defense Programs and used by the financial office. The WBS is broken down to the appropriate level of detail required for management control of a given task. At various levels of the WBS, the program offices and sites add the activities and corresponding budget “line items” that comprise each WBS element. Overall program budget projections are a roll-up of budget line items at all of the sites.

The WBS dictionary is comprised of a documented narrative of each work element in the WBS. Both the WBS and the WBS Dictionary are maintained under formal change control. The WBS has been updated according to defined WBS Guidelines to ensure that all components, where applicable, maintain a set of common elements. Such updates to the WBS include the implementation of a common LEP WBS to facilitate consistent cost collection and reporting across different LEPs.

Chapter 9

Conclusion

CHAPTER 9
CONCLUSION

This *Fiscal Year 2014 Stockpile Stewardship and Management Plan* (SSMP), including its classified Annex, is a key document for the NNSA nuclear security enterprise that captures the planning conducted across numerous programs and organizations. The process and analysis followed in developing the 25-year strategy for this SSMP was just as critical as the plan itself. The SSMP was produced by a large group of subject matter experts in an interagency process that provided a coherent, integrated view of the total program for Congress and DoD, as well as for the NNSA M&O contractor and Federal workforce. Like the *FY 2012 Stockpile Stewardship and Management Plan*,[1] this FY 2014 SSMP was built on the fundamentals of a capability-based enterprise. However, this SSMP takes on a much more ambitious scope of work. To accomplish this task, this SSMP implements new strategies in stockpile stewardship and management, making this a seminal planning document for the nuclear security enterprise. As with all plans, this plan will be updated as new analysis is completed and new challenges are identified.

This SSMP was generated by the Federal workforce of the NNSA in collaboration with the M&O contractors who execute the key technical activities of the nuclear security enterprise. The document was coordinated with DoD through the Nuclear Weapons Council, where most of the requirements originate for ensuring the Nation's stockpile is safe, secure, and reliable. In addition, the formulation of this SSMP was guided by issues for which Congress has specified that further analysis is required. The process of assembling many stakeholders to examine and review the current capabilities and requirements and to map them into a 25-year plan presented many challenges, particularly in a resource-constrained environment. However, the process of developing the SSMP also serves as a check on the internal program integration processes.

This plan is based on the premise that the nuclear security enterprise is a capability-based enterprise. As such, much of the plan is based on the inherent capacity of the nuclear security enterprise, which has often been the limiting factor in developing the long-term strategic plan for the nuclear weapons stockpile. Moreover, as in the past, the plan requires the assurance that certain capabilities are maintained, even when they are not on the critical path. This is most obvious in the case of maintaining the capability for underground nuclear testing, although the rest of the plan is predicated on not needing this capability. In general, this SSMP balances the capabilities for sustaining the stockpile; for conducting R&D in the science, technology, and engineering of the stockpile; and for modernizing the physical infrastructure that produces the certified stockpile. All three components are necessary to ensure an effective nuclear deterrent. This balance has been challenging in the past and is even more so today due to the increased amount of work that must be done as the stockpile and the infrastructure age.

For the FY 2014 FYNSP, this SSMP calls for four life extension programs and one major alteration to be conducted concurrently. In comparison to the *FY 2012 Stockpile Stewardship and Management Plan*, this SSMP accelerates the life extension of the cruise missile warhead and expands the effort involved

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[1] *An FY 2013 SSMP was not submitted to Congress in FY 2012 because analytic work conducted by DoD/NNSA to evaluate the out-year needs for nuclear modernization activities across the nuclear security enterprise was ongoing and as such pre-decisional.*

with the life extension of the W78 when it became the W78/88, involving all three national security laboratories. In addition, this SSMP sustains the arming, fuzing, and firing alteration of the W88. This very aggressive plan will place most of the nuclear weapons stockpile in some phase of life extension in the present decade. This work is absolutely essential and must be accomplished while maintaining the stockpile and continuing stewardship-based surveillance.

One of the significant changes to managing and modernizing the stockpile in this SSMP is the introduction of the Nuclear Weapons Council's "3+2" strategic vision for the stockpile. This strategy has guided many of the decisions outlined in this SSMP and will help level the workload while meeting DoD requirements. When fully implemented, the "3+2" strategic vision will reduce stockpile maintenance costs while maintaining strategic flexibility and offering the potential to consider decreasing the size of the stockpile hedge without increasing the risk. Another significant change from the *FY 2012 Stockpile Stewardship and Management Plan* is the plutonium strategy. The plutonium strategy is focused on meeting the mission requirements for stockpile modernization while leaving open options for future planning.

Future planning will include a number of as yet unresolved issues. In the summer of 2013, NNSA and the Office of Cost Analysis and Program Evaluation (CAPE) in the Office of the Secretary of Defense anticipate completing a number of studies to inform NNSA planning. Two of these studies are intended to achieve savings by identifying management efficiencies and setting workforce priorities, which will require detailed plans and tradeoff analyses. In addition, many of the life extension programs and elements of the plutonium strategy are still in the early study phase and the cost estimates are not complete. Furthermore, the work planned for FY 2013 may not be completed because of mandatory funding reductions and may require adjustments to out-year plans and dates. Finally, unforeseen technical challenges in the stockpile or geopolitical events could change the priorities on which this SSMP has been built. Therefore, while some elements may require adjustment, this SSMP is an executable plan aligned with DoD requirements to provide a safe, secure, and effective nuclear deterrent.

Appendix A

Requirements Mapping

APPENDIX A
REQUIREMENTS MAPPING

A.1 National Nuclear Security Administration Response to Public Law, Legislation, and Other Reporting Requirements

The SSMP consolidates a number of statutory reporting requirements and related Congressional requests. This appendix maps the statutory and Congressional requests to their respective SSMP chapter and section.

FY 2013 National Defense Authorization Act, H.R. 4310, Sec. 3133	NNSA Response
SEC. 3133. CONSOLIDATED REPORTING REQUIREMENTS RELATING TO NUCLEAR STOCKPILE STEWARDSHIP, MANAGEMENT, AND INFRASTRUCTURE.	
(a) CONSOLIDATED PLAN FOR STEWARDSHIP, MANAGEMENT, AND CERTIFICATION OF WARHEADS IN THE NUCLEAR WEAPONS STOCKPILE.—	
(1) IN GENERAL.—Section 4203 of the Atomic Energy Defense Act (50 U.S.C. 2523) is amended to read as follows:	
''SEC. 4203. NUCLEAR WEAPONS STOCKPILE STEWARDSHIP, MANAGEMENT, AND INFRASTRUCTURE PLAN.	*Unclassified* Chapters 2, 3, 4, 5, 6, 8 ——— *Classified Chapters 2, 3*
''(a) PLAN REQUIREMENT.—The Administrator, in consultation with the Secretary of Defense and other appropriate officials of the departments and agencies of the Federal Government, shall develop and annually update a plan for sustaining the nuclear weapons stockpile. The plan shall cover, at a minimum, stockpile stewardship, stockpile management, stockpile surveillance, program direction, infrastructure modernization, human capital, and nuclear test readiness. The plan shall be consistent with the programmatic and technical requirements of the most recent annual Nuclear Weapons Stockpile Memorandum.	*Unclassified* Chapters 2, 3, 4, 5, 6, 8 ——— *Classified* Chapters 2, 3, Appendix A
''(b) SUBMISSIONS TO CONGRESS.—	
''(1) In accordance with subsection (c), not later than March 15 of each even-numbered year, the Administrator shall submit to the congressional defense committees a summary of the plan developed under subsection (a).	
''(2) In accordance with subsection (d), not later than March 15 of each odd-numbered year, the Administrator shall submit to the congressional defense committees a detailed report on the plan developed under subsection (a).	*Unclassified* Chapters 2, 3, 4, 5, 6, 8 ——— *Classified* Chapters 2, 3, Appendix A

FY 2013 National Defense Authorization Act, H.R. 4310, Sec. 3133	NNSA Response
‘‘(3) The summaries and reports required by this subsection shall be submitted in unclassified form, but may include a classified annex.	
‘‘**<u>(c) ELEMENTS OF BIENNIAL PLAN SUMMARY</u>**.—Each summary of the plan submitted under subsection (b)(1) shall include, at a minimum, the following:	
‘‘(1) A summary of the status of the nuclear weapons stockpile, including the number and age of warheads (including both active and inactive) for each warhead type.	
‘‘(2) A summary of the status, plans, budgets, and schedules for warhead life extension programs and any other programs to modify, update, or replace warhead types.	
‘‘(3) A summary of the methods and information used to determine that the nuclear weapons stockpile is safe and reliable, as well as the relationship of science-based tools to the collection and interpretation of such information.	
‘‘(4) A summary of the status of the nuclear security enterprise, including programs and plans for infrastructure modernization and retention of human capital, as well as associated budgets and schedules.	
‘‘(5) Identification of any modifications or updates to the plan since the previous summary or detailed report was submitted under subsection (b).	
‘‘(6) Such other information as the Administrator considers appropriate.	
‘‘<u>(d) ELEMENTS OF BIENNIAL DETAILED REPORT</u>.—Each detailed report on the plan submitted under subsection (b)(2) shall include, at a minimum, the following:	*Unclassified* Chapters 2, 3, 4, 5, 6, 8 ——— *Classified 2, 3*
‘‘(1) With respect to stockpile stewardship and management—	
‘‘(A) the status of the nuclear weapons stockpile, including the number and age of warheads (including both active and inactive) for each warhead type;	*Unclassified* Chapter 2, Sections 2.2.1, 2.2.2 ——— *Classified* Chapter 2, Sections 2.1, 2.2, 2.3, 2.4
‘‘(B) for each five-year period occurring during the period beginning on the date of the report and ending on the date that is 20 years after the date of the report— (i) the planned number of nuclear warheads (including active and inactive) for each warhead type in the nuclear weapons stockpile; and (ii) the past and projected future total lifecycle cost of each type of nuclear weapon;	*Unclassified* Chapter 2, Sections 2.3, 2.6, 2.6.4; Chapter 8, Sections 8.8, 8.9 ——— *Classified* Chapter 2, Section 2.1.2
‘‘(C) the status, plans, budgets, and schedules for warhead life extension programs and any other programs to modify, update, or replace warhead types;	*Unclassified* Chapter 2, Sections 2.1, 2.2, 2.4, 2.6, Chapter 3, Sections 3.2.1, 3.2.2, 3.2.3, 3.3; Chapter 8, Section 8.9 ——— *Classified* Chapter 2, Sections 2.5, 2.6
‘‘(D) a description of the process by which the Administrator assesses the lifetimes, and requirements for life extension or replacement, of the nuclear and non-nuclear components of the warheads (including active and inactive warheads) in the nuclear weapons stockpile;	*Unclassified* Chapter 2, Sections 2.2, 2.3, 2.6; Chapter 3, Sections 3.2, 3.3, 3.4

FY 2013 National Defense Authorization Act, H.R. 4310, Sec. 3133	NNSA Response
''(E) a description of the process used in recertifying the safety, security, and reliability of each warhead type in the nuclear weapons stockpile;	*Unclassified* Chapter 2, Sections 2.2, 2.3, Figure 2-5; Chapter 3, Sections 3.2.3, 3.4 ——— *Classified* Chapter 2, Section 2.3; Chapter 3, Section 3.4
''(F) any concerns of the Administrator that would affect the ability of the Administrator to recertify the safety, security, or reliability of warheads in the nuclear weapons stockpile (including active and inactive warheads);	*Classified* Chapter 2, Section 2.2
''(G) mechanisms to provide for the manufacture, maintenance, and modernization of each warhead type in the nuclear weapons stockpile, as needed;	*Unclassified* Chapter 2, Sections 2.4, 2.6; Chapter 3, Sections 3.2, 3.3 ——— *Classified* Chapter 2, Section 2.5
''(H) mechanisms to expedite the collection of information necessary for carrying out the stockpile management program required by section 4204, including information relating to the aging of materials and components, new manufacturing techniques, and the replacement or substitution of materials;	*Unclassified* Chapter 2, Sections 2.2.3, 2.6.3; Chapter 3, Sections 3.3, 3.4.3
''(I) mechanisms to ensure the appropriate assignment of roles and missions for each national security laboratory and nuclear weapons production facility, including mechanisms for allocation of workload, mechanisms to ensure the carrying out of appropriate modernization activities, and mechanisms to ensure the retention of skilled personnel;	*Unclassified* Chapter 2, Sections 2.5, 2.6.4; Chapter 6, Sections 6.2.1, 6.2.3, 6.3, 6.3.2; Chapter 8, Section 8.10.2; Appendix E
''(J) mechanisms to ensure that each national security laboratory has full and complete access to all weapons data to enable a rigorous peer-review process to support the annual assessment of the condition of the nuclear weapons stockpile required under section 4205;	*Unclassified* Chapter 2, Section 2.2.2
''(K) mechanisms for allocating funds for activities under the stockpile management program required by section 4204, including allocations of funds by weapon type and facility; and	*Unclassified* Chapter 5; Chapter 8, Sections 8.1, 8.9, Table 8-1
''(L) for each of the five fiscal years following the fiscal year in which the report is submitted, an identification of the funds needed to carry out the program required under section 4204.	*Unclassified* Chapter 8
''(2) With respect to science-based tools—	
''(A) a description of the information needed to determine that the nuclear weapons stockpile is safe and reliable;	*Unclassified* Chapter 2, Sections 2.2, 2.3; Chapter 3, Section 3.4 ——— *Classified* Chapter 2, Sections 2.2, 2.3; Chapter 3, Section 3.4
''(B) for each science-based tool used to collect information described in subparagraph (A), the relationship between such tool and such information and the effectiveness of such tool in providing such information based on the criteria developed pursuant to section 4202(a); and	*Unclassified* Chapter 3, Section 3.5 ——— *Classified* Chapter 2, Section 2.3.1; Chapter 3, Section 3.4
''(C) the criteria developed under section 4202(a) (including any updates to such criteria).	

FY 2013 National Defense Authorization Act, H.R. 4310, Sec. 3133	NNSA Response
‘‘***(3) An assessment of the stockpile stewardship program under section 4201*** by the Administrator, in consultation with the directors of the national security laboratories, which shall set forth—	*Unclassified* Chapters 2, 3
‘‘(A) an identification and description of— (i) any key technical challenges to the stockpile stewardship program; and (ii) the strategies to address such challenges without the use of nuclear testing;	*Unclassified* Chapter 2, Section 2.6; Chapter 3, Section 3.4 *Classified* Chapter 2, Sections 2.2, 2.3; Chapter 3, Section 3.4
‘‘(B) a strategy for using the science-based tools (including advanced simulation and computing capabilities) of each national security laboratory to ensure that the nuclear weapons stockpile is safe, secure, and reliable without the use of nuclear testing;	*Unclassified* Chapter 2, Section 2.6; Chapter 3, Sections 3.4, 3.5 *Classified* Chapter 3, Section 3.4
‘‘(C) an assessment of the science-based tools (including advanced simulation and computing capabilities) of each national security laboratory that exist at the time of the assessment compared with the science-based tools expected to exist during the period covered by the future-years nuclear security program; and	*Unclassified* Chapter 3, Section 3.5 *Classified* Chapter 3, Section 3.4, 3.8.1, 3.8.2
‘‘(D) an assessment of the core scientific and technical competencies required to achieve the objectives of the stockpile stewardship program and other weapons activities and weapons-related activities of the Administration, including—	*Unclassified* Chapter 6
(i) the number of scientists, engineers, and technicians, by discipline, required to maintain such competencies; and	*Unclassified* Appendix E
(ii) a description of any shortage of such individuals that exists at the time of the assessment compared with any shortage expected to exist during the period covered by the future-years nuclear security program.	*Unclassified* Appendix E
‘‘***(4) With respect to the nuclear security infrastructure***—	*Unclassified* Chapters 1, 5
‘‘(A) a description of the modernization and refurbishment measures the Administrator determines necessary to meet the requirements prescribed in—	*Unclassified* Chapter 5
(i) the national security strategy of the United States as set forth in the most recent national security strategy report of the President under section 108 of the National Security Act of 1947 (50 U.S.C. 404a) if such strategy has been submitted as of the date of the plan;	*Unclassified* Chapter 5
(ii) the most recent quadrennial defense review if such strategy has not been submitted as of the date of the plan; and	*Unclassified* Chapter 5
(iii) the most recent Nuclear Posture Review as of the date of the plan;	*Unclassified* Introduction; Chapter 5
‘‘(B) a schedule for implementing the measures described under subparagraph (A) during the 10-year period following the date of the plan; and	*Unclassified* Chapter 5, Section 5.3.1, Figure 5-2
‘‘(C) the estimated levels of annual funds the Administrator determines necessary to carry out the measures described under subparagraph (A), including a discussion of the criteria, evidence, and strategies on which such estimated levels of annual funds are based.	*Unclassified* Chapter 8

FY 2013 National Defense Authorization Act, H.R. 4310, Sec. 3133	NNSA Response
''(5) With respect to the nuclear test readiness of the United States—	*Unclassified* Chapters 2, 4; Appendix C
''(A) an estimate of the period of time that would be necessary for the Administrator to conduct an underground test of a nuclear weapon once directed by the President to conduct such a test;	*Unclassified* Chapter 4, Sections 4.1, 4.2, 4.3; Appendix C, Section C.1 *Classified* Chapter 2, Section 2.2
''(B) a description of the level of test readiness that the Administrator, in consultation with the Secretary of Defense, determines to be appropriate;	*Unclassified* Chapter 4, Sections 4.1, 4.4; Appendix C, Section C.1 *Classified* Chapter 2, Section 2.2
''(C) a list and description of the workforce skills and capabilities that are essential to carrying out an underground nuclear test at the Nevada National Security Site;	*Unclassified* Appendix C, Section C.2.1, Tables C-2, C-3, C-4 *Classified* Chapter 2, Section 2.2
''(D) a list and description of the infrastructure and physical plants that are essential to carrying out an underground nuclear test at the Nevada National Security Site; and	*Unclassified* Chapter 5, Sections 5.1, 5.2, Table 5-1; Appendix E
''(E) an assessment of the readiness status of the skills and capabilities described in subparagraph (C) and the infrastructure and physical plants described in subparagraph (D).	*Unclassified* Appendix C, Section C.2.1
''(6) Identification of any modifications or updates to the plan since the previous summary or detailed report was submitted under subsection (b).	*Unclassified* Introduction; Chapter 1
''**(f) DEFINITIONS**.—In this section: ''(1) The term 'budget', with respect to a fiscal year, means the budget for that fiscal year that is submitted to Congress by the President under section 1105(a) of title 31, United States Code. ''(2) The term 'future-years nuclear security program' means the program required by section 3253 of the National Nuclear Security Administration Act (50 U.S.C. 2453).	
''(3) The term 'nuclear security budget materials', with respect to a fiscal year, means the materials submitted to Congress by the Administrator in support of the budget for that fiscal year. ''(4) The term 'quadrennial defense review' means the review of the defense programs and policies of the United States that is carried out every four years under section 118 of title 10, United States Code. ''(5) The term 'weapons activities' means each activity within the budget category of weapons activities in the budget of the Administration.	
''(6) The term 'weapons-related activities' means each activity under the Department of Energy that involves nuclear weapons, nuclear weapons technology, or fissile or radioactive materials, including activities related to— ''(A) nuclear nonproliferation; ''(B) nuclear forensics; ''(C) nuclear intelligence; ''(D) nuclear safety; and ''(E) nuclear incident response.''	

A.2 Ongoing Requirements

50 U.S. Code Sec. 2521	NNSA Response
Sec. 2521. Stockpile stewardship program (a) Establishment The Secretary of Energy, acting through the Administrator for Nuclear Security, shall establish a stewardship program to ensure – (1) the preservation of the core intellectual and technical competencies of the United States in nuclear weapons, including weapons design, system integration, manufacturing, security, use control, reliability assessment, and certification; and (2) that the nuclear weapons stockpile is safe, secure, and reliable without the use of underground nuclear weapons testing.	*Unclassified* Chapters 2, 3 ——— *Classified* Chapters 2, 3
(b) Program elements The program shall include the following:	*Unclassified* Chapters 2, 3
(1) An increased level of effort for advanced computational capabilities to enhance the simulation and modeling capabilities of the United States with respect to the performance over time of nuclear weapons.	*Unclassified* Chapter 2, Section 2.6; Chapter 3 ——— *Classified* Chapter 3, Section 3.4
(2) An increased level of effort for above-ground experimental programs, such as hydrotesting, high-energy lasers, inertial confinement fusion, plasma physics, and materials research.	*Unclassified* Chapter 2, Section 2.6; Chapter 3 ——— *Classified* Chapter 3, Sections 3.4, 3.8.1, 3.8.2
(3) Support for new facilities construction projects that contribute to the experimental capabilities of the United States, such as an advanced hydrodynamics facility, the National Ignition Facility, and other facilities for above-ground experiments to assess nuclear weapons effects.	*Unclassified* Chapter 5, Section 5.1, 5.3.1, Table 5-1, Figure 5-2
(4) Support for the use of, and experiments facilitated by, the advanced experimental facilities of the United States, including - (A) the National Ignition Facility at Lawrence Livermore National Laboratory; (B) the Dual Axis Radiographic Hydrodynamic Testing facility at Los Alamos National Laboratory; (C) the Z Machine at Sandia National Laboratories; and (D) the experimental facilities at the Nevada test site.	*Unclassified* Chapter 3, Sections 3.4, 3.5 ——— *Classified* Chapter 3, Section 3.4
(5) Support for the sustainment and modernization of facilities with production and manufacturing capabilities that are necessary to ensure the safety, security, and reliability of the nuclear weapons stockpile, including - (A) the Pantex Plant; (B) the Y-12 National Security Complex; (C) the Kansas City Plant; (D) the Savannah River Site; and (E) production and manufacturing capabilities resident in the national security laboratories (as defined in 50 U.S.C. 2523(f) of this title).	*Unclassified* Chapter 2, Sections 2.5, 2.6.4; Chapter 5, Sections 5.1, 5.2, 5.3, Figure 5-2 ——— *Classified* Chapter 2, Sections 2.4.2, 2.4.3

50 U.S. Code Sec. 2522	NNSA Response
Sec. 2522. Report on stockpile stewardship criteria	
(a) Requirement for criteria The Secretary of Energy shall develop clear and specific criteria for judging whether the science-based tools being used by the Department of Energy for determining the safety and reliability of the nuclear weapons stockpile are performing in a manner that will provide an adequate degree of certainty that the stockpile is safe and reliable.	*Unclassified* Chapter 2, Section 2.3.2 ——— *Classified* Chapter 2, Section 2.2
(b) Coordination with Secretary of Defense The Secretary of Energy, in developing the criteria required by subsection (a), shall coordinate with the Secretary of Defense.	*Unclassified* Chapter 2, Section 2.3.2

50 U.S. Code Sec. 2524	NNSA Response
Sec. 2524. Stockpile management program (a) Program required	
The Secretary of Energy, acting through the Administrator for Nuclear Security and in consultation with the Secretary of Defense, shall carry out a program, in support of the stockpile stewardship program, to provide for the effective management of the weapons in the nuclear weapons stockpile, including the extension of the effective life of such weapons. The program shall have the following objectives:	
(1) To increase the reliability, safety, and security of the nuclear weapons stockpile of the United States.	*Unclassified* Chapter 2, Section 2.6 *Classified* Chapter 2, Section 2.6
(2) To further reduce the likelihood of the resumption of underground nuclear weapons testing.	*Unclassified* Chapter 3, Section 3.4 *Classified* Chapter 3, Section 3.4
(3) To achieve reductions in the future size of the nuclear weapons stockpile.	*Unclassified* Chapter 2, Section 2.6 *Classified* Chapter 2, Section 2.1.3, 2.6
(4) To reduce the risk of an accidental detonation of an element of the stockpile.	*Unclassified* Chapter 2, Section 2.6.3; Chapter 3, Sections 3.3.3, 3.4.2 *Classified* Chapter 2, Section 2.5.2; Chapter 3, Section 3.4.2
(5) To reduce the risk of an element of the stockpile being used by a person or entity hostile to the United States, its vital interests, or its allies.	*Unclassified* Chapter 2, Section 2.8; Chapter 3, Section 3.3.3; Chapter 7, Sections 7.1.7, 7.2 *Classified* Section 3.4.2
(b) Program limitations In carrying out the stockpile management program under subsection (a), the Secretary of Energy shall ensure that -	
(1) any changes made to the stockpile shall be made to achieve the objectives identified in subsection (a); and	*Unclassified* Chapter 2, Section 2.6 *Classified* Chapter 2, Sections 2.5, 2.6
(2) any such changes made to the stockpile shall - (A) remain consistent with basic design parameters by including, to the maximum extent feasible, components that are well understood or are certifiable without the need to resume underground nuclear weapons testing; and (B) use the design, certification, and production expertise resident in the nuclear complex to fulfill current mission requirements of the existing stockpile.	*Unclassified* Chapter 2, Section 2.6; Chapter 3, Sections 3.3, 3.4 *Classified* Chapter 2, Section 2.6; Chapter 3, Section 3.4
(c) Program budget In accordance with the requirements under section 2529 of this title, for each budget submitted by the President to Congress under section 1105 of title 31, the amounts requested for the program under this section shall be clearly identified in the budget justification materials submitted to Congress in support of that budget.	*Unclassified* Chapter 8, Section 8.1, Table 8-1

A.3 Other Requirements

HASC 2013 NDAA	NNSA Response
The committee directs the Chief of Naval Operations, in coordination with the Commander, U.S. Strategic Command, the Director of the Navy's Strategic Systems Programs, and the Administrator for Nuclear Security, to submit a report to the congressional defense committees by August 15, 2012, on if and how the NNSA's proposed schedule for the W76 LEP meets the operational and hedge stockpile requirements of the Navy and U.S. Strategic Command throughout the full life of such LEP. *Title X (General Provisions)*	*Classified* Chapter 2, Sections 2.6, 2.6.1
Elsewhere in this title, the committee describes the well-documented problems related to governance, management, and oversight of the nuclear security enterprise. Based upon these concerns, the committee directs the Administrator for Nuclear Security, in coordination with the Secretary of Energy, to submit a report to the congressional defense committees by December 1, 2012, on the findings and recommendations contained in: *Title XXXI (Items of Special Interest)*	*Unclassified* Chapter 8
This section would require the Administrator to submit a report to the congressional defense committees within 180 days of enactment of this Act on the required reductions, the cost savings from the reductions and the transition to performance-based governance, management, and oversight required by sections included elsewhere in this title, and other matters. *Section 3111*	*Unclassified* Chapter 8

House Report accompanying the Energy and Water Development Appropriations Bill, 2013 (House Report 112-462)	NNSA Response
Nuclear Facilities Report: Project 10-D-501, Nuclear Facilities Risk Reduction (NFRR), Y-12 National Security Complex -- The Committee notes that the NNSA continues to fall behind on its commitments to complete overdue maintenance on the 9212 building at Y-12 specifically directed by this Committee in previous years. Not later than 60 days after enactment of this Act, the NNSA should provide a report on the latest facility condition of 9212, an assessment of the reasons for the continued delays in executing the project, actions to be taken to recover the project schedule, and future repairs that may be needed that are outside the scope of this project to ensure it can operate safely until the construction of the Uranium Processing Facility is complete. *H. Rept. 112-462, Page 119*	*Unclassified* Chapter 2, Section 2.6.4; Chapter 5, Sections 5.3, 5.3.1, Table 5-1; Appendix D, Section D.2.2

Appendix B

Science, Technology, and Engineering Campaigns Subprograms

APPENDIX B
SCIENCE, TECHNOLOGY, AND ENGINEERING CAMPAIGNS SUBPROGRAMS

Chapter 3 explained the ST&E base of stockpile stewardship and management. This appendix provides more detailed information regarding the subprograms of the various campaigns described in Section 3.7.

B.1 Science Campaign

B.1.1 Advanced Certification Subprogram

The Advanced Certification subprogram is focused on the integral task of enabling certification of an evolving stockpile using the advances in ST&E capabilities in the absence of underground nuclear testing. This subprogram develops tools that support the current stockpile, as well as future stockpile options, through certification of substantial new safety and security features. Advanced Certification provides a strong focal point for ST&E deliverables to enable certification for LEPs. The subprogram integrates scientific and technological advances that are supported elsewhere (*i.e.*, by the Science, ASC, and ICF Campaigns) with input from studies to improve the weapons certification process, refine computational tools and methods, advance physical understanding of surety mechanisms, understand failure modes, assess new manufacturing processes, and anticipate technological surprise.

B.1.2 Primary Assessment Technologies Subprogram

The Primary Assessment Technologies subprogram provides capabilities to assess stockpile primaries, enable a range of options for future LEPs, and underwrite improvements in weapons safety and security. A principal focus of the Primary Assessment Technologies subprogram for the next 5 years is to develop predictive capabilities for modeling boost and underwriting pit reuse options. These capabilities also provide the foundation for national security missions concerned with assessing foreign or improvised weapons.

B.1.3 Dynamic Materials Properties Subprogram

The Dynamic Materials Properties subprogram develops the fundamental knowledge and physics-based models that describe and predict the behavior of weapon materials at the extreme temperatures, stresses, strains, and strain rates experienced during a nuclear explosion. The materials of interest include high explosives, plutonium, uranium, and nonradioactive materials in weapons primaries and related components. The data are used to develop experimentally validated models that incorporate the physics of materials behavior and response under extreme conditions. Surrogates are used to aid understanding without using special nuclear materials. New experimental capabilities are developed as required to provide data and support its interpretation. The subprogram is closely coordinated with the Primary Assessment Technologies, Secondary Assessment Technologies, and Advanced Certification subprograms; with the ASC, ICF, and Engineering Campaigns and the DSW program; and with the Joint DoD and DOE Munitions Technology Program.

B.1.4 Advanced Radiography Subprogram

The Advanced Radiography subprogram develops the sources, targets, and detectors to diagnose hydrodynamic experiments and advanced platforms for dynamic material properties experiments, including those that obtain data on plutonium properties. These transformational technologies advance and improve the quality of scientific results at facilities such as DARHT, the Contained Firing Facility at Site 300, the Z pulsed power facility, the U1a Complex, and Proton Radiography at LANSCE. The main focus is to develop radiographic requirements and advanced analysis of radiographic information in response to the needs of the hydrodynamic program.

B.1.5 Secondary Assessment Technologies Subprogram

The Secondary Assessment Technologies subprogram develops and provides the capability to strengthen evaluation and assessment of secondaries, including the capability to evaluate the reliability and performance of configurations that may enter the stockpile without nuclear testing, thus supporting a broad range of LEP options. The subprogram also studies secondary performance for both stockpile and non-stockpile systems to enable assessment and quantification of performance margins and their associated uncertainties. It also develops predictive capabilities to quantify weapon output and its interaction with the environment. Secondary Assessment Technologies has a strong programmatic coupling with the high energy density facilities supported by the Science and ICF Campaigns, including the National Ignition Facility, the Omega laser facility, and the Z pulsed power facility.

B.2 Advanced Simulation and Computing Campaign

B.2.1 Integrated Codes Subprogram

The Integrated Codes subprogram produces large-scale, integrated simulation codes for stockpile assessments to support design studies, maintenance analyses, LEPs, SFIs, and weapons dismantlement activities. It maintains selected legacy codes and is responsible for engineering, emerging, and specialized codes that support the weapons mission. The integrated codes represent the repository for data from experiments on NNSA's high energy density facilities and legacy underground nuclear tests, as well as the accumulated experience of the DSW program user community. Predictive capabilities and national security missions will be achieved through the advances realized in these codes.

B.2.2 Physics and Engineering Models Subprogram

The Physics and Engineering Models subprogram develops microscopic and macroscopic models of physics and material properties and special purpose physics codes to investigate specific phenomena in detail. The latter are used in cases where data are difficult or impossible to obtain. This subprogram works with the Integrated Codes subprogram to perform initial validation and incorporate new models into integrated codes. The subprogram also works with the Verification and Validation subprogram on the final assessment of the models in the integrated codes. Extensive integration also occurs between the Physics and Engineering Models subprogram and the experimental programs of the Stockpile Stewardship Program executed by the Science, ICF, and Engineering Campaigns.

B.2.3 Verification and Validation Subprogram

The Verification and Validation subprogram is a bridge between the modeling and development community and the DSW program user community. It brings these communities together to evaluate the capability of the integrated codes and provide a predictive capability for applications. Verification activities demonstrate that the weapons codes are correctly solving equations related to the physics and engineering models. Validation activities ensure that the codes are solving the correct equations, *i.e.*, that the models themselves are correct. Together, these subprogram activities provide a technically rigorous, credible foundation for computational science and engineering calculations by developing and implementing tools that provide confidence in simulations of high-consequence nuclear stockpile problems. This subprogram also develops and implements uncertainty quantification methodologies to support QMU for weapon assessment.

B.2.4 Computational Systems and Software Environment Subprogram

The Computational Systems and Software Environment subprogram builds integrated, balanced, and scalable computational capabilities. The complexity and scale of nuclear weapons simulations require the ASC Campaign to lead the mainstream high performance computing community by investing in and influencing the evolution of computing environments. This subprogram provides the stability to ensure productive system use and protect NNSA's investment in secure simulation codes. Within the next decade, enhanced predictive capabilities, delivery of quantified margins and uncertainties, and achievement of DSW deliverables will demand exascale computing. The Computational Systems and Software Environment subprogram will continue to provide for acquisition and implementation of commodity technology class systems, such as the tri-laboratory Linux Capacity Clusters, as well as advanced technology class systems, such as RoadRunner, Cielo, and Sequoia.

B.2.5 Facility Operations and User Support Subprogram

This subprogram provides the physical facility and operational support for production computing, storage, and services to enable effective use of the ASC Campaign's tri-laboratory computing resources. Designers, analysts, and code and model developers provide the functional and operational requirements. The scope of operations includes planning, integration, and deployment; continued product support; procurement of equipment and media; quality and reliability activities; and collaborations. The subprogram covers physical space, power, and local area and wide area networking. The user support functions include computer center hotline and help desk services, account management, web-based system documentation, system status information tools, user training, trouble ticketing systems, and application analyst support at the three national security laboratories.

B.3 Engineering Campaign

B.3.1 Enhanced Surety Subprogram

The Enhanced Surety subprogram is designed to mature surety technologies that will enable a life-extended stockpile to fully meet modern nuclear safety standards and achieve new levels of use control and use denial performance. This activity supports the surety improvements being pursued by current LEPs. Advanced high explosive initiation technology under this subprogram supports the implementation of a nuclear safety architecture, wherein a weapon remains impervious to potential electrical and mechanical insults associated with severe accident scenarios. This subprogram is also pursuing use denial technologies to protect future weapons against the full spectrum of malevolent threat environments.

B.3.2 Weapon Systems Engineering Assessment Technology Subprogram

The Weapon Systems Engineering Assessment Technology subprogram develops the diagnostics, hardware and methodologies, and trained personnel to generate test data to enable responsive engineering assessments in support of stockpile management and transformation. Full-scale system tests will likely be reduced as the development cycle for weapons is compressed. The Weapon Systems Engineering Assessment Technology subprogram provides the linkage between capabilities in engineering sciences, computational simulation, test and evaluation, and weapon system qualification. The subprogram has been crucial to transformation of weapon assessment and qualification based on testing, to a framework based on validated predictive capabilities that involve multiple complex physics models and environments.

B.3.3 Nuclear Survivability Subprogram

The Nuclear Survivability subprogram refines current nuclear survivability capabilities while developing new capabilities to reduce the risk to the Nation's nuclear deterrence from hostile environments. Activities include enabling certification of nuclear survivability and the effectiveness of the evolving stockpile through R&D and integrating computational and experimental capabilities, new assessment methodologies, and further development of radiation-hardened technologies. The subprogram develops assessment tools to evaluate threat nuclear weapon radiation environments and system radiation responses, qualify radiation-hardened technologies, and improve radiation sources and diagnostics.

B.3.4 Enhanced Surveillance Subprogram

The Enhanced Surveillance subprogram assesses the impact of material behavior changes on weapon performance and safety. This joint science and engineering effort provides material, component, and subsystem lifetime assessments and develops predictive capabilities for early identification and assessment of stockpile aging concerns. The subprogram identifies aging issues with sufficient lead time to ensure NNSA has the refurbishment capability and capacity in place when required. The strategy emphasizes more robust stockpile surveillance for early problem identification because future problems will have a greater relative impact on the effectiveness of a smaller nuclear deterrent.

Typically, Enhanced Surveillance subprogram lifetime assessments include efforts to develop an understanding of the basic aging mechanisms and interactions of materials in components, assemblies, and subassemblies. Accelerated aging experiments are used to obtain data beyond that available from traditional stockpile surveillance. Experiments are also used to validate broader age-aware models that are developed to support lifetime assessments and predictions pertinent to LEPs. In addition, this subprogram provides new or improved diagnostic techniques for detection and quantification of aging degradation and other potential defects in the stockpile.

B.4 Inertial Confinement Fusion Ignition and High Yield Campaign

B.4.1 Ignition Subprogram

The demonstration of thermonuclear ignition in the laboratory and its development as a platform provides scientific and technical understanding to help address key weapons issues and validate codes used to assess and certify the stockpile. The demonstration of ignition is a major goal for NNSA and DOE. This subprogram supports research activities that optimize the prospects for achieving ignition on the National Ignition Facility, as well as the development and applications of robust ignition, advanced ignition, and burning plasma platforms that can be used to address key weapons issues once ignition is achieved. This includes experiments at NNSA's high energy density facilities and development of ignition target fabrication and assembly methods, advanced target diagnostic techniques, and systems engineering improvements essential to ignition efforts. This effort is supported by detailed theoretical designs and two- and three-dimensional simulations of the performance of ignition targets. The near-term emphasis is on activities to achieve indirect-drive ignition. In the longer term, this subprogram will develop advanced ignition concepts that may provide advantages over the initial indirect-drive ignition platform, such as higher yield and gain.

B.4.2 Support of Other Stockpile Programs Subprogram

Non-ignition experiments using the ICF Campaign's suite of high energy density facilities are valuable to assessing and certifying the stockpile. This subprogram leverages the experience of the researchers funded by the ICF Campaign to support NNSA's Stockpile Stewardship Program non-ignition high energy density physics needs. This is done through integrating the experimental infrastructure and capabilities required to execute high energy density physics experiments on ICF Campaign facilities as guided by the PCF. The ICF Campaign's high energy density facilities are used to perform experiments for which ignition and burn are not the focus, such as material properties, hydrodynamics, and radiation transport experiments. Activities include platform and diagnostic development at the Omega laser facility, the Z pulsed power facility, and supporting facilities. The capabilities developed will enhance NNSA's understanding of the behavior of matter at conditions approaching those in a nuclear weapon and the data obtained can validate models in weapons simulation codes.

B.4.3 Diagnostics, Cryogenics, and Experimental Support Subprogram

Science-based weapons assessments and certification require advanced experimental capabilities that can create and study matter at extreme conditions that approach the high energy density environments found in a nuclear explosion. This subprogram develops the specialized technologies needed for experiments on ICF Campaign facilities, as well as technologies for diagnostics, cryogenic systems, and user optics. Activities include the design and engineering of a complex array of diagnostic and measurement systems and the associated information technology subsystems. The data generated by these diagnostics provide key information required for both ignition and non-ignition experiments for stockpile stewardship.

B.4.4 Pulsed Power Inertial Confinement Fusion Subprogram

The Pulsed Power Inertial Confinement Fusion subprogram funds computational target design, experiments, and the experimental infrastructure (diagnostics and hardware) to assess advanced pulsed power concepts using magnetically driven implosions as a means to achieve thermonuclear fusion in the laboratory. A key objective of this subprogram is to determine the requirements for an advanced pulsed power driver that would achieve robust ignition and single-shot, high fusion yield.

B.4.5 Joint Program in High Energy Density Laboratory Plasmas Subprogram

The Joint Program in High Energy Density Laboratory Plasmas subprogram develops and maintains a cadre of qualified researchers to strengthen the ST&E base of stockpile stewardship. It is a joint program with DOE's Office of Science to support basic high energy density physics research that strengthens the ST&E base. This subprogram supports external users at the Omega laser facility through the National Laser Users' Facility Program and a joint solicitation with the Office of Science for high energy density laboratory plasmas research to be performed at universities and DOE laboratories. It also provides funding for some of the high-energy-density Stockpile Stewardship Academic Alliances activities and other university programs.

B.4.6 Facility Operations and Target Production Subprogram

Operation of NNSA's high energy density and target production facilities supports the goals of the ICF Campaign to meet DOE's national security needs. This subprogram funds the operations of ICF Campaign facilities, including the National Ignition Facility, the Omega laser facility, and the Z pulsed power facility, to support experiments for the ICF, Science, and Engineering Campaigns subprograms to meet stockpile assessment and certification needs. The subprogram also supports fabrication of sophisticated targets for weapons physics and fusion ignition experiments on these facilities. In addition, it supports operations at the Trident Facility at LANL.

Appendix C

Nuclear Test Readiness

APPENDIX C
NUCLEAR TEST READINESS

Chapter 4 discussed the Nation's posture regarding test readiness. This appendix provides more detailed information regarding the technological aspects of test readiness, in addition to the associated personnel and physical assets required.

In response to the need for clarity on U.S. posture on test readiness, a special task force was convened by the United States Strategic Command, Strategic Advisory Group. This special task force included the directors of NNSA's three national security laboratories. The task force concluded that assessments of the readiness for an underground nuclear test should be made on a technical basis and should assume such a test would be conducted only when the President has declared a national emergency or similar contingency and after any necessary waiver of applicable statutory and regulatory restrictions (*e.g.*, relating to health, safety, and the environment).

On this basis, the group concluded, albeit without a structured mechanism to validate specific estimates, that while a fully instrumented test to address a complex stockpile issue would take 24 to 36 months, tests to develop a new capability might take up to 60 months. The task force also concluded that a very simple test for political purposes could be conducted in as little as 6 to 10 months. (The Threshold Test Ban Treaty requires a 200-day notification of a test.)

C.1 Technological Aspects of Test Readiness Given Current State of Stockpile Stewardship

Although the *Nuclear Posture Review Report* (DoD 2010) reaffirmed and strengthened the commitment to maintain the U.S. nuclear deterrent capability without nuclear testing, NNSA is required to maintain a test readiness posture in which an underground test could be conducted within 24 to 36 months of direction from the President. The *Nuclear Posture Review Report* (DoD 2010) policy statement makes it plain that the United States never intends to return to nuclear testing, except if an unforeseen critical technical issue with the stockpile were to be discovered. The only remaining purpose for test readiness is to respond to another Nation engaging in testing in order to demonstrate that the U.S. deterrent capability is still effective. This scenario is among those considered by the Strategic Advisory Group Special Task Force and shown in **Table C–1**. The table represents estimates of time needed to prepare for and conduct a single or series of underground tests according to a variety of scenarios.

Table C–1. Technical aspect of test readiness

Reason for a Test	*Complexity of the Test*	*Relative Contribution to a Solution* [a]	*Time to Conduct (Technical Aspects)* [b]
Demonstrations (Single Test)			
Response to another Nation's test	L	–	6 – 10 Months
Signal resolve	L	–	6 – 10 Months
Experiments			
New Military Characteristics	L to H	L to H	36 – 60 Months
Stockpile Stewardship Program Confirmation	M to H	M	24 – 36 Months
Resolve Stockpile Problem	M to H	L	24 – 36 Months
Adversary Actions			
Technological Surprise	M to H	M	24 – 36 Months
Render Safe	M	M	24 – 36 Months
Effects/Survivability			
Effects	H	L	24 – 36 Months
Survivability	H	L	24 – 36 Months

L = Low, M = Medium, H = High
[a] Compared to Stockpile Stewardship Program
[b] Assuming waivers as needed

C.2 Nevada National Security Site Nuclear Test-Related Assets for FY 2013

This section presents a summary of the key[1] and critical[2] personnel and other resources necessary to conduct an underground nuclear test (UGT) at the Nevada National Security Site. This appendix is based on prior years' data with some FY 2013 revisions.

C.2.1 Underground Nuclear Test Personnel

Personnel data in this section covers the inventory of all Nuclear Test Organization (NTO) personnel and their individual skill sets that are described in the NTO workforce roster for resumption of a UGT. In the case of National Security Technologies (NSTec), its UGT personnel database also contains the employees' skills sets.

C.2.1.1 Nuclear Test Organization Underground Nuclear Test Personnel

Until FY 2009 NSTec maintained and tracked NTO UGT key and critical position requirements and personnel assignments as provided by NTO member organizations. The last formal review[3] of the NTO UGT key and critical position requirements, completed in August 2006, concluded that there are 411 NTO (multi-organization) position requirements for the resumption of a UGT. **Table C–2** provides the details of the key and critical position requirements by NTO member. The first column lists the following NTO organizations: Air Resources Laboratory/Special Operations and Research Division,

[1] *Key personnel are those who fill positions defined as necessary to the preparation for or conduct of an underground test in NSO M 450.X2-1 – Underground Nuclear Testing, Test Readiness, and Threshold Test Ban Treaty Verification.*
[2] *Critical personnel are those who fill positions defined as vital to the safe accomplishment of an underground test in NSO M 450.X2-1 – Underground Nuclear Testing, Test Readiness, and Threshold Test Ban Treaty Verification.*
[3] *Test readiness funding shortages for all test readiness activities have curtailed a number of activities, including keeping related databases current.*

NSTec, Nevada Field Office, Desert Research Institute, LANL, LLNL, SNL, and Wackenhut Services Incorporated.

Based on legacy NTO data and an FY 2013 update of the NSTec and LANL positions, at a minimum 92 of the 411 total NTO key and critical position requirements have no personnel assigned. The 92 vacancies consisted of 10 key position requirements and 82 critical position requirements (see **Table C–3**). These numbers are a significant increase over the estimates from FY 2011 of 59 total (5 key and 54 critical personnel vacancies). The LANL vacancies shown in Table C–3 resulted from the fact that the personnel assigned to these positions no longer appear in the LANL personnel directory. The NSTec vacancies are discussed in Section C.2.1.2.

Table C–2. Nuclear Test Organization key and critical position requirements

Nuclear Test Organization	*Key Position Requirements*	*Critical Position Requirements*	*Total*
Air Resources Laboratory/Special Operations and Research Division	3	7	10
National Security Technologies	14	167	181
Nevada Field Office	18	7	25
Desert Research Institute	2	27	29
Los Alamos National Laboratory	19	50	69
Lawrence Livermore National Laboratory	13	41	54
Sandia National Laboratories	7	32	39
Wackenhut Services Incorporated	2	2	4
TOTAL	*78*	*333*	*411*

Table C–3. Nuclear Test Organization key and critical vacancies

Nuclear Test Organization	*Key Personnel Vacancies*	*Critical Personnel Vacancies*
Air Resources Laboratory/ Special Operations and Research Division	2	1
National Security Technologies	2	39
Nevada Field Office	0	0
Desert Research Institute	0	17
Los Alamos National Laboratory	5	22
Lawrence Livermore National Laboratory	0	0
Sandia National Laboratories	1	3
Wackenhut Services Incorporated	0	0
TOTAL	*10*	*82*

The number of key personnel available for execution of an underground test has continued to decline as the staff who conducted tests retired, and there is no funded program in place at this time to train replacements for these key positions. To address this trend, a transition began to a two part strategy that relies on (1) robust stockpile stewardship activities to maintain the bulk of skills, facilities, and processes to conduct a nuclear test and (2) a test readiness component to preserve test readiness unique assets and capabilities not exercised by stockpile stewardship activities. This approach strengthens the ability to conduct a UGT without relying on legacy skill sets. Emphasis on leveraging the Stockpile Stewardship Program was given by the Strategic Advisory Group Special Task Force statement,[4] "The need for test readiness-unique personnel can and should be minimized by leveraging other Stockpile Stewardship activity." Recent advances in measurement capability of subcritical experiments form the basis of the Stockpile Stewardship support, while planning for maintenance of the readiness components is described in a Test Readiness Asset and Infrastructure Management Plan being developed for the Nevada Field Office. In addition, the Nevada Field Office authored "Planning for and Execution of an Underground Nuclear Test," a UGT resumption manual that captures organizational planning responsibilities and execution activities for future UGTs.

C.2.1.2 National Security Technologies Underground Test Personnel

The last formal review of NSTec key and critical position requirements was completed and validated in August 2006 by subject matter experts, managers, and the personnel assigned to the NSTec Key Position of UGT Project Manager. The review determined that the number of key position requirements decreased slightly from 16 to 14 and the critical position requirements decreased from 185 to 167 due to continuing refinements to the defense support system functional area models.

An FY 2013 update found that NSTec has 109 personnel assigned to 140 key and critical position requirements, and 41 critical position vacancies (see **Table C–4**). This is possible because a single individual with extensive UGT experience can be qualified to fill more than one position requirement when scheduling allows.

Among other options, NSTec has historically relied upon the Retiree Corps to address this shortage. Instituted in 1997, the Retiree Corps enlists retirees and former employees with UGT experience and expertise. The Retiree Corps currently consists of Nevada National Security Site contractor and Nevada Field Office retirees and former employees that are not counted in key or critical skill positions. The UGT Retiree Corps offers a supplemental method for access to UGT experience and can be used for mentoring and training as well as consulting, archiving, and advising on current UGT-related activities. With time, however, the success of this program is being tempered by a number of factors such as:

- The age of the retirees. It is now 20 years since the last nuclear test. As each year passes, the health of the retirees diminishes, as does the number available.
- The significant loss of ability to transition from once-used technologies to current practices to support ongoing stockpile activities and test readiness. Historic personnel skills are therefore of less utility in the modern technology environment.
- The lack of knowledge of current nuclear safety requirements limits a retiree's contributions.

With these factors, the Retiree Corps is not considered an enduring future staffing solution.

C.2.2 Physical Assets

It has been 20 years since execution of the Los Alamos DIVIDER test, the last test before onset of the October 1992 moratorium on UGTs. The Nevada National Security Site test readiness physical assets staff has continued to focus on identification and sponsoring minimal care efforts of UGT *unique* facilities, equipment, and inventory. *Unique* encompasses assets that represent a capability that must be available in order to successfully execute an underground nuclear test using the currently defined processes and are not readily available in the commercial sector.

[4] *Readiness for Underground Nuclear Testing and the Role of UGT, Dr. George Miller, United States Strategic Command, Strategic Advisory Group Special Task Force, 17 March 2010, slide 16.*

Table C–4. National Security Technologies underground nuclear test position vacancies

Position Title	Key or Critical	Number Required	Number Vacant
Project Management and Support			
- Project Manager	K	1	1
CAPTAIN-THREX, Scientist, THREX [a]	C	2	2
Electro-optics			
- Programmer, Application Support	C	1	1
- Electronic Technician	C	4	1
- Technical Advisor	C	1	1
- Fiber Optic Technician	C	4	1
Neutron Experiment			
- Electronic Technician	C	6	2
Reaction History			
- Electronic Technician	C	12	3
- Electronic Technologist	C	2	1
Containment Diagnostics			
- Electronic Technician	C	2	1
- Project Engineer	C	1	1
- Programmer, Application support	C	1	1
Control and Communication			
- Timing Station Technician	C	2	1
- Technical Advisor	C	1	1
- Timing and Firing Technologist	C	2	1
Detectors; Source Lab Technologist	C	1	1
Data Analysis and Scientific Support			
- Technologist, Data Analysis	C	3	2
- Programmer, Application Support	C	8	6
- Data Analysis Manager	C	1	1
- Scientist, Data Analysis	C	2	1
Event Support			
- Event Support Manager	C	1	1
Event Engineering			
- Engineer, Civil	C	2	1
- Project Engineer	C	2	1
Event Construction			
- Construction Superintendent	K	1	1
- Cable Superintendent	C	1	1
- Construction Manager	C	1	1
- Electrical Superintendent	C	1	1
- Mechanical Structures Superintendent	C	1	1
Canister-Rack Fabrication			
- Mechanical Engineer	C	2	1
Verification			
- Nevada National Security Site/Threshold Test Ban Treaty Coordinator	C	3	2

[a] *Currently this position is not required due to the NTO management decision that CAPTAIN-THREX diagnostics are not needed in the most likely test scenarios.*

For active mission-utilized assets, test readiness efforts have been limited to attempting to ensure that no modifications, use, or ownership transfer occurs that would preclude an ability to perform the UGT mission if, and when, ordered.

The following sub-sections address specific physical assets or physical systems deemed critical to successful accomplishment of the test readiness mission. In particular, UGT critical facilities, equipment, and inventory (other physical assets) are addressed.

C.2.2.1 Facilities

There are 81 North Las Vegas/Nevada National Security Site facilities designated as readiness assets that provide some unique readiness capabilities, either built in or housed within. Thus far, the transfer, reporting as excess, and decommission and destruction actions have been cleared through the readiness staff when such actions would involve one of these facilities.

C.2.2.1.1 Underground Nuclear Test Unique

Subject matter experts identified 35 North Las Vegas/Nevada National Security Site non-communication facilities several years ago and designated them as necessary for successful execution of a UGT or short series of tests. This status has been overtaken by time and other programmatic decisions and is in need of an in-depth review. These facilities have not been maintained in a manner that would minimize any jeopardy to Test Readiness requirements. They range from the North Las Vegas A-17 Twin Towers to Area 6 CP-170 Yucca Lake Meteorology Station.

C.2.2.1.2 Underground Nuclear Test Communications Critical

Several years ago 39 communications structures were deemed critical to successful UGT by subject matter experts. Because the overall communications systems (radio, telephone, and data) at one time were comprised of interrelated and interdependent pieces, the Readiness staff has relied on subject matter experts to determine which pieces are necessary to the UGT mission. Technological advances and a new communications system installed at the Nevada National Security Site are currently available and would most likely decrease requirements for current historic infrastructure and inventory. No formal communications study for the mesa has been conducted in the last two decades and may be necessary for resumption of testing.

C.2.2.1.3 Underground Nuclear Test Asset Storage

Nevada National Security Site facilities or associated storage yards are presently being used for storage of Readiness assets: Building 6-CP65 houses thousands of diagnostic equipment items, Building 6-903 yard is a Radioactive Materials Area storage of post-shot drilling system components, Building 6-911 yard is a Radioactive Materials Area storage of down hole logging assets, and Building 1 103 is storage of costly LLNL emplacement elevator system components that are no longer needed.[5]

C.2.2.2 Equipment

The focus on equipment assets whose retention is deemed critical to the successful execution of a UGT is on the equipment having unique characteristics specifically suited to support the need to conduct a nuclear test. The required characteristics of these assets often rule out new acquisition or leasing without arduous redesign, manufacturing, and approval processes.

C.2.2.2.1 Device Emplacement and Handling and Specialty Cranes

Design criteria and specifications for emplacement cranes were established through an exhaustive Nevada National Security Site community crane study accomplished in the late 1970s. That effort resulted in a family of specially built units that has been reduced to three specific units. These cranes have the special steel assemblies and fail-safe features specified as "must have" by the study and subject matter experts.

Manitowoc-4600T Emplacement Cranes and Equipment. There are two M-4600 cranes suitable for light UGT payload emplacement operations at Nevada National Security Site. Both are manufacturer designated as 350-ton capacity. However, when outfitted with UGT appropriate booms and swinging in a UGT appropriate radius (180 feet and 50 feet, respectively), they can handle loads up to approximately 200,000 pounds. This is somewhat short of the weight of a complex test package. One crane was used on the Unicorn Event and both have had their tires completely replaced during the last 4 years and are being exercised occasionally to keep their mechanical systems operational.

[5] *An emplacement study completed by the Joint Nevada Project Office (JNPO now JLON) during FY 2008 recommended (and was adopted) that only the Wire-rope method for emplacement be used for the next test. However, the study also recommended that all LLNL equipment continued to be stored, but not be maintained.*

Manitowoc-6000 Basic Emplacement Crane and Equipment. With the permanent transfer of the LANL-utilized M-4600 "Ringer" crane first to the LLNL National Ignition Facility and then to the Oak Ridge National Laboratory, the M-6000 crane at Nevada National Security Site is the only crane available that has ever been nuclear certified for very heavy test package weights. The basic crane (without the Lampson unit discussed below) can emplace packages weighing up to approximately 400,000 pounds. This crane is located at the Radiological/Nuclear Countermeasures Test and Evaluation Complex and is at least minimally exercised. The Joint Laboratory Operations-Nevada (JLON) Emplacement study specifically recommended, "Cranes to be used for emplacement and operator training should be put on a routine maintenance program assuring their viability long into the future and the ability to certify them for a nuclear test downhole operation in a time consistent with desired response for test execution."

Manitowoc-6000/Lampson LTL-800 Heavy Lift Attachment Emplacement Crane Suite of Equipment. M-6000 capability can be increased threefold when the Lampson LTL-800 unit is attached. Emplacement capability then becomes in excess of 1,000,000 pounds. These extreme weights were encountered with the later LLNL event packages. The various components for the LTL-800 are located within the "wet and wild" and Yucca Lake storage yards in Area 6.

The Lampson Transporter powered track unit has been reassembled since its return from the National Ignition Facility in 2004 and is located in Area 6.

Manitowoc Engineering Company Crane Studies. In late September of 2010, the Manitowoc Engineering Company, the crane manufacturing representatives, performed a detailed inspection and report on the status of all three test-critical cranes. Of the two 4600 cranes, 4 items were called out for replacement and 33 to 38 items were identified with considerable wear.

The summary of the inspection states that both machines are in structurally good condition. One crane, now located at the Radiological/Nuclear Countermeasures Test and Evaluation Complex, was cited for structural concerns with the 40 foot insert and the 20 foot insert. This machine should be rigged with the proper 4 1/2 offset links. It was recommended that the replacement of all boom pendants should be performed. Numerous upkeep and operational issues, as noted, need to be addressed to ensure integrity of the machine, including a complete paint job. If maintenance and repairs are performed, the crane should have a long life.

Similar specific comments were made for the Manitowoc 4600 located at the U1a site. Both cranes have local modifications and some repairs are inoperable or need better documentation and maintenance.

The Manitowoc 6000 was found to have very similar, if not greater, maintenance issues most likely due to inactivity and infrequent maintenance. Replacement of all pendants and backstays is recommended. Some replacements in air lines were not original equipment manufacturer rated. It was stated by the inspector that if the crane was run daily, leaks would likely appear in most if not all of the seals, gaskets, and hoses of the hydraulic and air systems. Significant service and maintenance is required.

The cost burden for the cranes must be identified as a cost to ongoing programs or identified as an infrastructure budget issue and fully funded each fiscal year. Without programmatic support AND routine operational usage neither the machines nor the operators will remain in the required support status needed for nuclear testing. With the likelihood of never returning to testing, the need for these cranes and the required support funding should be reviewed for possible termination and disposition as surplus to the Government's requirements.

Grove 14.5 and 18 Ton Handling Cranes. Three on-hand hydraulic cranes are equipped with the nuclear certification-required safety features and remain operational and certifiable. These cranes are in active mission use and tend to remain continuously operational and nuclear certifiable should the need arise.

Manitowoc-3950T. The Manitowoc-3950T is a general use crane that can be outfitted with a large Calweld auger attachment for drilling the surface holes needed for big-hole drilling operations. While present plans call for the use of existing emplacement holes, the retention of this crane and the Calweld associated boom and drilling equipment enables the Nevada National Security Site to maintain a limited drilling capability.

C.2.2.2.2 Retention and Potential Replacement of On-Hand Emplacement Cranes

There are "off-the-shelf" and in-use cranes capable of handling the requisite weights required for emplacement, but they have never been scrutinized for the unique UGT nuclear certification requirements (*i.e.*, in lowering a nuclear device, commercial cranes are designed with failsafe drop of load). Existing Nevada National Security Site cranes are operational and industrial-use certified, and almost certainly nuclear certifiable, but they are currently 25+ years old and their viability over the long-term future (10+ years) is uncertain. It is not cost effective to attempt to maintain current crane inventory in a condition to meet changing nuclear explosive safety or the authorization basis of the future.

C.2.2.3 Drilling Machines

Drilling operations at the Nevada National Security Site have covered most of the spectrum of industrial drilling activities. They have ranged from small, shallow holes for cores and anchors through shallow and deep-water wells, to the very Nevada National Security Site-unique device emplacement holes and post-shot drill-back and sampling holes. It is these last two that require the very specialized machines and component suites that have been the focus of attention by the Readiness staff. These operations can best be performed using on-hand rigs and equipment; hence, there are continuing efforts to preserve this capability and a means to cost-effectively reconstitute them if necessary. At this time, both the post-shot and big-hole rigs and their associated suites of subcomponents remain relatively intact and can be reconstituted. No near-term requirements for new emplacement holes are known, but subcontracting the job of drilling using Government-furnished equipment (which will require some refurbishment) is one option if drilling will be required.

C.2.2.3.1 IRI-1100 Post-Shot Rig and Equipment

The effort to obtain actual blast zone samples after an underground test culminated in the present design of the IRI-1100 rig and associated equipment. (In the past, sampling involved the hazardous lowering of rigs and drillers' equipment into the subsidence craters.) The IRI-1100 rig was designed and built specifically for the Nevada National Security Site post-shot mission. It operates from outside of the predicted zone of subsidence and is much safer and less labor intensive to operate than previous rigs. It has been successfully utilized in actual drill-back operations as recently as the summer of 2004. The Test Readiness Program funded an effort to "stack" (drillers' term for properly storing drill rigs between jobs) the IRI-1100 and all associated inactive equipment in a sequestered mode within the Nevada National Security Site Area 1 Drilling Subdock. Both regular and radioactive materials areas were utilized. Subsequent semi-annual limited operation of basic rig systems and documented, deferred necessary maintenance actions should enable successful and cost-effective reconstitution when necessary.

C.2.2.3.2 IDECO-3000 Big-Hole Rig and Equipment

The IDECO-3000 is a very large oil-field-type rig (30,000 foot class) that was designed specifically to accomplish drilling of UGT emplacement holes. Nevada National Security Site engineering and drilling experts developed the particular method of drilling very large diameter, deep, and very straight holes over the course of many years. The rig differs from those common to the oil and mining industry in that it was built to handle the very large, flat bottom bits and the greater than 100 inch liner unique to the task. The mast, sub-base, and drilling string are unique. The rig has been stored in the Area 6 Well #3 Casing Yard since the mid-90s. Drilling tools and various other subcomponents are also stored in the Area 1 Drilling Subdock.

A recent Internet survey and subject matter experts query indicates that two or three firms formerly capable of big-hole drilling no longer do so and the rigs utilized are no longer available. Predominant NTO opinion is that sufficient pre-drilled emplacement holes are available. Retention, thorough, and at least minimal maintenance actions are prudent for the IDECO-3000 to protect this unique asset in case existing holes are damaged or inadequate. Should any cleaning, reaming, or other repairs be required for an existing emplacement hole, the IDECO is the only known machine for this operation.

C.2.2.4 Forklifts

There are presently two nuclear-certifiable and four other special forklifts listed as Readiness-specific assets. The two nuclear capable units are in active mission use at the Device Assembly Facility and remain nuclear certified. Two other non-nuclear certifiable units are equipped with special diagnostics cable-handling fork fixtures that have been certified for use by the forklift manufacturer. Two others (capacity of 30 tons and 40 tons) are general-purpose units required for UGT and in regular mission use. There are some previously utilized forklift attachments, *e.g.*, the post-shot Blow-Out Preventer positioning fixture that must have forklift manufacturer approval before they could be utilized, or must have specific approval to proceed without manufacturer approval.

C.2.2.5 Special Transport

C.2.2.5.1 Heavy and Outsized Loads

Readiness assets such as event site assembly towers, drilling machine masts, emplacement sub-bases, tower modules, *etc.*, require the use of the Kenworth 100-ton tractor and Talbert 200-ton side-by-side trailer combination to enable onsite transport. The trailer has had all tires and the floor lagging replaced within the last 4 years. The Kenworth 70-ton tractor is used to pull the IRI-1100 post-shot rig as the 100-ton unit hitch 5th wheel is too high to accommodate the normal rig hitch of most tractor-trailers.

C.2.2.5.2 Special Materials

A very unique transporter, the Safe Secure Trailer/Transport is maintained in operational status for on-site transport of a Special Nuclear Material event package. Obviously, safety and security considerations dictate maintaining the Safe Secure Trailer/Transport in an operational status. The Safe Secure Trailer/Transport replaces the Device Transport Vehicles which were decommissioned in 2011.

C.2.2.6 Downhole Logging Equipment

Pre-moratorium UGT utilized 16 different log types during the course of day-to-day operations. A recent survey of the remaining UGT-experienced downhole logging subject matter experts led the Readiness staff to suggest retention of the three types described below. Other logging requirements can be satisfied utilizing outside contract sources. A considerable amount of effort will be required to relocate and store the three retained suites of logging equipment.

C.2.2.6.1 High Intensity GAMMA

Recent downhole logging experience utilizing industry-supplied instrumentation reinforced the logging subject matter experts' contention that the more sensitive Nevada National Security Site gamma logging capability be retained and maintained. The on-hand equipment has the requisite sensitivity threshold required for the UGT mission.

C.2.2.6.2 Big Hole Camera

Both the Big Hole Camera and the caliper tool described below are unique with respect to the diameter of the hole they are designed to log. Industry sources could probably accommodate these two requirements, but it would entail extensive fabrication and/or modification to their existing equipment. The camera module with the housing is currently on loan to the Las Vegas Atomic Testing Museum, with the understanding that it can be retrieved and returned to active service should the need arise.

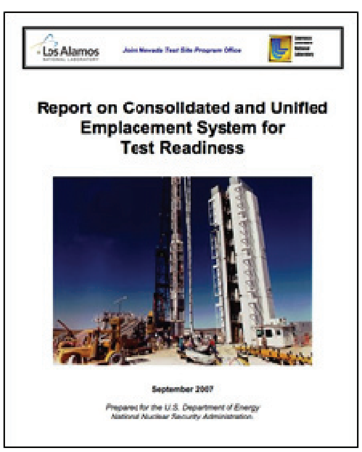
C.2.2.6.3 Big Hole Caliper

The sheer diameter of an emplacement hole makes this a unique logging operation. As with the camera suite, retention of the on-hand equipment is deemed cost effective when compared to the fabrication and/or modification that would be entailed with out-sourcing. This equipment is presently in minimal-care storage.

C.2.2.7 Emplacement

C.2.2.7.1 Emplacement System Study

In 2007, NNSA tasked the Joint Nevada Test Site Program Office (JNPO and now called JLON) with eliminating redundancies in test readiness from maintaining technologies for specific test operations developed separately by LLNL and LANL during the testing years. This paper specifically addresses the technologies for lowering the nuclear explosive and its diagnostics into a vertically drilled hole. Other test operations also carry unnecessary redundancies and should be assessed in the future, *i.e.*, containment plans and material emplacement techniques, ground zero layout, and operation sequences, *etc*.



Los Alamos

Joint Nevada Test Site Program Office

Report on Consolidated and Unified Emplacement System for Test Readiness

September 2007

Prepared for the U.S. Department of Energy National Nuclear Security Administration

Tests in a Nevada National Security Site tunnel complex should also be considered for similar analyses, as that may be a desirable test mode for technical reasons.

The NNSA's motivation was to reduce costs incurred by maintaining redundant technologies. In fact, more important than cost considerations, which are minimal in warehousing components, is narrowing the focus of the readiness community in their planning and exercise programs by reducing the breadth of potential concerns. That is, only one emplacement technique need be considered for maintenance, parts procurement, training, application to the appropriate Stockpile Stewardship experiments, *etc*.

The study recommended (among other things) that:

- The wire-rope harness medium used historically by LANL should be the single emplacement system maintained in readiness for the next set of UGT events. As such it will be the technique of choice for Stockpile Stewardship experiments requiring vertical emplacement and will be specified for readiness exercises.
- Within the Test Readiness Program, the Nevada Field Office should emphasize a Nevada Nuclear Test Infrastructure Program formalizing the responsibility to assure and maintain the centralized, non-redundant infrastructure for readiness for future tests. The Program would be responsible for infrastructure elements at the North Las Vegas Facility and the Nevada National Security Site matching test readiness requirements.
- All wire-rope expendable hardware and above ground emplacement technology hardware should be inventoried and maintained as critical readiness components.
- JLON should develop a plan to incorporate desired fabrication capabilities and UGT materials now at LANL and LLNL into the Nevada Throughput Improvement Plan (NTIP). That might include keeping inventoried and certified materials at the remote locations, qualifying vendors as appropriate, and relocating capabilities to the North Las Vegas Facility. Costs for various options should be analyzed.
- JLON should exercise this emplacement choice through Stockpile Stewardship experiment support, infrequent exercises, or other means.

C.2.2.7.2 ATLAS (Augmented Test Logistic Assembly System) Facility in North Las Vegas

The ATLAS (Augmented Test Logistic Assembly System) Facility in North Las Vegas was conceived and developed to provide significant efficiencies to fielding practices then in place. This facility houses a large machine shop, detector manufacturing and electronics laboratory, a sheet metal fabrication shop, Twin Towers for rack assembly, and data trailer storage and instrumentation processes. The facility provides everything necessary to pre-stage all mechanical and electronic systems for a test so that minimal time and logistic support needs to be spent in the field. The North Las Vegas Facility provides machine shops and assembly spaces for building precision canister frame sections on the order of 40 feet in length and 68 to 96 inches in diameter. As of May of 2012 parts of the facility were scheduled for deactivation and no longer considered mission essential for readiness.

C.2.2.7.3 LLNL Emplacement Equipment

The Gabbs event site in Area 2 had been designated as the preferred location in which to concentrate the LLNL-unique emplacement assets. Equipment was relocated from the Yucca Lake and other storage yards and the Area 1 Drilling Subdock where it had been left since cessation of UGT in 1992. The very unique, and costly, 1,000 ton elevators, slips, bales, plus other elevator equipment, were relocated to inside of Area 1 in Building 1-103. The JLON Emplacement Report suggested that all of the LLNL emplacement equipment continued to be stored, but no funding be used to maintain any of these assets.

C.2.2.7.4 Special Measurement Emplacement System Equipment

There are several Special Measurement Emplacement System equipment assets located at the U-9CT event site. The NSTec Readiness staff retains one of the line-tensioning modules and associated equipment that could be used to emplace sensing devices in an observation hole. The remaining Special Measurement Emplacement System equipment has been deemed unnecessary for Readiness.

C.2.2.7.5 Nuclear Security Enterprise Common Stemming Equipment

The Unicorn subcritical test employed stemming methodology and equipment that would comprise the majority of assets desired by both LANL and LLNL for a UGT. Only the amount of material and depth of stemming would differ for a UGT. The NSTec Readiness staff has identified and maintains this equipment to support a future UGT.

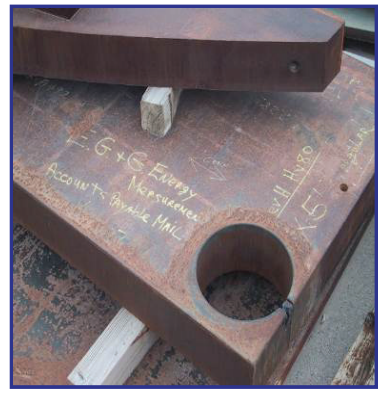
C.2.2.7.6 Other Inventory Assets

__Event Site Air Conditioners__. The large event site air conditioners are unique in several ways, including their ability to withstand post-detonation ground roll and still operate. It is likely that 24 or more of these units would be required for a complex scenario.

Presently, there are enough operable and reparable units on hand at the Nevada National Security Site to satisfy this level of requirement. Additionally, replacement units can be obtained from commercial sources and on-hand units can be totally rebuilt to specification or repaired. All refrigerant was removed from these units in 2010.

Vertical Pull-Test Facility. The Nevada National Security Site Area 2 Vertical Pull-Test facility is unique both in construction and utility in that it consists of the cased hole and hydraulic jacking system plus a few unique fabricated fixtures that enable the actual pull testing of long strings of drill pipe. However, the JLON Emplacement Study recommended wire rope as the emplacement method of choice, which means that the Vertical Pull-Test Facility will no longer be tracked as a critical facility. All of the existing equipment was not excessed at this time, but was stored in place against some possible future need.

C.2.2.7.7 Raw Materials



Special Steel. Fixtures and assemblies for handling UGT-related articles were most often constructed with special steel alloys such as HY-80, HY-100, A-537, *etc*. In the past, these alloys were often available only in large quantities and with fairly long lead-times. Further, certification and "chain of custody" records are somewhat spotty for on-hand stocks. Currently, small lots can be acquired from regular materials suppliers with very short lead-times.

Therefore, the NSTec Readiness staff will no longer pay special attention to the on-hand stocks of material. The inventory conducted during the summer of 2004 constitutes the last action for on-hand materials.

During the emplacement study, a number of items currently located at Los Alamos near facilities that have been identified as on the decommission and destruction list (the rack fabrication and pull-test facilities) were noted as being possible candidates for relocation to the Nevada National Security Site. Among those items were several hundred tons of special steel. No funding has been identified to accomplish this move and the material is currently still located in Los Alamos.

P-110 Emplacement Pipe. P-110 buttress threaded pipe, or casing, was the load bearing material string utilized in LLNL UGT to support very heavy package loads. Since the JLON Emplacement study identified wire rope as the emplacement method of choice, the pipe will continue to be stored in the A-1 drill yard, but no further maintenance action is anticipated.

Big-Hole Liner. Sufficient stocks of 60-inch to 144-inch liner (casing) remain on hand to satisfy a small number of tests. Occasionally, another mission may need to use a piece or two. Readiness staff reviews and approves such use to ensure they do not jeopardize Test Readiness capabilities.

<u>Shielding Materials</u>. It is assumed that any shielding material required by the national security laboratories can be obtained just in time. In the meantime, some on-hand shielding materials are located in the Area 6 Building 6-907b. Due to the HAZMAT nature of the contents, the Readiness staff has adopted a hands-off approach to contents in this facility other than to note it as a location used to store such materials. National security laboratory customers requiring these materials withdraw from the on-hand inventory, but such withdrawals have not (and are not anticipated to) jeopardize the UGT mission.

<u>Downhole Data Cable</u>. The large stocks of UGT required radio-frequency (RF) data cable on-hand at the Nevada National Security Site date from pre-moratorium days. The very specialized cable, *e.g.*, RF-19, is no longer manufactured and the chance of getting a manufacturer to refurbish the old tooling and reestablish an RF-19 line to support a small run for a single test has a low probability and/or an exorbitant cost penalty. On-hand stocks are probably adequate for a single UGT scenario with the caveats that the top two layers of spooled cable must be discarded and all cable would need to be discrete gas blocked. RF-14 cable is probably in the same situation. RF-44 is still available. Fiber optic cable is, for the most part, commercially available, but will require discrete gas blocks. Providing design and fabrication of discrete gas blocks for these fiber optic cables is a unique capability that must be maintained (fortunately it is currently being exercised as part of the LANL subcritical experiment program). The cable fabrication capability is still operational and some of the subject matter experts working there have actual UGT experience. As time passes, downhole cabling will be an area of increasing concern.

C.2.2.7.8 Event Site Diagnostics Trailers

Twenty-eight of the specially manufactured event site diagnostic trailers have been individually identified as required for the Readiness mission, some active and others not. A single methodology for shock mounting using racks and Hexcel material was agreed to by the Joint Test Office, a predecessor of JLON in the late 1990s. This was the preferred method of shock mounting utilized by LANL at the secession of testing. A few of the LLNL trailers have already been modified to utilize this shock mounting system. Many of the trailers have extensive numbers of diagnostic instruments either active or stored within. There are sufficient numbers and types of these trailers and they are serviceable for supporting UGT.

The diagnostics trailers identified and maintained as readiness assets are geographically split between LANL and LLNL. The trailers are located within the North Las Vegas Complex behind Building A-1, on the hill near Building C-3, and at various places on the Nevada National Security Site. Some of these trailers support active missions such as subcritical experiments at the Nevada National Security Site U-1a Complex. At least five of these trailers are available to support the UGT training effort. Two of these have been activated and are used for training and system evaluation. One training and evaluation trailer that was brought “on-line” is Trailer 9188, now set up for a LLNL Reaction History experiment. Setup included checkout and evaluation of over 500 pieces of equipment in this trailer. These trailers are available as a test bed to enhance UGT skills training and assess diagnostics equipment and replacement technologies.

C.2.2.7.9 Underground Nuclear Test Diagnostics Instrument Suites

The Test Readiness team continues to refine the database of over 34,000 diagnostics assets needed to execute a nuclear test. These assets and the post-shot drill back suite constitute the means of verifying a weapon’s actual performance and, therefore, they remain a top-level concern. Completion of co-location of the majority of inactive on-hand diagnostics equipment became a top priority for long-term cost effective management. Final groups of assets were moved from various North Las Vegas and Nevada National Security Site locations and centralized in the Nevada National Security Site Building CP-65, which has been organized as a diagnostics warehouse facility. Within that facility, the equipment has been identified and co-located by type of diagnostic experiment, such as LLNL Reaction History, LANL Neutron Experiment, and LLNL Special Measurements. Approximately half of these assets are non-expendable. Efforts to redistribute or locally excess the non-readiness assets continue. Several pallets in CP-65 are presently awaiting final NSTec Property actions.

A test bed in the A-1 Training room has been established to allow testing of the 260+ diagnostic cathode ray tubes that were stored in CP-65. Test results have indicated about a 30 percent failure rate with enough tubes remaining to support future UGT needs.

APPENDIX D

Physical Infrastructure Updates

APPENDIX D
PHYSICAL INFRASTRUCTURE UPDATES

Chapter 5 explained the activities to modernize and transition the post-World War II and Cold War era nuclear weapons facilities and physical infrastructure to meet future nuclear security enterprise needs. Appendix D provides the project descriptions that support this 25-year SSMP, including new high-priority projects added to the Integrated Priority List since the *FY 2012 Stockpile Stewardship and Management Plan*. Figure 5–2 in Chapter 5 shows the Integrated Priority List of approved and proposed capital construction projects, as well as the associated construction schedules and rough order-of-magnitude costs. This appendix also describes the security and capital equipment projects illustrated in Chapter 5, Figures 5–3 and 5–4, respectively. The projects proposed for funding beyond the FYNSP have not been fully evaluated for requirements or mission need; hence, those may be changed or eliminated as CD-0 approval approaches.

The annual capital-line-item budget is approximately $300 million in constant dollars from FY 2019 to FY 2038. That annual funding excludes capital FYNSP resources dedicated to the Uranium Capabilities Replacement Project (UCRP), formerly the Uranium Processing Facility (UPF). The project is called the UCRP, but the new facility which is a component of that project is still UPF. NNSA determined that mission-critical infrastructure projects can be accomplished more efficiently through a portfolio of non-line-item, expense-funded projects. Some projects in the *FY 2012 SSMP* have been moved to the new Capabilities Based Investment subprogram proposed in FY 2014. The projects that have been moved are noted in the descriptions below.

D.1 Plutonium Facilities

D.1.1 Research and Development

CMRR-NF at LANL. The President's FY 2013 budget request deferred CMRR-NF construction. NNSA plans to phase in capabilities sooner than planned for CMRR-NF by adding equipment in existing infrastructure. NNSA is also evaluating the feasibility of constructing small laboratory modules connected to existing nuclear facilities that could accommodate higher risk plutonium operations in more modern space. The CMRR-NF, or an alternative, project replaces functions of the aged CMR Building with hazard category 2 special nuclear material operations.

D.1.2 Manufacturing

TA-55 Reinvestment Phase II and III Projects at LANL. These projects will help extend the life of PF-4, the multi-purpose plutonium facility, by about 25 years.

- TA-55 Reinvestment Phase II has established a partial baseline (CD-2) and is fully funded. The project includes refurbishment of air dryers and replacement of the uninterruptible power supply, confinement doors, criticality alarms, vault water tank, and exhaust stacks, as well as seismic upgrades to the glove box stands. CD-4 completion is planned for the fourth quarter of FY 2017.

- TA-55 Reinvestment Phase III will update infrastructure systems (*e.g.*, mechanical, electrical, and structural) and modify the active confinement ventilation, replace the fire alarm, and remove other buildings from the TA-55 firewater loop.

PF-4 Manufacturing Process Equipment Upgrades at LANL. This project is not on the Integrated Priority List. The work is being executed and funded through operations resources. The Plutonium Sustainment subprogram would invest in equipment and infrastructure upgrades to increase pit capacity and capability to ramp up the requirements to 10, 20, and 30 pits per year by 2019, 2020, and 2021, respectively. The components of process equipment that have exceeded their end of life must be replaced just to maintain the current base pit manufacturing capability. Construction of the CMRR-NF or an alternative and further improvements to PF-4 are necessary to have a sustainable infrastructure with the inherent capacity to manufacture potentially up to 80 pits per year as early as 2030 to meet long-term needs.

PF-4 to Radiological Laboratory Utility Office Building Tunnel at LANL. NNSA will evaluate design options to build a tunnel that would optimize program operations between PF-4 and RLUOB.

D.1.3 Storage

Materials Staging Facility at the Pantex Plant. This major project would provide a modern, safe and secure staging area near the weapons production area. The existing staging and storage area is remote from the production area, which makes the material transfers between the staging and operations areas exposed, time-consuming, and costly. Although the staging area was constructed to the safety and security standards of the time, significant and costly administration and oversight are now required. By collocating storage and staging with production, the efficiency, security, and safety will increase while operational costs decrease.

D.1.4 Radioactive Waste Disposition

Transuranic Waste Facility TRU [Transuranic] Waste at LANL. Construction funding for this project has been requested for FY 2014. The scope provides for staging, characterization, and shipping and receiving of TRU waste bound for WIPP in Carlsbad, New Mexico. The project will replace solid waste operations performed in Area G, which will be closed in 2015 to comply with the Consent Order between DOE and the New Mexico Environmental Department.

Radioactive Liquid Waste Treatment Facility at LANL. The project will replace the 40-year-old system that processes radioactive liquid waste for the entire site and has diminishing reliability. The scope will upgrade the radioactive waste treatment system and support zero liquid discharge for 15 technical areas, 63 buildings, and 1,800 sources of radioactive liquid waste. The project will maintain a critical capability and provide compliance with current codes and standards, including seismic and electrical ones. The project plan has three phases and includes eliminating discharge of treated liquid to the environment. The project is not yet baselined.

D.1.5 Enabling Infrastructure

Electrical Infrastructure Upgrades at LANL. The project will update electrical systems that are aged, of insufficient capacity, and becoming unreliable. The current capabilities do not support the future LANL mission in a sustainable manner that satisfies NNSA requirements. The project will replace most deficient components of the current system to increase capacity, enhance reliability, increase the efficiency of electrical distribution and transmission systems, and support future needs. Funding is planned in the FY 2015 time frame.

Fire Stations at LANL. This project would replace two fire stations constructed in the early 1950s that are operating beyond their useful life. These are inadequate for assigned fire apparatus and personnel and do not meet current standards; their locations also do not support the required response times.

D.2 Uranium Facilities

Changes to or replacement of these facilities are being planned to modernize Y-12. These include (1) replacement of the aging enriched uranium production infrastructure and (2) consolidation and reduction of the high-security footprint. Modernization of the infrastructure is discussed in Appendix D, Section D.2.2, and reduction in the acreage devoted to high security is discussed in Section D.6.

D.2.1 Research and Development

Applied Technology Laboratory at Y-12. New construction has been proposed for this project to address deficiencies in Buildings 9202, 9203, and 9731. The facilities, each approximately 60 years of age, house R&D services that involve technology solutions and advancements for Y-12 and other nationally important uranium R&D missions. Continued occupancy of these non-code-compliant, aging facilities will increase the risk to the R&D capability and raise operating and maintenance costs.

D.2.2 Manufacturing

Uranium Capabilities Replacement Project (formerly the Uranium Processing Facility [UPF]) at Y-12. The new, approximately 400,000-square-foot facility will replace all of the highly enriched uranium production capability performed in four facilities that have a total square footage of about 850,000 (the area of the four buildings being replaced). The UCRP is designed to improve security, safety, reliability, and efficiency in operations and will substantially reduce annual operating costs. This major project will be executed in three phases, with the performance baseline to be established in FY 2014. Phase I consists of construction of the building structure, all associated support facilities, infrastructure, and utilities as well as the prioritization and equipment installation in the new UCRP of the highly enriched uranium processing currently performed in Building 9212. Phase II involves the highly enriched uranium metal working, machining, and inspection processes that are conducted in Buildings 9215 and 9998. Phase III involves the processes associated with Building 9204-2E (*e.g.*, radiography, assembly and disassembly, quality evaluation, and production certification for weapons secondaries). Highly enriched uranium processing in 9204-2E, 9215, and 9998 will continue until those processes have been transitioned and are fully operational in the UCRP.

Nuclear Facility Risk Reduction at Y-12. The Nuclear Facility Risk Reduction Project will improve the reliability of existing highly enriched uranium processing facilities in Buildings 9212 and 9204-2E until the UCRP is constructed. The process support systems are showing age-related deficiencies that have impacted reliability. The project is in the construction phase and is on schedule and within budget based on the approved baseline. The project forecast closeout (CD-4) is on schedule for FY 2016.

Replacement of Non-Highly-Enriched Uranium Production Facilities at Y-12. Y-12's mission to produce nuclear weapons components is encumbered by a number of aged, oversized, and inefficient facilities that provide non-highly-enriched uranium material and components. Modernization plans call for replacing these facilities with two new facilities, the Lithium Production Facility and the Consolidated Manufacturing Complex. The specifics of each proposed project are as follows:

- **Lithium Production Facility.** This project would replace Building 9204-02, which was built in 1944. Lithium production and related non-nuclear special materials operations are currently performed in that building. The facility has exceeded its useful life and has mechanical and structural problems and increasing deferred maintenance. The project would construct a smaller replacement facility outside the PIDAS. It was previously part of the Consolidated Manufacturing Complex, but because of greater urgency, is now being proposed separately. The funding for the preliminary design is planned to begin in FY 2016.
- **Consolidated Manufacturing Complex.** This major project would replace facilities constructed in the 1940s and 1950s in which production work is performed for depleted uranium, special materials, and general manufacturing to support canned subassembly production. These facilities are deteriorating, are oversized for today's mission, and do not meet current codes and standards. They are costly to operate, have many operational issues, and have exceeded their expected life. As a follow-on to the Lithium Production Facility, the project would consolidate the balance of non-highly-enriched uranium production functions in a smaller, modern facility with greatly reduced annual operating costs.

D.2.3 Enabling Infrastructure

Fire Station at Y-12. This project would replace the 1940s-era fire station, which is confined within the most highly protected area of Y-12, close to enriched uranium and other hazardous operations. The new station would be in a location to assure timely, safe response to all site emergencies and consolidation of all site fire protection operations. This is an approved project, and funding is planned within the next 5 years.

Emergency Operations Center at Y-12. This project would replace the Plant Shift Superintendent's operation and the Technical Support Center that provides onsite emergency response. The current facility was constructed in the 1940s and is not suitable for sustained emergency management support. This is an approved project, and funding is planned within the next 5 years.

Plant Maintenance Facility at Y-12. This project would replace an oversized facility constructed in 1944. The new facility would consolidate satellite maintenance facilities in one modern, efficient location.

Materials Receiving and Storage Facility at Y-12. This project would support consolidation of non-enriched-uranium materials staged in multiple deteriorating buildings and disposition of an offsite, leased facility where the bulk of Y-12 procurements and supplies are received. The new facility would consolidate receipt and storage functions to increase efficiency and reduce annual costs.

D.3 Tritium Facilities

There is no change in the plan for the tritium facilities at SRS, known collectively as Tritium Responsive Infrastructure Modifications (TRIM). The TRIM initiative is a portfolio of independent general plant, operating, and expense projects, plus a line-item project. The site is also evaluating the R&D needs to support future tritium operations in light of a shrinking DOE site budget.

D.3.1 Manufacturing

Tritium Responsive Infrastructure Modifications at SRS. The TRIM portfolio of projects would consolidate tritium operations. The 53-year-old, mission-critical H-Area Old Manufacturing Facility has exceeded its expected useful life and is increasingly inefficient to maintain and operate; about one-third of the facility is no longer used, and it consumes the most energy of any SRS facility. Multiple H-Area Old Manufacturing Facility support systems have deteriorated beyond reasonable repair; other facility systems require significant attention and eventual upgrades to maintain compliance with Federal regulations such as fire protection codes. The projects would replace sustainment of the facility and consolidate and move all H-Area Old Manufacturing Facility operations into newer facilities. TRIM is an approved project and remains well aligned with NNSA's modernization objectives.

H-Area New Manufacturing Risk Reduction at SRS. This project would replace and refurbish tritium processing systems and components. The H-Area New Manufacturing Facility, formerly known as the Replacement Tritium Facility, began production in 1994. Several tritium processing and support capabilities need to be replaced or refurbished. Tritium gas processing requires replacement on an 8- to 10-year cycle. The project would refurbish or replace facility systems or components that require recapitalization.

D.4 High Explosives and Assembly and Disassembly Facilities

High explosives operations occur at the Pantex Plant and other sites. The safety of these operations is of paramount concern. A series of line-item and expense-funded projects have been proposed to refurbish and revitalize the high-explosive and assembly and disassembly infrastructure, as discussed below.

D.4.1 Research and Development

High-Explosives R&D at LLNL. The project would modernize and recapitalize the NNSA High Explosive Research and Development Center of Excellence capabilities. These facilities, which support the high-explosives mission for weapon design and certification, already exceed or are approaching end of life. The project would include retrofitting or replacing the firing tanks, upgrading aging or obsolete control systems and integrated diagnostics, and refurbishing capabilities for synthesis, formulation, pressing, and performance testing. The refurbished facilities would provide core competencies for weapons high-explosives R&D and capabilities to fabricate and process large charges for national security missions.

High-Explosives Special Facility Equipment at LLNL. This project would refurbish or replace equipment, key capabilities, and facilities currently used in the synthesis, formulation, processing, and testing of high explosives. The goal is to recapitalize the experimental capabilities in the intermediate years by maintaining core capabilities to meet mission deliverables and bring maintenance costs to an affordable level.

D.4.2 High-Explosives Production

High-Explosive Pressing Facility Update at the Pantex Plant. This funded project is in the construction phase and is scheduled for completion in FY 2017. It will replace facilities that are deteriorated and often unavailable for production. The new facility will consolidate pressing, initial machining, and magazine storage; it will have a connecting ramp and will improve the safety, quality, and efficiency of operations.

High-Explosive Science Technology and Engineering Facility at the Pantex Plant. The project would construct a new facility to consolidate operations currently located in several aging (40- to 65-year-old) buildings, one semi-permanent trailer, and one laboratory area. These operations support the production-related mission of developing production technologies and manufacturing and testing high explosives. The modern structures will have significantly reduced energy costs and increased operational efficiencies. Funding is planned within the next 5 years.

High-Explosive Formulation Facility at the Pantex Plant. The project would replace 65-year-old buildings to provide operational efficiencies for plastic-bonded explosive production and comply with current safety codes. The Cold War era buildings lack the safety elements needed for explosive operating structures. This project will support booster, detonator, mock, extrudable, and specialty explosives formulation. The upgraded capacity would support future LEPs and lower operating costs.

High-Explosive Component Fabrication and Qualification Facility at the Pantex Plant. The proposed project would replace two facilities that are almost 60 years old and are limiting operations. These facilities are inefficient and unreliable and jeopardize the ability to meet scheduled rates of weapons assembly and dismantlement. The project would construct a consolidated facility with improved environment, safety, and health control, enhanced efficiency, and reduced maintenance.

High-Explosives Packaging and Staging Facility at the Pantex Plant. The project would replace one administrative and three storage magazines for movement of explosives. The storage magazines were built between 1942 and 1966 with less-rigorous design standards; they have deteriorated with age, resulting in reduced explosive limits. The project would construct new magazines to support long-term explosives operations in Zone 11. The new facility would provide operational efficiencies; the current magazines do not have the capacity for high-explosive synthesis, pressing, or formulation.

Inert Machining Facility at the Pantex Plant. This project would house inert parts and fixtures for fabrication operations to test and analyze the NNSA Weapon Surveillance Program. Parts generated from the dismantlement process would also be sanitized in the facility. These operations will support the DSW program, specifically component disposition and stockpile surveillance, in accordance with NNSA requirements. The state-of-the-art facility will be instrumental in developing and maintaining critical skills to support future stockpile surveillance.

Building 12-079 Inert Storage Refurbishment at the Pantex Plant. This proposed project would modernize the inert parts storage facility. Constructed in 1980, the facility will be due for refurbishment in the late 2020s.

D.4.3 Assembly and Disassembly Enabling Infrastructure

These proposed projects would provide subsystem upgrades to support safety, security, and maintenance refurbishment. Chapter 5, Table 5–1, current limitation of capability risk status has changed color from green to yellow due to concerns with the cell and bay subsystems, antiquated equipment technology, and lack of replacement parts.

Fire Protection Building Lead-ins Replacement at the Pantex Plant. The project would replace ductile and cast iron pipe installed between 1979 and 1985 to ameliorate pipe degradation and soil corrosion. It would replace piping into Zone 12 production support buildings and ramps from the High-Pressure Fire Loop up to and including the riser flange, thereby radically decreasing the possibility of failures.

Nondestructive Evaluation Facility at the Pantex Plant. The project would replace a Cold War era building in which explosive limits have reduced productivity and the capability to build, maintain, and retire nuclear weapons. The explosive limits also restrict analytical and scientific capabilities. The new facility would incorporate safety and security enhancements, eliminate administrative controls, and provide mission agility, thereby boosting operational efficiencies and greatly reducing energy costs.

Cells Upgrade at the Pantex Plant. The project would implement various upgrades and repairs to the assembly and disassembly cells (Cells 1 and 8 in Building 12-44 and Cell 4 in Building 12-98) required for nuclear explosive operations. This newly proposed project would also increase cell capacity flexibility by 20 percent.

Zone 11 High Pressure Fire Loop (HPFL) (PTX). This project would restore reliable fire suppression water distribution for the high explosive area at Zone 11. The upgraded HPFL will be designed to provide water at a pressure, flow rate, and quantity to meet the demands of the fire suppression system in each facility. The project proposes to replace the Zone 11 HPFL piping to increase worker safety, avoid operational shutdowns, and preserve capital investments.

Ultraviolet Flame Detection System (for Bays and Cells Support Equipment) at the Pantex Plant. The project has been retitled the Flame Detection System. It was moved to the Capabilities Based Investment subprogram and would be expense funded. It replaces ultraviolet flame detection systems with infrared detectors in weapons assembly and disassembly facilities.

Facility Installed Continuous Air Monitoring Equipment Replacement (for Bays and Cells Support Equipment) at the Pantex Plant. This proposed project has been moved to the Capabilities Based Investment subprogram and would be expense-funded. It has been retitled the “Radiation Alarm Monitoring System.” The project will replace tritium and alpha sensors that are no longer supported or fabricated by the manufacturers.

Buildings 12-005C (12-035/12-068) Shops Replacement at the Pantex Plant. This project would replace the three shops that support various organizations in design, fabrication, and installation phases and are at the opposite end of the site from the operating facilities inside the secure area. The project would relocate and consolidate the shops into one shop.

D.5 Non-Nuclear Component Facilities

D.5.1 Research and Development

Radiation-Hardened Integrated Circuits Microelectronics Trusted Foundry at SNL. Building 858N is the only “trusted foundry” for radiation-hardened silicon chips for nuclear weapons. This major proposed project would construct and equip the replacement for 858N, which is too small for the next-generation tool size, weight, and process equipment. The tooling is obsolete and no longer supported by industry, so no spare parts for tooling exist.

D.5.2 Manufacturing

KCRIMS project at the Kansas City Plant. As part of the strategy to provide a smaller, more-efficient nuclear security enterprise, NNSA is leasing a new manufacturing facility for the Kansas City Plant, through the General Services Administration. Personnel and equipment relocation and installation activities are under way from the Kansas City Plant’s Bannister Federal Complex to the recently constructed Kansas City Plant National Security Campus (KCPNSC) as part of the KCRIMS project. The KCPNSC is under a 1.5-million-square-feet LEED Gold-certified facility. Full operations and occupancy are projected for FY 2014.

D.6 Special Nuclear Material

D.6.1 Transportation

The STA Program safely and securely transports nuclear weapons, weapons components, and special nuclear material to meet DOE, DoD, and other customer requirements. The program has numerous facilities and infrastructure that must be maintained. No capital construction projects are planned at this time.

D.6.2 Security Protection

The Defense Nuclear Security Program protects NNSA personnel, facilities, nuclear weapons, and information from a full spectrum of threats, especially terrorism. The Construction Program includes projects to support the safeguards and security mission of the nuclear security enterprise.

Security Protection – Plutonium

- **Nuclear Materials Safeguard and Security Upgrades Project Phase II at LANL.** Phase II in TA-55, scheduled for completion in the first quarter of FY 2014, will provide an effective, robust, physical security system to address the 2005 Design Basis Threat, protection strategies, and security requirements.
- **Protective Force Portal Upgrade and Enhancement at the Pantex Plant.** This project provides upgrades to the access and egress protective force stations and portals in order to maintain an effective security operation. The scope includes facilities and equipment to control personnel during access and egress, conduct contraband searches, house new equipment to enhance both personnel and vehicle search activities, and provide life-cycle replacement of access control equipment.
- **Device Assembly Facility Argus at NNSS.** This project will install Argus security system, an interconnected, computer-based personnel access system adopted by DOE and NNSA as the standard security technology for the nuclear security enterprise. Argus will provide integrated intrusion detection, alarm monitoring, and access control. The Argus will replace the aging Process Equipment and Control System (PECOS) in the Device Assembly Facility.

Security Protection – Uranium

- **Security Improvement Project at Y-12.** A new security system will be installed to manage and integrate personnel security and access control systems at existing facilities (*e.g.*, the Highly Enriched Uranium Materials Facility, vault type rooms, and the Y-12 Visitors Center). Argus will provide integrated intrusion detection, alarm monitoring, and access control and will enhance the Central Alarm Station and Secondary Alarm Station. The project, which is under construction with a baseline completion in June 2014, is ahead of schedule with a forecasted completion of June 2013.
- **West-end Protected Area Reduction at Y-12.** This West-end Protected Area Reduction initiative, a UCRP subproject, would construct an interim system of physical barriers and electronic sensors to reduce the 150-acre PIDAS to 80 acres. The project is currently under design to streamline site accessibility during UCRP construction.

- **Protected Area Reduction Project at Y-12.** This project has been eliminated and replaced with three standalone projects. These projects will support the final reduction of the Protected Area from 80 to 20 acres and are linked to full-scope operations at the UCRP.
- **PIDAS Sensor Modernization at Y-12.** This project would replace sensor systems that have been in operation for about 30 years, but are in an area of PIDAS with an anticipated life of an additional 50 years. The project would also reorient the direction of the sensor fields to provide maximum effectiveness for the location of future special nuclear material facilities.
- **Central Alarm Station Relocation at Y-12.** The Secondary Alarm Station is in a 67-year-old building that requires costly upgrades for safety, fire protection, and environmental protection. This proposed project will terminate Secondary Alarm Station operations in Building 9710-2, an aging facility with numerous challenges, and ensure the Central or Secondary Alarm Station is inside the smaller-footprint protected area when Y-12 removes the Area 5 facilities. The project will also eliminate certain adversarial scenarios, thereby providing for Protective Force staff reduction. The scope of the UCRP includes construction of a highly protected, long-term, underground location for alarm and access-control management. The Central Alarm Station Relocation Project would establish Argus operations in that new location, transfer Central Alarm Station activities to the new location, and relocate the Secondary Alarm Station operations.
- **Entry Control Facilities at Y-12.** This project proposes new Entry Control Facilities to replace the Protected-Area access points constructed in the mid-1980s. These access points are already beyond their optimum life-span, and access points constructed during implementation of the Graded Security Program will be at the end of their expected life in about 2025. This project will be executed when UCRP Phases II and III are implemented. The new pedestrian and vehicle access points will be capable of meeting requirements at much-lower maintenance costs during the life of the Highly Enriched Uranium Materials Facility and UCRP.

Security Protection – Weapons Assembly and Disassembly

- **Zones 4 and 12 PIDAS Refurbishment at the Pantex Plant.** This proposed project would replace security systems that have been in service for more than 10 years and are reaching technological obsolescence, resulting in a lack of available parts and supported software and a decrease in the maintainability and reliability of the systems. The project is being considered by the Defense Nuclear Security Program; the decision on the project would be made in the post-FYNSP period.
- **Protective Force Portal Upgrade and Enhancement Project at Pantex.** This proposed project would upgrade and enhance the access and egress Protective Force Stations and Portals to maintain an effective security operation. The project is being considered by the Defense Nuclear Security Program, but no decision has been made to date.

D.7 Design, Certification, Experiments, and Surveillance Facilities

D.7.1 Potential Infrastructure Modernization

Proposals for design, certification, experiments, and surveillance facilities are based on infrastructure modernization and are in two categories. The first category is primarily site specific and intended for initiation within the next decade. The second category, Large Science and Technology Tools, is a projection of stockpile requirements to the post-2020 period and would be a major system acquisition. All of these items are part of the Integrated Priority List found in Chapter 5, Figure 5–2, and the nominal schedules and costs for security and capital equipment projects shown in Figures 5–3, and 5–4.

Exascale at Multiple Locations. This project would provide the Nation with the next generation of extreme-scale computing capability to solve important problems in energy, the environment, national security, and science. The two NNSA sites being considered for this advanced computing capability are LANL and LLNL, using operating resources in the post-FYNSP budget.

Silicon Fabrication Recapitalization at SNL. This project would be expense-funded retooling, equipment, and infrastructure work in the silicon fabrication facility to extend the process life (*e.g.*, wafer technology) by 10 to 15 years.

Enhanced Radiography Equipment Capability at the Nevada National Security Site. The existing Cygnus dual-axis radiographic source is not sufficient in penetrating power for some future plutonium experiments as currently conceived. This expense-funded project proposes to implement an upgrade capability to the radiography systems and infrastructure in FYs 2014–2018.

Test Capabilities Revitalization Phase II at SNL. This project is funded and in the construction phase. The project supports the B61 LEP first production unit and provides the environmental infrastructure to evaluate the nuclear explosives package and the non-nuclear and systems engineering for the W78 and W88 LEPs. Project completion is expected in FY 2014.

Energetic Materials Characterization at LANL. This project would provide modernized, reliable, and efficient infrastructure for energetic material operations and critical surveillance and safety capabilities related to nuclear stockpile and homeland security needs. The project would replace several facilities that are more than 50 years old, are obsolete, require excessive maintenance, and cannot be configured to accommodate requirements.

LEP and Warhead Assessment Revitalization at LLNL. The project would refurbish critical equipment to support the B61, cruise missile warhead LEP, and W78/88-1 LEP warhead development programs as well as annual assessment and certification activities. The equipment is unique and will require revitalization through a 4- to 5-year recapitalization program.

Weapons Engineering Facility at SNL. This project would replace five buildings totaling 300,000 square feet that have poor operational reliability with a new, centralized 200,000-square-foot facility that has high security and updated computing technology and will support weapons activities, including surveillance and power source (batteries) work.

Research Reactor Facility at SNL. This newly proposed project would accommodate the Annular Core Research Reactor in a safer, more secure, more productive facility. The 50-year-old building was not designed to house a reactor, but was retrofitted some years later. The reactor is currently safe and operational, but the risk of long-term or permanent closure will increase with time because of the possibility of facility failure, a safety incident, a change in requirements, or regulatory noncompliance. The existing fuel elements (unique and perhaps irreplaceable UO_2BeO elements) would be transferred to the new facility.

Weapons Manufacturing Support Facility at LANL. This project would consolidate facilities to provide reliable, safe, effective machining and fabrication for non-nuclear weapon components. The smaller facility would reduce the financial burden and provide support to LANL missions that are not currently available.

Mission Support Science and Technology Laboratory at SNL. This project would integrate existing and emerging science and technology with the DSW program. Construction of this new laboratory would support core products for the power systems of gas transfer systems and surety systems, as well as stockpile surveillance, annual assessments, and SFIs. The current facility housing these capabilities is aging and has seismic deficiencies.

Weapons Engineering Science and Technology at LLNL. This project would consolidate and modernize 1950s-era core weapons engineering buildings. These facilities, which support weapon design, engineering, and evaluations, are past their useful life and require replacement or refurbishment to provide an integrated, cost-effective infrastructure for mission-critical activities. The existing facilities have an increasing maintenance backlog (and hence increasing operational costs), as well as seismic deficiencies and legacy contamination (*i.e.*, beryllium). The consolidated and modernized facilities would have a reduced footprint. The proposal will include the cost to deactivate and decommission the vacated space.

Modern Threat Abeyance Center at SNL. The project would contribute to protecting DOE assets from emerging threats, including terrorism. The proposed new facility and staff would be dedicated to quick, thorough technical response to identified threats against the stockpile and other nuclear assets. This new project would construct laboratory, office, and multi-purpose space, including light laboratories, applications test facilities, engineering and materials sciences laboratories, weapon component integration laboratories, and the enabling information infrastructure.

Matter-Radiation Interaction in Extremes (MaRIE) at LANL. The three national security laboratories developed an Experimental Facilities Roadmap to describe the relationship among mission objectives, scientific and technical capability needs, and future experimental facilities to meet those needs. The roadmap identifies the gaps in the ability to sustain the stockpile over the coming decades. The national security laboratories submitted proposals to the Stockpile Stewardship Program for consideration in the "Large Science Tools" competition. The MaRIE proposal was determined to close the identified gaps and was selected for further development. MaRIE will support key NNSA goals to understand the condition of the stockpile and extend the life of warheads. Defense Programs plans to pursue CD-0 for MaRIE in FY 2013.

Seismic Rehabilitation at LLNL. LLNL is located in a seismically active region; there is a high probability of one or more earthquakes of magnitude 6.7 or greater in the next 30 years. LLNL conducted a comprehensive seismic evaluation of its entire facility inventory and determined that seismic rehabilitation is needed for about 60 buildings that do not meet "life safety" standards. This project would rehabilitate 10 to 15 of the most seismically deficient buildings by providing upgrades essential to continuing operations in mission-critical facilities.

Robust Secure Communications Laboratory at SNL. This new project would invest in the science and engineering of the nuclear security enterprise with the goal of protecting DOE critical systems from exploitation or failure. The project would construct a facility to meet the substantial challenges associated with providing secure communications and hardware.

Gravity Weapons Certification at SNL. The equipment and infrastructure used to capture data and support flight test operations at the Tonopah Test Range are aged and obsolete and require constant, proactive maintenance. This project would maintain the capability to validate the performance of gravity nuclear weapons from development through surveillance to support NNSA and Air Force requirements. The proposal provides several options for repairs, refurbishment, and upgrades to roads, the power grid, facilities, and equipment associated with this capability.

Consolidated Environmental Test Facility at SNL. This newly proposed project would replace the 1950s-era Buildings 860 and 865, which have mechanical, electrical, and structural systems that are inefficient to maintain and operate and beyond their useful life. The buildings do not meet current seismic or accessibility codes. The multiple environmental test capabilities housed in the facilities are unique and necessary for weapon component and stockpile certification. The project would consolidate and collocate related activities so staff can improve testing operations and reliability.

Materials Science Modernization at LLNL. This proposed project would provide a materials research complex and modern infrastructure for materials fabrication, characterization, and testing in support of LLNL's national security mission.

Nuclear Security Applications Facility at LLNL. This project would construct a facility dedicated to nuclear threat countermeasures. LLNL nuclear forensics provides mission critical support to a variety of missions, notably including nuclear nonproliferation, nuclear counterproliferation, and nuclear counterterrorism (pre-detonation, post-detonation, and interdicted device forensic analysis), as well as environmental programs. The ability to provide the requisite world-class forensics support is severely hampered by the aging infrastructure of existing LLNL facilities (including but not limited to Building 151).

D.7.2 Enabling Infrastructure

Device Assembly Facilities Lead-in Piping at the Nevada National Security Site. This project would remediate 20 years of galvanic and microbial corrosion that has decreased the fire-suppression lead-in pipe's thickness by up to 80 percent. The project has been transferred from Defense Programs to the new Office of Infrastructure and Operations. The project will be expense funded.

Emergency Operations Center at SNL. The Emergency Operations Center has numerous operational difficulties, including: no radio communications with the City of Albuquerque Fire Department; one line of communications with the City of Albuquerque Police Department; a need to support central alarm stations and secure communication lines; no place to hang Level-A personal protective equipment suits; no garaging for emergency response vehicles; and the inability to store self-contained breathing apparatus in vehicles. This project would consolidate personnel and equipment to improve the emergency response capability and response time. The current Center is within the TA-1 primary exposure zone; as such, in some events, Center personnel would have to "shelter in place" rather than respond. The project would therefore relocate the Emergency Operations Center outside the "Zone of Exposure" in TA-1.

Emergency Operations Center at LLNL. This project would replace the current temporary Emergency Operations Center in Building 490, which does not meet California or national standards or DOE requirements for such a facility. The Emergency Operations Center is collocated within a large, unsecure building that creates operational, safety, and security risks. The proposal is to construct a facility with office space, a media center, communications, and an alarm monitoring and dispatch center.

Communications Systems Improvements at the Nevada National Security Site. This project would address elements of the telecommunications and information technology infrastructure for the Nevada Site Field Office that are suffering from technological obsolescence and limited capacity.

Data Center Consolidation at the Nevada National Security Site. This project has been removed from the Integrated Priority List.

Mission Support Consolidation at SNL. This proposed project would replace and consolidate facilities that are over 40 years old, as well as temporary structures that house executive management and support services personnel.

Receiving and Distribution Center at LANL. This proposed project would replace an obsolete 60-year-old facility that requires excessive maintenance and repair, is in an inappropriate location, and has inadequate seismic strength.

Obsolete Office and Light Laboratory Building at LANL. This proposed project would support relocation of over 1,500 staff who are in temporary, aged trailers and transportable structures. These structures will not support ongoing and future missions in a sustainable manner. The project would construct an efficient, flexible office facility with quality space utilization that meets modern sustainability and energy-saving mandates and standards.

Reshaping the NNSA Albuquerque Campus (formerly, Reshape SNL/New Mexico TA-1). This project is no longer on the Integrated Priority List because funding assumptions changed and did not rank high enough. The project will be deleted from the next edition of the SSMP. This proposed project would reduce the security area, fencing, and TA-1 footprint at SNL by reshaping the boundary and entries and relocating the gate to Kirtland Air Force Base.

Electrical Reliability and Distribution at LLNL. The proposed project would update the power system, which lacks the capacity and reliability to meet forecasted loads, as well as the open campus capability, beyond FY 2014. LLNL facilities are vulnerable to power disruptions, especially at the National Ignition Facility and the Terascale Facility. The project would install a new, additional external electric utility power source, a main power substation, and other systems. Transmission lines would be moved underground.

Livermore Valley Visitor Center at LLNL. This project is no longer planned as a line-item construction project. It would construct a visitor center as a transformational element in the Livermore Valley Open Campus. Visitors would be greeted and screened in a central facility with common areas shared by all Livermore Valley Open Campus facilities. The project would be a major component of the Livermore Valley Open Campus effort to provide collaboration among laboratory, Federal, state, local, and industrial partners. The scope, cost, and method for funding this effort are in the preconceptual stage.

APPENDIX E

Site Workforce Data

APPENDIX E
SITE WORKFORCE DATA

The data in this appendix was collected from the national security laboratories, nuclear weapons production facilities, and the Nevada National Security Site. The sites used data from the end of FY 2012 as a base and developed their projections to reflect the FY 2014 FYNSP, using the Common Occupational Classification System to provide a standard characterization of the workforce. Each site provided a description of their mission, M&O workforce summary profile, gains and losses in essential-skills positions over the last 5 years, workforce projections for essential skills, and a narrative of their M&O workforce outlook.

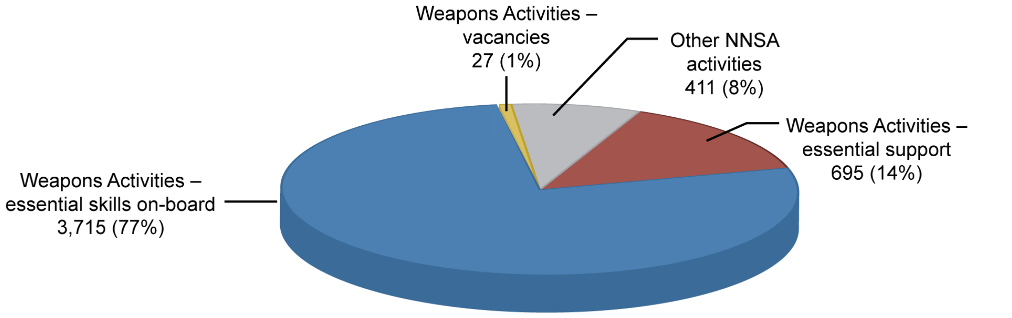
E.1 Los Alamos National Laboratory

M&O Contractor: Los Alamos National Security, LLC

E.1.1 Mission

LANL conducts research in the design and development of nuclear weapon components; designs and tests advanced technology concepts; provides safety, security, and reliability assessments and certification of stockpile weapons; maintains production capabilities for limited quantities of plutonium components (pits) for delivery to the stockpile; manufactures nuclear weapon detonators for the stockpile; and conducts tritium R&D, hydrotesting, high-explosives R&D, and environmental testing. LANL will be a Center of Excellence for Nuclear Design and Engineering and the Center of Excellence for Plutonium. Moreover, its mission is enhanced by being a supercomputing platform host site and by its plutonium pit production R&D using TA-55, which will include eventual use of the CMRR-NF or an alternative, detonator production and contained high-explosives R&D, DARHT for world-class hydrodynamic testing, LANSCE for nuclear and materials research, and materials research using the proposed Matter-Radiation Interaction in Extremes Facility (aka MaRIE) as a potential science magnet.

E.1.2 Los Alamos National Laboratory Management and Operating Contractor Workforce Summary Profile

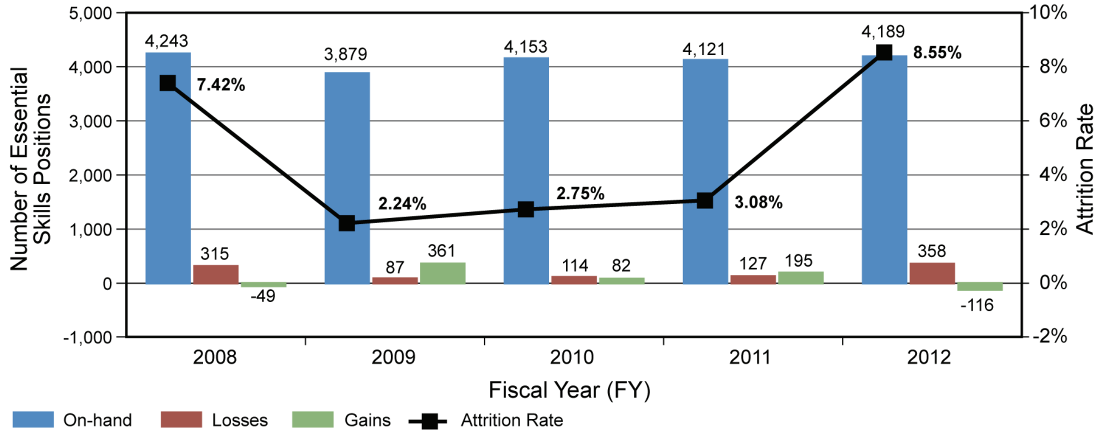


Total NNSA Weapons Activities positions planned at Los Alamos National Laboratory – 4,848.

- Beginning in fiscal year 2013, Los Alamos National Laboratory's total management and operating workforce consisted of 7,605 positions.
- 4,410 positions, 91 percent, supported the Defense Programs Weapons Activities.
- The workforce includes career, limited-term, and laboratory associate employees. Students and postdoctoral fellows were not included.

Figure E–1. Los Alamos National Laboratory NNSA management and operating contractor workforce in fiscal year 2013

E.1.3 Los Alamos National Laboratory Management and Operating Contractor Gains and Losses over the Last 5 Years



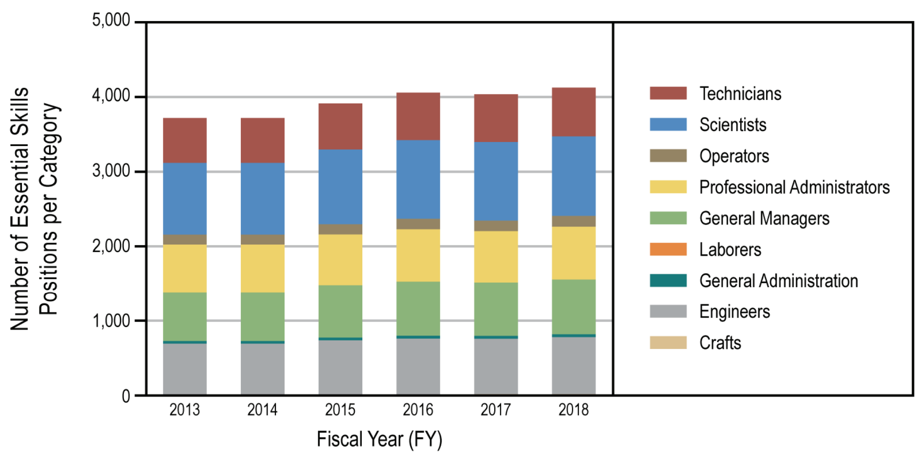
- Attrition rates have fluctuated over the past 5 years, averaging about 4.8 percent, comparable to other research laboratories.
- Attrition rates for the scientific and engineering workforce have been similar to those of the overall workforce.
- The overall workforce has changed over the past 5 years, from 4,243 positions in FY 2008 to 4,189 positions in FY 2012.
- There has been an emphasis on hiring scientists and engineers, increasing from 1,639 positions in FY 2008 to 1,812 positions in FY 2012.

Note: Los Alamos National Laboratory employees are organized according to a matrix based on programmatic needs. Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions.

The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure E–2. Los Alamos National Laboratory NNSA management and operating contractor gains and losses in essential-skills positions over the last 5 years

E.1.4 Los Alamos National Laboratory Management and Operating Contractor Workforce Projections for Essential Skills



- Reflects Los Alamos National Laboratory essential-skills workforce projections for FY 2013 through 2018. These projections are categorized by occupational series using DOE's Common Occupational Classification System.
- Based on recent budget information, the weapons activities essential-skills workforce will increase from 3,715 in FY 2013 to just over 4,180 by FY 2018.
- The scientists, engineers, and technicians workforce will increase in FY 2014 to 2,353 to approximately 2,538 by FY 2018.

Figure E–3. Los Alamos National Laboratory NNSA management and operating contractor workforce projections for essential skills

E.1.5 Management and Operating Contractor Workforce Outlook

Overall retention of employees at LANL is not an issue at this time. LANL has a good retention rate for its career employee population and a better retention rate for employees supporting weapons activities with essential skills. Historically, LANL has been able to recruit and replenish the workforce considered essential to Defense Programs.

However, projections over the next 5 years indicate the need to replace approximately 600 scientists, engineers, and technicians to support weapons activities. Some essential-skills areas, such as nuclear design and evaluation, underground experimentation, threat reduction, lasers, pulsed power, and accelerators, are expected to lose over 40 percent of their current population within the next 5 years. These essential-skills areas, along with computer and computational sciences, computational physics, and high-performance computing, are long-term vulnerabilities.

LANL's ongoing efforts to hire and retain employees with essential skills cover a broad range of programs and initiatives. LANL has formed several institutes, each with a partner university or a consortium of universities. LANL sponsors extensive workforce development "pipeline" education programs for students and postdoctoral researchers. The internal pipeline is used to ensure employees with the essential skills are developed to meet future needs. Seventy-one percent of all new R&D staff hires and conversions in the last 5 years have been from the internal pipeline (students, postdoctoral fellows, and limited-term employees). Fifty-three percent of all current R&D employees were at one time students or postdoctoral fellows at LANL.

With the exception of the areas mentioned in the second paragraph above, such as computational and nuclear design scientists, LANL's recruitment strategies and internal pipeline have been effective. Recent strategies in recruiting and expedited hiring practices have improved LANL's ability to hire support engineers; however, because of the time required to learn the job and the competition for employees with computer and computational skills, recruiting computational and nuclear design scientists will continue to be a challenge.

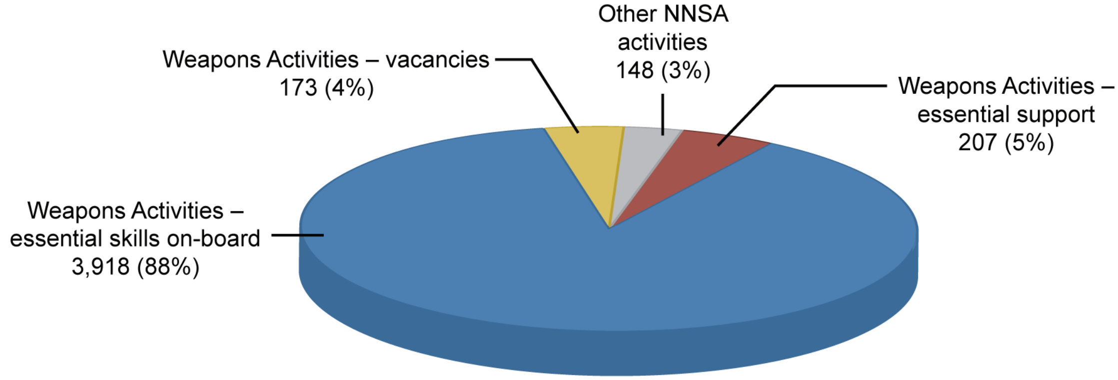
E.2 Lawrence Livermore National Laboratory

M&O Contractor: Lawrence Livermore National Security, LLC

E.2.1 Mission

LLNL conducts research in the design and development of nuclear weapon components; designs and tests advanced technology concepts; provides safety, security, and reliability assessments and certification of stockpile weapons; conducts nuclear threat reduction and nuclear counterterrorism R&D and emergency response; and conducts nonproliferation R&D and support. LLNL has a variety of specialized experimental capabilities including plutonium R&D, tritium, radiochemistry, high-explosives R&D, hydrotesting and environmental testing of weapons systems with high explosives, and special nuclear materials. LLNL is a Center of Excellence for Nuclear Design and Engineering, as well as NNSA's Center of Excellence for High-Explosives R&D. In addition, LLNL maintains one of the Nation's premier high-performance computing capabilities and the National Ignition Facility in support of the mission of the Stockpile Stewardship Program. These capabilities, together with LLNL's high-explosive facilities, serve as mission-aligned science magnets for attracting the next generation of stockpile stewards.

E.2.2 Lawrence Livermore National Laboratory Management and Operating Contractor Workforce Summary Profile

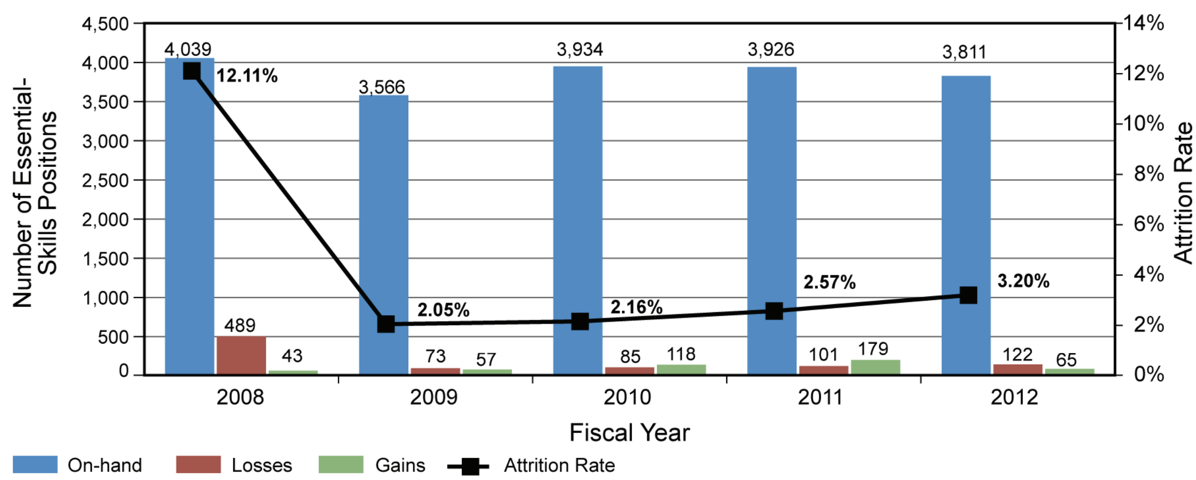


Total NNSA Weapons Activities positions planned at Lawrence Livermore National Laboratory – 4,446.

- 4,125 positions, 93 percent of the positions, support Defense Programs Weapons Activities.

Figure E–4. Lawrence Livermore National Laboratory NNSA management and operating contractor workforce in fiscal year 2013

E.2.3 Lawrence Livermore National Laboratory Management and Operating Contractor Gains and Losses over the Last 5 Years

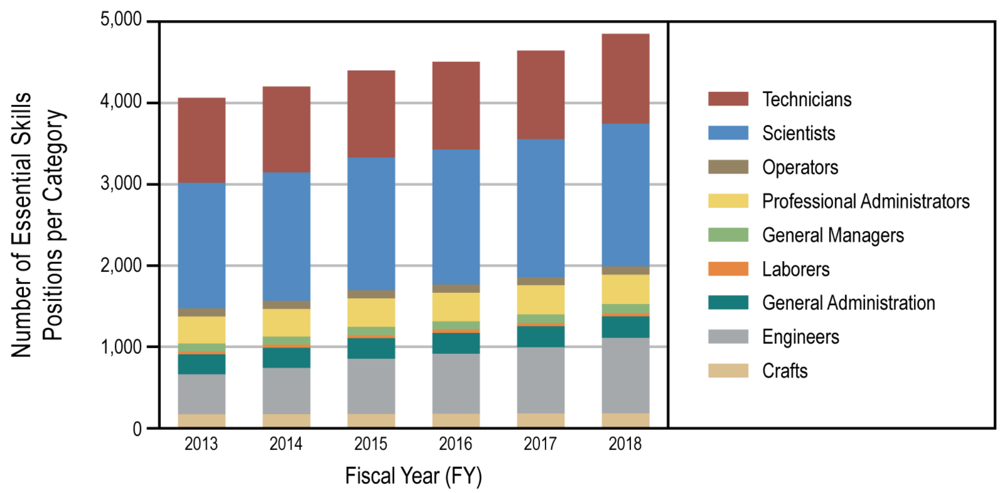


- Attrition rates have remained relatively stable over the last 4 years.
- Attrition rates for the scientific and engineering workforce are consistent with that for the overall workforce.
- The workforce has declined slightly over the past 5 years, from 4,039 positions to 3,811.
- Over the past 3 years, there has been acceleration in hiring scientists and engineers, from about 1,670 in FY 2009 to about 1,965 at the end of FY 2012, to meet anticipated workload requirements stemming from the W78 Life Extension Program

Note: *Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.*

Figure E–5. Lawrence Livermore National Laboratory NNSA management and operating contractor gains and losses in essential-skills positions over the last 5 years

E.2.4 Lawrence Livermore National Laboratory Management and Operating Contractor Workforce Projections for Essential Skills



- Lawrence Livermore National Laboratory projections have the essential-skills workforce gradually growing over the next 6 years.
- The scientist workforce, in particular, will increase from the current level of about 1,492 positions to a peak of about 1,812 in FY 2018.

Figure E–6. Lawrence Livermore National Laboratory NNSA management and operating contractor workforce projections for essential skills

E.2.5 Lawrence Livermore National Laboratory Management and Operating Contractor Workforce Outlook

LLNL's highly skilled and dedicated workforce is its most valuable asset. Every effort is made to ensure that staff with the required skills are being developed and retained. The opportunity to address difficult problems of national importance with state-of-the-art tools and facilities is expected to continue drawing talented people to LLNL. Currently, the LLNL has the skilled workforce necessary to meet the needs of the weapons program.

LLNL has a tremendously skilled, valuable, and committed workforce that is carefully managed to ensure the skill mix necessary to achieve mission objectives. As the arena is highly competitive, constant effort must be made to attract and retain a qualified workforce. LLNL relies on healthy programs, Laboratory Directed Research Development, and postdoctoral initiatives to help attract the best and the brightest to the Laboratory. Other factors—including old facilities, non-value-added safety and security requirements, compensation that is not commensurate with industry standards, and restricted travel—offer challenges in the recruiting and retention of LLNL's ST&E workforce. LLNL continues to be concerned about the following:

- The ability to hire high quality individuals
- The potential for increased non-retirement attrition rates among the early and mid-career staff who are responsible for execution of the bulk of the program and have skills knowledge and attributes that are still broadly marketable
- Retention of retirement-eligible individuals

The Stockpile Stewardship Program remains extraordinarily successful in developing the tool set required to maintain the stockpile in the absence of testing and using those tools, to train the next generation of stockpile stewards. The program was specifically designed to maintain the skills necessary in the absence of nuclear testing. The Stockpile Stewardship Program's aboveground experimental facilities, such as the National Ignition Facility, High Explosives Applications Facility, Contained Firing Facility, and JASPER at the Nevada National Security Site, provide data required for stewardship. In addition, these facilities provide LLNL's weapons designers with opportunities to carry out complex, integrated physics experiments that hone designer judgment as issues are investigated or potentially new phenomena are revealed. Designer judgment is developed through computational simulation and constitutive and integrated experiments. Ensuring the LLNL staff has access to the world's leading computational resources, up to and including exascale-level high performance computing, is key not only to attracting the best and brightest, but also to maintaining this critical judgment in the absence of nuclear testing.

The involvement of the LLNL workforce in the annual assessment process for the stockpile provides a basis for developing and exercising the judgment of new nuclear weapons staff in dealing with difficult issues related to nuclear design and engineering, in much the same way that development of nuclear weapons and underground testing did. Participation in the Independent Nuclear Weapons Assessment Process has empowered LLNL staff to take a deeper look at a broader range of stockpile systems and to improve their analysis skills through in-depth technical peer review. The assignment of the W78/88-1 LEP to LLNL provides an essential path for maintaining the competency and capability of LLNL's cadre of designers and engineers through the exercise of an integrated system design, engineering, and manufacturing program. Because of the success of the Stockpile Stewardship Program and the continual involvement of personnel in maintaining the enduring stockpile, risks associated with the eventual condition when no weapon designers will have designed, tested, and deployed a new weapon are minimal.

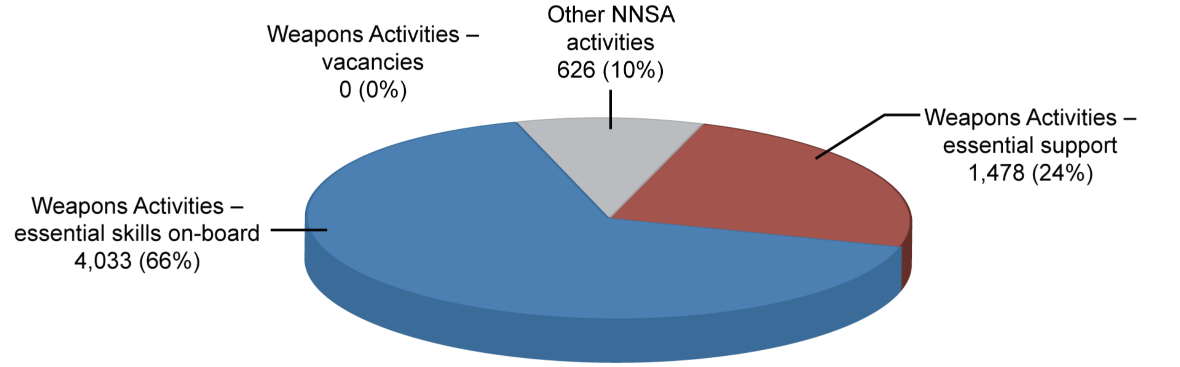
E.3 Sandia National Laboratories

M&O Contractor: Sandia Corporation

E.3.1 Mission

SNL conducts systems engineering of nuclear weapons; performs research, design, and development of non-nuclear components; manufactures non-nuclear weapons components (including neutron generators for the stockpile); provides safety, security, and reliability assessments of stockpile weapons; and conducts high-explosives R&D and environmental testing. SNL will be the Center of Excellence for Non-Nuclear Design and Engineering and the Center of Excellence for Major Environmental Testing. SNL's mission will be enhanced by (1) using the Microelectronics and Engineering Science Applications Complex as an engineering magnet, (2) conducting major weapons environmental testing using TA-3 and other New Mexico facilities, (3) performing energetic devices R&D using the Explosives Test Facility, and (4) using its neutron generator design and manufacturing facilities.

E.3.2 Sandia National Laboratories Management and Operating Contractor Workforce Summary Profile

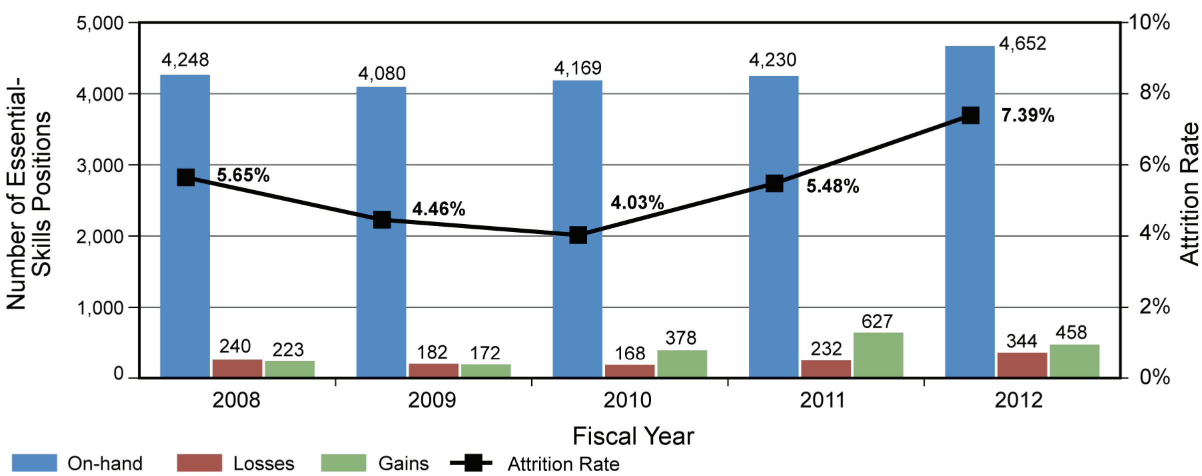


Total NNSA Weapons Activities positions planned at Sandia National Laboratories – 6,137.

- The Defense Programs Weapons Activities totals 5,511 positions; 90 percent of the NNSA workforce at Sandia National Laboratories.

Figure E–7. Sandia National Laboratories NNSA management and operating contractor workforce in fiscal year 2013

E.3.3 Sandia National Laboratories Management and Operating Contractor Gains and Losses over the Last 5 Years



- Attrition rates across the weapons activities workforce have averaged 5.3 percent for the last 4 years.
- Attrition rates for scientists and engineers are consistent with the overall nuclear weapons workforce.
- From FY 2008 through FY 2010, the workforce declined from 4,248 to approximately 4,169. There was an increase in FY 2011 to 4,230, followed by an additional increase to 4,652 in FY 2012.
- Over the past 3 years, there has been acceleration in hiring of scientists, engineers, and technicians to meet workload requirements associated with stockpile modernization activities such as the B61 Life Extension Program and the W88 Alteration.

Note: Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure E–8. Sandia National Laboratories NNSA management and operating contractor gains and losses in essential-skills positions over the last 5 years

E.3.4 Sandia National Laboratories Management and Operating Contractor Workforce Projections for Essential Skills

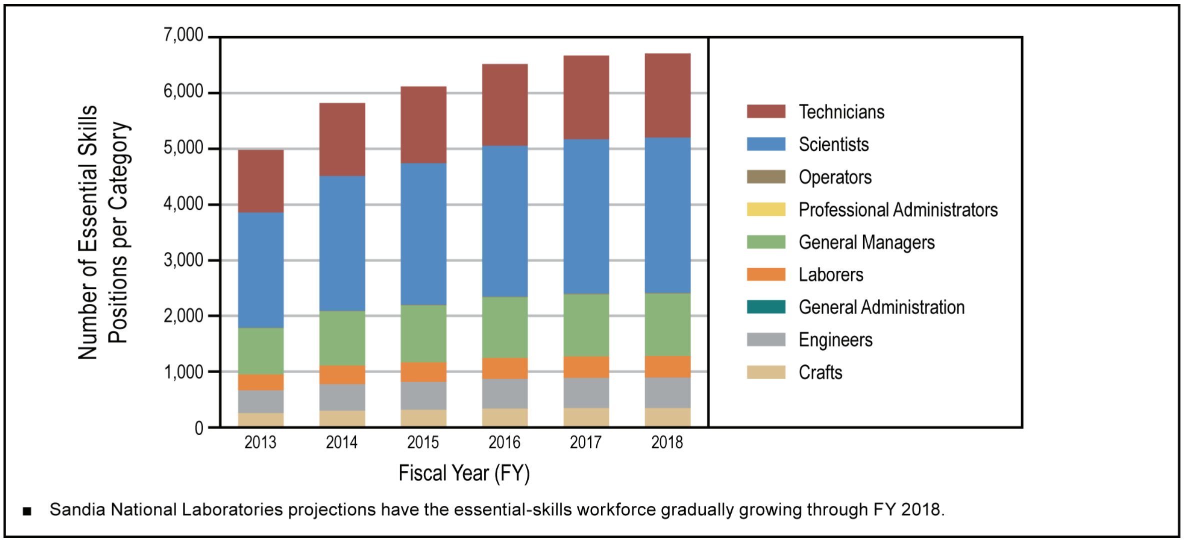


Figure E–9. Sandia National Laboratories NNSA management and operating contractor workforce projections for essential skills

E.3.5 Sandia National Laboratories Management and Operating Contractor Workforce Outlook

SNL uses many programs and approaches to recruit, develop, and retain the workforce to support its mission needs. SNL's approach to managing the workforce begins with the Integrated Workforce Management Process, which drives a comprehensive self-evaluation of multiple factors, *e.g.,* competency review, organizational structure and span of control, talent management, and workforce composition. From this action, the annual Workforce Acquisition Process is used by organizations to complete 2-year tactical workforce projections, as well as to identify long-term strategic needs.

The Workforce Acquisition Process drives SNL's hiring plan for the near term, based on projected retirements, voluntary separations, and work needs. This detailed workforce planning is a direct input to SNL's recruiting process and program. The information sizes the recruiting effort and shapes the demand for off-campus, early career, and highly experienced hires. The Workforce Acquisition Process creates linkages between revenue and cost projections and mission execution, thereby driving SNL's strategic and tactical workforce planning. By aligning these actions with anticipated work, SNL increases its focus on hiring to meet mission needs and provides a roadmap to track progress. Hiring performance to the workforce plan is tracked, and projections are reviewed and updated quarterly to reflect changes in the business environment, *e.g.,* more or less growth than projected, or more or less attrition than projected.

Long-term strategic needs input is used by SNL organizations to consider emerging skill sets or future challenges. This information may result in the development of new educational or pipeline programs, as well as the targeting of new skills that can be integrated into the SNL workforce to meet future mission needs. These programs include the Masters Fellowship Program, a strategic recruiting program to attract and retain key talent, and the Critical Skills Masters Program. Other pipeline programs include the Center for Cyber Defenders and the Student Intern Program. These programs leverage the workforce plan as insight into future skill sets. SNL also participates in targeted recruiting events such as on-campus recruiting, technical talks with students, and specific industry hiring programs, such as Supercomputing-10 for computer engineering.

SNL seeks to hire top talent, and there is always more demand than supply in all technical disciplines. This pool of available talent is further reduced by the requirement for U.S. citizenship. Consequently, competition for candidates in virtually all science and engineering disciplines is significant. When looking at computer engineers and scientists, for example, it is likely that SNL alone would have sufficient demand to hire most of the available top talent who are U.S. citizens. SNL, as well as the other national security laboratories, is competing head-to-head with other high-profile companies such as Google, Microsoft, and Intel for this talent. This supply and demand situation increases the cost of these skill sets, and other factors such as geography, cost of living, and location fit rise in importance for the applicant.

As SNL prepares to engage a new generation of staff, it is important to acknowledge that students are taught that they will have five to seven careers versus the single career of past generations. This predisposition increases pressure on comparability between competing value propositions and challenges the traditional national security laboratory paradigm that employees will stay for an entire career. Therefore, SNL expects to see increasing pressure on retention of those nuclear weapons skill sets that may take 15 years to develop and train. This will be a long-term challenge.

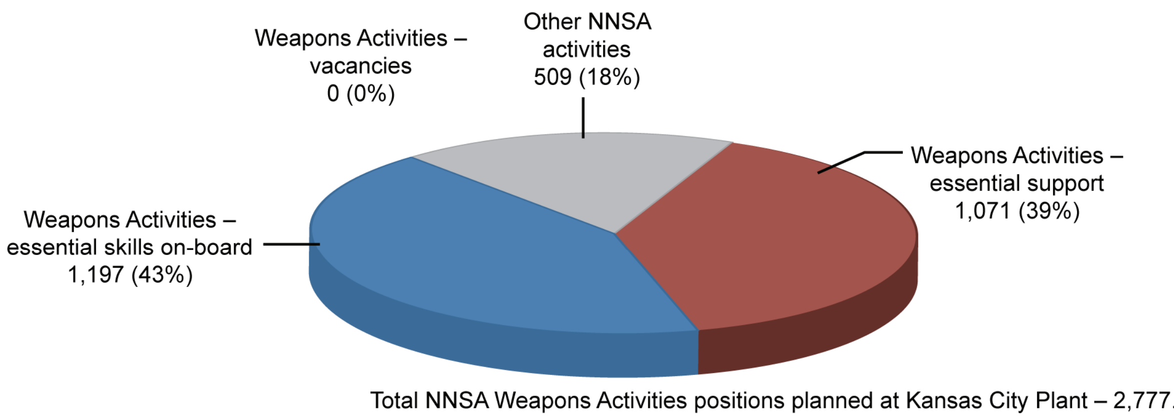
E.4 Kansas City Plant

M&O Contractor: Honeywell

E.4.1 Mission

The Kansas City Plant manufactures, procures, evaluates, and tests non-nuclear weapons components.

E.4.2 Kansas City Plant Management and Operating Contractor Workforce Summary Profile

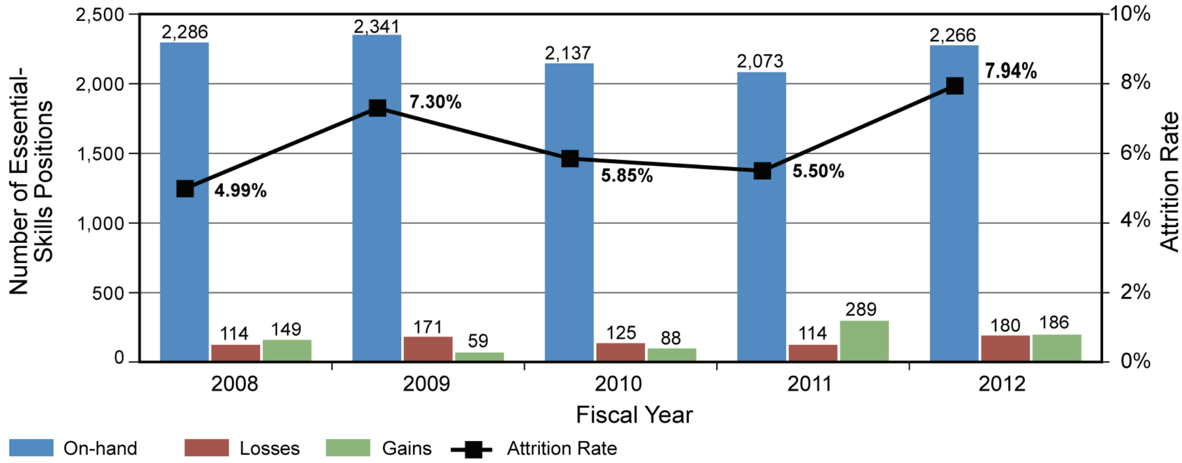


Total NNSA Weapons Activities positions planned at Kansas City Plant – 2,777.

- Beginning in fiscal year 2013, the Kansas City Plant's total management and operating workforce consisted of 2,777 positions; all except 509 positions support Defense Programs Weapons Activities.
- 2,268 positions, 82 percent of the workforce, support Weapons Activities.

Figure E–10. Kansas City Plant NNSA management and operating contractor workforce in fiscal year 2013

E.4.3 Kansas City Plant Management and Operating Contractor Gains and Losses over the Last 5 Years

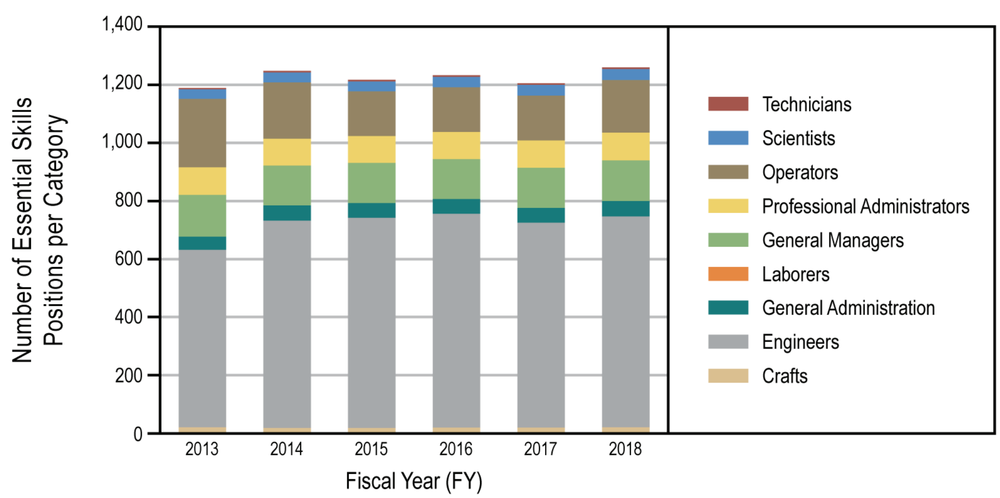


- Attrition rates have fluctuated over the past 5 years, averaging about 6.3 percent.
- Attrition rates for the scientific and engineering workforce are similar to those of the overall workforce.
- Workforce reductions have occurred over the past 4 years, from 2,341 positions in FY 2009 to 2,266 positions in FY 2012.
- The Kansas City Plant has been able to replace and replenish its workforce during that time.

Note: Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure E–11. Kansas City Plant NNSA management and operating contractor gains and losses in essential-skills positions over the last 5 years

E.4.4 Kansas City Plant Management and Operating Contractor Workforce Projections for Essential Skills



- While the Kansas City Plant workforce has been decreasing over the last 4 years, the essential-skills workforce is expected to level off in the future.

Figure E–12. Kansas City Plant NNSA management and operating contractor workforce projections for essential skills

E.4.5 Kansas City Plant Management and Operating Contractor Workforce Outlook

The non-nuclear manufacturing capabilities needed to accomplish the Kansas City Plant's mission are readily available in today's labor market as long as the compensation and benefits packages remain competitive.

While 40 percent of the essential-skills workforce is eligible to retire now, that number will increase to over 60 percent in the next 10 years. In the future, electrical and mechanical engineers will be needed with skills in engineering and design, manufacturing, radar, and optics. To ensure the identification, recruitment, development, and retention of employees with these and other skills, the Kansas City Plant has instituted a robust and systematic workforce planning process, as well as a variety of recruitment strategies and training and development programs.

The Kansas City Plant continues to offer a competitive compensation and benefits package. Compensation is only slightly lagging the market as a result of recent salary freezes, and is currently sitting at approximately 95 percent of the market. The benefits package is comparable to that of other large industries. However, there may be a potential impact on retention if the Kansas City Plant is unable to keep salaries competitive with the commercial sector as economic conditions improve.

The Kansas City Plant works diligently to provide training and development for all employees. The Kansas City Plant also has a robust rewards and recognition program to recognize employees for various levels of contributions to the business.

All programs and activities are reviewed regularly and refined as necessary to ensure appropriate skills are available to execute and support the Kansas City Plant's missions.

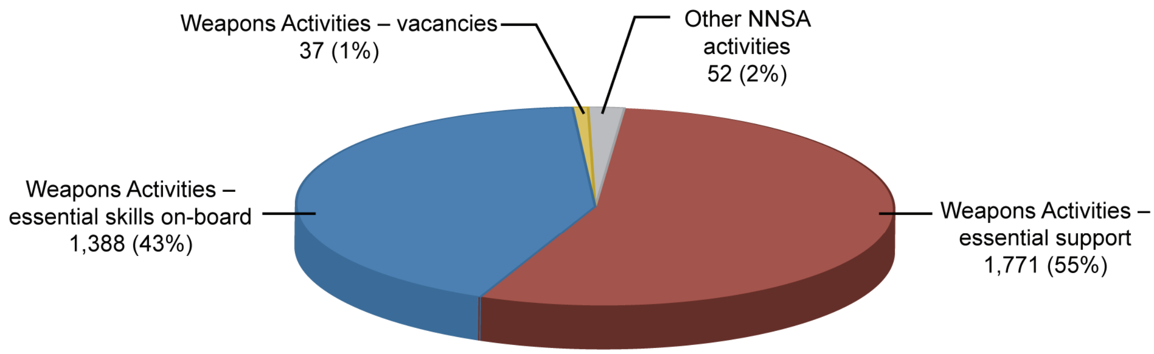
E.5 Pantex Plant

M&O Contractor: Babcock & Wilcox Pantex

E.5.1 Mission

The Pantex Plant dismantles retired weapons; fabricates high-explosives components and performs high-explosives R&D; assembles high-explosive, nuclear, and non-nuclear components into nuclear weapons; repairs and modifies weapons; performs nonintrusive pit modification; and evaluates and performs surveillance of weapons. The Pantex Plant maintains Security Category I and II quantities of special nuclear material (*i.e.*, special nuclear materials that require the highest level of security) for the weapons program and stores special nuclear material in the form of surplus plutonium pits, pending transfer to SRS for disposition. The Pantex Plant will be the Center of Excellence for Assembly and Disassembly of Nuclear Weapons, as well as the Center of Excellence for High-Explosives Production and Machining. Its mission will be enhanced by nondestructive weapon or pit surveillance using the existing Weapons Engineering Testing Laboratory, its proposed new Weapons Surveillance Facility, its updated high-explosives machining and production facilities, and its consolidated weapon and pit storage via the new underground Zone 12 storage facility.

E.5.2 Pantex Plant Management and Operating Contractor Workforce Summary Profile

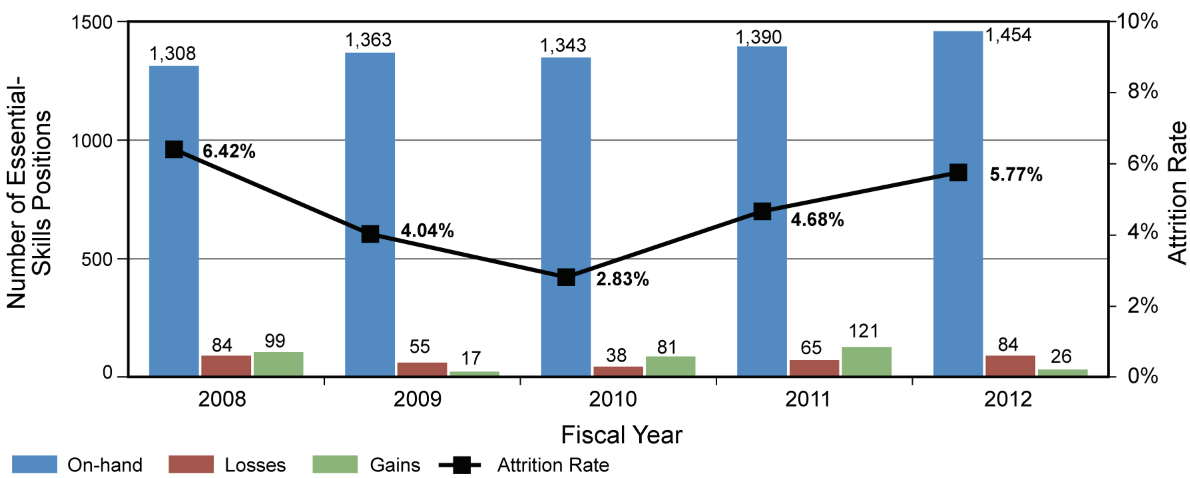


Total NNSA Weapons Activities positions planned at Pantex Plant – 3,248.

- Pantex Plant's total workforce consists of 3,248 positions; all except 52 support the nuclear weapons program.
- 77 percent of the essential-skills positions consists of engineers, scientists, operators, or technicians who have specific technical skills that often require several years to develop.

Figure E–13. Pantex Plant NNSA management and operating contractor workforce in fiscal year 2013

E.5.3 Pantex Plant Management and Operating Contractor Gains and Losses over the Last 5 Years

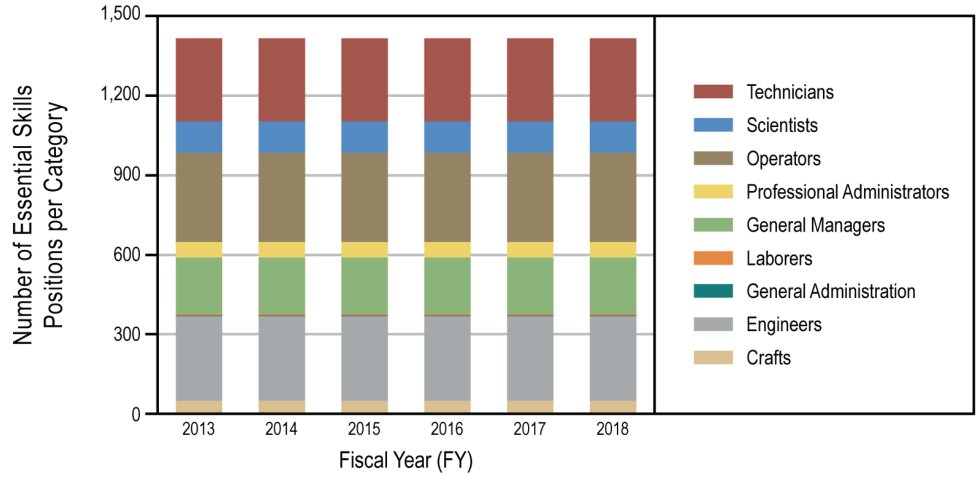


- The Pantex Plant's attrition rate has averaged about 4.7 percent over the past 5 years.
- Essential-skills positions have continued to grow over the past 5 years, from 1,308 positions in FY 2008 to about 1,454 positions in FY 2012. Scientific positions have increased from about 83 in FY 2008 to about 126 in FY 2012.

Note: Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure E–14. Pantex Plant NNSA management and operating contractor gains and losses in essential-skills positions over the last 5 years

E.5.4 Pantex Plant Management and Operating Contractor Workforce Projections for Essential Skills



- Reflects Pantex Plant's essential-skills workforce projections for FY 2013 through 2018. These projections are by occupational series, using DOE's Common Occupational Classification System.
- These projections have Pantex Plant's essential-skills workforce at a steady state of 1,425 through 2018.

Figure E–15. Pantex Plant NNSA management and operating contractor workforce projections for essential skills

E.5.5 Pantex Plant Management and Operating Contractor Workforce Outlook

Historically, the Pantex Plant has been able to recruit and replenish its essential-skills workforce. Essential-skills staffing requirements for FY 2013 through 2038 are projected at 1,474, with a focus on engineers and technicians. The Pantex Plant conducts an ongoing workforce planning process to ensure needed skills are identified and available as workload changes occur. The planning process provides management with a roadmap for workforce restructuring, realignment, staffing, and employee development.

At this time, attrition remains relatively low, thereby facilitating the Pantex Plant's ability to retain a skilled workforce. The Pantex Plant is in a remote location. Should national employment conditions improve, the demand for engineering and other technical skills will likely increase, which will create new challenges for recruiting and retaining employees with the essential skills. Based on current hiring and attrition data, gaps are anticipated in engineering, authorization basis, information technology, risk management, tester design, and fire protection over the next 10 years. Potential impacts to the Pantex workforce as a result of the impending contract consolidation with Y-12 are unknown at this time.

To ensure a skilled workforce is maintained and sustained, the Pantex Plant will continue to use strategies and programs that have proven successful. The Pantex Plant continues to partner with regional universities to provide a pipeline for the essential skills needed for future missions. Compensation and benefits are monitored to stay competitive for talent in the lean technical market. Because of continuing weapons work, the Pantex Plant has a distinct advantage in collecting and refining weapons assembly and disassembly knowledge. The weapons experts are training and mentoring the next generation of technicians, engineers, and scientists.

E.6 Savannah River Site – Tritium Programs

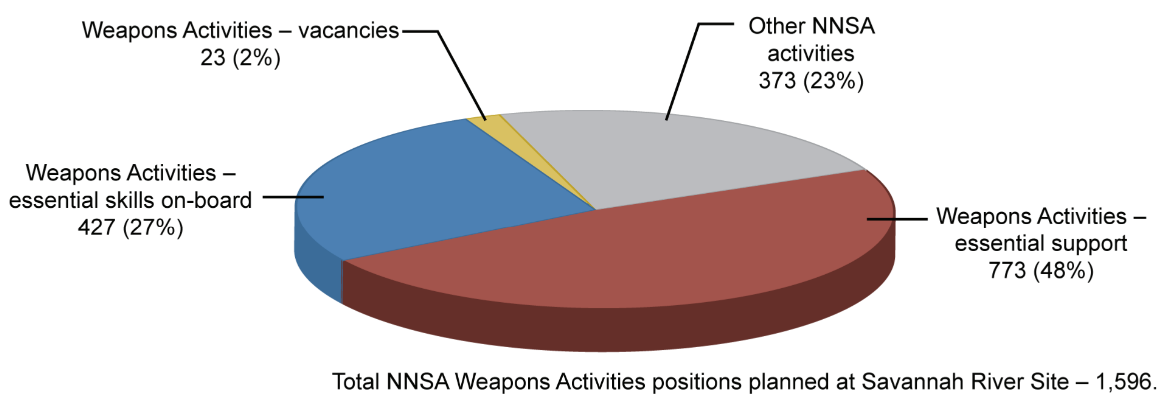
M&O Contractor: Savannah River Nuclear Solutions

E.6.1 Mission

SRS extracts tritium and performs loading, unloading, and surveillance of tritium reservoirs. SRS does not maintain Security Category I and II quantities of special nuclear material associated with NNSA weapons activities, but does maintain Security Category I and II quantities of special nuclear material associated with other DOE activities, such as the Environmental Management Program. SRS will be the Center of Excellence for Operations involving large quantities of tritium, and its mission will be enhanced by tritium production, R&D, and supply management facilities, as well as by R&D to support gas transfer system design.

SRS is different from other NNSA sites that are part of the nuclear security enterprise because it is managed by the DOE Office of Environmental Management. The M&O contractor has approximately 5,640 employees, of whom approximately 450 positions (with 23 vacancies at the end of FY 2012) are dedicated to NNSA's Tritium Programs mission and scope. NNSA funding also supports a portion of the landlord services costs provided by the Office of Environmental Management's M&O landlord to NNSA. This situation provides some flexibility in moving skill sets from one project to another to address workload and budget changes.

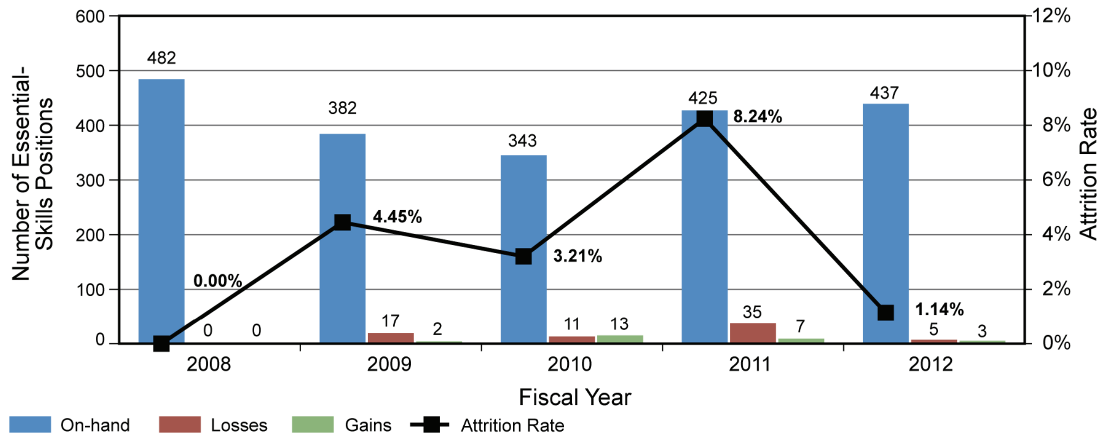
E.6.2 Savannah River Site Management and Operating Tritium Programs Contractor Workforce Summary Profile



- 1,200 positions, or 75 percent of the NNSA workforce, support the Defense Programs Weapons Activities.
- 427 positions (27 percent) are considered essential-skills positions for Weapons Activities.

Figure E–16. Savannah River Site NNSA management and operating Tritium Programs contractor workforce in fiscal year 2013

E.6.3 Savannah River Site Management and Operating Tritium Programs Contractor Gains and Losses over the Last 5 Years

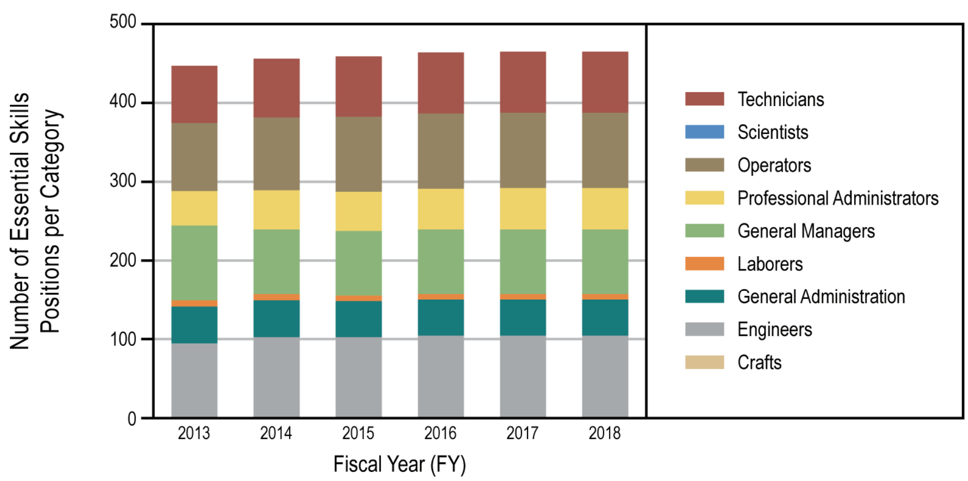


- Attrition has been modest, averaging 4.2 percent over the past 4 years.
- A 9.3 percent reduction in the workforce occurred over the past 5 years, from about 482 positions in FY 2008 to 437 positions in FY 2012.
- The Savannah River Site has been able to replace and replenish its workforce during the past 5 years, even as the skill mix has evolved.

Note: Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure E–17. Savannah River Site NNSA management and operating Tritium Programs contractor gains and losses in essential-skills positions over the last 5 years

E.6.4 Savannah River Site Management and Operating Tritium Programs Contractor Workforce Projections for Essential Skills



- The Savannah River Site Tritium Programs essential-skills workforce is expected to remain at its current state of about 450 positions through FY 2018.
- Some temporary increases in personnel will be necessary to complete the Tritium Responsive Infrastructure Modifications scope. Actual project personnel numbers have not been fully estimated.

Figure E–18. Savannah River Site NNSA management and operating Tritium Programs contractor workforce projections for essential skills

E.6.5 Savannah River Site Management and Operating Tritium Programs Contractor Workforce Outlook

Because the workforce is expected to remain stable in the coming years, SRS is in a good position to sustain an essential-skills workforce through 2038. For the next several years, this workforce could be impacted by a significant increase in pension and medical contributions and the recent decision concerning the Pit Disassembly and Conversion Project, thereby eliminating a substantial portion of the site funding base. An evaluation of the impacts has not been completed. SRS is viewed as a major employer in the Central Savannah River Area and draws a strong pool of candidates from the area.

While there is no challenge in recruiting young engineers, SRS has experienced some difficulty in retaining them. In an effort to resolve this concern, SRS is creating a formal rotation program for young professionals. Individuals will be hand-selected to participate in the program based on their performance and potential for growth. The focus is to rotate these individuals into new roles across the organization approximately every 18 months. This focused rotation will allow participants to broaden their skill set while staying challenged and enthusiastic about the work offered. The kickoff of this program occurred during FY 2012.

E.7 Y-12 National Security Complex

M&O Contractor: Babcock & Wilcox Y-12

E.7.1 Mission

Y-12 manufactures uranium components for nuclear weapons, cases, and nuclear components composed of CSAs; performs quality evaluation and surveillance activities on subassemblies and components; maintains Security Category I and II quantities of special nuclear material; conducts component dismantlement, storage, and disposition of these nuclear materials; and supplies highly enriched uranium for use in naval reactors. Y-12 is the Center of Excellence for Uranium and Canned Subassemblies, and its mission performance will be enhanced by storage of enriched uranium in the Highly Enriched Uranium Materials Facility, processing enriched uranium and performing R&D within the Uranium Capabilities Replacement Facility, and manufacturing non-highly enriched uranium components and subassemblies within the Consolidated Manufacturing Complex.

E.7.2 Y-12 National Security Complex Management and Operating Contractor Workforce Summary Profile

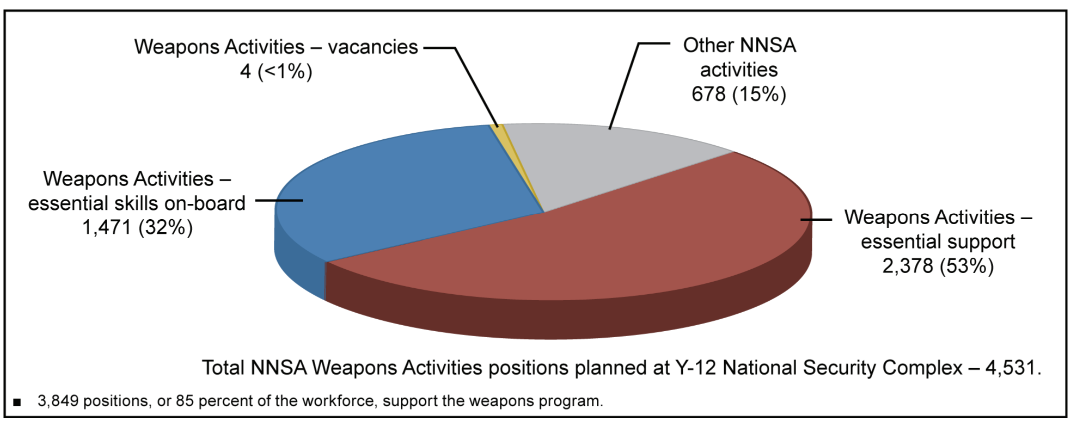
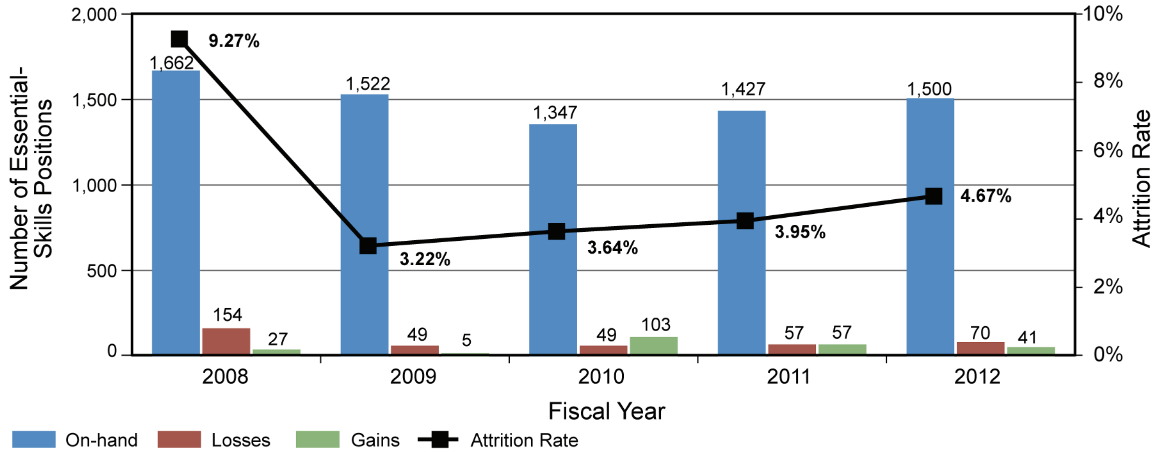


Figure E–19. Y-12 National Security Complex NNSA management and operating contractor workforce in fiscal year 2013

E.7.3 Y-12 National Security Complex Management and Operating Contractor Gains and Losses over the Last 5 Years

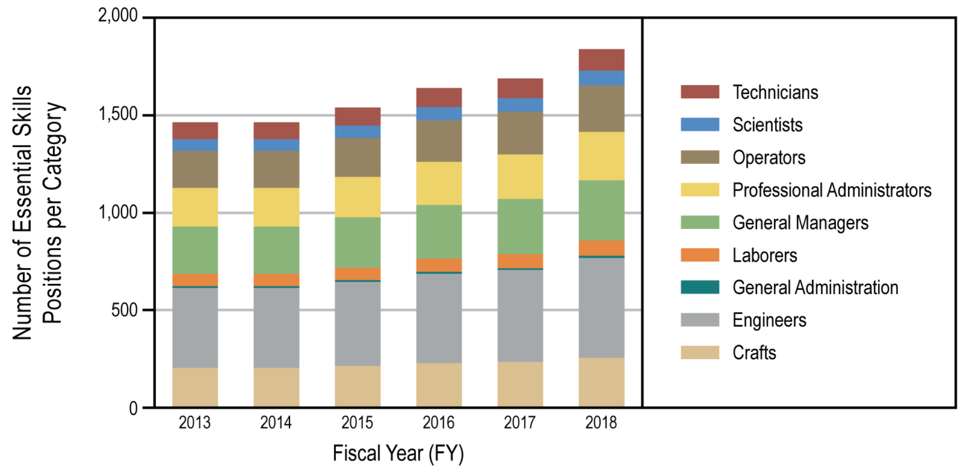


- The essential-skills workforce has decreased over the past 5 years, from a high of 1,662 positions in FY 2008 to 1,500 positions in FY 2012.
- Attrition rates have slightly declined over the past 5 years, averaging about 4.1 percent over the last 3 years.
- Attrition rates for the scientists, engineers, and technicians workforce are comparable to that of the overall workforce.
- The Y-12 National Security Complex has been able to replace and replenish its workforce during the last 5 years, even as the skill mix has evolved.

Note: Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure E–20. Y-12 National Security Complex NNSA management and operating contractor gains and losses in essential-skills positions over the last 5 years

E.7.4 Y-12 National Security Complex Management and Operating Contractor Workforce Projections for Essential Skills



- While the Y-12 National Security Complex essential-skills workforce has shown some decrease, it is projected to grow in support of the Uranium Capabilities Replacement Facility and overlapping life extension programs with a peak in FY 2018.

Figure E–21. Y-12 National Security Complex management and operating contractor workforce projections for essential skills

E.7.5 Y-12 National Security Complex Management and Operating Contractor Workforce Outlook

Y-12's essential-skills resources are on target, and there are no expected shortages of employees with the skill sets needed to meet the Y-12 mission. The upcoming contractor change does present some uncertainties that may impact external recruiting for positions requiring specialized, in-depth experience, mid-career hires, and senior-level managers.

With the job situation in the U.S. stabilizing and the economy improving, voluntary terminations may increase, resulting in new challenges for recruiting and retaining employees with essential skills. In 2012, Y-12 experienced an increase in attrition, with retirement accounting for the majority of terminations. However, the company has been in a hiring freeze caused by budget constraints and contract consolidation. As new job growth in the market comes to fruition, the attrition for engineers and other critical skills may increase.

Recruiting efforts target both mid-career candidates and recent college graduates. This approach is a key strategy for knowledge transfer that creates a pipeline of future incumbents at different career stages. The positions for which Y-12 has the most difficulty recruiting include fire protection engineers, nuclear criticality safety engineers, quality managers, and quality assurance mid-career hires. The company has been successful with hiring in other engineering disciplines, craft positions, and technical occupations that are required to sustain critical skills at Y-12.

Several recruitment and retention strategies are in place to ensure Y-12 continues to maintain a qualified, skilled, and competent workforce. Such strategies include partnering with colleges and universities, employee development programs such as job rotation and mentoring, and a program called Career One. Career One is a job-rotation program designed especially for new engineering graduates during their first 2 years at Y-12. They work in different engineering disciplines in 4- to 6-month increments to gain insights into each field so they can better determine which career path is the best fit. Workshops and training sessions offered at Y-12 further expand their knowledge and technical skills.

E.8 Nevada National Security Site

M&O: National Security Technologies (NSTec)

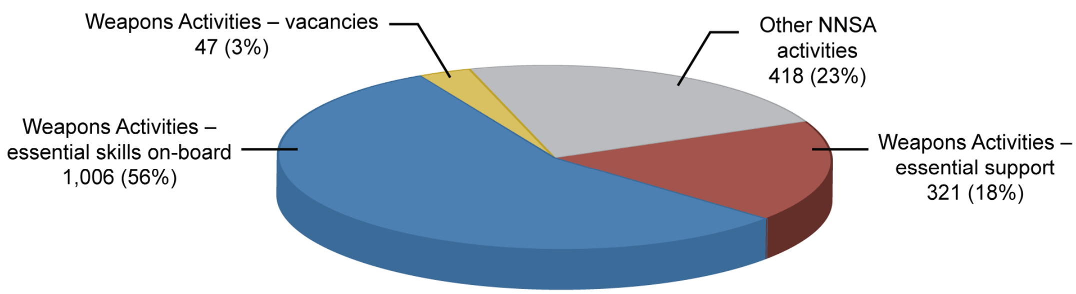
E.8.1 Mission

The Nevada National Security Site is the Center of Excellence for High-Hazard Testing and Experimentation, and its mission includes the conduct of subcritical and plutonium experiments at the U1a Complex and JASPER, criticality experiments at the Nuclear Criticality Experiments Research Center, large-scale high-explosives and hydrodynamic materials testing at BEEF, and special nuclear material staging and handling at the Device Assembly Facility. Offsite experiment support, including diagnostics R&D, post-experiment data post processing, and data analysis algorithm development, is provided by the workforce to the national security laboratories in California and New Mexico and at the Nevada site.

The Nevada National Security Site maintains the capability to resume underground nuclear testing, if directed by the President of the United States, by conducting hydrotests and high-hazard experiments (both aboveground and especially underground) involving both nuclear material and high explosives and by developing high-bandwidth, multi-channel, transient-event instrumentation systems. The Nevada National Security Site workforce also conducts non-nuclear experiments; performs R&D activities; safeguards Security Category I and II quantities of special nuclear material; provides training on nuclear safeguards, criticality safety, and emergency response; and affords the Nation the capability to dispose of a damaged nuclear weapon or an improvised nuclear device.

Nevada National Security Site support of NNSA's Defense Nuclear Nonproliferation and Emergency Operations continues to provide additional and valuable opportunities to maintain skills that are essential to supporting the SSMP. The synergy among these missions concerning design, fabrication, deployment, experiment execution, and analysis of specialized diagnostic sensors and systems is of particular importance for the Nevada National Security Site's support of the SSMP.

E.8.2 Nevada National Security Site Management and Operating Contractor Workforce Summary Profile

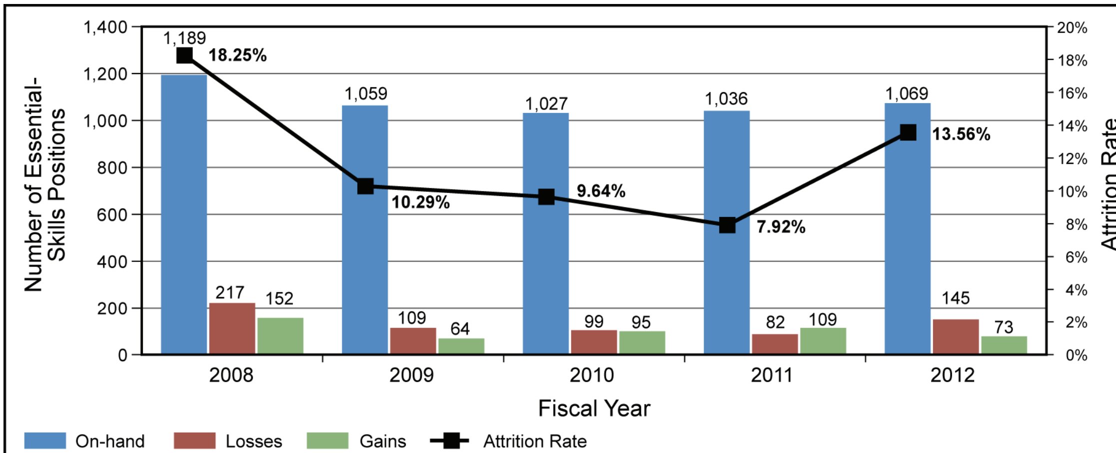


Total NNSA Weapons Activities positions planned at the Nevada National Security Site – 1,792.

- 1,327 positions, 74 percent of the workforce, support the Defense Programs Weapons Activities.

Figure E–22. Nevada National Security Site NNSA management and operating contractor workforce in fiscal year 2013

E.8.3 Nevada National Security Site Management and Operating Contractor Gains and Losses over the Last 5 Years

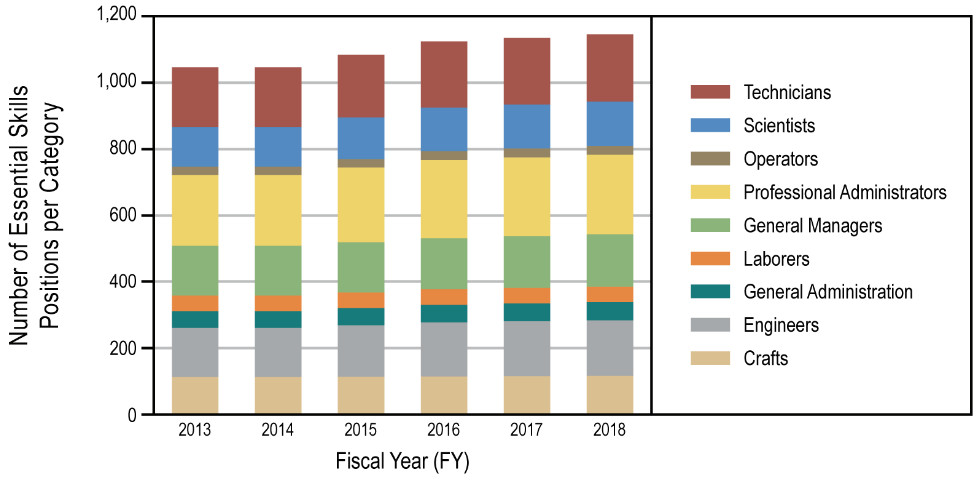


- Attrition rates have fluctuated over the past 5 years, averaging about 12 percent, due to an abnormal attrition spike in FY 2008.
- The essential-skills workforce has declined over the past 5 years, from about 1,189 positions in FY 2008 to about 1,069 positions at the end of FY 2012.

Note: Some of the gains and losses relate to changes in the projects employees are working on and are not terminations or hire actions. The attrition rate (stated as a percentage for a 1-year period) is defined as the loss of the employees that have the essential skills and qualifications to perform the required work.

Figure E–23. Nevada National Security Site NNSA management and operating contractor gains and losses in essential-skills positions over the last 5 years

E.8.4 Nevada National Security Site Management and Operating Contractor Workforce Projections for Essential Skills



- The projections have the workforce on a glide path to increase by 111 essential positions between FY 2012 and FY 2018, primarily in scientific, engineering, and technician occupations.
- The ability to fill the essential-skills positions is not a management concern at this time.

Figure E–24. Nevada National Security Site NNSA management and operating contractor workforce projections for essential skills

E.8.5 Nevada National Security Site Management and Operating Contractor Workforce Outlook

The Nevada National Security Site's processes, programs, and sources for recruiting and retaining employees have been demonstrated to be effective for the entire workforce, as follows.

- The Nevada National Security Site in FY 2012 filled 89 percent of positions designated with essential skills; these positions are consistently filled within 90 days of becoming vacant.
- The overall annualized attrition rate for FY 2012 was 5.5 percent (excluding crafts and layoffs), while the calculated turnover in "essential weapons personnel" was 13.6 percent.

The Nevada National Security Site opens several positions for students in relevant technical degree programs each summer, thereby giving the students experience in their chosen field, as well as an introduction to what the Nevada National Security Site does and how it does it.

The annual Compensation Increase Plan includes requested funding based on published salary surveys and positions to market. Requested adjustment budgets fluctuate with the job market and NNSA Compensation Increase Plan guidance.

There is currently no shortage of personnel with essential skills; however, there are many cases in which the Nevada National Security Site is "one deep" in the ability to perform work. The average age of the employee population is approximately 51 years, and significant losses through retirements are anticipated over the next decade. While efforts to mitigate this mission risk have been successful over the past few years, the essential skills of greatest concern over the next 5 years include the following:

- Nuclear weapons assembly and disassembly
- Nuclear explosive safety

- Nuclear and plasma physics
- Nuclear weapon quality engineering
- Nuclear data analysis
- Nuclear forensics (radiochemistry)
- Cable equalization
- Customized radiation and neutron detector fabrication and calibration
- Health physics

Although the Nevada National Security Site is diligently working to fill gaps due to attrition by strategically hiring and training the next generation of personnel, the following factors influence the Nevada National Security Site's efforts to hire, retain, and train personnel with essential skills:

- Funding. It is difficult to ramp up activities without firm, long-term funding in place to support new personnel. Managers can only add or replace employees when budgets permit.
- Q clearances. The process to obtain a Q clearance can easily take more than 6 months, and a new employee is therefore unable to perform the work they were hired to do until their clearance is granted. The requirement for U.S. citizenship decreases the candidate pool in many technical disciplines.
- Human Reliability Program Certification. This certification can take several months to obtain, even when the individual already has a Q clearance. At the Nevada National Security Site, employees in bargaining units (represented employees) receive additional pay for carrying this certification; non-bargaining employees often ask why they receive nothing extra for the added burden of participating in the certification program.
- Qualification and Certification. The processes and procedures for some activities take several months or years to learn prior to becoming qualified and certified to work on systems or activities.
- Nationwide Organization. The Nevada National Security Site M&O contractor has offices on the East Coast (Andrews Air Force Base) and the West Coast (Santa Barbara and Livermore, California), as well as in New Mexico and Nevada. The M&O contractor competes for employees on a nationwide basis, as well as in the communities in which it operates. Differences in the job markets and costs of living make it difficult to maintain internal equity across the Nevada National Security Site while retaining employees at outlying locations.

E.9 Work for Others

The NNSA Work for Others (WFO) projects provide a valuable opportunity to leverage personnel and facilities to provide capabilities to other Federal agencies, private industry, and universities and colleges. The application of these technical skills and capabilities to NNSA's broader national security mission is discussed in the chapter sections that follow.

E.9.1 Work for Others (Outside the Weapons Activities Account)

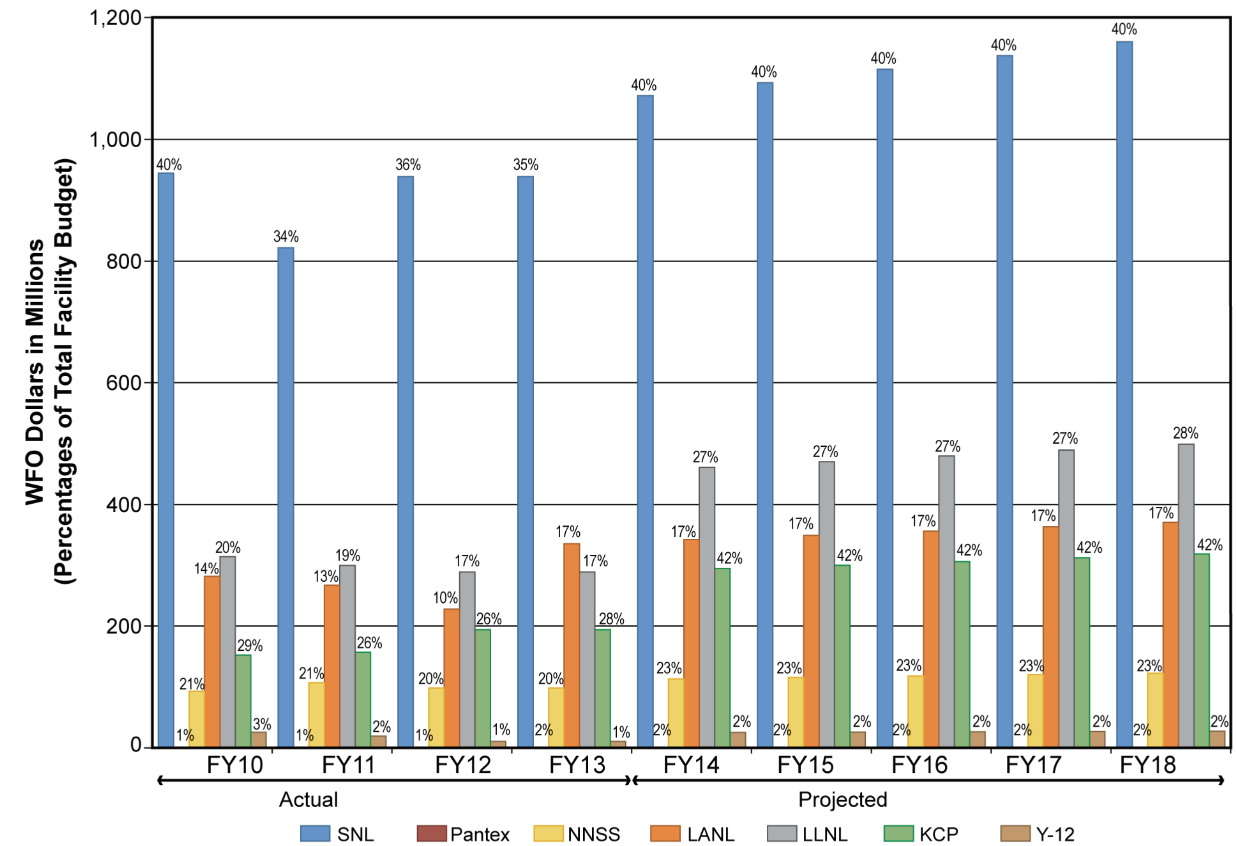
An important DOE/NNSA policy is acceptance of non-DOE-funded work through reimbursable agreements, provided that a legal and regulatory authority exists to perform such work. WFO is a mechanism that provides for implementation of this policy. WFO is often referred to as reimbursable work; to be clear, WFO is a subset of reimbursable work, but unlike reimbursable work, WFO excludes any revenues from pure technology transfer activity generated by the national security laboratories (*e.g.*, licensing or Cooperative Research and Development Agreements). The strong ST&E capabilities that support the NNSA mission provide a unique expertise that is not found in industry, other Government agencies, or academia. These capabilities are often required by other customers to meet their own national security mission needs. Through WFO projects, DOE makes its national security laboratories, the Nevada National Security Site, and the nuclear weapons production facilities available to solve problems for others when these entities are unable to acquire the capability to perform the work elsewhere. WFO activities benefit NNSA by the following:

- Providing a means to exercise and hone essential skills and maintain key capabilities
- Challenging the NNSA workforce and tools by augmenting regimes of experiments and modeling
- Providing relevant, exciting, and challenging work to aid in workforce training, recruiting, and retention
- Gaining weapons-relevant insights from specific WFO studies

Most of NNSA's WFO portfolio supports other Federal agencies, such as DoD; however, the Atomic Energy Act of 1954 permits DOE to perform work for the private sector, academia, state and local governments, and foreign governments. WFO projects must not adversely impact the execution of required NNSA programmatic activities and must not be in direct competition with the domestic private sector. By DOE Order, all use of NNSA capabilities by other agencies is conducted on the basis of full cost recovery. The advantage to NNSA is that WFO work provides the sites with another tool to balance annual variations in weapon workload and workforce to retain a greater number of staff with weapons experience.

E.9.2 Work for Others Activities at National Nuclear Security Administration Facilities

Figure E–25 provides an overview of the WFO-related current and projected resources and percentage of total site funding for the three national security laboratories, the Nevada National Security Site, and three nuclear weapons production facilities. NNSA's SRS currently does not track WFO resources. The WFO activities leverage the skills and capabilities of the NNSA sites and provide access to their unique tools, equipment, and parts. The skills and capabilities of the sites, coupled with access to such an environment, provide an asset that is not available in commercial industry. WFO activities offer a unique opportunity at the NNSA sites to provide important national security services and processes, while providing a means to develop and exercise essential technical skills and capabilities that are important to the Nation's nuclear weapons program. It is important to note that approximately 40 percent of SNL's annual budget is supported by WFO activities. In Figure E–25, the out-year WFO projections for the sites for FY 2014 through FY 2017 are based on a standard escalation rate of 2 percent per year.



Total Facility Budget	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
SNL	2,366,000,000	2,420,406,000	2,601,468,000	2,646,711,000	2,699,645,220	2,753,638,124	2,808,710,887	2,864,885,105	2,922,182,807
Pantex	545,153,000	585,965,000	650,208,000	647,598,000	660,549,960	673,760,959	687,236,178	700,980,902	715,000,520
NNSS	447,973,000	510,921,000	487,784,000	488,200,000	497,964,000	507,923,280	518,081,746	528,443,381	539,012,248
LANL	2,000,450,000	2,111,227,000	2,175,093,000	2,001,406,000	2,041,434,120	2,082,262,802	2,123,908,058	2,166,386,220	2,209,713,944
LLNL	1,573,576,000	1,610,431,000	1,672,861,000	1,668,684,000	1,702,057,680	1,736,098,834	1,770,820,810	1,806,237,226	1,842,361,971
KCP	531,657,000	599,762,000	742,437,000	688,999,000	702,778,980	716,834,560	731,171,251	745,794,676	760,710,569
Y-12	876,155,000	823,561,000	994,335,000	1,007,098,000	1,027,239,960	1,047,784,759	1,068,740,454	1,090,115,263	1,111,917,569

Key:
FY = fiscal year
KCP = Kansas City Plant
LANL = Los Alamos National Laboratory
LLNL = Lawrence Livermore National Laboratory
Pantex = Pantex Plant
NNSS = Nevada National Security Site
SNL = Sandia National Laboratories
WFO = Work for Others
Y-12 = Y-12 National Security Complex

Figure E–25. Work for Others actual and projected resources and percentages by site

E.9.3 Federal Agencies, State, and Local Government

In addition to their primary NNSA mission, the national security laboratories, nuclear weapons production facilities, and the Nevada National Security Site provide technical resources and facilities to a variety of other Federal agencies, as well as to state and local governments, through NNSA-sponsored WFO. WFO encompasses conventional defense, strategic defense, counterproliferation and nonproliferation, treaty verification, environmental cleanup and monitoring, energy uses, high-performance computing, safeguards and security, radiation effects, materials development and characterization, law enforcement, transportation, space efforts, and a variety of other national security areas. Federal agencies and state and local governments can enter into an interagency agreement with NNSA to obtain the unique services of the national security laboratories and the nuclear weapons production facilities.

E.9.4 Private Industry and Academia Partnerships

NNSA has been supporting the transfer of technology to external partners for over three decades, making it possible for those partners to access the science and technology, personnel, and infrastructure at its sites. NNSA uses a variety of agreement mechanisms to develop partnerships with industry, universities, and colleges. The goals and objectives of the private industry or academia partner, coupled with funding sources for the agreement and for NNSA's strategic business objectives, are among the factors used to determine the most appropriate partnering mechanism. In addition to standard types of agreements, NNSA also offers nondisclosure agreements and memoranda of understanding when appropriate.

E.9.5 Licensing

Through its national security laboratories, nuclear weapons production facilities, and the Nevada National Security Site, NNSA holds patents, copyrights, trademarks, and mask works that are available for licensing. WFO partners can license certain rights to NNSA-developed intellectual property for commercialization or for private use. The licenses are usually nonexclusive and bear royalties. Exclusive licenses typically have limitations, such as the field or term of use, as well as performance requirements, such as commercialization results.

E.10 Total Management and Operating Contractor Workforce at Sites Engaged in Weapons Activities

The M&O contractors form the core of the scientific, engineering, and manufacturing capabilities at the national security laboratories, the nuclear weapons production facilities, and the Nevada National Security Site. NNSA also relies on M&O contractors at other DOE laboratories to provide specialized capabilities. Of the approximately 43,000 contractor personnel at the eight Government-owned facilities, roughly 30,000 support NNSA work and, within that portion, approximately 26,000 directly support Defense Programs weapons activities. As depicted in **Figure E–26**, the majority of that workforce resides at the national security laboratories.

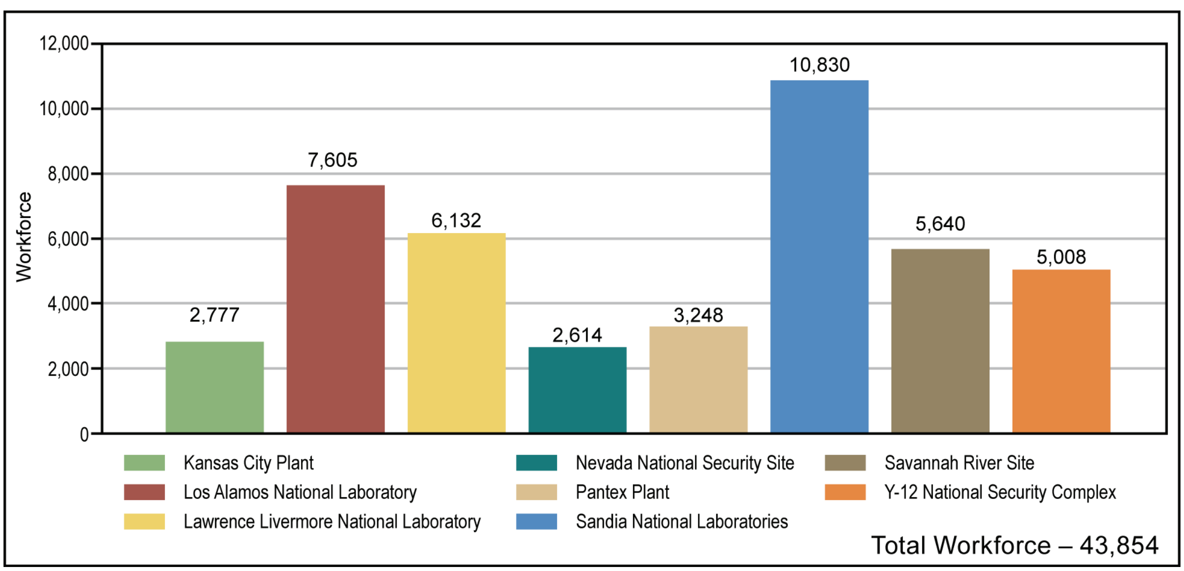


Figure E–26. Total NNSA management and operating contractor workforce planned for fiscal year 2013

A Report to Congress

Fiscal Year 2014 Stockpile Stewardship and Management Plan

June 2013

National Nuclear Security Administration

National Nuclear Security Administration
1000 Independence Avenue, SW
Washington, DC 20585