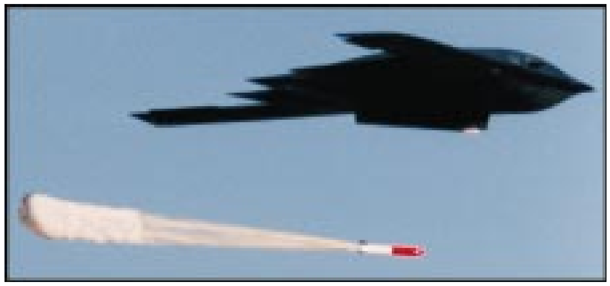
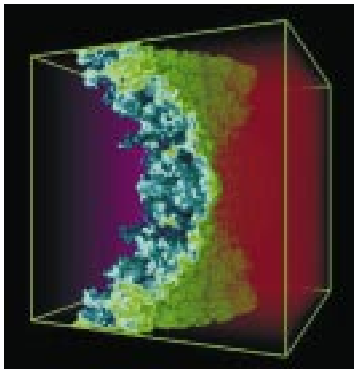
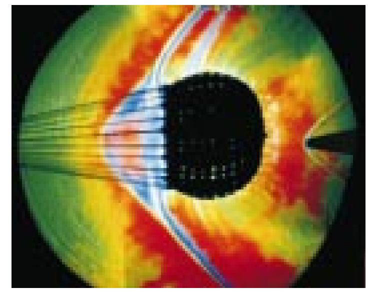


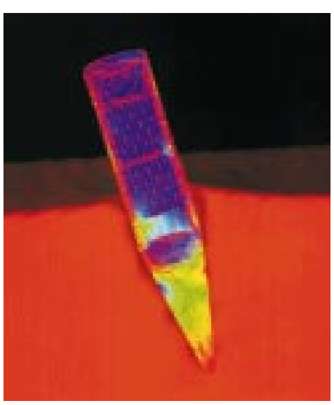


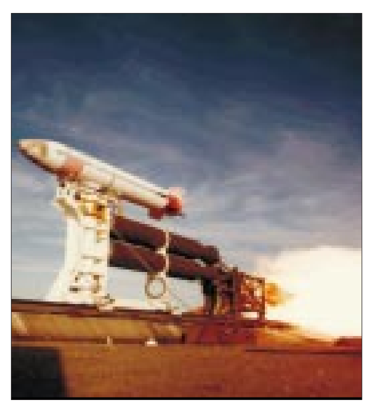
U.S. Department of Energy

Stockpile Stewardship Program

30-Day Review







November 23, 1999

U.S. Department of Energy

Stockpile Stewardship Program

30-Day Review

November 23, 1999

Table of Contents

Stockpile Stewardship Program
30-Day Review

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1 Purpose of this Review

1.1. Statement by Secretary Richardson on Stockpile Stewardship (October 14, 1999)

LAST NIGHT PRESIDENT CLINTON reaffirmed that the United States will continue to observe–as we have since 1992–a policy of not conducting nuclear tests. As Secretary of Energy one of my most important responsibilities is to ensure that the U.S. nuclear stockpile remains safe, secure and reliable without nuclear testing. The U.S. nuclear deterrent remains a supreme national interest of the United States.

The Department of Energy, with our national laboratories and production facilities, will continue to maintain U.S. nuclear weapons through the Stockpile Stewardship Program. The program rests on developing an unprecedented set of scientific tools to better understand nuclear weapons, on significantly enhancing our surveillance capabilities, and on completing a new manufacturing program needed to extend the life of our nuclear weapons. Through Stockpile Stewardship, the Secretaries of Defense and Energy have successfully certified the nuclear stockpile for the last three years, and we are well along our way to a fourth certification that the stockpile remains safe and reliable and that nuclear testing is not needed at this time.

In order to ensure our continued confidence in the structure, progress and accomplishments of this important program, I have directed the Under Secretary of Energy, Ernest P. Moniz, to undertake a comprehensive internal review of the Stockpile Stewardship Program and to report back to me within 30 days. The review will examine the accomplishments of the program over the last three years and the program structure in meeting current and long-term needs for certifying the stockpile. This will form the basis for assessing whether the balance between program elements supports the national strategy.

In particular we must ensure that we are placing sufficient attention and resources to recruiting and retaining the best scientists and engineers in our nation to meet the challenge of maintaining our nuclear stockpile without testing. We must also review the balance of activities at the production facilities and at the national laboratories to ensure that the priority given to these important tasks is commensurate with the needs of the program.

For the Stockpile Stewardship Program to be successful the Administration and the Congress must work together to demonstrate their commitment to the U.S. nuclear deterrent by providing for sustained and stable funding for the program over the years to come. This will be true whether or not a Test Ban Treaty is ratified since the U.S. will inevitably continue to rely on the new paradigm for maintaining its weapons in the post-Cold War era where we are not building new weapons systems, and where we are dependent on a new set of facilities and scientific resources to meet this critical challenge.

The importance of a credible nuclear deterrent to our national security was reaffirmed during last week's Senate debate. We at the Department of Energy will continue our work to fulfill this important national security mission.

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1.2. Charge to the Senior Technical Advisors from Under Secretary Moniz

ON OCTOBER 14, 1999, the Secretary of Energy directed me to undertake a comprehensive internal review of the Stockpile Stewardship Program and report my findings to him within 30 days. In order to accomplish this task I have invited a group of senior members of the defense and scientific communities to advise me on the structure, balance, and ability of the Stockpile Stewardship Program to maintain a safe, secure, and reliable nuclear weapons stockpile in the absence of nuclear testing both now and in the future.

I ask the Senior Technical Advisors to evaluate the program based on issues such as: the program goals, structure, and organization; the ability of the program to meet DoD/DOE requirements; the health and status of the nuclear weapons complex infrastructure, including both facilities and human resources; and the appropriateness of the program resources, schedules and integrated plan. This input will be central to the Secretary's assessment of how these factors contribute collectively to our level of confidence in the stockpile now and in the future.

A comprehensive overview of the Stockpile Stewardship Program will be presented by the Office of Defense Programs and senior staff from the nuclear weapons complex on November 8-9, 1999, at U.S. Strategic Command. The afternoon of November 9 will be spent evaluating the program, defining the key issues, and framing recommended actions. This discussion will shape the Stockpile Stewardship Program review presented to the Secretary. The report will identify the key accomplishments and challenges of the Stockpile Stewardship Program, the critical senior-level decision points and issues facing the program, and the programmatic areas that will require additional study in the future.

Ernest J. Moniz

Under Secretary
United States Department of Energy

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1.3. Stockpile Stewardship 30-Day Program Review Participants

Chair

Dr. Ernest J. Moniz
Under Secretary
United States Department of Energy

Senior Technical Advisors

Dr. John Birely (retired)
Los Alamos National Laboratory

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Lawrence Livermore National Laboratory

Mr. Gene Ives (retired)
Sandia National Laboratories

Dr. Raymond Jeanloz
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Mr. Frank Miller
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Mr. Robert Peurifoy (retired)
Sandia National Laboratories

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DOE Senior Staff

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Principal Deputy Assistant Secretary for Operations
Office of Defense Programs
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Dr. Maureen McCarthy
Office of the Under Secretary
U. S. Department of Energy

Dr. Robin Staffin
Office of the Secretary
U. S. Department of Energy

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Mr. James Landers
Deputy Assistant Secretary for Program Support
Office of Defense Programs
U. S. Department of Energy

Ms. Karen Clegg
President
Allied Signal, Kansas City Plant

Mr. Robert Van Hook
President
Lockheed-Martin Energy Systems, Y-12

Dr. William Weinreich
President
Pantex Plant

Dr. Thomas Hunter
Senior Vice President
Sandia National Laboratories

Dr. George Miller
Associate Director
Lawrence Livermore National Laboratory

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Ms. Kathy Carlson
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Mr. Rick Glass
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Dr. Jerry Freedman
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Dr. John Harvey
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U. S. Department of Defense

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2 Overview of the Stockpile Stewardship Program

THE STOCKPILE STEWARDSHIP PROGRAM (SSP) was established in response to the FY 1994 National Defense Authorization Act (P.L. 103-160), which called on the Secretary of Energy to "establish a stewardship program to ensure the preservation of the core intellectual and technical competencies of the United States in nuclear weapons." In the absence of nuclear testing the Stockpile Stewardship Program must: 1) support a focused, multifaceted program to increase the understanding of the enduring stockpile; 2) predict, detect, and evaluate potential problems due to the aging of the stockpile; 3) refurbish and remanufacture weapons and components, as required; and 4) maintain the science and engineering institutions needed to support the nation's nuclear deterrent, now and in the future. The SSP has been reviewed extensively since its inception. A list of reviews of the Stockpile Stewardship Program is given in Appendix A.

As the civilian steward of the nation's nuclear weapons complex, the Department of Energy (DOE) is responsible to the nation for the safety, security, and reliability of the nuclear arsenal. The Department of Defense (DoD) is the military customer for the nuclear stockpile and partners with the DOE in setting requirements and establishing production goals. The Secretary of Energy represents and is obligated to the United States public to ensure that the nuclear arsenal remains safe, secure and reliable. A key challenge of the Stockpile Stewardship Program is to balance military weapon performance goals against civilian and military surety and safety concerns.

A significant fraction of the nation's nuclear weapon systems are scheduled to undergo refurbishment during the next decade. Additional systems will be simultaneously undergoing engineering and manufacturing development in preparation for refurbishment. The DOE must be able to remanufacture weapon components and continue to certify them as safe, secure and reliable against threats of the 21st century. Two key systems–the W80 and the W76–are a large part of the nation's nuclear deterrent and the refurbishments of these systems will represent a significant effort to be undertaken during the next decade. The W76–as part of the Trident submarine weapon system–plays a particularly important role as one of the most survivable elements of the U.S. nuclear deterrent. Developing the tools, technologies, and skill-base required to refurbish these systems is a major challenge of the Stockpile Stewardship Program. The cost and schedule of these tools and technologies, and the availability of the proper skills in the work force, must be factored into the development of the requirements expressed in the life extension programs of these two weapons.

2.1. Program Goals and Organization

THE HIGHEST PRIORITY OF the SSP is to ensure the operational readiness of the U.S. nuclear weapons stockpile. The SSP program is organized into three focus areas: 1) Directed Stockpile Work (DSW), designed to ensure that stockpiled weapons meet military requirements; 2) Campaigns, designed to provide the science and engineering capabilities needed to meet the ongoing and evolving DSW requirements; and 3) Infrastructure (Readiness in Technical Base and Facilities, (RTBF)) that is required for stockpile work and computational and experimental research activities.

2.1.1. New Business Model

During the last year, DOE's Office of Defense Programs (DP) has undertaken a major shift in program management strategy, which has resulted in significant changes to the supporting planning, budgeting, and orga-

The nation's enduring nuclear weapon stockpile, shown in the accompanying table, contains thirteen systems within nine weapon classes. The W84, which is in the inactive stockpile (IS), is also listed. It's carrier, the ground-launched cruise missile, was eliminated by the Intermediate-Range Nuclear Forces Treaty of 1988.

Weapon	Description	Delivery System	Laboratories	Primary Use	Service	Date Entered Service
B61-3/4/10	Non-Strategic Bomb	F-15, F-16, NATO Tornado	LANL & Sandia	Air to Surface	Air Force, NATO	B61-3: 10/79 B61-4: 8/79 B61-10: 8/90
B61-7/11	Strategic Bomb	B-52, B-2	LANL & Sandia	Air to Surface	Air Force	B61-7: 9/85 B61-11: 11/97
W62	ICBM Warhead	Minuteman III ICBM	LLNL & Sandia	Surface to Surface	Air Force	4/70
W76	SLBM Warhead	Trident I (C4) Trident II (D5)	LANL & Sandia	Underwater to Surface	Navy	11/78
W78	ICBM Warhead	Minuteman III ICBM	LANL & Sandia	Surface to Surface	Air Force	9/79
W80-0/1	ALCM/ACM/ TLAM-N Warhead	SSN Attack Submarine, B-52	LANL & Sandia	Air to Surface Underwater to Surface	Navy Air Force	W80-0: 3/84 W80-1: 2/82
B83	Strategic Bomb	B52, B-2	LLNL & Sandia	Air to Surface	Air Force	9/83
W87	ICBM Warhead	Peacekeeper ICBM	LLNL & Sandia	Surface to Surface	Air Force	7/86
W88	SLBM Warhead	Trident II (D5)	LANL & Sandia	Underwater to Surface	Navy	6/89
W84 (IS)	GLCM	No current carrier, removed by INF	LLNL & Sandia		Air Force	9/83

nizational structure of the SSP. The change in approach responds to important drivers that DP presently faces. These include weapon refurbishments starting in FY 2006, an aging workforce in the nuclear weapons complex, and an aging stockpile that must be maintained. It also responds to the need for intensive internal and external review to ensure that the program will achieve its goals, while preserving the institutional viability of the laboratories, production plants, and the test site.

The approach now used by DP to manage the SSP involves developing an understanding of both the fixed and variable costs associated with the program. The fixed costs are associated with the physical infrastructure, *i.e.*, the costs associated with maintaining only the infrastructure, facilities, capital equipment, construction, and other functions that are necessary to have a viable nuclear weapons complex. DP has termed fixed costs as Readiness in Technical Base and Facilities.

The variable costs are those that are associated with the actual work that is performed within the nuclear weapons complex. DP has established two categories of variable costs. The first category is Directed Stockpile Work, which are those activities that directly support the day-to-day work and activities associated with the refurbishment and certification of specific weapons in the nuclear stockpile. The second category of variable costs is termed "Campaigns," which are focused science and engineering activities that address critical capabilities, tools, computations and experiments needed to achieve weapons stockpile certification, manufacturing, and refurbishment now and into the future, in the absence of nuclear testing.

It is important to understand that the fixed-cost portion of the SSP – RTBF – must be funded. No weapons work or other activities can take place unless the infrastructure exists and is maintained in the appropriate state of readiness. The implementation of this approach of identifying both fixed and variable costs of the program provides DP, laboratory and plant managers an improved and coordinated tool for determining the costs associated with managing the nuclear weapons complex.

Another business practice introduced this year by DP was the establishment of a rigorous planning process that clearly lays out programmatic milestones to be achieved within each element of the SSP. The complete Stockpile Stewardship Program is now defined by a series of program plans that have a five-year planning horizon, each with an accompanying annual implementation plan. The five-year program plans describe the goals and objectives of the program elements, and the annual implementation plans provide detailed sets of milestones that allow for accurate program tracking and oversight.

The combination of identifying the fixed and variable costs associated with the program, and the rigorous planning that has been done, is expected to provide an increased level of focus and integration within the program, and a much greater level of resolution of program activities. DP management believes that, because of the increased focus, this approach will significantly improve the laboratories' and production plants' ability to support, maintain, and build an excellent work force with the skill mix needed to ensure success of the SSP. This approach also is key to sustaining the laboratories as premier scientific and engineering institutions, supporting the manufacturing activities necessary to maintain and modernize the stockpile.

2.1.2. Directed Stockpile Work

The Directed Stockpile Work (DSW) Program addresses activities that directly support the readiness of the enduring nuclear weapons stockpile now and for as long into the future as is required. It focuses on nuclear stockpile life-cycle management, maintains the nuclear deterrent as specified in the Nuclear Weapons Stockpile Plan (see Chapter 3), and includes stockpile-related workload, policy guidance, coordination, and oversight of all activities that directly support stockpile requirements. DSW policy and program guidance is formulated within DP and implemented by a team consisting of DP, the national laboratories, and the production plants that together comprise the nuclear weapons complex.

DSW encompasses a broad range of activities that focus on the reliability, surety, and performance of nuclear weapons. These activities include research, development, and production associated with: weapon maintenance; surveillance; life extension; assessment and certification; baselining; dismantlements; design assessments; engineering; and production readiness across the nuclear weapons complex. DSW represents the programmatic foundation for setting current weapon system activities and implementing future weapon stockpile requirements.

The key DSW program goals are to:

Maintain the readiness of the deployed stockpile.

- Execute the limited life component exchange program (LLCE);
- Confirm the safety, reliability, and performance of deployed weapon systems; and
- Conduct authorized weapon alterations, modifications and repairs.

Support nuclear deterrent into the future.

- Refurbish the current stockpile to achieve life extension; and
- Provide the capability to modernize weapons.

Dispose of retired weapons and associated components.

- Dismantle retired weapons; and
- Provide for materials and component disposition.

2.1.3. Campaigns

Campaigns are technically challenging, multi-year, multi-functional efforts conducted across the Defense Programs laboratories, the production plants, and the Nevada Test Site (NTS). They are designed to develop and maintain specific critical capabilities that are needed to sustain a viable nuclear deterrent. The goal of the Campaigns is to provide the capabilities needed to address current and future stockpile issues by employing world-class scientists and engineers, and by providing the most advanced scientific and engineering infrastructure. The Campaigns provide a focus and planning framework that enables the laboratories to sustain their scientific preeminence.

Campaigns have milestones and specific end-dates designed to focus efforts in science and computing, applied science and engineering, and production readiness, on well-defined deliverables related to the stockpile. Currently, there are eighteen Campaigns. It is anticipated that as these mature and milestones are achieved, new Campaigns will be identified and implemented.

Eight Campaigns deal primarily with providing the scientific understanding necessary to certify the nuclear weapons stockpile in the absence of nuclear testing and to support the stockpile modernization required for weapon life extensions.

- *Primary Certification Campaign* – includes experimental activities that will develop and implement the ability to certify rebuilt and aged primaries to within a stated yield level without nuclear testing. Capabilities developed under this Campaign directly support DSW, including the B61, W80, and W76 life extensions, and certification of the newly-fabricated W88 pit.

  End State: Develop the tools required to certify the performance and safety of any newly fabricated replacement or aged primary based on hydrodynamics and generalized materials descriptions.

- *Dynamic Materials Properties Campaign* – includes efforts to develop physics-based, experimentally-validated data and models of all stockpile materials at a level of accuracy commensurate with the requirements of primary and secondary certification.

  End State: Provide complete, accurate and experimentally-validated models that describe the state and evolution of material properties in imploding primaries, with special emphasis on plutonium.

- *Advanced Radiography Campaign* – develops technologies for three-dimensional imaging of imploding surrogate-material primaries, with sufficient resolution to resolve uncertainties in primary performance.

  End State: Provide accurate 3-D imagery of imploding surrogate primaries.

- *Secondary Certification and Nuclear-Systems Margins Campaign* – includes experimental and computational activities designed to determine the minimum primary yield needed to produce a militarily effective weapon. The activities in this Campaign will develop a validated, predictive computational capability for each system in the stockpile, determine the primary radiation emission and energy flow, and determine the performance of nominal, aged, and rebuilt secondaries.

  End State: Determine margins and weapon-primary factors necessary to produce a militarily effective weapon.

- *Inertial Confinement Fusion (ICF) Ignition & High Yield Campaign* – includes experimental activities at the National Ignition Facility (NIF) and other facilities that will enhance experimental capabilities for stewardship. Material conditions that can be reached at the NIF, together with the diagnostics available, will also provide enhanced experimental capability for primary certification and weapons-relevant materials dynamics measurements.

  End State: Achieve ignition implosion by FY 2006.

- *Certification in Hostile Environments Campaign* – will validate computational tools for certification, reevaluate nuclear-weapon hostile environments, develop radiation-hardened technologies, and demonstrate certification technologies on the W76 life extension program.

  End State: Develop certification tools and microsystems technologies required to ensure that refurbished weapons meet Stockpile-to -Target Sequence (STS) hostile environment requirements.

- *Defense Applications and Modeling Campaign* – uses the tools of the Accelerated Strategic Computing Initiative (ASCI) to provide 3-D, high-fidelity, full-system simulation software required for engineering, safety, and performance analyses of weapons in the stockpile.

End State: 3-D high-fidelity-physics, full-system simulation capability.

- *Weapon System Engineering Certification Campaign* – establishes science-based engineering methods to increase confidence in weapons systems through validated simulation models and high fidelity experimental tests. This Campaign will validate engineering computational models, and will develop a suite of tools to enable science-based certification of the B61, W80, and W76 as required by the SLEP.

  End State: Establish a predictive capability integrated with fewer, but smarter, experiments to assess weapon performance with science-based certification.

Three engineering Campaigns focus on providing specific tools, capabilities, and components necessary to support the maintenance, modernization, refurbishment and continued certification of specific weapons systems. These campaigns support both certification and DSW work.

- *Enhanced Surety Campaign* – develops enhanced surety options, including modern levels of use-denial capabilities that may be considered for incorporation in scheduled stockpile refurbishment. This Campaign will develop enhanced surety options for the B61, W80, and W76 weapon systems in time to support refurbishment schedules.

  End State: Meet modern nuclear safety standards and upgrade use-denial capabilities, in time for scheduled weapon refurbishments.

- *Enhanced Surveillance Campaign* – develops the tools needed to predict or detect the precursors of age-related defects before they jeopardize warhead safety, reliability or performance. Material, component, system characterization, and predictive modeling and simulation are central to this activity. With sufficient lead time, the necessary redesigns, refurbishments, and re-certifications can be made efficiently and cost effectively within the capabilities and capacity of a "right-sized" manufacturing complex. The Enhanced Surveillance Campaign develops the technologies and methods, as well as the fundamental understanding of materials properties and weapons science, to improve detection and predictive capabilities. These capabilities will be used to develop new estimates for weapon lifetimes.

  End State: Provide lifetime assessments and the quantitative decision basis for future life extension programs.

- *Advanced Design and Production Technologies (ADAPT) Campaign* – is designed to accelerate and advance product realization technologies by developing capabilities to deliver qualified refurbishment products cheaper, better, and quicker. This Campaign will develop modeling and simulation tools and information management technologies to enable full-scale engineering development with minimal hardware prototyping, and through totally paperless processes, for monitoring weapon refurbishment activities.

  End State: Provide the capability to deliver qualified stockpile life extension program refurbishment products upon demand at one-half cost, one-half the current time and with zero stockpile defects by 2005.

Seven readiness Campaigns focus on sustaining the manufacturing base within the nuclear weapons complex. Some manufacturing processes and capabilities are no longer practical. Without a viable manufacturing capability, the U.S. nuclear deterrent cannot be maintained. These campaigns are driven by the current work required to maintain the stockpile as characterized by the Stockpile Life Extension Process (SLEP) schedule, and the fact that weapons must remain reliable for decades beyond the anticipated deployment period established when they originally were manufactured.

- *Pit Readiness Campaign* – will reconstitute pit manufacturing within the DOE nuclear weapons complex, including the reestablishment of the technical capability to manufacture all war reserve pits for the enduring stockpile at a capacity of 20 pits per year. These pits will be produced at LANL.

  End State: Develop an automated, expandable, robust manufacturing capability to produce stockpiled and new-design pits, without underground testing, within 19 months of the establishment of a need for a new pit, and with a stockpile life greater than the weapon system.

- *Secondary Readiness Campaign* – will ensure future manufacturing capabilities (equipment, people, and processes) are in place and ready for production of secondaries. This includes the reestablishment of special materials processing, replacement of sunset technologies, development of technical work force competencies, and the development of component certification/re-certification techniques. This Campaign develops, implements, and maintains the appropriate capability and capacity to accomplish Directed Stockpile Work, and responds to surge production scenarios to manufacture/remanufacture replacement components for all weapon systems in the active stockpile.

  End State: Develop the capability to deliver a first production-unit secondary with 36 months of receiving a request.

- *High Explosives (HE)/Assembly Readiness Campaign* – is focused on ensuring future manufacturing capabilities for high-explosive fabrication and weapon assembly.

  End State: Develop the capability for HE/assembly readiness by 2008, by providing the technologies, facilities, and personnel for high-explosives component manufacturing, production re-qualification, and weapon assembly/disassembly operations to support a Phase 6.4 (see Section 3.2.7) cycle time of 19 months.

- *Nonnuclear Readiness Campaign* – focuses on ensuring that future manufacturing capabilities for nonnuclear components will be available.

  End State: By FY 2006, bring all identified production vulnerabilities to an acceptable level of risk; develop advanced technologies to yield defect-free products at half the traditional cost and within 19 months after the need is defined.

- *Tritium Readiness Campaign* – will provide a source of tritium commensurate with the Secretary of Energy's Record of Decision announced in December 1998. This designated the Commercial Light Water Reactor (CLWR) as the primary technology option, with a linear accelerator option to be developed as a backup. New tritium is needed by approximately FY 2005.

  End State: By FY 2006 deliver tritium gas at a steady state to the Savannah River Site Tritium Loading Facility. Develop and demonstrate key components of linear accelerator and target/blanket technologies and complete preliminary design of Accelerator Production of Tritium (APT) Facility.

- *Material Readiness Campaign* – includes activities to support the construction of a new Highly Enriched Uranium (HEU) storage facility at Y-12. This will result in the consolidation of long-term HEU material at a state-of-the-art facility. It also will involve planning activities for new nuclear material storage vaults, to provide for long-term storage of national plutonium assets.

  End State: Develop by FY 2005 a fully integrated material management system supporting strategic material needs with either stockpiled material or the capability to produce new material.

- *Transportation Readiness Campaign* – will provide sufficient transport capacity to meet the requirements of the DOE and the DoD for safe and secure transportation of nuclear weapons, nuclear components, and other cargoes related to maintenance of the stockpiled weapons. It will field improved transportation equipment, and increase personnel training to counter postulated threats anticipated by the year 2010. The capacity will be at a level meeting the standards set for Transportation Safeguards Division (TSD) transport security. This is a multi-faceted campaign with improvements in both personnel and equipment.

End State: Field improved transportation equipment and increase personnel training to counter postulated threats anticipated by the year 2010; provide safe and secure transport of nuclear weapons and components.

2.1.4. Readiness In Technical Base and Facilities – Maintaining an appropriate infrastructure

Readiness refers to maintaining a state of preparedness to be able to perform necessary activities and functions now and into the future. In addition to ongoing activities, the SSP must maintain the capabilities to design, develop, test, and produce nuclear weapons in the future, if so ordered by the President. The Readiness in Technical Base and Facilities portion of the SSP serves all of these functions. It contributes in a real and tangible way to confidence in DOE's performance of stockpile stewardship. Readiness is required in three areas. First, it is essential to have high-quality, motivated people with the correct skills to carry out stewardship, resolve unanticipated technical issues, and resume design, development, testing, and production if it becomes necessary. Second, the proper infrastructure must exist to support the activities of these people, both from a stewardship perspective and from the perspective of resuming weapon development, testing and production. This infrastructure must be maintained and upgraded as technology evolves. Third, the special experimental and computational facilities needed for stewardship in the absence of nuclear testing must be developed. RTBF is at the heart of stewardship, and ultimately enables the DOE to be ready to develop, produce, and test nuclear weapons.

The primary goal of RTBF is to ensure that the infrastructure is in place and available to conduct the scientific, engineering, and manufacturing activities of the Stockpile Stewardship Program. It also encompasses those activities needed to ensure that the infrastructure – utilities, facilities, equipment – are operationally safe, secure and environmentally compliant within a defined level of readiness. RTBF also addresses safeguards and security needs, particularly cyber-security, at each of the sites. The remainder of this subsection summarizes RTBF activities related to facilities and infrastructure, test readiness, simulation infrastructure, and other activities in more detail. Human resources issues are addressed in Chapter 6.

RTBF activities are directed by DOE Federal personnel at Headquarters, supported by the Albuquerque, Nevada, Oakland, and Oak Ridge Operations Offices for contract management, and implemented by contractor personnel at the Lawrence Livermore National Laboratory, Livermore, California; the Los Alamos National Laboratory, Los Alamos, New Mexico; the Sandia National Laboratories, Albuquerque, New Mexico, Livermore, California, and Tonopah, Nevada; the Nevada Test Site, Las Vegas, Nevada; the Pantex Plant, Amarillo, Texas; the Kansas City Plant, Kansas City, Missouri; the Y-12 Plant, Oak Ridge, Tennessee; and the Savannah River Site, Aiken, South Carolina. Site-specific summaries of capabilities and ongoing and planned construction of planned major scientific facilities are contained in Appendix E.

Facilities and infrastructure. At the three Defense Programs laboratories and the test site, this includes operation of existing scientific facilities, planning for major new scientific facilities, and planning and construction of smaller facilities necessary to provide a modern, evolving infrastructure. The enormity of developing a comprehensive scientific understanding of all aspects of nuclear weapons has led the laboratories to develop a number of facilities that are unique and of a "national scale." Those presently under construction include the Dual-Axis Radiographic Hydrodynamic Test Facility (DARHT) at the Los Alamos National Laboratory (LANL), and the National Ignition Facility (NIF) at the Lawrence Livermore National Laboratory (LLNL). Considered for construction are the Advanced Hydrodynamics Facility (AHF) at LANL, which would enable high-resolution, multiple-axis proton radiography, and the Microsystems and Engineering Sciences Applications facility (MESA) at Sandia, which would provide research, design, and production capabilities for microsystem-based weapon surety options. To prepare for the large computer systems necessary to meet the SSP's simulation objectives, major new computer facilities are under construction at both LLNL and LANL as part of ASCI. Also at the three laboratories and the test site, there is a coordinated, ten-year plan to provide continuous updating of the physical infrastructure by planning, constructing, and eventually operating conventional facilities that are necessary to sustain a constant infusion of new technology into the four institutions.

At the production sites (Pantex Plant, Kansas City Plant, Y-12, Savannah River Site, and certain facilities at LANL and Sandia), facilities infrastructure activities follow a "science-based" approach that aims to provide a weapon production capability that will enable successful, timely execution of the SLEP schedule. The production facilities, in concert with the weapon design laboratories, must constantly address issues pertaining to facilities, technology, personnel, and business practices. Because of the past cost-saving efforts to downsize the nuclear weapons complex in place rather than build an entirely new, extremely expensive one, significant gaps exist in some areas of capability and capacity that will have to be overcome to prepare for the SLEP-driven future manufacturing mission.

The science basis for manufacturing processes must be established to validate the safety and reliability of produced components without nuclear testing. Science-based manufacturing involves increased application of process modeling and simulation, enhanced data collection for real-time product and process characterization, implementation of process-based quality, the use of modern development and production technologies, and the implementation of more effective technical business practices for seamless integration across the weapons complex. Examples of resulting actions include the identification of improved engineered controls, elimination of nonessential hazardous materials, and enhanced inter- and intra-lot quality pedigree. Examples of the benefits include shorter product cycle times, better-characterized products, reduced risk to the work force, and increased process efficiency.

Maintaining test readiness. Activities are conducted at the Nevada Test Site to preserve the skills and facilities required to resume testing within 24 to 36 months, if so directed by the President. Key and critical positions are identified for the functional areas necessary to safely execute an underground nuclear test. Overall readiness is supported by experimental programs conducted at the test site. In particular, test readiness at NTS is critically dependent on the Campaigns and laboratory-based experiments that exercise high-bandwidth recording and advanced diagnostic development that are not required for subcritical experiments.

Simulation and computing infrastructure. Simulation science plays a prominent, underpinning role in the SSP. A significant portion of RTBF focuses on providing the infrastructure necessary at each of the sites for ASCI. Major activities include:

- Acquisition of terascale computer systems;
- Development of problem solving environment software to enable effective use of massively parallel computers;
- Development of distance- and distributed-computing software, tools and systems;
- Development of extremely high-bandwidth data visualization capabilities;

- Partnerships with universities; and
- "Path forward" activities through which SSP is partnering with computer vendors to develop next-generation computer systems.

Other RTBF activities. The final category of RTBF comprises small but nevertheless important activities required for overall SSP success. Examples include waste management activities, water treatment, and seismic studies. Also included are education and technology partnership activities.

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3 The Requirements Process

3.1. National Requirements

THE UNITED STATES NUCLEAR weapons program remains the cornerstone of the nation's deterrence policy, and must be ready to carry out the President's orders for weapon employment, if necessary. The Stockpile Stewardship Program was established in response to the FY 1994 National Defense Authorization Act (P.L. 103-160), which called on the Secretary of Energy to "establish a stewardship program to ensure the preservation of the core intellectual and technical competencies of the United States in nuclear weapons." It is the policy of the United States Government that the nation's nuclear deterrent is to be maintained in the absence of underground nuclear testing. The SSP must meet the requirements for performance, safety, reliability and security set forth in Public Laws, Presidential Decision Directives (PDDs and NSDDs), the Nuclear Weapons Stockpile Plan (NWSP), the Nuclear Posture Review (NPR), and other national security guidance. DOE is also required by Public Law to provide for tritium production (P.L. 104-106 and 106-65), maintain a manufacturing infrastructure capable of meeting the objectives of the NPR (P.L. 104-106), and carry out a program to provide for the extension of the effective life of weapons in the stockpile (P.L. 106-65).

3.1.1. Nuclear Weapons Stockpile Plan

Annually, the President issues the Nuclear Weapons Stockpile Plan (NWSP), which is prepared by the Nuclear Weapons Council and forwarded through the Secretaries of Defense and Energy for approval. This sets the requirement to maintain a safe and reliable nuclear weapon stockpile, and specifies for Congress the number of warheads, by type, in the stockpile. Under the current NWSP (1998), DOE is required to support the stockpile at the Strategic Arms Reduction Treaty (START I) level. Should START II enter into force, DOE must continue to maintain the capability to return to START I levels under the "lead and hedge" strategy defined in the NPR and the Quadrennial Defense Review (QDR).

3.1.2. Nuclear Posture Review

In 1994, DoD conducted the Nuclear Posture Review, which was revalidated by the May 1997 DoD Quadrennial Defense Review. The NPR assumes in the future there will be no nuclear testing or fissile material production. The NPR further states that DOE is to:

- Maintain the capability to design, fabricate, and certify new warheads;
- Develop a stockpile surveillance engineering base;
- Demonstrate a capability to re-fabricate and certify weapon types in the enduring stockpile;
- Maintain a nuclear weapons science and technology base; and
- Ensure tritium availability.

3.1.3. Stockpile Stewardship Program Plan

The DOE Stockpile Stewardship Plan is a corporate-level, multi-year program plan that embodies DOE's strategy to ensure high confidence in the safety, reliability, performance, and security of the nuclear weapons stockpile. The Plan responds both to Presidential Directives and Public Laws. The Stockpile Stewardship Plan is prepared annually and is submitted by the Secretary of Energy to Congress by March 15 of each year, as mandated by the FY 1998 National Defense Authorization Act (P.L. 105-85, Sect. 3151).

3.2. DoD/DOE Relationship

THE PRESIDENT IS ULTIMATELY responsible for executing the nation' s nuclear weapons policy. The DoD and DOE work together at many levels to advise the President and carry out the policy. The success of the Stockpile Stewardship Program depends on a strong partnership between DoD and DOE. This relationship is codified in the 1953 memorandum of agreement, as amended, between the Atomic Energy Commission and the DoD, and in the Atomic Energy Act of 1954. It is further specified in the 1983 memorandum of understanding, which defines dual-agency responsibilities for nuclear weapons. The DoD is responsible for establishing military requirements, which are incorporated into the President' s NWSP; developing and operating complete weapon systems; training personnel; and maintenance of nuclear weapon employment plans. The DOE is responsible for conducting nuclear warhead research and development; producing nuclear warheads; performing stockpile surveillance; producing and managing nuclear materials; dismantling retired weapons; maintaining critical capabilities within the nuclear weapons complex (laboratories, production plants, and the test site); conducting sub-critical and other experiments; and advancing simulation capabilities in support of stockpile stewardship.

3.2.1. Nuclear Weapons Council

The Nuclear Weapons Council (NWC), established by the FY 1987 National Defense Authorization Act, is responsible for coordination and resolution of nuclear weapons issues that are of mutual interest to the DOE and DoD. The NWC is a joint DoD-DOE council codified and given specific responsibilities by Title 10, United States Code, Section 179. The NWC is comprised of three members: the Undersecretary of Defense for Acquisition, Technology, and Logistics, who serves as Chairman; the Vice Chairman of the Joint Chiefs of Staff; and a senior representative of the DOE selected by the Secretary (currently the Under Secretary). The Assistant to the Secretary of Defense (Nuclear, Chemical and Biological Defense Programs) serves as Executive Secretary and Staff Director for the Council. The NWC has one subordinate committee and one working group. NWC' s responsibilities include:

- Preparing the annual Nuclear Weapons Stockpile Memorandum;
- Developing nuclear weapons stockpiles options and the costs of such options;
- Coordinating programming and budget matters pertaining to nuclear weapons programs between the Department of Defense and the Department of Energy;
- Identifying various options for cost-effective schedules for nuclear weapons production;
- Considering safety, security, and control issues for existing weapons and for proposed new weapon program starts;
- Ensuring that adequate consideration is given to design, performance, and cost tradeoffs for all proposed new nuclear weapons programs;
- Providing broad guidance regarding priorities for research on nuclear weapons;
- Coordinating and approving activities conducted by the Department of Energy for the study, development, production, and retirement of nuclear warheads, including concept definition studies, feasibility studies, engineering development, hardware component fabrication, warhead production, and warhead retirement; and
- Preparing comments on annual proposals for budget levels for research on nuclear weapons and transmitting those comments to the Secretary of Defense and Secretary of Energy before the preparation of annual budget requests by the Secretaries of those departments.

3.2.2. Nuclear Weapons Council Standing and Safety Committee

The Nuclear Weapons Council Standing and Safety Committee (NWCSSC) is the joint senior executive and flag officer-level committee established to provide advice and assistance to the NWC. The NWCSSC coordinates and ensures completion of all actions destined for the NWC, conducts joint transactions between the DoD and the DOE, and generally deals with significant nuclear weapons matters that can be resolved without being elevated to the NWC. In particular, the NWCSSC acts (on behalf of the NWC) as the point of contact for DoD and DOE on all atomic energy matters that either Department determines relate to nuclear weapons research, development, production, maintenance, or dismantlement, allocation of nuclear material, and nuclear weapon safety matters. The NWCSSC has ten members:

- The Assistant to the Secretary of Defense (Nuclear, Chemical and Biological Defense Programs), who serves as Chairman;
- The DOE Principal Deputy Assistant Secretary for Military Application, who serves as Vice Chairman;
- The DOE Deputy Assistant Secretary for Military Application and Stockpile Operations;
- One member representing the Undersecretary of Defense (Policy);
- One member each from the Army, Navy, and Air Force;
- One member from the Joint Staff;
- One member from the United States Strategic Command; and
- One member from the Defense Threat Reduction Agency.

3.2.3. Nuclear Weapons Requirements Working Group

The Nuclear Weapons Requirements Working Group (NWRWG) enhances the deliberative decision-making process by creating a forum for additional senior-level attention to nuclear weapons issues. The NWRWG is a sub-group to the NWCSSC and its purpose is to review, prioritize, and where appropriate, more precisely define high-level DoD nuclear weapons requirements for inclusion in the annual NWSP, the DOE Stockpile Stewardship Plan, and other planning documents. Membership of the NWRWG is similar to that of the NWCSSC, with the addition of the Deputy Assistant to the Secretary of Defense for Nuclear Matters and deletion of the Assistant to the Secretary of Defense for Nuclear, Chemical and Biological Defense Programs, and the Army member. The Vice Chair of the NWCSSC, the DOE's Principal Deputy Assistant Secretary for Military Application, serves as NWRWG Chairman.

3.2.4. Project Officer Group (POG)

Every nuclear weapon or weapon family in the stockpile has a Project Officer Group (POG). There is also one POG for each retired system and one for use control. The POG is led by the appropriate military Service, and DOE field and laboratory personnel serve as members. DOE Headquarters staff are observers to the POGs. The POG is a field-level group that is dedicated to the well-being of its weapon, including development, modifications and alterations, resolution of significant findings, deployment, and maintenance. The functions of POGs for nuclear weapons include:

- Coordinating the design, development, test, weapon system integration, evaluation, and other life-cycle activities that are performed by the military Services and the DOE on joint DoD-DOE nuclear weapons activities;

- Making technological and interface tradeoffs that still meet the requirements and do not significantly change the Military Characteristics (MCs) or acceptability of the weapon, exceed program limits set by the DoD and DOE, or exceed guidance provided by the NWC and achieve the best balance between requirements and available DoD and DOE resources;
- Notifying the cognizant military Service and the NWC of interpretations of the MCs as a result of tradeoff decisions, and recommending changes to the MCs to the NWC; and
- Examining issues affecting safety, security, cost, performance, reliability, or other significant matters that may require resolution at higher levels in the DoD or DOE, or decisions by the NWC.

3.2.5. Other DOE/DoD Interactions

Due to the vital importance of the nuclear weapons stockpile, there are a number of other DoD, independent, and joint organizations and groups that study and recommend improvements for stockpile stewardship. Three of note are:

<u>STRATCOM</u> The mission of the United States Strategic Command (STRATCOM) is to deter military attack on the United States and its allies, and should deterrence fail, employ forces so as to achieve national objectives. STRATCOM deploys the vast majority of U.S. nuclear weapons, so close ties with the DOE are essential. The Commander in Chief, STRATCOM, annually issues a report and recommendations on Annual Certification, with the advice on technical issues of his Strategic Advisory Group.

<u>Defense Nuclear Facilities Safety Board</u> The Board is responsible for independent, external oversight of all activities in DOE's nuclear weapons complex affecting nuclear health and safety. The Board reviews operations, practices, and occurrences at DOE's defense nuclear facilities and makes recommendations to the Secretary of Energy that the Board believes are necessary to properly protect public health and safety.

<u>Defense Threat Reduction Agency</u> DTRA is responsible for nuclear weapon support and operations, on-site inspections, cooperative threat reduction, technology security, and defense against chemical and biological weapons. Close cooperation between DOE and DTRA is required in nuclear support, operations, and weapon-related personnel training.

3.2.6. Developing Stockpile Requirements

DSW activities to maintain the nuclear stockpile are accomplished through several DP vehicles, including the 6.X process, the SLEP, and the Production & Planning Directive (P&PD). Under the broad DSW umbrella, each of these vehicles contributes to the formulation and execution of weapon Life Extension Programs (LEPs). The 6.X process provides a robust system to develop Life Extension Options (LEOs). SLEP organizes the LEOs into discrete units, and allows for workload planning to balance the laboratory and plant workload levels over time, consistent with the needs of the stockpile, and the capacities of the laboratories and the production plants. SLEP culminates with a recommendation to DP management in the integrated weapon schedule, and when approved, the integrated weapon schedule is distributed to the field in the P&PD. Each of these DP vehicles are outlined below.

3.2.7. The 6.X Process

In the 1953 memorandum of agreement, the DOE and the DoD established a formal phased acquisition process to authorize the design, development, and production of new weapons. The phases in the process reflect the logical progression of necessary activity, and establish milestones to facilitate program management. The weapon life-cycle acquisition phases are:

Phase 1	Concept Development
Phase 2	Program Feasibility Study
Phase 2A	Design Definition and Cost Study
Phase 3	Development Engineering
Phase 4	Production Engineering
Phase 5	First Production
Phase 6	Quantity Production and Stockpile
Phase 7	Retirement/Storage

Because all enduring stockpile weapons are currently in Phase 6, an expanded process within this Phase is used to provide a framework for, and management of, weapon refurbishment. This process is referred to as the Phase 6.X process, and it provides a framework for DOE to conduct and manage modernization activities for existing weapons. A detailed work plan for implementing the 6.X process for modernization is being developed by the DOE, with input and coordination from the DoD. The proposed work plan still needs to be presented to, and approved by, the NWC. It makes the maximum use of the established structure, flow, and practices from the traditional acquisition process that previous weapon systems passed through, and applies to the new paradigm of refurbishing existing weapons. For purposes of the 6.X process, the enduring stockpile phase is designated Phase 6.0, and is the beginning and end point of the 6.X process. The individual phases (6.1 through 6.6) follow the sequence of the traditional acquisition process:

Phase 6.0	Quantity Production and Stockpile (presence in the stockpile before and after the refurbishment project)
Phase 6.1	Concept Assessment
Phase 6.2	Feasibility Study and Option Downselect
Phase 6.2A	Design Definition and Cost Study
Phase 6.3	Development Engineering
Phase 6.4	Production Engineering
Phase 6.5	First Production
Phase 6.6	Full-scale Refurbishment

Figure 1 illustrates the Phase 6.X major activities. Each phase ends with a major project decision to go forward into the next phase, to remain in the present phase, or to return to an earlier phase (including a return to Phase 6.0, which would be not to modify the weapon).

Phase 6.0 activities are those normal ongoing activities that occur on all stockpile systems. These activities may expose issue(s) that warrant development of concept(s) to address them. Phase 6.0 activities include:

- Routine maintenance, such as limited life component exchange, inspections, and tests, done on a recurring basis;
- Stockpile evaluation (also called "surveillance") to evaluate weapon systems for degradation of reliability, safety, or performance. The Stockpile Evaluation Program includes the Significant Finding Investigation (SFI) process for investigating and evaluating any significant anomalies observed in stockpiled weapons through surveillance;
- Annual certification to review the current health of the stockpile, and state whether a return to underground nuclear testing is required; and
- Baselining to assure that weapon system configuration is well understood and documented for reference in the event that future changes become necessary.

All Product Change Proposals (PCPs) are evaluated by DP for applicability to the Phase 6.X process. By default, the following go through the Phase 6.X process:

- All Modifications and Alterations (Mods/Alts), except for the Alt 900 Series;

Figure 1. Phase 6.X Major Activities

Phase	6.1	6.2	6.2A	6.3	6.4	6.5	6.6
Title	Concept Assessment	Feasibility Study & Option Downselect	Design Definition & Cost Study	Development Engineering	Production Engineering	First Production	Full-scale Refurbishment
Approval Authority	DOE or DoD	NWC or its delegates	DOE and DoD	NWC or its delegates	DOE	DOE	NWC or its delegates
Typical Length of Phase	6 Months	6 - 12 Months	6 - 12 Months	1 - 3 Years	1 - 2 Years	3-12 Months	Variable
Documentation	Refurbishment Option(s) Report	MIR Phase 6.2 Report IPR Report Validated MCs, STS & ICDs Draft Certification Plan Draft DPP & JIPP PID	RDCR Phase 6.2A Report IPR Report DPP JIPP	Draft Addendum to FWDR Baseline Cost Report Draft PCP Refined DPP & JIPP Preliminary DRAAG Report Approved MCs, STS & ICDs IPR Report	CERs QERs PMD IPR Report Updated DPP & JIPP SEP Final PCP	MAR Final DRAAG Report Addendum to FWDR IPR Report (Note 2) Updated DPP & JIPP	End-of-Project Report IPR Report (Note 2) Final DPP
Major Reviews (Note 1)		IPR	IPR	Preliminary DRAAG IPR	IPR	Final DRAAG IPR (Note 2)	IPR (Note 2)

Note 1 - This does not include the required management reviews, or reviews called out by the cognizant Laboratories

Note 2 - An IPR and IPR Report will be required if a conditional MAR is released or an issue develops in Phase 6.5 or 6.6.

CERs - Complete Engineering Releases
DoD - Department of Defense
DOE - Department of Energy
DPP - DOE Project Plan
DRAAG - Design Review and Acceptance Group
FWDR - Final Weapon Development Report
ICDs – Interface Control Documents
IPR - Interlaboratory Peer Review
JIPP - Joint Integrated Project Plan
MAR - Major Assembly Release
MCs - Military Characteristics
MIR - Major Impact Report
NWC - Nuclear Weapons Council
PCP - Product Change Proposal
PID - Planning Information Document
PMD - Program Management Document
QERs – Qualification Evaluation Releases
RDCR - Refurbishment Design and Cost Report
SEP - Stockpile Evaluation Plan
STS - Stockpile-to-Target Sequence

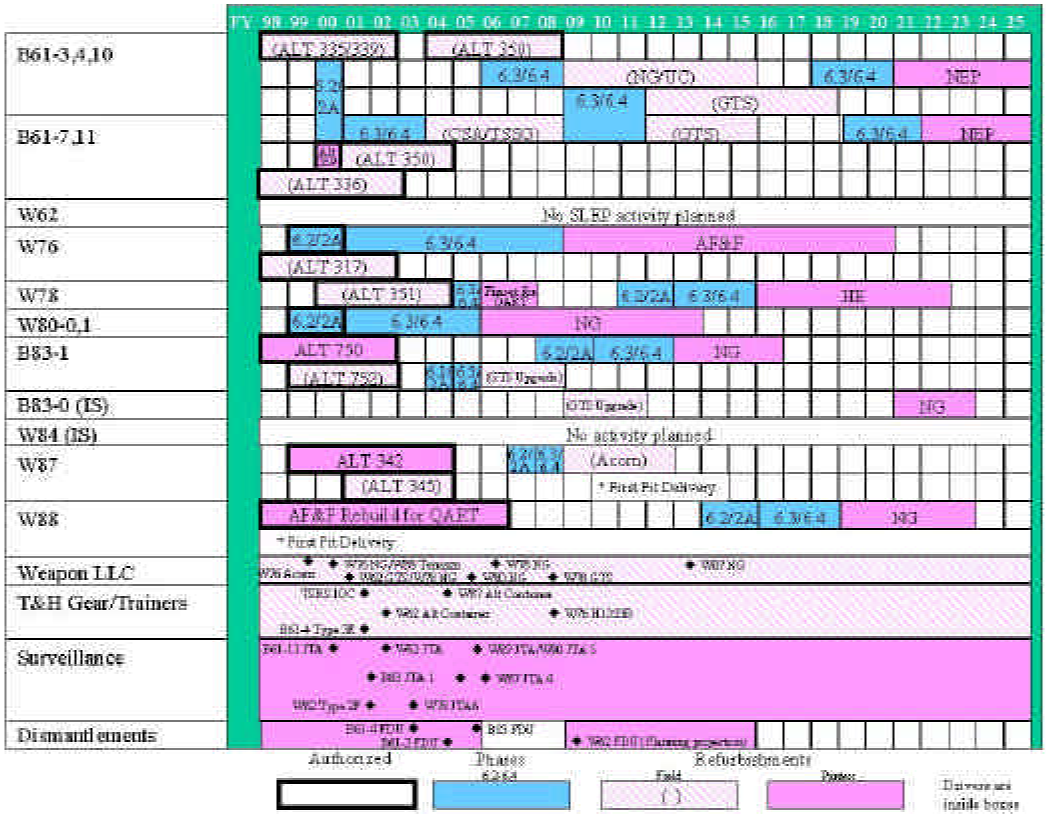
- Changes to the Stockpile-to-Target Sequence (STS) that require an alteration of a weapon; and
- Changes to the Military Characteristics (MCs).

The NWC or its delegates must approve all PCPs, changes to the STS that require a change to a weapon, and changes to the MCs.

3.2.8. The Stockpile Life Extension Process

The proposed Stockpile Life Extension Process schedule is shown in Figure 2. This schedule reflects input from the POGs and still needs formal approval by the NWC. The current SLEP schedule calls for refurbishment of the W80, W76 and B61 systems within the next decade. The SLEP schedule is documented in the DOE-issued annual Production & Planning Directive (P&PD), which provides the authority necessary to implement DP's responsibilities in support of the SSP, the NWSP, and the Requirements and Planning Document (formerly the Long-Range Planning Assessment (LRPA)). Additionally, the P&PD provides direction and guidance for all major stockpile requirements for FYs 2000-2005, and provides planning information for FYs 2006-2025. Phase 6.2/6.2A activities are underway for the W76 and W80. The results of these studies will be presented to the NWC in early 2000. Phase 6.2/2A activity on the B61 (all models) will commence in FY 2000. Production of refurbished W80 and W76 warheads is scheduled to start in FYs 2006 and 2008, respectively. Also shown in the figure are scheduled weapon Limited Life Component Exchanges (LLCEs), training, surveillance, and dismantlements.

Figure 2. The Stockpile Life Extension Schedule



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4 Impact of Arms Control Agreements on the Stockpile Stewardship Program

SEVERAL ARMS CONTROL AGREEMENTS and related national policies directly impact the Stockpile Stewardship Program. These include the Comprehensive Test Ban Treaty, the Presidential moratorium on nuclear underground testing, the START I and START II Treaties, and the possible framework for a future START III Treaty.

4.1. Comprehensive Test Ban Treaty

THE COMPREHENSIVE TEST BAN TREATY (CTBT) will – after it enters into force – prohibit "all nuclear weapon test explosions or other nuclear explosions anywhere in the world." It was adopted on September 10, 1996, by the United Nations General Assembly by a vote of 158 to 3, with 5 abstentions, after two and one half years of negotiation at the 61-nation Conference on Disarmament in Geneva, Switzerland. On September 24, 1996, the treaty was opened for signature at the United Nations, and President Clinton signed it on behalf of the United States. As of September 30, 1999, 155 nations had signed the treaty, including the five that have nuclear weapons. To enter into force, 44 nuclear-capable states must ratify the treaty. To date, 51 nations have ratified the treaty, including 26 of the required 44. On October 13, 1999, the U.S. Senate rejected the CTBT by a vote of 51 to 48, with one abstention, after three days of hearings. That same day, the President reaffirmed the United States' policy to refrain from nuclear testing, stating that "the United States will continue, under my presidency, the policy we have observed since 1992 of not conducting nuclear tests."

4.2. START I/II

AT THE MARCH 21, 1997, Helsinki Summit, President Clinton and Russian President Yeltsin underscored their interest in further nuclear warhead reductions beyond START I and II, as well as the need to monitor nuclear warhead inventories, nuclear warhead dismantlement, and fissile materials resulting from warhead reductions. At the conclusion of the Summit, the Presidents agreed that once START II is ratified by the Russian Duma and enters into force, the United States and Russia will immediately commence negotiations on a START III agreement. In August 1999, the United States and Russia commenced discussions, but not negotiations, about START III and potential modifications to the Anti-Ballistic Missile Treaty to accommodate a U.S. national missile defense deployment.

The impacts of START I and II center on Department of Defense strategic force structures, and involve the downloading of ICBMs and SLBMs, and the elimination of some strategic nuclear delivery vehicles. START I and II affect DOE in terms of the stockpile size and composition, warhead return, transportation schedules, and the dismantlement of excess warheads. Under START I and II, there are no Russian on-site inspections at DOE facilities. START III will be the first treaty to significantly impact DOE operations because of its warhead and fissile material transparency components. Impacts resulting from additional reductions in the size of the stockpile are not expected to be significant.

The stockpile workload requirements do not significantly change between START I and II, because the total stockpile size does not appreciably change. Most weapons removed from active status under START I will be placed in the inactive stockpile to meet "lead and hedge" requirements contained in the NPR. These weapons' limited life components will be removed, but the warheads will still undergo life extensions as defined by the SLEP schedule. The dismantlement workload will increase slightly for the few weapons that will be retired. There is an anticipated small reduction, on average, in the SLEP workload as systems are retired. The relative timing for refurbishments and dismantlements has yet to be determined, and capacity at Pantex will need to be sized to accommodate the simultaneous requirements of both.

4.3. START III

START III MAY REQUIRE the DOE to dismantle excess nuclear warheads resulting from a new lower accountable level of 2,000-2,500 strategic nuclear warheads. It may also require that the DOE prepare, negotiate, and implement transparency measures at both U.S. and Russian facilities to provide confidence that dismantlement and destruction of some number of nuclear warheads actually takes place. It is anticipated that START III provisions will be expanded in future follow-on treaties, so potential impacts to DOE and DoD operations must be considered carefully.

Modifications to Pantex operations, equipment, and facilities are being examined to ensure that potential START III transparency requirements can be implemented without adverse impact to the SSP and its annual certification requirements.

The stockpile workload will change under START III. The overall reduction in delivery system numbers, in addition to a potential negotiated quantity of warhead dismantlements, will increase the dismantlement workload. This dismantlement workload will need to be reconciled with the required SLEP refurbishment schedule.

4.3.1. Goals

Helsinki's START III goals include:

- Establish lower aggregate levels of strategic nuclear warheads in the U.S. and Russia;
- Promote transparency of strategic nuclear warhead inventories and the destruction of strategic nuclear warheads; and
- Promote irreversibility of reduction in strategic nuclear warhead inventories, including prevention of a rapid increase in the number of warheads.

4.3.2. Issues

- Intrusiveness of the START III regime and its impact on stockpile stewardship, especially at a time of increased SLEP work;
- Protection of classified and sensitive information from being inadvertently revealed to Russian on-site inspectors; and
- The potentially unfunded costs of implementing the START III regime, which would be a requirement above existing stockpile stewardship commitments. Because the implementation details of any START III agreement presently are undetermined, the associated budget requirements are not known. The cost of any START III provisions outside of normal DOE operations must be considered as additional to the current Stockpile Stewardship Program budget.

4.3.3. Technical Approach

The START III planning effort at DOE has been active since the March 1997 Helsinki Joint Statement. DOE is continuing to evaluate the impact of potential START III monitoring activities at various facilities in the DOE nuclear weapons complex. The national laboratories have contributed by assessing the risks to stockpile stewardship, and by participating in a number of working groups to prepare DOE for START III discussions. Milestones for START III planning are contingent on the pace of negotiations.

4.3.4. Risks

By adding a significant requirement to support a new arms control regime, DOE's flexibility for performing weapon operations at Pantex will likely be reduced. The DOE has a responsibility to maintain the safety, reliability, and performance of the stockpile, and any provisions that hinder that mission must be carefully considered. Any Russian inspection at Pantex will disrupt normal weapon operations and will require planning and extensive operational and security measures to ensure that the health of the enduring stockpile is not compromised. DOE will fully support any funded initiatives agreed to by the United States, but will also work to mitigate any risks by careful planning and implementing provisions that place support of the stockpile as the highest priority.

4.3.5. Integration

4.3.5.1. Other Programs/Campaigns

Stockpile stewardship activities are likely to be affected by the provisions of START III, especially if it requires an intrusive regime at the Pantex Plant. A Russian presence at DOE's only assembly and disassembly facility could fundamentally alter the flow of material and information through the nuclear weapons complex.

Transportation Readiness: Warheads must be transported from DoD facilities to the Pantex plant for dismantlement. Weapons "in process" between the DoD and DOE are not expected to be monitored under START III provisions.

4.3.5.2. Sites

Because Pantex is DOE's single facility for assembly and disassembly of weapons, it will likely be the major focus of provisions of START III that affect DOE. Y-12 may be affected by provisions for monitored storage of fissile material from warheads dismantled under START III. Expertise from the national laboratories and DOE Operations Offices is important to ensure provisions of START III do not unacceptably affect stockpile stewardship. It is not expected that the laboratories or other DOE facilities will be directly affected by START III, but it will be necessary to prevail upon the expertise at the Defense Programs laboratories, production plants, and the DOE Operations Offices to ensure that provisions of START III do not affect unacceptably stockpile stewardship activities.

4.3.5.3. Other Offices, Agencies and Organizations

DOE's Office of Defense Programs and the Office of Nonproliferation and National Security are working together to formulate a recommended DOE position regarding START III. The Office of Fissile Material Disposition is involved to ensure a smooth handoff of fissile material resulting from START III dismantlements to organizations focusing on material disposition. Other agencies represented on the National Security Council-led Arms Control Interagency Working Group are the Department of Defense (Office of the Secretary of Defense and The Joint Staff), the Department of State, and the Central Intelligence Agency.

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5 Accomplishments

ONE METRIC FOR EVALUATING the success of the SSP is to examine program accomplishments in the areas of stockpile maintenance, surveillance, assessment and certification, design and manufacturing, simulation and modeling, and experimental facilities.

5.1. Stockpile Maintenance

THE DOE IS RESPONSIBLE for maintaining the existing stockpile with capabilities to design, develop, and produce components. The primary strategy of stockpile maintenance is to preserve the readiness of the stockpile by meeting directed stockpile requirements by supplying hardware for limited life component exchanges (LLCEs), stockpile repairs, stockpile rebuilds, and by supporting the military by providing assistance in training, publication of manuals, and development of test and handling equipment. Stockpile maintenance also provides long-range support to the stockpile through life extension that includes refurbishment and modernization. Life extension activities include studies to define and establish appropriate alterations or modifications necessary to modernize and extend the life of the weapons for an additional 30 years.

Accomplishments in these areas include:

- Developed the Stockpile Life Extension Process.
- Completed three annual certifications of the stockpile, which resulted in no requirement for underground nuclear testing.
- Developed, certified, produced, and fielded the B61-11 to replace the B53 bomb.
- Conducted field retrofits to enhance the surety of the B61 bomb.
- Completed W76 Dual Revalidation.
- Fielded SafeGuard Transporters (SGT) to enhance the security of weapons in shipment.
- Began first production of the W76 ACORN and Neutron Generators.
- Resumed uranium operations at Y-12 Plant.
- Made the first W88 development unit pit at LANL.
- Conducted hi-fidelity flight testing.
- Developed 51 gas generators and 808 tritium reservoirs in FY 1999, required to keep weapons operational.
- Began the 6.2/2A life extension study for the W76.
- Began the 6.2/2A life extension study for the W80.
- Achieved first production unit and delivery to DoD of the W87 LEP.
- Began the planning for the 6.2/6.2A life extension study for the B61.

5.2. Stockpile Surveillance: Predicting and Detecting Problems

STOCKPILE SURVEILLANCE HAS BEEN a major element of the U.S. nuclear weapons program ever since the first weapons were put into service. Approximately 14,000 weapons have been examined and subjected to a variety of nonnuclear experiments and flight tests since 1958. In cases where these nonnuclear tests could not provide conclusive answers, nuclear tests of stockpile warheads or warhead components were conducted. All of the warhead types in the enduring U.S. nuclear weapons stockpile have had repairs or retrofits, and several have required repairs to the nuclear explosive package.

To successfully maintain an aging stockpile, new surveillance methods and predictive capabilities are needed so that the full range of problems that may arise in the enduring stockpile can be detected. There is also a need to predict and identify aging-related changes and their potential effects on warhead safety and performance. Some changes may have little or no effect, whereas others could make a major difference. The prohibition against performing nuclear tests has put a high premium on the fundamental understanding of the properties and response of stockpile materials. Of particular importance is the development of advanced capabilities–experimental, theoretical and computational–to predict physical properties of matter under the extremely broad range of dynamic conditions found in nuclear explosions. These include materials, radiative, and nuclear properties. These efforts are primarily supported by the Enhanced Surveillance Campaign, the Dynamic Materials Properties Campaign, and the Defense Applications and Modeling Campaign.

Accomplishments in this area include:

- Pits - The program has established the dominant aging mechanisms for pits and begun testing old pit materials. The program has begun fabrication of accelerated aging alloys, and has also fielded a suite of diagnostic tools to test new and aged samples.
- Canned Subassemblies (CSAs) - The program has established the principal aging mechanism for CSAs and selected units from specific weapon types for special study. The work has resulted in CSA types being ranked by potential for corrosion and assessed lifetimes of key components. Work has also established a three-dimensional war reserve compatibility model, demonstrated neutron imaging as a superior system for flaw detection, and developed corrosion protection systems.
- High Explosives (HE) - The program has demonstrated that main charge high explosives are aging gracefully. It has also provided recommendations regarding reuse of main charges for the W87 and W76 life extension programs. The program has also demonstrated that aging does not degrade safety during impacts in accident conditions. To support continued monitoring of identified signatures of aging, the program has developed and delivered several new HE performance tests to the routine surveillance program.
- Systems - The program has used new miniaturized instrumentation to characterize key features during missile flight while preserving system fidelity to the greatest extent possible.
- Non-nuclear components - Accomplishments in this area center on the characterization of components and the fielding of tests to monitor changes in components. The program has categorized the large number of non-nuclear components to identify those most likely to exhibit aging effects, those most important to weapon performance, and those most pervasive in the stockpile. One example of a new test is an examination tool to rapidly screen an important component for weld flaws.
- Non-nuclear materials - The program has developed and implemented a non-destructive method to monitor warhead space (sealed volumes) for signs of organic-chemical degradation. Data from the program also avoided replacement of components in fielded units by understanding component behavior.
- Fundamental Plutonium High-Pressure Thermodynamic Properties - The first-principles determination of the high-pressure properties of plutonium illustrates fundamental advances in our ability to predict the properties of actinides under conditions of relevance to stockpile performance.
- Hydrogen equation-of-state (EOS) - Equation-of-state experiments on hydrogen isotopes revealed important behavior at Mbar pressures, highlighting the difficulties with

theories of matter undergoing strong shocks. For example, gas gun experiments have succeeded in “metallizing” fluid hydrogen under shock-loading conditions above 1.4 Mbar. The existence of a metallic phase of hydrogen confirms a fundamental prediction made 50 years ago.

- High-Performance Quantum Simulations of HF-H_2O Fluid Mixtures - Detonation of insensitive high explosives (IHE) produces hydrogen-bonded HF and H_2O. The performance of IHE is sensitive to the presence of these molecules, but there is no experimental data because of the highly corrosive nature of these mixtures. Quantum-level terascale ASCI calculations to simulate an equimolar mixture of HF and H_2O have been performed to elucidate the structural and thermal properties of these mixtures at high pressure and temperature. These simulations revealed structural information at high pressure and temperature, showing the formation of stable $F^{-}(H_2O)^+$ complexes.

- Discovery of Polymeric Carbon Dioxide - The existence of extended-solid forms of major detonation products (CO_2, N_2, C, H_2O) at high explosive (HE) detonation conditions provides critical information for developing predictive HE performance models. In a breakthrough discovery, a team of LLNL scientists has synthesized a new extended-solid form of polymeric CO_2 under conditions of ultra-high pressures and temperature. The CO_2 polymer–a carbon-based analogue to α-quartz (SiO_2)–was also found to be an optically non-linear, super-hard material, which could lead to new technology innovations. This discovery has led to many scientific publications in 1999, including in Science, Phys. Rev. Lett., The New York Times, C&E News, and Laser Focus World.

- Laser-Driven Nuclear Physics - As part of the studies related to the National Ignition Facility (NIF) and laser-driven radiography, observations of nuclear physics phenomena produced by the interaction of an extremely powerful laser with matter have been performed. In particular, measurements of the production of 100 MeV electrons, the fission of nuclei, and the production of anti-matter have been performed.

- Gold Opacity Measurements - Recent opacity experiments on the Nova (LLNL) and Omega (University of Rochester, Laboratory for Laser Energetics) lasers have extended Rosseland mean opacity measurements into new areas. Opacity measurements of high temperature gold plasmas have resolved large differences between opacity models that affect the design and interpretation of a large class of stockpile stewardship experiments on lasers and pulsed power devices. The experiments have also proven the techniques needed for the high temperature opacity experiments proposed for the NIF.

- Los Alamos Neutron Science Center (LANSCE) Neutron Total Cross Sections - Measurements of the total cross section for neutrons on 37 different nuclei to an accuracy of 1% for neutrons in the energy range from 5-600 MeV have been performed. These precision measurements represent a significant step forward in the nuclear data needed in the evaluation of nuclear cross sections for stockpile calculations and provided important input to the design of projects involving spallation neutron sources (APT, *etc*.). The program is being expanded to lower neutron energies interacting with nuclei in the actinide region.

- 1998 American Physical Society Award for Excellence in Plasma Physics - Awarded to Peter Celliers, Gilbert Collins, Luiz DaSilva, and Robert Cauble, LLNL.

- 1997 American Physical Society Award for Shock Compression Science - Awarded to William Nellis and Arthur Mitchell, LLNL.

5.3. Assessment and Certification: Analyzing and Evaluating

DATA AND TEST RESULTS must be analyzed, assessed, and evaluated before conclusions can be drawn regarding the safety and reliability of stockpile warheads. A significant imperative of assessment and certification is to conduct a program using the best tools available to baseline the existing stockpile while a number of experienced designers with nuclear test expertise remain to mentor new designers. This baselining activity is an integral element of DSW. There are many areas of warhead operation that cannot be adequately addressed with existing tools and the current knowledge base of the weapons scientists and engineers. Of particular concern is the assessment challenge posed by heretofore unrecognized problems. The SSP must support rigorous computational and experimental processes not only to confirm and extend what is known and expected but also to close gaps in our current understanding. This ability to fill in gaps is especially important in those areas where nuclear testing would have been used to bound the margins of our concerns in the past.

In the absence of nuclear testing, different experiments and tools must be relied on to obtain data relevant to nuclear warhead performance. However, because these older tools were designed to complement nuclear testing, they are not, in and of themselves, sufficient in the absence of nuclear testing. A suite of enhanced capabilities and facilities that will be used to fill in the knowledge gaps and provide data relevant to various stockpile concerns has been identified.

These efforts are principally supported by the Primary Certification Campaign, the Secondary Certification and Nuclear-Systems Margins Campaign, the Certification in Hostile Environments Campaign, the Weapon System Engineering Certification Campaign, the Advanced Radiography Campaign, and the Inertial Confinement Fusion (ICF) Ignition & High Yield Campaign.

Accomplishments in these areas include:

- Multi-laboratory radiation-flow experiments have been performed on ICF facilities, Nova, Omega and Z, confirming that AGEX experiments coupled with detailed modeling can meet weapons physics goals.
- The conditional certification of the MC4380 neutron generator to hostile environments without UGT tests demonstrated the efficacy of a certification process based on validated models plus AGEX experiments, pending reconfiguration of the Annular Core Research Reactor (ACRR).
- Advances in ICF target physics, especially higher efficiency hohlraum-capsule designs, are reducing the technical risk in achieving ignition on NIF.
- Equation-of-state experiments on deuterium at the Nova laser won the Excellence in Plasma Physics Award of the American Physical Society. These results impact analysis of weapon performance and provide improvement of anticipated ignition experiments at the National Ignition Facility.
- Developed preliminary models to support certification of weapons systems in the normal flight environment.
- Developed model of mass transport in weapon secondaries, and provided framework for long-lived secondary assemblies.
- Developed preliminary computational baseline models for some aspects of the W80 nuclear explosive package.
- Developed computational engineering models for structural and thermal analyses.
- The first hydrodynamic test was successfully completed using the first axis of the DARHT facility. The improved radiographic performance offered by this facility will be crucial to developing the needed resolution for benchmarking primary code calculations and assessing system perfor-

mance re-certification of the existing stockpile or future remanufactured weapons.

- With the commissioning of DARHT, research leading to the next generation of advanced hydrodynamic testing has been demonstrated through time-resolved imaging of weapon parts, proving the applicability of proton radiography for primary simulation and testing.

- A concept for proton radiography, based in part on improved image focusing techniques, has opened a possible route to multi-time, multi-view radiographic images of dynamic behavior in nuclear weapon conditions. The viability of this approach has been demonstrated with dense, static targets at the Alternating Gradient Synchrotron at Brookhaven National Laboratory, and multi-time images in low-density dynamic implosions with LANSCE at Los Alamos.

- Conventional hydrodynamic testing has successfully shown that the low-temperature performance of insensitive high explosive (PBX 9502) primaries conforms to design intent. These tests, coupled with the first-time imaging of HE burn around corners utilizing LANSCE, have greatly enhanced the capabilities for certifying weapon performance at extreme conditions within the STS.

- Subcritical experiments were successfully performed to enhance data for high-pressure EOS and ejecta evolution for plutonium. First-ever data for the actual EOS of the current weapon-grade plutonium were obtained and found to be consistent with expectations. Ejecta experiments were performed and demonstrated the capability to image and quantify the temporal and spatial distributions of surface ejecta. These experiments, combined with the results of the Materials Dynamics and Enhanced Surveillance Campaigns, will form the basis of new primary simulations that more accurately model real material performance.

- A series of experiments leading to the performance of full-scale systems tests were successfully completed to examine anomalous case fracture incidents. Correlations between manufacturing defects and accelerated case deformation were accomplished validating the experimental techniques for upcoming full-scale system tests.

5.4. Design and Manufacturing: Refurbishing and Certifying

WITH AN IMPROVED UNDERSTANDING of the effects of aging on warhead safety and reliability, developed through the enhanced surveillance and assessment efforts, DOE will be able to take a proactive approach to refurbishment. The goal is to replace or fix components through systematic modernization, before aging-related changes jeopardize warhead safety or reliability. The DSW Stockpile Life Extension Process (SLEP) provides the framework for research and development activities and production planning that will strive to overcome these and other hurdles facing stockpile stewardship. To complicate this effort, some manufacturing processes and capabilities are no longer practical. Replacement of these processes and capabilities is a significant challenge to the maintenance of the U.S. nuclear deterrent.

The six production readiness Campaigns–Pit Readiness, Secondary Readiness, HE/Assembly Readiness, Nonnuclear Readiness, Tritium Readiness, and Material Readiness–and the ADAPT and Enhanced Surety Campaigns are required to sustain the manufacturing base within the nuclear weapons complex.

Accomplishments in these areas include:

- W87 First SLEP–Successfully met the first production unit milestones and delivery for initial operational capability, and is continuing to provide units to the DoD.

- Underground Nuclear Test Readiness– During FY 1999, DOE and DoD (Program Analysis and Evaluation) assessed the DOE's readiness to resume underground nuclear testing within the two to three year period directed by the President. The review team concluded that readiness is adequate, provided that funding does not decrease. The Nuclear Weapons Council (NWC) accepted the analysis, but requested an evaluation of additional test scenarios and the possibility of reducing the readiness period. This work is underway.

- Assessed age-induced replacement needs in support of the W80 and W76 6.2 studies.

- Enhanced Surety.

  - Designed direct optical initiation and optically-isolated micro CDU compatible with the W76 and W78;

  - Initiated the EUCOM PAL Theater Secure Recode System;

  - Designed and validated infrared sources for sensors and subminiature triggers;

  - Fabricated parts for integrated miniature strong link;

  - Completed W78 slow heat studies;

  - Continued installation of B61-3/4/10 Alt 339 and 335;

  - Resolved 10 items regarding safety studies and safety assessments;

  - Achieved FSED for new security concepts in FY 1999;

  - Started 6.x studies for W76 and W80;

  - Introduced encrypted PAL in the B83-1 Quality Improvement Program;

  - Demonstrated micro firing set;

  - Initiated the fielding of the B61-11 allowing the retirement of the B53-1;

  - Developed, certified, and fielded the T1565A to replace the T1565, which was not Y2K compliant; and

  - Successfully utilized interactive electronics procedures on test-bed assembly.

- Advanced Design and Production Technologies (ADAPT).

  - Interconnected the distributed nuclear weapons complex via SecureNet;

  - Used electronic data capture and networked access to acceptance data across the design and production complex for the W87 LEP;

  - Developed and used a model-based approach for product realization of telemetry systems, nuclear weapon components, assemblies, and test hardware;

  - Developed and applied computer models of sites and processes in planning and resource scheduling;

  - Applied virtual prototyping methods to neutron generator design and certification, and used visualization techniques to identify unknown weapon performance issues;

  - Completed and deployed new processes to recycle nitric acid used in plutonium operations and dispose of HE in an economical and environmentally acceptable manner; and

  - Demonstrated for the first time in the nuclear weapons complex, a totally paperless Product Definition Release.

- Pit Readiness.

  - Identified all manufacturing processes (~103) needed to produce new W88 pits;

  - Deployed all but three of the manufacturing processes;

  - Forty-four processes will require design-agent and production-agent qualification approval. Twenty-four plans have been completed, and all plans will be completed by January 2000;

- Manufactured four complete pit development units, and another one is scheduled for completion in November 1999; and
- Manufactured twelve process-development shells.

5.5. Simulation & Modeling: Underpinning the Stockpile Stewardship Program

COMPUTATIONAL MODELING AND PREDICTION are integral to every activity within the Stockpile Stewardship Program, and underpin our ability to maintain confidence in the nuclear deterrent under a no-nuclear-testing regime. ASCI provides the leading-edge, high-end simulation capabilities needed to meet weapon assessment and certification requirements without nuclear testing. To accomplish this, ASCI integrates the resources of the national laboratories, computer manufacturers, and academia.

Accomplishments in the ASCI Program include:

Applications

- See classified ASCI accomplishments in the compilation of 30-Day Review STRATCOM presentations.
- ASCI simulations have enabled the certification of the MC4380 neutron generator. This is the first radiation-hardened component to be certified without an underground nuclear test.
- Resolved a nuclear test anomaly by using a 3-D ASCI application code. The calculation required four months on ASCI Blue Mountain, and would have required 80 years on a Cray-class supercomputer.
- Simulated a nuclear-test diagnostic measurement for the first time. The calculation took one day on ASCI Blue Mountain, and would have required 2-3 years on a Cray-class supercomputer.
- Simulated re-entry body response to a hostile radiation environment. The analysis was requested by DoD to define a future STS test program.
- High-fidelity confinement vessel simulation was performed to support the hydrodynamic experimental program. The simulation was run on ASCI Blue Mountain using 1 million brick elements to simulate structural and dynamic response of the vessel.
- High-fidelity casting simulations have been done in parallel using Telluride in support of the W88 pit rebuild.
- The Eolus project computed simulated radiographs of an experiment that reduced background signal levels by greater than a factor of 150 for DARHT.
- Current "hero" calculations can do 1,000 or more time steps on a billion-cell mesh, creating datasets in the 10-100 terabyte range.
- During CY1998, multiple weapons applications were scaled to run on many thousands (>5,000) of processors.

Platforms

- The world's three most powerful computers are the current ASCI platforms at Los Alamos, Livermore, and Sandia National Laboratories.
- Performance of the present day ASCI machines (Blue Pacific at Lawrence Livermore, Blue Mountain at Los Alamos, and Red at Sandia) is between three and four TeraOPS.
- ASCI Red (SNL) ran the first ever demonstration of a sustained TeraOPS capability (1.068 TeraOPS, 1.068×10^{12} floating-point operations per second) on December 4, 1996. This was the first demonstration of a sustained TeraOPS capability by a general purpose computer system.

- Both ASCI Blue systems were delivered in the Fall of 1998 (3-5 months ahead of schedule). Programmatic usage of this platform is extremely high and many historic scientific calculations (world record number of zones, complexity of calculations, *etc*.) have been performed.

Physics and Materials Modeling

- A new high-explosive grain-level model has been developed and incorporated into an ASCI application code for assessment of its utility on stockpile problems.

Verification and Validation

- A baseline survey of software quality assurance (SQA) practices was completed for all ASCI code projects at all three labs.

Problem Solving Environments

- New programming methodologies and software architectures used in ASCI code development have dramatically decreased the time and effort required to parallelize simulation codes.

Distance- and Distributed-Computing (DisCom2)

- A parallel high-performance network architecture has been demonstrated and is ready for wide area deployment in FY 2000.

Visualization and Interactive Environment for Weapons Simulation (VIEWS)

- Initial versions of the Data and Visualization Corridors (DVCs) have been deployed at all three laboratories, and have been used in support of the neutron generator certification and the ASCI applications burn-code mileposts.

University Partnerships–University Alliances and Institutes

- ASCI has established partnerships with universities under the Alliances program. This involves over 400 university researchers that are providing valuable expertise in algorithms development and potential access to future program personnel.

National Awards received by the ASCI Program

- 1999 Gordon Bell Prize for high-resolution, 3-D simulations of Richtmyer-Meshkov instability and mixing using the ASCI Blue Pacific SST supercomputer.
- 1998 VeriBest Superior Systems Award: Reconfigurable Communications Hardware Board, SNL.
- 1997 R&D 100 Award: High Performance Storage System, a collaboration of LLNL, LANL, ORNL, SNL and IBM Global Government Industry.
- 1996 R&D 100 Award: Scalable Asynchronous Transfer Mode (ATM) Encryptor, SNL.
- 1996 R&D 100 Award with Giganet for network performance among massively parallel computers.

5.6. Experimental Facilities: Underpinning the Stockpile Stewardship Program

NEW EXPERIMENTAL CAPABILITIES WILL be required to achieve certification in the absence of underground nuclear testing. These include subcritical experiments, as well as advanced experimental facilities to provide high-resolution data on the stages of nuclear explosions. The facilities are Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility and the National Ignition Facility (NIF), which are currently under construction, and Atlas, which is in detailed design. Also included is the Short Pulse Spallation Source enhancement to the Los Alamos Neutron Science Center (LANSCE), which is an upgrade to an existing facility. In addition, the need for an Advanced Hydrotest Facility (AHF) is being studied for the future.

The first axis of DARHT has been brought into operation as the lead facility for radiography of dense objects. The second axis of DARHT, to provide two views and four time sequenced pictures, is under construction, and is scheduled for completion at the end of FY 2002.

Accomplishments include:

- LANSCE–A proof-of-principle demonstration for proton radiography successfully culminated in the firing of the joint Los Alamos/UK-AWE experiment named "Billi G." The dynamics of this first-of-its-kind experiment were captured in a 14-frame series spanning a few microseconds. This demonstration not only illustrated the multi-framing capabilities but also the ability to examine realistic objects of relevant radiographic density with protons.
- Chemistry and Materials–Orientation Imaging Microscopy has revealed that the probabilistic nature of uranium hydride reactions is significantly controlled by the uranium microstructure. Results indicate that specific uranium crystallographic orientations are most rapidly attacked when exposed to hydrogen. This work will enable a correlation between uranium components that have been subjected to a variety of manufacturing processes resulting in varied but predictable microstructural conditions and eventual hydride corrosion susceptibility.
- Subcritical Experiments–Three subcritical experiments were successfully conducted during FY 1999, as planned. Los Alamos National Laboratory executed Cimarron. Lawrence Livermore National Laboratory completed Clarinet and Oboe 1. Oboe is a series of small subcritical experiments in vessels. All three experiments obtained data on the behavior of plutonium subjected to shock from high explosives.
- High Temperature Hohlraums for Stockpile Stewardship Program Experiments–Experiments demonstrating the creation of high temperature hohlraums on Nova have validated NIF capabilities critical for the Stockpile Stewardship Program.
- DARHT–Successfully conducted (November 8, 1999) first hydrodynamic test, marking the operational readiness of the first axis of DARHT. The second axis is to be completed in 2002.
- NIF–The NIF conventional facilities, including target-chamber installation, and pilot optics production are on schedule and meeting their goals. However, installation of laser equipment has proven more complex than anticipated originally, and will take longer and cost more than planned.

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6 Stockpile Stewardship Program Challenges - Now and in the Future

THE STOCKPILE STEWARDSHIP PROGRAM faces many significant challenges as it moves into the future. These challenges center on making the right decisions for an uncertain future. The SSP's approach is to ensure that production capabilities and capacity are in place when needed, to have the significant experimental and computational facilities available in time to annually certify the stockpile, and in time to impact the SLEP schedule, and to preserve premier science and engineering capabilities to maintain, refurbish and modernize nuclear weapons.

With the new business model of Campaigns, DSW, and RTBF, DP is implementing new methods for addressing a broad range of stockpile issues. The SSP now has the management tools to redefine the program and make difficult decisions. For example, DP has defined criteria for certifying reliability, design, and production readiness for FY 2005. Establishing these criteria has resulted in tightly coupled experimental programs and readiness efforts with measurable deliverables. With the new business model, the program accepts that meeting DSW milestones requires limits to experiments and options. In a similar manner, the program has also addressed the challenge of defining and executing test readiness. In most cases, meeting these challenges has forced the SSP to develop new approaches that support the program's commitments both to directed stockpile work and to sustaining the science and engineering base needed to maintain a safe, secure, and reliable stockpile.

6.1. Personnel Challenges

THE ULTIMATE SUCCESS OF the SSP depends on the excellence of the scientists, engineers, and managers at the laboratories, production plants, test site, and at DOE. Preserving a cadre of nuclear-weapon-experienced personnel within these institutions is one of the most pressing and crucial challenges DP faces. Unstable funding leading to voluntary and involuntary separations at the laboratories and plants, pressures from increased security requirements, and a perceived decline in the importance and excitement of nuclear stewardship have contributed to a loss of valuable skills throughout the nuclear weapons complex.

6.1.1. The Chiles Commission

To understand comprehensively the issues surrounding the personnel challenges, Congress directed in Public Law 104-201 the establishment of the Commission on Maintaining U.S. Nuclear Weapons Expertise. This Commission, chaired by Admiral H. G. Chiles, Jr., reported its findings and twelve recommendations (Summarized in Appendix C) to Congress on March 1, 1999. These findings and recommendations also were supported by the Foster Panel report.

In response to the Commission's recommendations, DP immediately formed a Steering Group of senior headquarters, field office, and production plant and laboratory representatives to develop a path forward for each of the Commission's twelve recommendations. Admiral Chiles, the Defense Nuclear Facilities Safety Board, and the Nuclear Weapons Council have been briefed regarding the path forward, and have endorsed DOE's strategy to address each recommendation. One of the most important recommendations calls for the development of work force plans for each DP facility. These site-specific plans address Federal, production plant and laboratory human resource needs over the next decade to ensure that the weapon complex has in place qualified scientists, engineers and technical experts who can ensure the safety and reliability of the enduring stockpile.

Challenge: Maintaining the proper skill mix. Skill mix at the laboratories and the plants is an issue. Because the Stockpile Stewardship Program has shifted away from underground testing toward a more simulation-based and aging-analysis-oriented approach, it is necessary to shift the skill mix at the laboratories accordingly. Likewise, at the production plants, there will be more emphasis on computer- and network-based design tools and techniques in the next decade. This may necessitate a shift in skill mix at the plants. Changing the skill mix at the institutions across the nuclear weapons complex will be a major challenge, possibly requiring more employment reductions in order to implement hiring programs that target needed skills and disciplines.

Challenge: Attracting and retaining a premier workforce. Two factors that have significantly impacted recruitment and retention are resource constraints combined with increased programmatic need for maintenance of the stockpile. This has resulted in fewer opportunities to conduct exploratory research at the laboratories. Another factor that is causing stress in the scientific environment is the new categorization of some research topics as "sensitive unclassified technical information" (SUTI); this may preclude scientists and engineers from publishing their results in the open literature, or sharing information at technical meetings or conferences. In most instances, information that is designated as SUTI within the DOE complex is openly published by other scientists at non-DOE institutions.

Another workforce issue is the pay freeze implemented during the early 1990s, which has resulted in a measurable loss in market position for the salaries of scientists and engineers, especially in highly competitive areas such as information science and technology. The scientific productivity at the laboratories is also impacted by the long lead time needed to process clearances. In the months following the publication of the Cox Commission Report, the overall morale at the laboratories has diminished due to a perceived lack of trust in the nuclear weapons workforce. If unchecked, these and related factors could severely impair the laboratories' ability to attract and retain the caliber of scientists and engineers required to steward the stockpile into the 21st century. DP is addressing many of these issues through actions that implement the Chiles Commission recommendations.

6.2. Infrastructure Challenges

BALANCING INVESTMENTS IN INFRASTRUCTURE with other important activities is a significant challenge. DP faces significant challenges in the next decade with regard to the facilities and infrastructure needed to preserve the U.S. nuclear deterrent. Plans to develop and implement necessary new facilities, and upgrade the nuclear weapons complex infrastructure have been underway by DP, the laboratories, NTS, and the production plants for the past several years. The overarching challenges in this area are 1) to have production capabilities and capacity in place when needed; and 2) to have the significant experimental and computational facilities available in time to achieve the SLEP schedule. Appropriate programmatic support is needed to certify and refurbish weapons during the next decade. Many of the necessary facilities are now under development at the laboratories, production plants, and the test site. Construction of others is planned to occur during the next few years. The remainder of this subsection covers each of the challenge areas mentioned above. Discussion is combined for annual certification and upgrading the stockpile, because there is significant overlap in their infrastructure challenges.

Challenge: Certifying and refurbishing the stockpile without underground nuclear testing. In the absence of underground nuclear testing, certification is being achieved through combined efforts in stockpile surveillance, stockpile maintenance, nonnuclear experimentation and testing, and computational simulation, performed by a diverse and skilled workforce. Certification becomes increasingly more challenging as both the stockpile and the workforce, with weapon-design experience, age. The development of new nonnuclear experimental facilities, simulation capabilities, and processes to evaluate archived data are essential to maintaining high confidence in the safety, security, reliability, and performance of the stockpile. The experimental and computational tools used in the past were designed to complement, not replace, nuclear testing. As a consequence, they are not, in and of themselves, sufficient to maintain confidence in the absence of nuclear testing. A suite of enhanced capabilities and facilities is being developed to fill in the associated knowledge gaps, and provide data to address and resolve stockpile concerns that have been identified.

During the next decade, it will be necessary to refurbish and modernize stockpile weapons, starting with the W80 in FY 2006, and the W76 in FY 2008. These upgrades are necessary to replace limited-life components, upgrade tritium storage technology, and to modernize weapon surety features. Because significant changes will be made to these weapon systems, and underground nuclear tests may not be performed, it will be necessary to use a significantly different approach for certification than has been used in the past. This new approach requires that computational facilities be available to simulate weapon performance with full-fidelity physics in three dimensions. Also required are facilities to conduct subcritical experiments to verify dynamic properties of nuclear weapon materials. Additional radiographic facilities, both x-ray and proton, are required along with facilities for developing microsystem-based surety options. While some of these facilities exist today (*e.g.*, subcritical test facilities) or are under construction (*e.g.*, DARHT and NIF), others are only in a planning stage (*e.g.*, MESA and AHF). Because the SLEP calls for production of refurbished weapons by FY 2006, it is essential to continue development of facilities that are underway, and transition from planning to developing and constructing those that are not.

An important focus of the planned upgrades is to increase nuclear weapon surety (safety, reliability, and security), consonant with NSDDs, DoD Directives, and DOE Orders. Surety features in stockpile weapons are based on 1960s and 1970s technology. Considerable progress has been made during the past five years that now makes it feasible to incorporate new technologies based on microsystems devices and other technologies. These technologies offer the possibility of eliminating all safety exceptions and security “hot spots” in the current stockpile. Failure to develop and mature these technologies during the next 3-5 years could lead to the re-use of 20- to 30-year-old technology in refurbished weapons, which then would remain in the stockpile for at least thirty years. This is viewed by DP as unacceptable from a safety and security perspective, and exploration of a wide variety of options for consideration by both DoD and DOE is warranted in the national interest.

Challenge: Dealing with facility legacy and the need for modernization. Depreciating production facilities in the late 1980s and early 1990s was the prudent decision in light of the decline in production workload and the geopolitical environment at that time. Unfortunately, DP is now faced with the realities of those aged and marginally maintained facilities. During the past year, the Nuclear Weapons Council tasked the Department of Defense Comptroller’s Office of Program Analysis and Evaluation (PA&E) to conduct an independent review of the nuclear weapon production infrastructure. PA&E’s initial findings highlighted the contrast between DOE’s current and historical rate of reinvestment in facilities (0.8% of replacement value) and the industry and DoD norm (2-4% of replacement value). This has resulted in a large bow wave of deferred improvements. For example, 70% of the facilities at Y12, 80% of the facilities at the Kansas City Plant, 50% of the facilities at Los Alamos National Laboratory, 40% of the facilities at Pantex, and 40% of the Savannah River tritium facilities are more than 40 years old. These facilities were not designed or built for today's missions and operational standards, nor were they designed or constructed to meet today's environmental, safety, and health standards. As these facilities continue to age, their maintenance and operating costs continue to rise.

In addition to maintaining the programmatic and site infrastructure at the production plants, the SSP is proceeding with a major initiative to "right-size" the manufacturing complex to better match changes in the workloads and budgets with maintenance of core capabilities and facilities. This right-sizing is being conducted consistent with the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (PEIS), the Record of Decision for which was signed by the Secretary of Energy on December 19, 1996. The PEIS formally defines the architecture of the weapons complex for the future. The right-sizing originally was based on "find or fix" scenarios, and current facility planning has been re-scoped accordingly, and is reflected in the implementation of the new business model.

The aim of the production readiness campaigns and RTBF is to ensure that the production facilities are ready and able to deliver defect-free modernized weapon components for SLEP weapon refurbishments. Before the B61 and W76 SLEP refurbishments can be completed it may be necessary to re-establish material formulation and fabrication capabilities for critical weapon components. Other future SLEPs may require reestablishing the ability to synthesize and formulate high explosive materials that are no longer available commercially. Future SLEPs could introduce micro-machined non-nuclear components never before used in nuclear weapons. All of these processes must be established, proven, and certified before any war reserve production can proceed.

Challenge: Build new, certifiable pits using new tools and processes in a new environment. When Rocky Flats was closed in 1989, U.S. pit production came to a halt, interrupting the production of war-reserve W88s. Presently, the U.S. is the only nuclear power that lacks the ability to manufacture pits. The recently released Foster Panel Study noted the need for more planning for long-term pit production. Although DoD does not require DOE to produce pits *per se*, it does require DOE to support the stockpile as defined by the NWSP. To do this, DOE performs surveillance on weapons, some of which is destructive, to assure that their performance can be certified. Because of the increased longevity of weapons remaining in the stockpile, more systems than originally planned will be tested destructively. This produces a requirement to manufacture pits so as not to deplete the required stockpile. The first of the new certifiable pits will be required for the W88 warhead, whose production availability requirement is the end of FY 2001. Subsequent to the W88, the next pit manufacturing requirement to support the surveillance program will be for the W87.

In the future it may become necessary to manufacture large quantities of pits for stockpiled weapons due to unforeseen requirements that surface from the surveillance program, or changing national security requirements imposed by DoD. For the near term, support to the surveillance program will be met with a limited pit production capability being implemented at LANL. Incremental increases to the pit production capacity at LANL must be balanced with the need to maintain the plutonium research capabilities at the laboratory. The requirements and designs for alarge-scale pit production facility are being evaluated now.

Challenge: Preserving needed skills in the absence of testing. By PDD, the President has stipulated that DOE must be prepared to resume underground nuclear testing within 24 to 36 months, if so directed. Presently, NTS has plans that would allow a limited level of testing to be performed within 12 months of receiving a Presidential Directive to conduct a test. The ability to resume testing has two important dimensions. First, the necessary infrastructure needs to be kept in place, providing required facilities, diagnostics, and equipment. Second, key and essential personnel who possess the expertise required to perform tests, and collect and analyze test data, must be retained. Performance of subcritical experiments uses much of the needed equipment and infrastructure, and exercises the human skills required for this activity. Subcritical experiments are supported by the Campaigns and RTBF, and it is essential that adequate support for these be sustained. It will also be necessary to continue to support and maintain test facilities that are not used by subcritical experimentation.

Challenge: Balancing the implementation of programmatic requirements and new security upgrades. During the last year, a number of security-related issues within the nuclear weapon complex have been surfaced. These include cyber-security, the protection of classified information and special nuclear materials, and the protection of nuclear weapons while being transported from station to station. At the agency level, a new office reporting to the Secretary was created to consolidate the management and execution of all security activities. Ultimate resolution of these security-related issues will have significant financial, and in some cases, cultural, impacts on the laboratories and plants.

To execute its stockpile stewardship mission, the SSP depends on an information network that interconnects its sites. This information network presents challenging security risks that must be managed carefully to properly protect Restricted Data. The most significant risk is that introduced by interconnecting the multiple sites. These interconnections require that previously used security approaches, *i.e.*, those based on physical protection of stand-alone systems, are no longer adequate, and must be upgraded to a system-based approach for both physical and electronic security measures. The presence of the interconnections also means that the damage that can be done by malicious insiders is greatly increased, and requires electronic safeguards more capable than any currently in use.

Because of these issues, an intensive study of cyber-security recently has been performed within DP. It covered the status of cyber-security and needed upgrades at both the laboratories and the plants. The study found that secure information environments across the complex were outdated and poorly supported compared to unclassified systems. This situation reduces the efficiency of DOE contractors in maintaining the stockpile expeditiously. The findings of this study are documented in the Information Security Management (ISecM) plan published November 15, 1999 for DOE management consideration and implementation decisions.

The study recommends a broad range of improvements to DP's computer networks. These begin with creation of an Agency Secure Network (ASN) that will provide the functionality necessary to conduct the nuclear weapons program, while providing security commensurate with the classification levels of the information. The ASN will be a single, integrated network to allow better management, improve security design and implementation, and eliminate redundant efforts. The report also recommends upgrades to the unclassified networks that process sensitive information to provide better protection of sensitive information while ensuring that it is sharable with industrial partners who need access to it. Finally, it recommends that standards be established for open networks to ensure the integrity and availability of the information that is shared publicly. The study concludes that a robust set of cyber-security related upgrades would cost approximately $850 million, and would take four years to complete. At present, funds are not identified to commence the needed upgrades. A prioritization process will be needed.

As a result of reviews of the management of classified information during the past few years, certain nuclear weapon sigma categories are proposed to be elevated from the Secret Restricted Data (SRD) level to the Top

Secret Restricted Data (TSRD) level. This will require significant physical and administrative changes in the management of information that falls into the affected categories. More significantly, however, would be the requirement to operate the ASCI supercomputers, the networks that interconnect them, and the facilities in which scientists and engineers use them at the TSRD level. The cost impacts associated with this change presently are being analyzed, and are expected to be very large. The Office of Defense Programs has sent a letter on this "Higher Fences" initiative to DoD to inform them of the issue, and that it will need to be addressed through the Nuclear Weapons Council interface.

More stringent procedures are being implemented to protect special nuclear material (SNM), classified hardware, and the manufacturing of classified hardware at the laboratories and the plants. In some instances, these tighter practices are resulting in entire facilities being operated as a vault, with extensive physical protection measures being required. The increased level of security also frequently requires the restructuring and redeployment of protective forces, and other physical protection measures, all of which drive up security costs.

During the past year, DP's Transportation Safeguards Division (TSD), which is responsible for providing safe, secure and cost-effective transportation for nuclear weapons in DOE custody, received a "marginal" security rating. DP has developed a "Get Well Plan" to remedy this situation. Upgrades are planned both for the transportation fleet and personnel who execute TSD's activities. Within the fleet, the older armored tractors and safe secure trailers (SSTs) are being replaced with newer models, incorporating up-to-date technologies for protection, communication, and tracking. In the personnel area, training and training facilities are being upgraded to accommodate the new standards. Additionally, professional leadership training, analogous to that used by the military, is being developed and deployed. In aggregate, these activities will allow TSD to counter additional threat scenarios that could impact the security of transported weapons. In response, DP executive management has committed to increasing funding for the Transportation Safeguards Division through aggressive budgeting and reprogramming.

6.3. Business Challenges

THE STOCKPILE STEWARDSHIP PROGRAM currently faces several management challenges. These include: 1) the need for further integration across the nuclear weapons complex to increase efficiency; 2) the need to assess and manage program risk; 3) the need to assess requirements and produce deliverables within the constrained resources; and 4) the need to improve the management practices for the construction of large, technically complex scientific facilities.

Historically, the nuclear weapons complex evolved as a number of sites that were intentionally isolated from each other. As a result the contractors that manage the laboratories and plants have established independent business practices geared to their specific mission assignments. This has impacted the ability of the laboratories and the plants to work effectively and efficiently together. New business practices are being developed and implemented by DP to increase coordination and integration across the complex.

7 Summary and Findings

7.1. Introduction

THE DEPARTMENT OF ENERGY is the civilian agency responsible for providing the Nation with nuclear weapons and for ensuring that those weapons remain safe, secure and reliable. This stewardship and management responsibility addresses the supreme national interest of sustaining the nuclear deterrent. Carrying out the responsibility entails a complex linked set of activities ranging from scientific research to detailed surveillance and remanufacturing, while continuously sustaining the reliability that underpins our strategic military posture.

In 1992, the United States declared a moratorium on underground nuclear testing and, since 1995, the Administration has pursued a zero-yield comprehensive nuclear test ban. The President and the Congress have directed DOE to continue to maintain the safety, security, and reliability of the enduring stockpile. The DOE is closely partnered with the Department of Defense (DoD) in this mission. The DOE, in addition to being accountable for maintaining nuclear weapons in accordance with DoD specifications, has the responsibility to represent the public's interest in assuring the safety and security of these weapons. The generation of requirements and certification of weapons systems are accomplished through joint DOE/DoD processes that work through the auspices of the Nuclear Weapons Council for the Secretaries of Defense and Energy.

This review of the Stockpile Stewardship Program provides an opportunity for assessing program accomplishments over the last few years, for evaluating program direction and goals, and for identifying those investments in facilities and people that will best position the program to meet both near-term and long-term challenges. The review is carried out in the context of:

- *No testing with nuclear yield*

  Maintaining the nuclear deterrent without nuclear testing has led to a profound change in the program structure. In particular, in-depth science-based weapon surveillance, subsystem experiments, and large-scale simulation now play a much more prominent role. Fundamental progress in understanding of nuclear weapons has been made that is laying the foundation for a robust program for maintaining weapons of well-tested designs.

- *Continuous reliability of weapon systems*

  Even as the program changes dramatically, and new scientific capabilities are developed, the weapon systems that form our deterrent must be maintained reliably year in and year out. This is addressed through a rigorous annual certification process, now in its fourth year. This requirement drives significant work throughout the DOE complex, in collaboration with DoD.

- *Preparing for the future*

  The stewardship program must take a long view that extends decades into the future, both in providing the capability to remanufacture certifiable weapon components and in sustaining the needed scientific and human resource base. It must be emphasized that the programmatic decisions taken years hence about each weapon system will be based, in large part, on the science and engineering performed by the laboratories. Thus, the weapons laboratories must remain premier scientific organizations, with an appropriate infrastructure and skill mix. Concomitantly, the laboratories must be viewed as excellent places to do science, so that recruitment and retention of the best talent continues. This is the ultimate basis for successful and sustainable stewardship under any technical approach. In addition, viable production facilities are needed to meet the manufacturing requirements of the stockpile refurbishment program.

Accomplishing this stewardship task, in the absence of underground testing, requires not just new and innovative technical approaches; it demands a clear articulation of our underlying approach to decision making, problem solving, and prioritization. Thus, this review addresses the overall Program organization.

This review is not designed to assess the intricate details of specific program elements or resource requirements; rather, it is a chance to take stock and determine if DOE is fundamentally on the right track and is making the investments today needed to be outstanding nuclear stewards tomorrow. Does DOE have the infrastructure and tools, across the nuclear weapons complex, to meet current goals? Does DOE have the program flexibility required to be responsible stewards in the future? Does DOE's decision-making philosophy and investment portfolio reflect both short-term drivers and long-term needs? Does DOE have the correct planning process in place to allow the program to balance appropriately the workload and resources between the production of deliverables and the investment in science and engineering?

A key challenge of the Stockpile Stewardship Program is to balance DoD's military drivers, which result in a targeted set of goals and schedules, against the set of technical issues arising from aging in nuclear weapons. The Program must be fundamentally robust enough to support the evolving production and certification requirements and sufficiently flexible to address unanticipated problems and issues. It must also be able to sustain an environment that fosters inquiry and problem-solving in both science and engineering. The DOE has the responsibility to provide the leadership required to balance the demand for short-term deliverables against the need for long-term institution building. DOE's decision-making throughout the Stockpile Stewardship Program must reflect both objectives.

A significant fraction of the nation's nuclear arsenal is scheduled for refurbishment over the next decade. Two key systems–the W80 and W76–are a large part of the nation's nuclear deterrent and will comprise the majority of the directed stockpile workload early in the new century. The W76–as part of the Trident submarine weapon system–plays a particularly important role as one of the most survivable elements of the nation's deterrent. Developing the tools, technologies, skill-base, and production capabilities required to refurbish and modernize these systems is a major challenge of the Stockpile Stewardship Program. The cost and schedule of these tools and technologies, and the availability of the proper skill mix in the work force, must be factored into the development of the requirements expressed in the life extension programs for these two weapons.

To meet near-term refurbishment goals, the DOE must work closely with the DoD to: 1) identify and assess technical drivers and schedules for weapon component replacement and/or certifiable modification; 2) develop schedules for production and certification; 3) determine current and projected resource requirements; and 4) develop a process for changing the work plan to accommodate unexpected technical issues. This review is an opportunity to evaluate the current structure of the requirements generation process and to recommend actions to strengthen this process for the DOE, in partnership with the DoD.

Performing stockpile stewardship without testing has been likened to the technical challenge of putting a man on the moon. Needless to say, with a sustained national commitment over the better part of a decade, America succeeded in that challenge. DOE expects to succeed as well in stockpile stewardship with the same level of national commitment to the nuclear deterrent and to America's preeminent scientific and technical enterprise. This review will help define elements of that commitment.

7.2. General and Specific Program Findings

7.2.1. The Stockpile Stewardship Program structure is on track.

Substantial progress has been made in the development of the organizational structure and management of the Stockpile Stewardship Program (SSP). The restructuring of the program into Directed Stockpile Work (DSW), Campaigns, and Infrastructure–Readiness in Technical Base and Facilities (RTBF)–is a positive step in the right direction. Program management is on the right track. Continuing work is needed to address and balance the evolving challenges of maintaining a safe, secure, and reliable stockpile, and supporting the scientific, engineering and manufacturing institutions needed to carry out this mission.

7.2.2. Science-based SSP is the right path.

In 1993, President Clinton directed the DOE to develop the SSP to maintain the nation's nuclear arsenal without testing. Science-based SSP responds to a supreme national interest, and the program is on track. Substantial progress has been made in the SSP during the past five years in developing the scientific and technical capabilities to meet program goals. Significant accomplishments in the directed stockpile work and the simulation and experimental science campaigns are providing important data and analyses that are needed for the certification of weapon components. Science-based stockpile stewardship moves the nuclear weapons complex from a paradigm based on new weapons design and development to one focused on life extension through modernization. This approach has required a change in attitude, programmatic direction, and approach across the weapons complex.

Up until 1992, nuclear testing was primarily a tool for developing and verifying new weapon design and performance. The ultimate challenge for the program today and into the future is to create and sustain the organization, knowledge base, and tools that will provide a robust scientific foundation for understanding weapon performance; this is a significant change from the historic approach. To date, the SSP is on track to meet this challenge, but more work is required to strengthen the technical foundations, the physical and human infrastructure, and the SSP program planning process. The true test of the science-based approach to stockpile stewardship will be its ability to recognize and meet a diverse set of technical challenges well into the future.

7.2.2.1. Specific Program Findings

- Several technical areas such as primary and secondary certification are exceedingly challenging science and engineering problems requiring extensive experimental and computational efforts. The campaign plans for these efforts are a good comprehensive start. Continuing work is needed to define the certification process and to develop metrics for success.

- The large-scale experimental and computational facilities such as DARHT and ASCI, respectively, are already providing important data and analysis capabilities that are increasing our understanding of aging and performance of the stockpile. In particular, the modifications leading to the B61-11, the life extension of the W87 warhead, and certification of the Sandia-designed neutron generator were made possible because of scientific advances achieved with these new capabilities.

- The Directed Stockpile Work has successfully produced significant quantities of weapon alterations, modifications, and limited life component exchanges each year, most notable of these was the fielding of the B61-11 and Alt 342 for the W87.

- Production readiness, especially at Y-12, needs more support because many of these facilities have not been maintained and need to be restored in a timely manner to meet refrubishment production schedules.

- Programs to maintain test readiness are on track and supporting the national requirements; however, more long-range planning is needed to ensure that the Nevada Test Site will have the infrastructure and intellectual base to maintain readiness for twenty years or more. Work is currently underway in the Nuclear Weapons Council to evaluate options for enhancing test readiness through consideration of specific testing scenarios.

7.2.3. SSP baseline will continuously evolve.

The overall development of the science-based stockpile stewardship integrated baseline continues to be an evolving process that was started at the inception of the SSP. The work of the last four years should be considered as part of the ongoing effort to "develop the SSP baseline." The program baseline must: 1) define a realistic assessment of the scope and schedule for the Directed Stockpile Work; 2) identify scopes, schedules and end-states for each of the Campaigns; 3) build contingency and flexibility into both the Directed Stockpile Work and the science, engineering, and readiness campaigns; and 4) ensure that the facilities (existing and new capital construction) are scoped and scheduled to meet program requirements. This baseline will be used as an important management tool for setting priorities for future work within the Office of Defense Programs.

7.2.3.1. Specific Program Findings

- The SSP needs to refine a resource-bounded systems analysis approach to establish a solid program baseline; *i.e.*, the goals and milestones of the science, engineering, and readiness Campaigns, and the certification and SLEP schedules they support, must be commensurate with the allotted resources.

- Transformation of aging data into estimates of weapon component lifetimes is needed to establish a program baseline for refurbishment. More will be needed in the SSP to connect the results of the research Campaigns with the development of revised estimates for the component lifetimes; these lifetime estimates need to be presented to and coordinated by the Nuclear Weapons Council.

- Arms control agreements have a direct bearing on the workload and schedules of the SSP. At present, the stockpile must be maintained to support a START I stockpile level. Although the total number of delivery systems would be reduced if START II were to be implemented, the Directed Stockpile Work for the SSP under START I and START II are nearly the same since the total of the active and inactive stockpiles remain essentially constant under both treaties.

- Potential elements under consideration for a proposed START III treaty could have a significant impact on the workplans for the SSP, especially at the Pantex plant. The potential for a monitored warhead dismantlement regime and prescribed dismantlement numbers and timetables will need to be factored into the refurbishment schedules and costs.

7.2.4. The process for generating program requirements needs attention.

The current DoD/DOE process for generating program requirements has problems on both ends. At present, DOE, the laboratories and plants absorb requirements presented by several elements within the DoD and develop workplans and budgets. The resulting refurbishment plans and SLEP schedules are presented to the Nuclear Weapons Council. More work is needed within the Office of Defense Programs to address both the technical and process issues involved in developing requirements. Program drivers (requirements) must be differentiated from "wish-lists" of activities that should or could be done if resources and schedules permit. A lack of prioritization of program drivers at DoD is causing the DOE to accept an expanding set of additional "requirements." In addition, DOE's lack of a formal process for assessing military and civilian requirements, developing implementation plans–with corresponding scopes, schedules and budgets–and prioritizing the workplan has caused significant stress in the SSP.

It was agreed that the DOE should work more closely with the DoD to generate a more comprehensive and coordinated process for generating, assessing, and implementing requirements. There was strong support among the Senior Advisors for having both Departments work through the Nuclear Weapons Council–and its Standing & Safety Committee and Requirements Working Group–to develop a more defined workplan for prioritizing program drivers and developing requirements for DoD and DOE. Likewise, a more formal process is needed within the SSP to evaluate resource impacts of proposed requirements from the NWC and to establish the program milestones and goals. This will require a much more robust prioritization process and more senior-level DOE management support. The SSP program planning and prioritization must clearly identify scope, schedule, and resources for meeting requirements and, when necessary, indicate regrets (schedule relief) and/or additional resources needed to stay on target.

7.2.4.1. Specific Program Findings

- A more structured process is needed at DOE to assess the military requirements. The SSP must be optimized to balance the drivers for increased margins, minimal changes to the weapon, and the need for enhanced surety features. Simply remanufacturing 30-year-old parts may not match the military needs for performance with the public expectation for enhanced safety. In addition, reproducing vintage technologies is no longer practical at the engineering and manufacturing facilities.
- When evaluating surveillance and refurbishment requirements, the random sampling approach should be supplemented so as to focus on aging as a key phenomenon.
- The "lessons learned" from the W76 dual revalidation should be reviewed and used by DoD and DOE, through the Nuclear Weapons Council, to develop workplans for future dual revalidations or baselines.
- In weapon refurbishments (such as that for the W80), military logistical options (such as performing refurbishment by tail number) should be considered as part of overall system optimization. This may relieve stress and resource requirements for the SSP.
- The W62 is not part of the present SLEP schedule, but arms control issues may force DOE to keep it in the stockpile. An assessment of options, costs, and schedules for maintaining or dismantling this warhead is needed.
- More work is needed by DOE, in coordination with DoD, to assess the requirements and implementation plans for the W76 and W80 LEPs.
- The DoD and DOE should work through the Nuclear Weapons Council to evaluate potential programmatic impacts from future arms control negotiations.

7.2.5. Despite the many accomplishments, the program is under stress.

In order to meet program goals and military requirements, the SSP must have an extensive and diverse set of concurrent activities in Directed Stockpile Work, science and engineering Campaigns, readiness Campaigns, and infrastructure planning and management. The overlap in activities needed to meet the W80 and W76 LEP schedule, combined with additional requirements assumed by the program, have seriously depleted program contingency and flexibility. In addition, the original program plans developed in 1996 did not consider the production capacity requirements that will be necessary to meet the stockpile refurbishment mission. Changes and upgrades to the manufacturing facilities are needed in order for DOE to meet the military's near-term and long-term production requirements.

Additional pressures such as increased security requirements, newly discovered stockpile issues, and resource limitations have collectively forced the program, overall, to be "wound too tight" with too little program flexibility or contingencies. This is evident from the fact that the Campaign and Directed Stockpile Work is so tightly intertwined that adjustments to specific program milestones or budgets may result in significant regrets for the SSP as a whole. Flexibility and contingency is needed in both the science and engineering programs and the production facilities to address these issues. Indicators of stress include lowered morale in parts of the work force and increased difficulty in recruitment of top scientists and engineers.

7.2.5.1. Specific Program Findings

- The current requirements generation process has resulted in the program absorbing too many drivers as "requirements." More assessment, prioritization and coordination is needed to develop viable workplans across the complex.
- A significant source of program stress has resulted from the yet-to-be-determined consequences of new security requirements, including: the implementation of new cyber-security regulations; restrictions/moratoria on foreign visitors and assignments to the laboratories; the introduction of polygraph testing; and uncertain impacts of new export control procedures on the scientific community (*e.g.*, sensitive unclassified technical information). These issues are placing a significant burden on resources throughout the program and lessening the scientific attractiveness of the institutions, thus making recruitment and retention more difficult.
- More contingency is needed in the resources and program planning of the science and engineering campaigns to allow the program to accommodate future unanticipated requirements and to continue to allow creative scientific enquiry.
- More contingency is needed in the resources at the production facilities to ensure continuity in the workforce and functionality and safety of the facilities.
- Maintaining scientific quality through the laboratory peer review process should be a key objective of the program. There is a risk that the program is becoming so integrated that the strength of the inter-laboratory peer review process between LANL and LLNL could be weakened.
- Closer cooperation is needed between the Defense Programs laboratories and the plants on engineering and manufacturing projects. This may require changing contracting processes to facilitate more direct exchanges and cost-sharing.
- Reductions in resources for programs, such as radiochemistry and nuclear manufacturing engineering, could leave the complex without a critical intellectual base to meet long-term program goals.
- The number and complexity of the new experimental and computational facilities under construction is a significant challenge for the SSP program planning process. Issues surrounding the construction of NIF have indicated the need for more rigorous program planning and project management oversight for these facilities.

7.2.6. More work is needed to prioritize the directed stockpile workload.

The Office of Defense Programs should use the new DSW management plan to implement a more rigorous process for prioritizing the work done across the complex. This is particularly important for the W76 and W80 LEP refurbishments. The workplan for the SLEP schedule needs to prioritize the military and civilian program drivers into "musts," "shoulds," and "coulds." The workplan must reflect the cost and schedule for each of the program elements and a well-defined set of options for each of the major program activities. This is essential for ensuring that the SLEP schedules proposed to the DoD are feasible and realistic. Better coordination is needed across the nuclear weapons complex (DOE, DoD, the laboratories and plants) to assess the military drivers and develop overall implementation plans for the SSP.

7.2.6.1. Specific Program Findings

- A set of options and priorities needs to be defined for the implementation of the W76 and the W80 LEP schedules. This should result in a list of programmatic trigger points requiring senior-level decision making.
- Clarification is needed about the military priorities for setting the workplan for the W76 and W80 LEP schedule.
- More support is needed for W88 pit production capability at LANL in order to meet requirement for first pit production in 2001 and certification in 2004.
- The balance of work dedicated to hostile environments should be reexamined.

7.2.7. 'Metrics of Success' need to be defined for the DSW program and each Campaign.

Well-defined sets of metrics are needed to set the standards for certifying weapon components and estimating lifetimes, in the absence of nuclear testing. These standards must ensure that our current high-level of confidence in the stockpile is maintained, in accordance with the necessary military standards and civilian expectations. This will require changing and building upon the traditional approach that relied extensively on the personal experience of the designers. This also requires program responsibility and accountability to ensure that the science programs are both supporting scientific inquiry and focusing on the defined path forward.

Each of the Campaigns have stated "end-states" and the Campaigns have provided a structure within which metrics can be set. Programmatic discipline will be needed to ensure that the end-states are met according to a well-defined set of metrics. The cautionary message, "Better is always the enemy of good enough," must be a guide. In addition, obtaining more knowledge about the health of specific weapon systems and components should not be confused with loss of confidence in their reliability and safety. Problems that are detected and fixed are measures of program success not program or system failure. It is the nature and responsibility of the SSP to ask questions about weapons that were never asked before.

7.2.7.1. Specific Program Findings

- More analysis is needed to define the measurements and metrics (precision and accuracy) required to estimate weapon component lifetimes and performance/surety characteristics.
- A well-defined process is needed to develop the proper balance between increasing margins, upgrading surety features, and minimizing changes to the design, during refurbishments.
- Certifying the stockpile without underground testing into the future will require that the design and integration laboratories, and the production plants define specific metrics for safety, surety and reliability.

7.2.8. Additional external review and oversight is needed.

A standing external advisory committee (*e.g.*, Defense Programs Advisory Committee) could provide ongoing insight, assessments, and advice on the program structure and effectiveness. Large-scale projects (*e.g.*, AHF, MESA, NIF, *etc.*) also need stronger external review earlier in the program planning process and more extensive vetting with senior DOE management.

7.2.8.1. Specific Program Findings

- The program would benefit from more continuity in the external review process. Senior advisory committees, established under the Federal Advisory Committee Act, have been used extensively by the DOE. In addition to providing the DOE with program advice, they also are very effective in communicating with organizations outside the Department. The Office of Defense Programs, and the Department as a whole, should benefit from establishing a senior advisory committee that will focus specifically on the Stockpile Stewardship Program.
- There was strong support for the proposed JASON 2000 Summer Study to evaluate the focus, pace, and appropriateness of the current Campaigns.
- An extensive collection of internal and external reviews have already been done on the SSP. The lack of adequate database management within the program makes accessing and utilizing these findings very cumbersome. An accessible electronic database is needed to improve the program's ability to respond to the recommendations made by the many and varied program review teams.

7.2.9. Increases in programmatic and security requirements have impacted the stability and morale of the work force.

Plants: The plants indicated that most of their current stresses resulted from continued budget instability and uncertainty. Employment reductions are planned at most sites in FY00 and FY01. This will adversely impact the plants' ability to meet both the FY00 and FY01 proposed workload. A lack of contingency in resources impacts the plants' ability to recruit and retain the necessary skill mix. Retention of mid-level engineers and scientists with 2 to 5 years experience is particularly difficult. In addition, retaining and recruiting managers with 5 to 15 years experience is getting significantly more difficult. Additional resources are needed to provide adequate lead time to recruit and train the needed work force skill mix to meet capacity (not just capability) requirements. The plants have developed programs that provide career path incentives and merit-based rewards in response to the Chiles Commission recommendations. Continued implementation of these programs will require additional resources.

7.2.9.1. Specific Program Findings for Production Plants

Workforce issues reported by the plants include:

- Safety concerns resulted in shutdown of enriched uranium operations at the Y-12 plant in 1994. Since that time, only part of this operation has been restarted. The Department must rapidly return to full capability to resolve security concerns and production needs.
- Lack of approved safety authorization basis for operations at Pantex prevents the contractor from working on four of the ten weapons in the enduring stockpile. Establishing a basis for surveillance and production of these four systems should be a high priority during FY 2000.
- Employment at the Kansas City Plant has dropped from 3790 in FY 1993 to 2556 in FY 1999. Additional reductions would put at risk the engineering and production support for surety upgrades to the enduring stockpile.

- A strong recommendation was made that DOE needs to permit the contractors at the plants to have the freedom to pursue a wide range of personnel incentive programs to build and maintain the critical workforce. This is consistent with a Chiles Commission recommendation that "DOE establish and implement plans [...] for replenishing essential technical workforce needs in critical skill," across the nuclear weapons complex.

Laboratories: The laboratories are suffering morale problems due to impacts of new security requirements, budget uncertainty, and reduction (or elimination) of resources to support innovative scientific inquiry. In particular, there have been significant changes in the last five to eight years in the ability of the laboratories to conduct long-term exploratory research. It should be noted that many of the key elements of the present stewardship program including ASCI, high-powered lasers, proton radiography, and materials modeling, owe their existence to exploratory research that was conducted five to ten years earlier.

There is also an urgent need to reestablish the compact (and trust) between laboratories and DOE to address these issues. It is absolutely crucial that the scientific excellence at the laboratories be maintained in order for the SSP to succeed both now and into the future. Recruiting and retention of scientists and engineers at the laboratories is being impacted by the perception that the laboratories are offering fewer long-term creative and challenging career paths.

More balance is needed at the laboratories between the near-term Directed Stockpile Work programs and scientific research programs that contribute to long-term institution building. A stronger program planning process is needed to ensure that the emphasis placed on producing deliverables (Directed Stockpile Work) is commensurate with the SSP need to maintain scientific excellence, an imperative for sustaining a creative intellectual environment. However, it was also noted that more effort is needed to focus and prioritize these activities at the laboratories so that the programs are sustained within the mandated resources. More insight and management advocacy is needed at DOE/DP into laboratory program planning and budgeting to make the long-term planning process more effective.

7.2.9.2. Specific Program Findings for Laboratories

Work force issues reported by the laboratories include:

- Reduction in LDRD (6% down to 4%) in FY00 will impact the breadth and scope of the fundamental/exploratory science programs. This could undermine the scientific appeal of the laboratories in the short term and science-based stockpile stewardship in the longer term.
- At LANL, two top candidates for a Division Director post withdrew from consideration citing a decline in the scientific environment; several other senior- and junior-level staff members have left the laboratory in direct response to the recent security changes at the laboratory. Several employees have expressed serious concerns about no longer being trusted at the laboratory and many have opted for transfers to unclassified research groups.
- LLNL reported significantly more problems recently in recruiting and retaining top-notch employees due to: 1) security constraints (polygraphs, cyber-security, restrictions on foreign nationals, and sensitive unclassified technical information (SUTI) designations); 2) additional Congressional constraints (travel restrictions, LDRD reductions); and 3) institutional issues (credibility of LLNL management, viability of future of laboratory). The reductions in LDRD will result in a 20% reduction in postdoctoral appointments.

- Sandia reported that its image as Employer of Choice has been affected adversely by recent downsizing; continued funding uncertainties; polygraph testing; and security concerns. The 5-year DOE complex salary freeze has resulted in loss in market position. Time to process clearances discourages new hires and delays productivity. Recent budget reductions in DP-funded student programs will impact negatively Sandia's student interns program and reduce its interactions with academic institutions.

7.2.10. SLEP production needs for the next decade require stable reinvestment in, and planning for, work force and plant modernization.

More long-range planning is needed to ensure that the plants maintain the physical structures and proper skill mix to produce at the capacity anticipated by the SLEP schedule. In general, the basic capability exists at the plants, but meeting short-term capacity demands will require more stable funding. Additional resources are needed now for recapitalization and modernization investments to provide plants and laboratory production facilities with tools for capacity production in the near future. More flexibility in funding at the plants is required to respond to emerging technical issues/problems in the DSW and campaigns.

7.2.10.1. Specific Program Findings

- The costs, schedules, impacts, and programmatic options for a proposed monitored warhead dismantlement at Pantex, under a possible START III Treaty, must be evaluated, prioritized and incorporated into the SSP planning process.
- The plants and laboratories have not made significant investments in production equipment and facilities during the past decade. This is impacting the ability of the complex to keep pace with industry standards for engineering and production.
- Traditionally, recapitalization was accomplished through development and production of new weapon systems. In particular, Sandia's reinvestment rate–once among the highest in the complex–has dropped dramatically since the end of the design work; it is now ten times less than comparable industrial firms such as Intel and Hewlett-Packard.
- Some key production areas at Y-12 are operating in the absence of physical safety controls, and thus are relying heavily on administrative controls and personal protective equipment. A continued lack of improvements to the existing facilities at Y-12 could jeopardize the program's ability to meet campaign end-states.

7.2.11. More long-term planning is required for new capital construction projects.

There was a strong sense that more work is needed in developing the long-term plan for future pit production capabilities and capacity. This plan needs to be presented and worked in the NWC within the next year. There was also consensus that large-scale SSP projects (*e.g.* MESA, Atlas, AHF) need better and more timely vetting with DOE senior-level management, DoD, and external review bodies.

7.2.11.1. Specific Program Findings

- An in-depth analysis of short-term pit production options may be needed. In particular, the plans, budgets and schedules for manufacturing 20 pits per year at LANL may need additional review. The production activities at LANL must be balanced to ensure that the scientific research done at TA-55 is not adversely impacted.
- Long-term conceptual planning is needed to evaluate options for building a large-scale pit production facility. This recommendation was a key element of

the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile (Foster Panel, November 15, 1999).

- Stronger project management oversight and review in Defense Programs will greatly help multi-year program planning. A mechanism similar to that employed in the Office of Science is the suggested pathway.

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Appendix A

Listing of All SSP Program Reviews

JASON Reviews:

1. Science Based Stockpile Stewardship (JSR 94-345)
2. Letter report: Vic Reis Stewardship Assumptions (JSR 94-346)
3. Accelerator Production of Tritium: 1995 Review (JSR 95-310) (follow-on to JSR 92-310)
4. Nuclear Testing (U) (JSR 95-320) (SRD)
5. Simulation for Stewardship (JSR 96-315)
6. Preliminary Review of Stockpile Stewardship and Management (JSR 96-320)
7. Subcritical Experiments (JSR 97-300)
8. Signatures of Aging (JSR 97-320)
9. Signatures of Aging Revisited (JSR 98-320)
10. System-Level Flight Tests (JSR 98-310)
11. Remanufacture (JSR 99-300)
12. Primary Performance Margins (U) (JSR 99-305) (SRD)
13. Inertial Confinement Fusion Review (Hammer, 1996)
14. Inertial Confinement Fusion Review (Drell, 1994)
15. Enhanced Fidelity Flight Testing, 1998

Congressional Oversight:

1. Commission on Maintaining U.S. Nuclear Weapons Expertise, March 1, 1999 (Chiles Commission)
2. Commission for Assessment of the Reliability, Safety and Security of the U.S. Deterrent
3. Department of Energy and Department of Defense Report on Long Range Plan on Pit Production to the Committees on Armed Services of the Senate and House of Representatives (U), March 5, 1999

GAO Reports:

1. ASCI, June 1999, DOE Needs to Improve Oversight of the $5 Billion Strategic Computing Initiative (GAO/RCED-99-195)
2. ASCI, Information Technology: Department of Energy Does Not Effectively Manage It's Supercomputers (GAO/RCED-98-208)
3. ASCI program implementation of milestones and budget projections
4. Nuclear Weapons – Key Nuclear Weapons Component Issues are Unresolved, November 1998 (classified supplement issued in July 1999)
5. DOE: Problems and Progress in Managing Plutonium, April 17, 1998
6. Nuclear Weapons: Design Reviews of DOE's Tritium Extraction Facility, March 31, 1998
7. Combating Terrorism: Spending on Government-Wide Programs Requires Better Management and Coordination, December 1, 1997
8. Nuclear Weapons: Capabilities of DOE's LLC Program to meet Operational Needs, March 5, 1997
9. Nuclear Weapons: Improvements Needed to DOE's Nuclear Weapons Stockpile Surveillance Program, July 31, 1996
10. LANL Plutonium Processing Facility

11. Stockpile Stewardship Management – (on-going) Examining how SSP budget, planning and organizational structure is integrated to support implementation of program activities and to avoid duplication.

12. Tritium alternatives, selection criteria, cost estimates and independent review

Congressional Research Service Studies and Reports:

1. Nuclear Weapons: Comprehensive Test Ban, updated November 10,1998

2. Nuclear Weapons Production Capability Issues, June 1998

3. Nuclear Weapons, Capabilities of DOE's Limited Life Component Program to Meet Operational Needs, March 1997

4. Nuclear Weapons, Improvements Needed to DOE's Nuclear Stockpile Surveillance Program, July 31, 1996

5. Testimony, Status of DOE's Nuclear Stockpile Surveillance Program, March 13, 1996

6. Nuclear Weapons Stockpile Stewardship: A Comparison of Alternatives, December 14,1995

7. Nuclear Deterrence of Non-Nuclear Threats: Implications for U.S. Policy, November 29, 1995

8. Nuclear Dilemmas: Nonproliferation Treaty, Comprehensive Test Ban, and Stockpile Stewardship, December 15, 1994

DOE-Sponsored:

1. ATLAS Pulsed Power Facility Review of Planned Technical Activities by DP-13, September 1999

2. Secretary of Energy Advisory Board Task Force Reviewed fusion energy (including inertial fusion energy) and the role of Defense Programs (Report issued September 1999)

3. "A View of DoD's Requirements for DOE's Programs in 2010 - A Strategy for Sustained Capability and Flexible Response; Meeting National Security Requirements" (a.k.a. the "2010 Report") August 1997

4. "The Laboratories' Contribution to the SSP" (a.k.a. the "Robin Report" January 1998

5. ASCI Burn Code Review #1, June 1998

6. ASCI Alliance External Review, October-November 1998

7. ASCI Blue Ribbon Panel Review, December 1998-January 1999

8. ASCI DisCom Review, January 1999

9. ASCI Burn Code Review #2, scheduled June 1999

10. Subcritical Experiment Evaluation Committee (SEEC) has reviewed all subcritical experiments to insure that their design will keep them subcritical when executed. The SEEC also examined other technical aspects of the subcritical experiment program and provided assessments to DOE, the laboratories and the Nevada Test Site, which were discussed and evaluated in July 1999.

Independent External Reviews (IER):

1. Renovate Existing Roadways at Nevada Test Site (Defense Programs Project No. 99-D-108)

2. Model Validation and Systems Certification Test Center (MVSCTC) at SNL/ALO (Defense Programs Project No. 99-D-106)

3. Central Health Physics Calibration Facility at LANL (Defense Programs Project No. 99-D-105)

4. Protection of Real Property (Roof Reconstruction – Phase II at LLNL) (Defense Programs Project No. 99-D-104)

5. Isotope Sciences Facilities at LLNL (Defense Programs Project No. 99-D-103)
6. Rehabilitation of Maintenance Facility (RMF) at LLNL (DOE 99-D-102)

National Academy of Sciences:

1. Review of ICF, March 1997

DoD Sponsored:

1. USSTRATCOM Strategic Assessment Team (SAT) review of SAG studies
   - high explosives
   - gas transfer systems
   - development of metrics for the nuclear stockpile
   - nuclear explosive safety studies
2. Joint Advisory Committee on Nuclear Weapons Surety (JAC)
   - manufacturing study by General Welch
3. DoD Program Analysis & Evaluation issues analysis to the Nuclear Weapons Council
   - tritium
   - pit production
   - ASCI
   - NIF
   - underground nuclear testing within the 2-3 years
4. Institute for National Security Studies, National Defense University: "US Nuclear Policy in the 21st Century," August 1998

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Appendix B

Recommendations from the Chiles Commission Report

The Commission on Maintaining United States Nuclear Weapons Expertise (Chiles Commission) was prescribed by the National Defense Authorization Act of FY 1997. The Congress identified the need for the Commission because of the substantial changes in the environment affecting nuclear weapons design, production, and testing since the end of the Cold War. In view of these changes, the Commission was tasked with reviewing ongoing efforts by the Department of Energy (DOE) to attract scientific, engineering, and technical personnel, recommending improvements and identifying actions where needed, and developing a plan for recruitment and retention within the DOE nuclear weapons complex.

The Chiles Commission Report offers 12 specific recommendations for action under four broad categories: National Commitment; Program Management; Personnel Policies; and Oversight. With respect to National Commitment, the Commissioners urged the Congress and the Administration to make a concerted and continuing effort to unequivocally and clearly convey the importance of the nuclear weapons mission to the nuclear weapons community. In the area of Program Management, the Commission recommended measures to improve communication among the laboratories as well as ways to strengthen coordination within the DOE and between agencies. Regarding Personnel Policies, the Commission issued specific recommendations for improving the Department's ability to recruit and retain the technical talent it will need, now and in the future, to replace the test-experienced nuclear scientists and engineers as they retire from the workforce. Finally, the report calls for reinvigorated Congressional Oversight and a multi-year fiscal commitment to stable funding for the Stockpile Stewardship Program.

Following receipt of the Commission Report, DP formed a Steering Group of senior program officials from Headquarters, field offices, industrial plants and the weapons laboratories to develop a coordinated "Path Forward" on each of the 12 Commission recommendations. The Steering Group developed a coordinated action plan and briefed senior department officials, Chiles Commission members, the Nuclear Weapons Council and the Defense Nuclear Facilities Safety Board (DNFSB). There is an overall consensus that DP's Path Forward is sound and can achieve the objectives outlined in the Commission Report.

Commission Recommendations

The twelve major Commission Recommendations are organized into four areas:

A. NATIONAL COMMITMENT

1. Reinforce the National Commitment and Fortify the Sense of Mission.

B. PROGRAM MANAGEMENT

2. Complete an Integrated, Long-Term Stockpile Life Extension Program Plan.
3. Strengthen the DOE - Department of Defense (DoD) Relationship.
4. Take Immediate Steps to Achieve Greater Laboratory Coordination.
5. Expedite Improvements and Efficient Use of the Nuclear Weapons Production Complex.
6. Establish Clear Lines of authority within DOE.

C. PERSONNEL POLICIES

7. Establish and Implement Plans on a Priority Basis for Replenishing Essential Technical Workforce needs in Critical skills.
8. Provide Contractors with greatly expanded latitude and flexibility in Personnel Matters.
9. Expand training and career planning programs, which are adapted to the dramatically changed workforce environment.
10. Expand the use of former nuclear weapons program employees.

D. OVERSIGHT

11. Create a permanent Defense Programs Advisory Committee.
12. Enhance Congressional Oversight.

Appendix C

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4. FY 1996 National Defense Authorization Act, Public Law 104-106.
5. FY 2000 National Defense Authorization Act, Public Law 106-65.
6. Strategic Arms Reduction Treaty I, http://www.state.gov/www/global/arms/starthtm/start.html.
7. Strategic Arms Reduction Treaty II, http://www.state.gov/www/global/arms/starthtm/start.html.
8. "Report of the Quadrennial Defense Review," May 1997, http://www.defenselink.mil/pubs/qdr/.
9. "An Agreement between the AEC and the DoD for the Development, Production, and Standardization of Atomic Weapons," March 21, 1953.
10. "A Memorandum of Understanding between the Energy Research and Development Administration and the Department of Defense on Nuclear Weapons Development Liaison Procedures," September 4, 1975.
11. "Memorandum of Understanding between the Department of Defense and the Department of Energy on Objectives and Responsibilities for Joint Nuclear Weapon Activities," January 17, 1983.
12. "Supplement to the 1953 Agreement for the Development, Production, and Standardization of Atomic Weapons between the Department of Energy and the Department of Defense," September 5, 1984.
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14. FY 1987 National Defense Authorization Act, Public Law 99-661.
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16. "Nuclear Weapons Production and Planning Directive (P&PD) 2000-0," U.S. Department of Energy, October 1999.
17. "Joint DoD-DOE FY00 Requirements & Planning Document," Nuclear Weapon Council, July 16, 1999.
18. Comprehensive Test Ban Treaty, http://www.state.gov/www/global/arms/ctbtpage/trty_pg.html.
19. Anti-Ballistic Missile Treaty, http://www.state.gov/www/global/arms/treaties/abmpage.html.
20. Strategic Arms Reduction Treaty III, U.S. Department of State, in process.
21. FY 1997 National Defense Authorization Act, Public Law 104-201.
22. "Report to Congress and the Secretary of Energy, Commission on Maintaining United States Nuclear Weapons Expertise," March 1, 1999.
23. "FY 1999 Report to Congress of the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile," November 8, 1999.

24. “Final Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People’s Republic of China,” U.S. House of Representatives, January 3, 1999.

25. “Joint Review of DOE’s Stockpile Stewardship Program, Manufacturing Infrastructure Overview,” presented to the Nuclear Weapons Council Standing and Safety Committee, October 25, 1999.

26. “Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management,” DOE/EIS-0236, September, 1996.

27. “DOE Defense Programs Complex Information Security Action Plan, Volume I, ISecM, Report of the Integrated Cyber-Security Management Task Force,” October 15, 1999, LA-CP-99-235.

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Appendix D

Acronyms

ACM	Advanced Cruise Missile
ACRR	Annular Core Research Reactor
ADAPT	Advanced Design and Production Technologies
AGEX	Above Ground Experiment
AHF	Advanced Hydrodynamics Facility
ALCM	Air-Launched Cruise Missile
APT	Accelerator Production of Tritium
ASCI	Accelerated Strategic Computing Initiative
ASN	Agency Secure Network
ATM	Asynchronous Transfer Mode
AWE	Atomic Weapons Establishment
CDU	Capacitive Discharge Unit
CLWR	Commercial Light-Water Reactor
CTBT	Comprehensive Test Ban Treaty
DARHT	Dual-Axis Radiographic Hydrodynamic Test
DNFSB	Defense Nuclear Facilities Safety Board
DoD	Department of Defense
DOE	Department of Energy
DSW	Directed Stockpile Work
DTRA	Defense Threat Reduction Agency
DVC	Data and Visualization Corridor
EOS	Equations of State
EUCOM	European Command
GLCM	Ground-Launched Cruise Missile
HE	High Explosive
HEU	Highly Enriched Uranium
IBM	International Business Machines
ICBM	Intercontinental Ballistic Missile
ICF	Inertial Confinement Fusion
IHE	Insensitive High Explosive
INF	Intermediate-Range Nuclear Forces Treaty
IS	Inactive Stockpile
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LEO	Life Extension Option
LEP	Life Extension Plan
LLCE	Limited Life Component Exchange
LLNL	Lawrence Livermore National Laboratory
LRPA	Long-Range Planning Assessment
MC	Military Characteristics
MESA	Microsystems and Engineering Sciences Applications
MLNSC	Manuel Lujan Neutron Scattering Center
NIF	National Ignition Facility
NPR	Nuclear Posture Review
NSDD	National Security Decision Directive
NTS	Nevada Test Site
NWC	Nuclear Weapons Council
NWCSSC	Nuclear Weapons Council Standing & Safety Committee
NWRWG	Nuclear Weapons Requirements Working Group
NWSP	Nuclear Weapons Stockpile Plan
ORNL	Oak Ridge National Laboratory
OSD	Office of the Secretary of Defense Programs

P&PD	Production and Planning Directive
PA&E	Office of Program Analysis and Evaluation
PAL	Permissive Action Link
PBX	Plastic-Bonded Explosive
PCP	Product Change Proposal
PDD	Presidential Decision Directive
PEIS	Programmatic Environmental Impact Statement
POG	Project Officer Group
QDR	Quadrennial Defense Review
RTBF	Readiness in Technical Base and Facilities
SFI	Significant Finding Incident
SGT	SafeGuard Transporter
SLBM	Submarine-Launched Ballistic Missile
SLEP	Stockpile Life Extension Process
SNL	Sandia National Laboratories
SNM	Special Nuclear Material
SRD	Secret Restricted Data
SSP	Stockpile Stewardship Program
SST	Safe Secure Trailers
START	Strategic Arms Reduction Treaty
STRATCOM	Strategic Command
STS	Stockpile-to-Target Sequence
SUTI	Sensitive Unclassified Technical Information
TLAM-N	Tomahawk Land Attack Missile–Nuclear
TSD	Transportation Safeguards Division
TSRD	Top Secret Restricted Data
UGT	Underground Test
UK	United Kingdom
USAF	United States Air Force
VIEWS	Visualization and Interactive Environment for Weapons Simulation

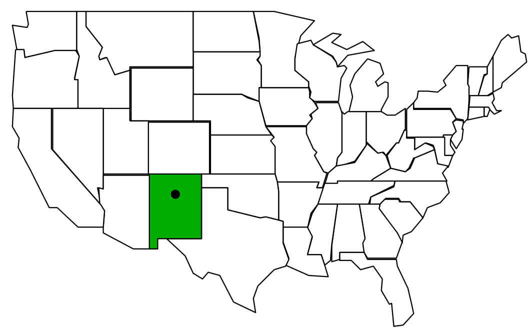
Appendix E

Site Descriptions

Los Alamos National Laboratory

MISSION

- Weapons Research & Development
- Stockpile Support
- Pit Manufacturing
- Reconfiguration / Rapid Reactivation
- Other Defense Programs
- Environmental Restoration/Waste Mgmt.
- Nonweapons Work



Location	Los Alamos, NM
Contractor	University of California
Established	1942
Area	29.6k Acres

UNIQUE ASSETS – KEY TO DEFENSE PROGRAMS:

Chemistry and Metallurgy Research Building (CMR)

The CMR Building was completed in the early 1950s to house research and experimental facilities for analytical chemistry, plutonium and uranium chemistry, and metallurgy, as well as some engineering design and support functions. In 1960, an addition (Wing 9) was constructed to support programs requiring hot-cell facilities. The facility also houses some other materials-related functions, including some uranium and other actinide research, fabrication, and metallography activities, and destructive and nondestructive analysis.

TA-55 Plutonium Facility

LANL is responsible for the design of the nuclear explosive package in many of the U.S. weapons. In addition, since the end of the Cold War, LANL now conducts the pit surveillance program and limited pit fabrication using the TA-55 plutonium R&D facility, due to termination of the nuclear weapons missions at the Rocky Flats Plant.

TA-55 provides chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides as well as providing a number of other capabilities in nuclear material handling, and applied research in plutonium and actinide chemistry. (See Processes and Technology section.)

Pit fabrication includes all activities necessary to fabricate new pits, to modify the internal features of existing pits (intrusive modification), and to recertify or requalify pits. Nonintrusive modification pit reuse, which is an inherent capability of the Pit Fabrication Facility, includes the processes and systems necessary to make modifications to the external features of a pit, if necessary, and to recertify the pit for reuse in a weapon. Existing equipment has been retained as much as possible, but some equipment has been and will continue to be upgraded.

Weapons Engineering Tritium Facility (WETF)

WETF is located in Buildings 205 and 205A in the southeast section of TA-16 outside the explosive area. Building 450 (Neutron Tube Target Loading, NTTL) is in the final stages of construction and upon startup will be included as part of the WETF facility. WETF is in a secured area patrolled by armed guards. Building 205 was specifically designed and built to process tritium safely and to meet user needs and specifications. Planning for WETF began in 1981 to replace an aging tritium-processing facility located at TA-33. Construction began in 1982 and was completed in 1984. WETF began operation in 1989. The ORR for Building 450 is expected to be completed in late FY 2000.

Sigma Complex

The Sigma Building (Building 66) and three other main buildings [Building 35 (Press Building), Building 141 (Beryllium Technology Facility, formerly the Rolling Mill Building), and Building 159 (Thorium Storage Building)] make up the Sigma Complex, which is enclosed by a security fence and to which access is controlled by a guard station. The complex, which encompasses over 200,000 ft^2 (60,960 m^2), was constructed in increments during the 1950s and 1960s and has been used for a variety of nuclear materials missions. Building 141 has been refurbished and is expected to be fully operational in late FY 2000. Today, the facility is primarily used for synthesizing materials and for processing, characterizing, and fabricating metallic and ceramic items, including items made of depleted uranium (DU). In the past, Sigma Complex processed all isotopes of uranium; therefore, much of the equipment is radioactively contaminated at very low levels. Nonradioactive hazardous materials used included a number of chemicals and metals such as beryllium. This facility includes specialized laboratories, a rolling mill, and a 5,000-ton press

TA-18

TA-18 is referred to as the Los Alamos Critical Experiments Facility (LACEF). It is also known as Pajarito Laboratory or Pajarito Site. The TA is a restricted area surrounded by a security fence with several additional layers of security at each of the Kivas. LACEF, which has operated since 1946, is the last general-purpose nuclear experiments facility in the US. It supports a variety of programs that range from national security programs, such as the Emergency Response program, Strategic Defense Initiative research, and Strategic Arms Reduction Treaty verification research, to development of instrumentation for nuclear waste assay and high-explosives detection. (See Processes and Technology section.)

Los Alamos Neutron Science Center (LANSCE)

LANSCE comprises a high-power, 800-MeV proton linear accelerator (linac); a Proton Storage Ring (PSR); neutron production targets at the Lujan Center and the Weapons Neutron Research (WNR) facility; a proton radiography facility; a high-power materials irradiation area called the Los Alamos Spallation Radiation Effects Facility (LASREF); an isotope production facility (IPF); and a variety of research spectrometers.

With the ability to produce protons and neutrons using the world's most powerful proton linac, LANSCE is ideal for research in radiography, condensed-matter science and engineering, accelerator science, and nuclear science. LANSCE uses these research capabilities to contribute to the Department of Energy (DOE) Stockpile Stewardship Program and to support a National User Program open to scientists from universities, industry, and federal laboratories. Within LANSCE, DP assumes management, operation, and maintenance responsibility for all facilities, except for the Manual Lujan, Jr. Neutron Scattering Center (MLNSC). The MLNSC facility is operated as a National User Facility. Management, operations, and maintenance responsibilities at MLNSC are shared by DP and DOE's Office of Science based upon their programmatic usage.

<u>Balance of Plant:</u>

The Laboratory occupies 43 square miles (111 km^2) of land owned by the DOE, which is divided into 47 separate, currently active Technical Areas (TAs). TA-3 is the main technical area, where almost half of the personnel of the Laboratory are located. TA-0, the townsite, contains leased facilities located on Los Alamos County land. Only one TA—TA-57, the Fenton Hill Site, which lies approximately 28 miles (45 km) west of Los Alamos—is noncontiguous. The Laboratory currently consists of approximately 2,043 structures. Of these, 1,835 are buildings, which contain 7.3 million square feet. The other structures consist of meteorological towers, water tanks, manholes, small storage sheds, electrical transformers, etc. As explained above, part of the resources of the Laboratory are the specialized facilities that have been built and maintained at Los Alamos over the last 50 years. Most of these facilities have been designed and built to handle hazardous energy sources.

Facilities & Infrastructure:

Nonnuclear Facilities

The directed fabrication of nonnuclear components associated with the LANL Stockpile management program included the manufacturing of detonators, detonator simulators, pit mockups, beryllium parts, calorimeters, and tritium loading of neutron tube targets. The missions for these components were transferred to LANL as part of the nonnuclear component of the Complex 21 Nuclear Weapons Complex Reconfiguration Program initiated in 1991, and formally implemented as part of the construction line item project 93-D-123, Complex-21 Nonnuclear Consolidation (NNR). The overall NNR project was initiated to downsize the nonnuclear manufacturing component of the nuclear weapons complex while maintaining neutron generator production capacities at the START II level, as predicated by the Bush-Yeltsin agreement announced June 17, 1992.

Nuclear Facilities

Fundamental to current and future nuclear programs at LANL is the maintenance and augmentation of the capabilities and facilities infrastructure required to support the complete range of LANL's existing nuclear responsibilities, which include samples, and components fabrication for R&D, pit surveillance, materials science and technology development, materials stabilization, pit rebuild and fabrication, neutron source recovery, and other missions and activities.

LANL is currently planning and actively pursuing upgrades to several nuclear facilities, some of which are decades old. The planned upgrades will allow the facilities to continue to support R&D capabilities needed for ongoing missions and to continue providing the necessary plutonium technologies and capabilities essential to the management and refurbishment of the stockpile. These maintenance and upgrades are independent of the pit manufacturing assignment, full implementation of which would call for some additional facility modifications or enhancements.

Chemistry and Metallurgy Research Building (See "Unique Assets" Section)

This building is approximately 45 years old and is beyond the expected life cycle. Upgrades will be required for this facility to operate in a safe, secure, and compliant mode for the next decade. Subsequently plutonium operations will require a replacement facility.

TA-55 Plutonium Facility (See "Unique Assets" Section)

TA-55 is now over 20 years old. Several of the systems of the building need upgrading, and components approaching the end of their useful life need to be replaced. Planning is continuing on a Capability Maintenance and Improvement Project (CMIP) to refurbish safety systems, to make the modifications required to support limited-scale pit manufacturing, and to maintain the ability to continue with present assignments, including the non-weapons activities such as the MOX fuel efforts. The near-term part of the CMIP will focus on the safety infrastructure and the replacement of safety items such as the air-supply ductwork, the uninterruptable power supply, the backup electrical generator, and the continuous air monitors. In the short term, the LANL small-scale pit manufacturing efforts will also benefit from upgrades and improvements to the trolley system and to equipment of facility provisions for operations such as radiography, foundry, metal preparation, machining, assembly, waste management, analytical chemistry, and material control and accountability.

Design work is in progress on the Nuclear Materials Security and Safeguards Upgrades Project, which will provide an updated and fully integrated security control system, associated alarm systems, and other items for TA-55 as well as other nuclear materials facilities at LANL.

The TA-55 Fire Loop project involves the replacement of the Plutonium Facility's external water piping that supplies the fire suppression systems inside the buildings. The project includes anchoring existing water tanks and installing seismic upgrades to aboveground lines in the water pump houses.

Weapons Engineering Tritium Facility

Following upgrades scheduled for completion in FY00, the facility will begin lending support to TA-55 special recovery line, which processes tritium-contaminated objects.

Processes and Technology:

The vast majority of all the process equipment and process technologies currently in use in the LANL nonnuclear production facilities (Beryllium Technology, High Power Detonator, Neutron Tube Target Loading, Pit Support, and Calorimetry facilities) were transferred to LANL under the NNR construction project and Complex 21 Reconfiguration Program. As such, they are either new or have been upgraded to the state-of-the-art standards at the time they were installed and made operational.

Additional neutron tube target loading capacity and capability to support the START I production requirements have been included in the Rapid Reactivation Project and will reflect state-of-the-art technologies and maintain complete compatibility with the process equipment and technologies installed as a part of the NNR project. This additional capacity and capability is now being designed and fabricated, for installation at the existing WETF facility, TA-16, with WR qualification to be completed in May 2001.

In addition, processes and technologies at TA-55 provide chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides into many compounds and forms. Additional capabilities include the means to safely and securely ship, receive, handle, and store nuclear materials, as well as manage the wastes and residues produced by TA-55 operations. A core capability is basic and applied research in plutonium and actinide chemistry. Core competencies are maintained in the Plutonium Facility for each type of plutonium processing activity. Extensive plutonium recovery processes are maintained including the ability to convert the recovered material to plutonium metal. A separate portion of the facility is dedicated to fabricating ceramic-based reactor fuels and to processing ^{238}Pu used in radioisotope heat sources. In addition, analytical capabilities, materials control and accountability techniques, and a substantial R&D base are available to support these core capabilities. A sophisticated nuclear materials measurement and accountability system is used at TA-55. The system includes nuclear materials accounting, nuclear materials management and modeling, a measurement support operation, operation of a nondestructive assay laboratory, nuclear materials packaging and transfer, and nuclear materials storage. All nuclear materials that are in process or are stored onsite are monitored to ensure that material balances are properly maintained and inventoried on a real-time basis. The nuclear-materials-packaging and transfer operation receives nuclear material into the facility and transfers shipments out of the facility. The nuclear materials storage operation provides a safe storage location for the actinide materials at the Plutonium Facility. The Plutonium Facility has extensive capabilities for treating, packaging, storing, and transporting the radioactive waste produced by TA-55 operations. Liquid wastes are converted to solids or are piped to the RLWTF at TA-50. Some solid TRU wastes are immobilized in cement, others are consolidated in drums or are packaged in waste boxes. Low-level wastes are also packaged at this facility. Solid wastes of all types are stored at TA-55 until they are shipped to Laboratory waste storage or disposal locations, primarily at TA-54.

Processes and technologies at TA-18 provide capabilities in the areas of design, construction, research, development, and application of critical experiments. In addition to criticality work, technologies at TA-18 include teaching and training related to criticality safety and applications of radiation detection and instrumentation. The TA-18 complex provides processes and technologies to DOE's nuclear facilities and nuclear materials programs with criticality safety support for specific facility process operations and for facility safety analysis. Critical assembly experiments are performed to access the safety and performance of individual production operations and devices and to validate the results of calculational methods. Operations, support, and supervisory personnel throughout DOE receive criticality safety training at the facility.

Workforce:

Los Alamos is currently in the process of hiring and training WR qualified production staff to meet projected Pit production workload and is developing a trained workforce in the non-nuclear component area.

Construction:

Project 00-D-105, Strategic Computing Complex, LANL

Mission/Scope/Status:

The SCC will be a three-story structure with approximately 267,000 gross square feet which will house the world's largest and most capable computer (initially 30 TeraOPS, or 30 trillion floating point operations per second) in a specially designed 43,500-square-foot computer room. This room will be supported by electrical and mechanical rooms in excess of 60,000 square feet.

The facility will provide a dynamic environment for approximately 300 nuclear weapons designers, computer scientists, code developers, and university and industrial scientists and engineers to collaborate to extend the cutting edge of simulation and modeling development in support of nuclear weapons stockpile stewardship requirements. These scientists and engineers will work together, with support personnel, in simulation laboratories (approximately 200 in classified and 100 in unclassified areas). The facility will be located in Technical Area 3 (TA-3) at the Los Alamos National Laboratory.

A Design/Build contract has been signed for the construction of the main facility. A separate contact to construct the utilities was signed with the JCINM.

Project 99-D-132 Nuclear Materials Safeguards and Security Upgrades Project, LANL

The Nuclear Material Safeguard and Security Project (NMSSUP) replaces the existing Los Alamos National Laboratory (LANL) security system, addresses Special Nuclear Material (SNM) facility requirements, and addresses malevolent vehicle threats at key nuclear facilities.

Project 99-D-122, Rapid Reactivation, Various Locations

This project will increase the complex's capability to protect START I (START II with Hedge) requirements. Minor facility modification and additional equipment is required, and therefore, included under this line item, to increase capacity to provide START I (START II with Hedge) requirements.

Los Alamos National Laboratory: Neutron Tube Target Loading

The LANL subproject consists of designing, constructing, and installing a third target loader within the existing space of the Neutron Tube Target Loading Facility (NTTL)

Project 95-D-102, CMR Upgrades Project, Los Alamos National Laboratory, Los Alamos, New Mexico

The primary purpose of this project is to upgrade facility systems and infrastructure that have been in continuous operation for over 40 years and are near the end of their useful life. Such upgrading will ensure the continued safety of the public and Laboratory employees and increase the operational safety, reliability and security of essential activities. Increased safety, reliability, and security are critical to the continued operation of the Laboratory's Stockpile Management Programs and other national defense programs.

Project 97-D-102, Dual-Axis Radiographic Hydrotest (DARHT) Facility, LANL

Mission/Scope/Status:

The DARHT Phase 1 machine has been completed and is operational. Phase 2 is underway.

Included in DARHT Phase 2 is the second flash x-ray electron beam accelerator, which will be necessary to complete the essential dual-axis configuration of the facility. Their sequential acquisition allowed DOE to take advantage of engineering and scientific advances that have occurred since construction of the first machine. In September 1997, the Department selected the Long-Pulse Linear Induction Accelerator because it presented the greatest technological advancement for the lowest cost and least risk for the second machine. It will be capable of providing four high-quality beam pulses over four microseconds with each pulse comparable in quality to the single pulse machine in the first axis. The longer Phase 2 machine made it necessary to increase the size of the west accelerator hall by 1,300 square feet over the original plans.

Project 96-D-103, Atlas, LANL

Mission/Scope/Status:

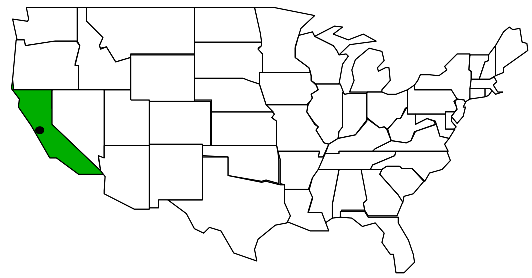
The Atlas facility will provide enhanced Los Alamos National Laboratory pulsed power experimental capability to support high energy above ground experiments, an essential capability requirement for DOE's stockpile stewardship program. The scope of work includes:

- Design, procurement, assembly, and installation of the Atlas 45-50 Megampere, 30-36 Megajoule capacitor bank with associated controls and power supplies in Buildings 125 and 294 at TA-35.
- Modification of approximately 34,000 square feet of Building 125 at TA-35 to support Special Facilities Equipment (SFE) installation and completion of operational upgrades to the facility.
- Utilization of existing 1,430 MVA generator in Building 301 at TA-35 for electrical power.
- Installation of a power storage equipment area of 2,600 square feet in Building 294 and upgrades to the control room area of 1,600 square feet in Building 125 at TA-35; also provides power distribution and diagnostic cabling to experiments in Building 125.
- Completion of site work and utilities to support the use of up to 3 Government-Furnished diagnostic trailers and installation of new dielectric oil storage tank adjacent to Building 125 at TA-35.

Lawrence Livermore National Laboratory

MISSION

- Weapons Research & Development
- Stockpile Support
- Reconfiguration / Rapid Reactivation
- Other Defense Programs
- Environmental Restoration/Waste Mgmt.
- Non-weapons Work



Location	Livermore, CA
Contractor	University of California
Established	1952
Area	1 sq. mile

UNIQUE ASSETS – KEY TO DEFENSE PROGRAMS:

- High Explosives Applications Facility – the most modern facility for HE research in the world.
- Flash X-ray Facility – this hydrodynamic facility has been the most capable in the world. It is now shut down during construction of the new Contained Firing Facility that will house the FXR machine and a reinforced firing chamber for containment of debris.
- The Superblock, housing modern facilities for special nuclear materials research and engineering testing. The Plutonium Facility supports a number of DP-funded research efforts.
- The Secure and Open Computing Facilities meet the needs of programmatic work and serve as a testbed for development of high performance computer hardware and software.
- The National Ignition Facility, currently under construction, will offer unique capability for investigating fusion burn and the high temperature and pressure environments characteristic of nuclear weapons.

Construction:

Project 00-D-103, Terascale Simulation Facility, LLNL

Mission/Scope/Status:

The project provides for the design, engineering and construction of the Terascale Simulation Facility (TSF - Building 453) which will be capable of housing the 100 TeraOps-class computers required to meet the Accelerated Strategic Computing Initiative (ASCI). The building will encompass approximately 270,000 square feet. The building will contain a multi-story office tower with an adjacent computer center. The Terascale Simulation Facility (TSF) proposed here is designed from inception to enable the very large-scale weapons simulations essential to ensuring the safety and reliability of America's nuclear stockpile. The timeline for construction is driven by requirements coming from the ASCI within the Stockpile Stewardship Program (SSP). The TSF will manage the computers, the networks and the data and visualization capabilities necessary to store and understand the data generated by the most powerful computing systems in the world.

The TSF project will construct a building (Building 453) of approximately 270,000 square feet located adjacent to an existing (but far less capable) computer facility, Building 451, on the LLNL main site. The building will contain a multi-story office tower with an adjacent computer center. The computer center will house computer machine rooms totaling approximately 47,500 square feet. The computer machine rooms will be clear span (without impediments) and of an aspect ratio designed to minimize the maximum distance between computing nodes and switch racks.

The ceiling height will be sufficiently high to assure proper forced air circulation. A raised access floor will be provided in order to allow adequate room for air circulation, cabling, electrical, plumbing, and fire/leak detection equipment.

Project 96-D-105, Contained Firing Facility Addition, LLNL

Mission/Scope/Status:

This project is a 33,370 square foot facility consisting of four related structures with the purpose of providing increasingly safe and environmentally compliant firing of explosive charges up to a 60-kg limit of energetic high explosives. This project will be positioned on the existing firing table site adjacent to B801. The four structures are a structurally reinforced Firing Chamber, a Support Facility, a Diagnostic Equipment Facility, and an Office Module.

The Firing Chamber is designed to contain the effects of cased high explosive materials used in various laboratory experiments. The high explosive quantities vary in operational weight up to approximately 60 kg, or an equivalent TNT design weight of approximately 206.3 pounds. The chamber must be protected from shrapnel from explosive casings. All major structural elements are to remain elastic to permit repetitive chamber usage with no structural damage.

The two-inch floor plate and four-inch anvil plate were fitted into place. Approximately half of the wall plate has been installed to date. Work on the office module is progressing well. The walls and roof have been completed as well as the mechanical and electrical rough-in work. Windows are being specially fabricated to meet the accidental detonation blast load criteria. They are expected to be delivered in December.

Project 96-D-111; National Ignition Facility (NIF)

Mission/Scope/Status:

The Project provides for the design, procurement, construction, assembly, installation, and acceptance testing of the National Ignition Facility (NIF), an experimental inertial confinement fusion facility intended to achieve controlled thermonuclear fusion in the laboratory by imploding a small capsule containing a mixture of the hydrogen isotopes, deuterium and tritium. The NIF is being constructed at the Lawrence Livermore National Laboratory (LLNL), Livermore, California as determined by the Record of Decision made on December 19, 1996, as a part of the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS).

The mission of the National Inertial Confinement Fusion (ICF) program is to execute high energy density physics experiments for the Stockpile Stewardship program, an important part of which is the demonstration of controlled thermonuclear fusion in the laboratory. Technical capabilities provided by the ICF program also contribute to other DOE missions including nuclear weapons effects testing and the development of inertial fusion power. As a key element of the Stockpile Stewardship Program, the NIF is designed to achieve propagating fusion burn and modest (1-10) energy gain within 2-3 years of full operation and to conduct high energy density experiments, both through fusion ignitions and through direct application of the high laser power. The NIF is one of the most vital facilities in the stockpile stewardship program. The NIF will provide the capability to conduct laboratory experiments to address the high energy density and fusion aspects that are important to both primaries and secondaries in stockpile weapons.

Project 90-D-102-01, Site 300 Facilities Revitalization, LLNL

Mission/Scope/Status:

This project was initiated to provide new equipment and facilities and to upgrade existing roads and utilities around the LLNL Site 300. New facilities included the Central Control Post, the Bunker Support Facility, and the High Optic Facility. New equipment included Special Facilities and Standard diagnostic equipment.

A 380-foot section of the Main Site Road was converted to a four-lane road, with shoulders, to create a new entrance to Site 300. In addition, the intersection of the Main Site Road and the road to the west of firing area was reconstructed to add additional lanes.

The Site water distribution was upgraded by adding two new 8-inch lines and a new 96,000-gallon storage tank.

Project is progressing as scheduled and is expected to be completed in December 1999.

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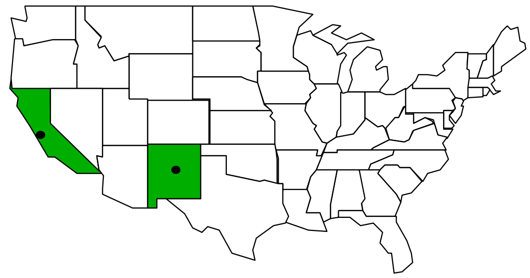
Sandia National Laboratories



MISSION

- Weapons Research & Development
- Stockpile Support /Weapons Production
- Other Defense Programs
- Environmental Restoration/Waste Mgmt.
- Nonweapons Work

Location	Albuquerque, NM	Livermore, CA
Contractor	Lockheed-Martin Corporation	
Established	1948	1956
Area	17.61K Acres	410 Acres

UNIQUE ASSETS – KEY TO DEFENSE PROGRAMS:

In support of nuclear weapon R&D:

- Microelectronics Development Laboratory.
- Compound Semiconductor Research Laboratory.
- Above-ground test facilities (ACRR, SPR, Gamma Radiation Facility, Z-facility, Saturn, Hermes).
- Processing & Environmental Technology Laboratory.
- Explosive Component Facility.
- ASCI "Red" Terascale Computer.
- Integrated Test Complex.
- Tonopah Test Range.
- Kauai Test Range.

SNL also has the mission to support the future development and WR manufacturing of neutron tubes, neutron generators and switch tubes.

- **Building 870** is primarily used for most of the processing and assembly operations associated with SNL's production mission of neutron generators.
- **Weapons Evaluation Test Laboratory (located at Pantex)**

Balance of Plant:

Balance of plant includes additional site support activities, not covered previously in Building 870, necessary for SNL to perform its mission functions. These include such things as explosive-assembly operations, final acceptance testing, packaging for shipment, DOE-bonded storage, etc.

Facilities & Infrastructure:

Existing production facilities at the Sandia National Laboratories (SNL) are those primarily involved with neutron generator production. These missions were transferred from the Pinellas Plant, Largo, Florida as a part the nonnuclear component of the Complex 21 Nuclear Weapons Complex Reconfiguration Program initiated in 1991, and formally implemented as part of the construction line item project 93-D-123, Complex-21 Nonnuclear Consolidation (NNR). The overall NNR project was initiated to downsize the nonnuclear manufacturing component of the nuclear weapons complex while maintaining neutron generator production capacities at the START II level, as predicated by the Bush-Yeltsin agreement announced June 17, 1992.

The existing SNL facilities identified to support the neutron generator production mission were appropriately sized and upgraded to meet all current commercial construction, DOE ES&H, and security codes, orders, and regulations. The SNL NNR project was initiated in July 1993and construction was completed in January 1997. The facilities are now in production operations.

Additional neutron generator production capability and capacity is currently being designed and constructed within the existing SNL production facility complex to support a START II stockpile level while protecting the capability to support a START I level as directed by P&PD 97-0. This additional capability and capacity requirement is being realized through construction line item project 99-D-122, Rapid Reactivation Project. Started in March 1999, this project is scheduled to be completed in FY 2001. Although not anticipated in the foreseeable future (through FY 2005), there may be some modifications to current neutron generator designs. However, it is not anticipated that any major modifications to existing manufacturing processes or facilities will be required.

Processes and Technology:

Processes and technologies were transferred from the Pinellas Plant, beginning in 1993. The processes and technologies were upgraded or replaced as required, as a part of the NNR construction project. Detailed "Make/Buy" analyses and decisions were made regarding process equipment and process technology issues associated with the existing process equipment residing at the Pinellas Plant prior to initiating transfer to SNL in the 1994-1995 time frame. As a result, the vast majority of all the process equipment and process technologies currently in use in the SNL neutron generator production facilities are new or have been upgraded to the state-of-the-art standards at the time they were installed.

Additional neutron generator process equipment being purchased to support the START I production requirements have been included in the Rapid Reactivation Project and will reflect state-of-the-art technologies and maintain complete compatibility with the process equipment and technologies installed as a part of the NNR project.

Workforce:

SNL is currently in the process of hiring and training WR process qualified production staff to meet the projected neutron generator production workload. However, SNL is expressing concern that they are not being able to hire qualified staff because of operating budget constraints. There is a hiring freeze associated with Stockpile Maintenance, Dismantlement/Disposal, and Stockpile Support for FY00 due to inadequate resources, with a prediction that the freeze will continue into the foreseeable future. In addition, there are insufficient funds to adequately cross-train the existing technical staff to help compensate for the hiring freeze. It is important that adequate and timely funds be appropriated to SNL to support and maintain their aggressive hiring and training schedule, in support of production delivery schedules, stockpile maintenance, the dismantlement/disposal, and stockpile support programs.

Construction:

Project 01-D-102, Microsystems and Engineering Science Applications (MESA) Facility, SNLA

Mission/Scope/Status:

The Microsystems and Engineering Science Applications (MESA) Facility is proposed to be a new, state-of-the-art capability at Sandia National Laboratories to capitalize on the advances in microsystems to develop needed weapon technologies by FY 2003. It will provide essential facilities and capabilities to integrate: 1) advanced component and subsystems design and stewardship; 2) computational simulation and engineering; and 3) next generation microsystems development and production to enable a safe, secure, reliable, and affordable nuclear stockpile, now and in the future.

Microsystems devices are microelectronic-based chips that embody electronics, micromachines, optoelectronics, and sensors. As a result, these devices can sense, think, act, and communicate. As a result of their microscopic feature size, they are extremely rugged, and because they are based on microelectronics-related technology, they are extremely reliable and inexpensive to fabricate. Microsystems devices are expected to revolutionize many technology applications during the next two decades, including improving the surety of the Nation's nuclear weapon stockpile.

The MESA project includes:

- Construction of a new heavy-lab (clean room) and associated tooling to provide a next-generation replacement of Sandia's Compound Semiconductor Research Laboratory (CSRL).
- Re-tooling of the existing Microelectronics Development Laboratory (MDL).
- Construction of light laboratories and offices/workspaces for weapons designers, computational and engineering scientists, and microsystems technologists to achieve the effective and timely research, design, development, integration, and computational qualification of microsystem-based devices, components, and subsystems.
- Under consideration as an FY 2001 new start.

01-D-101, Distributed Information Systems Laboratory (DISL), SNLL

Mission/Scope/Status:

The Distributed Information Systems Laboratory (DISL) is a proposed new research facility at Sandia National Laboratories to develop and implement distributed information systems for Defense Programs (DP). It consolidates at one accessible location all activities focused on incorporating those systems to support DP's Stockpile Stewardship Program (SSP). Research at DISL will concentrate on secure networking, high performance distributed and distance computing, and visualization and collaboration technologies that do not exist today, yet need development to help create design and manufacturing productivity environments for the future nuclear weapons complex. The major objective of DISL is to bring together these technologies to develop a distributed information systems architecture that will link the nuclear weapons complex of the future.

- Under consideration as an FY 2001 new start.

00-D-107, Joint Computational Engineering Laboratory, SNLA

Mission/Scope/Status:

The Joint Computational Engineering Laboratory (JCEL) will be a new, state-of-the-art facility at Sandia National Laboratories for research, development, and application of leading-edge, high-end computational and communications technologies. JCEL will provide office space and laboratories for 175 people in a building with a total of approximately 55,200 gross square feet. JCEL will be the center of Sandia's computational modeling, analysis, and design community, and will be constructed in close proximity to Sandia's existing computer and communications building, presently occupied by part of this community.

Plan, design, and construct a new, three-story building to accommodate a total of about 175 people, which will provide classified and unclassified space in close proximity. The project will provide computer equipment to: display three-dimensional simulations; support engineers and scientists from other DOE labs, universities, and the private sector; and provide video conferencing capability. Computer equipment includes: Interactive Multimedia equipment; Virtual Reality/Advanced Visualization equipment; high-end 3D graphic workstations and printers; and design and analysis workstations. In addition, the project will move existing furniture and install some new furniture. Site landscaping, parking, pedestrian access improvements, signage, and fencing improvements will be provided.

Project 96-D-104, Process and Environmental Technology Laboratory, SNLA

Mission/Scope/Status:

The Processing and Environmental Technology Laboratory (PETL) is proposed to be a three story office and light lab building with a partial basement containing approximately 151,435 gross square feet (79,200 nsf). It will focus R&D and production support activities to address ES&H issues in the nuclear weapons complex and at Sandia. The facility will collocate activities dealing with materials and process research, materials support for the stockpile, analytical support for production of non-nuclear components, and maintenance and dismantlement of weapons.

The PETL will provide modern laboratory facilities and collocate functions that are currently spread throughout Sandia TA I in temporary or substandard space.

The building is approximately 65% complete. All precast wall panels and most of the windows have been installed.

The penthouse is completely enclosed. Design activities for the occupancy of the building have started, including equipment move lists and furniture selection and layout.

01-D-126, Weapons Evaluation Test Laboratory (WETL), Sandia National Laboratories, Pantex

This facility will provide a laboratory environment capable of supporting the Enhanced Surveillance Program (ESP) through flexibility of floor space configuration, appropriate adjacencies for an optimal work environment, and the mechanical and data infrastructure to be dependable and efficient in supporting advanced test technologies.

99-D-122, Rapid Reactivation, Various Locations

This project will increase the complex's capability to protect START I (START II with Hedge) requirements. Minor facility modification and additional equipment is required, and therefore, included under this line item, to increase capacity to provide START I (START II with Hedge) requirements.

Sandia National Laboratories: Neutron Generators Facilities (NGF)

The SNL subproject consists of rearranging existing space within Building 870, adding additional space to adjacent buildings, and the procurement of additional production equipment

Project 90-D-102-03, Technology Support Center, SNLA

Mission/Scope/Status:

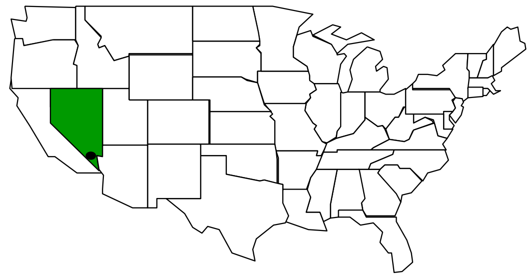
TSC consists of two buildings: 1) Office/Light Lab/Conference Area (O/LL); two-story, 99,000 gross square feet (44,000 net square feet) concrete framed and concrete masonry structure with all mechanical and electrical systems and all site improvements. 2) Gamma Irradiation Facility (GIF), a single-story, 12,500 gross square feet (10,000 net square feet) steel frame stucco high bay lab with low-bay ancillary spaces. The high bay will house three test cells and an 18-foot-deep pool. The low bay includes offices, assembly labs and mechanical and electrical rooms.

When completed, GIF will: 1) Reduce the Area V resident population, thereby reducing the risk of potential radiation exposure to personnel either during normal operations or accidentally; 2) provide a permanent facility to replace substandard facilities; 3) separate the GIF from the ACRR; 4) modernize and enlarge the GIF; and 5) relocate the low intensity cobalt array (LICA) from AREA I to the GIF.

Nevada Test Site

MISSION

- ♦ Test Resumption Readiness
- ♦ Subcritical Experiments
- ♦ Facilities Diagnostic Support
- ♦ DSW Certification Experimental Data



Location	Las Vegas, NV
Contractor	Bechtel NV
Established	1950
Area	1,350 sq. miles

UNIQUE ASSETS – KEY TO DEFENSE PROGRAMS:

- Nuclear Explosion Test Beds.
  - Emplacement boreholes (vertical)
  - Tunnels (horizontal)
- Test resumption equipment and personnel.
- U1a – subcritical experiment test bed (explosive experiments with Special Nuclear Materials).
- Physical size and remoteness from populated areas. Arial extent of the NTS, which reduces potential impacts on neighbors–equivalent to the state of Rhode Island–and infrastructure to support experiments.
- Infrastructure to support nuclear-weapon experiments.
- DAF – modern assembly/disassembly facility.
- BEEF – Big Explosive Experiment Facility (high explosive testing) to 70,000 pounds high-explosive equivalent.
- JASPER – Two stage gas gun for actinide series experiments (Special Nuclear Material) [under construction].
- Experiment diagnostics for remote field use.
- A-1 High Bay, A-1 Expansion Bay and A-17 Twin Towers at North Las Vegas Complex.

Facilities & Infrastructure:

More than 1,100 support buildings and laboratories are spread across the Nevada Test Site. The Nevada Test Site is a unique expanse of federally controlled land and facilities in a remote region of southern Nevada. The 1,350 square miles that make up the Nevada Test Site are surrounded by the Nellis Air Force Range and unpopulated land controlled by the U.S. Bureau of Land Management. The geology, hydrology, meteorology and radiological environments are well characterized. The *Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* and the associated *Record of Decision* allow for the execution of a variety of complex and unique projects and experiments while maintaining protection of the public and the environment.

The U1a Facility is an underground experimental complex at the U.S. Department of Energy's Nevada Test Site. The U1a complex supports routine test site activities in which high explosives are detonated to test the readiness of equipment, communications, procedures, and personnel.

Test data will help maintain the reliability of the nuclear weapons stockpile by allowing scientists to gain more knowledge of the dynamic properties of aging nuclear materials. Of particular interest is data on the behavior of plutonium that can be used in computer calculations of nuclear weapon performance and safety in the absence of actual underground nuclear testing.

The complex is located in Area 1 of the Nevada Test Site, approximately 90 miles northwest of Las Vegas. The complex, consisting of horizontal tunnels about one-half mile in length mined at the base of a vertical shaft approximately 960 feet beneath the surface, was mined in the late 1960s for an underground nuclear test, which was later canceled. In 1988, the shaft was reopened, and a 1,460-foot horizontal tunnel was mined south at the 962-foot level of the shaft. In 1990, the Ledoux nuclear test was conducted in the tunnel.

The vertical shaft is equipped with a mechanical hoist for personnel and equipment access while another vertical shaft about 1,000 feet away provides cross ventilation, instrumentation, utility access, and emergency egress. On the surface, there are several temporary buildings and instrumentation trailers. The most distinguishable landmark at the complex is the white air building, which was used for experiment assembly during Ledoux.

The 100,000-square-foot nuclear explosive Device Assembly Facility (DAF) is located in Area 6 of the Department of Energy's Nevada Test Site. Built at a cost of approximately $100 million, the DAF is expected to become a centerpiece for innovative alternative uses of the test site.

Construction began on the DAF in the mid-1980s when nuclear weapons testing was still in progress. DAF's original purpose was to consolidate all nuclear explosive assembly functions, to provide safe structures for high explosive and nuclear explosive assembly operations, and to provide a state-of-the-art safeguards and security environment. Now that America is no longer conducting underground nuclear weapons tests, the DAF has the potential for other uses, including disassembly of nuclear weapons retired from the U.S. stockpile.

The DAF has five assembly cells, four high bays, three assembly bays, five staging bays, a component testing laboratory, two shipping and receiving buildings, two decontamination facilities, three small vaults, an administration building, alarm stations, an entry guard station, and a mechanical and electrical support building.

The main facility is covered with a minimum of five feet of earth. The major operating facilities, assembly cells and bays, the radiography bays, and the shipping and receiving building have bridge cranes. The five assembly cells have rotating polar bridge cranes. The DAF's activities will comply with the National Environmental Policy Act, and all applicable federal, state, and local regulations. Each assembly cell is designed and tested to undergo an explosion from a maximum high explosive device without injury to personnel outside of the cell. Gravel covers are designed to minimize release of nuclear material in the unlikely event of an accidental explosion.

The Big Explosives Experimental Facility (BEEF) is a hydrodynamic testing facility, located at the Department of Energy's Nevada Test Site in Area 4, about 95 miles northwest of Las Vegas, Nevada.

The need for the BEEF site originated when, due to community encroachment near the Lawrence Livermore National Laboratory (LLNL) facility in Livermore, California, DOE was no longer allowed to perform large high explosive experiments at the facilities Site 300, Shaped Charge Scaling Project. Therefore looking at the Nevada Test Site as a location to continue to perform these large high explosive experiments, two earth-covered, two-foot thick steel reinforced concrete bunkers, built to monitor atmospheric tests at Yucca Flat in the 1950s, were located and found to be ideally configured.

The facility consists of a control bunker, a camera bunker, a gravel firing table, and associated control and diagnostic systems. The facility has conducted safely conventional high-explosives experiments using a test bed that provides sophisticated diagnostics such as high-speed optics and x-ray radiography on the firing table, while operating personnel are present in the bunker.

In order to conduct large conventional high-explosive experiments on the site firing table while operating personnel are present in the control bunker, it first had to be certified as safe. To achieve this, scientists conducted *Popover* — a series of high explosive (up to 7,800 pounds) tests which were detonated 27-feet from the bunker's buried outer wall.

The test data was used to develop an effects profile that defined the relationship of the high-explosive charge size and detonation point to blast effects, such as overpressure, bunker wall strain, dynamic response (acceleration), and noise amplitude. Together these results demonstrated that the bunker would provide a safe working environment.

The Big Explosives Experimental Facility will play a large role in accumulating data supporting stockpile stewardship, along with a variety of new experimental programs, that will expand this nation's non-nuclear experiment capabilities. This facility complements the U1a complex and other DOE hydrodiagnostic facilities.

From roads to power transmission systems, the Nevada Test Site has a vast infrastructure to support both large and small projects.

Electric

The Nevada Test Site boasts around 265 miles of electrical transmission and subtransmission lines. Test site power loads currently are served from two independent 138 kV transmission lines. In addition, 20 megawatts of on-site diesel generation is available for emergency backup power. The test site transmission system capacity is about 45 megawatts.

The Nevada Test Site is located within 110 miles of large 500 kV transmission lines at Eldorado Valley, part of the southern Nevada hub for several key power transmission corridors connecting major load centers and generation systems in Utah, California, Nevada, and Arizona.

Hydrology and Water

Hydrology

Groundwater movement is one of the most thoroughly studied aspects of the vast, arid desert of the Nevada Test Site. Hydrologists, geologists, and other scientific experts have analyzed groundwater at the test site since the 1970s, and studies continue. The purpose of their study is to determine groundwater flow rates and directions, the nature and location of aquifers, and other information.

Water

The Nevada Test Site is served by a water system comprising 11 operating wells for potable water and one for nonpotable water (with pumps, boosters, sumps, reservoirs, and chlorinator water softeners), 27 storage tanks, 13 usable construction-water sumps, and six water transmission systems (100 miles of supply and distribution lines). The system also serves a variety of domestic, construction, and fire-protection water uses. The wells produce more than 6,000 gallons of water per minute, nearly 9 million gallons per day. Inactive wells, if brought on line, could supply an additional 2,200 acre-feet per year.

Seismic Monitoring

For more than 30 years, the Nevada Test Site team has operated an extensive seismic network of remote monitoring stations in Utah, California, and Nevada. The network records both earthquakes and nuclear explosions to provide information for treaty verification and nonproliferation studies.

The seismic program includes a permanent 13-station geophone network and other portable data acquisition units. To ensure safety, test site technicians use this system to monitor ground motion activity immediately after experiments are conducted. The geophone network produces information that helps scientist plan re-entry activities after an underground test involving explosives, and portable equipment allows researchers to provide other locations with site-specific seismic and ground motion information. Researchers also operate portable strong-motion seismic stations to measure the effects of ground motion on buildings.

<u>Construction</u>:

Project 99-D-108, Renovate Existing Roadways, NTS

Mission/Scope/Status:

This project will provide for the renovation of 37.0 miles of Mercury Highway from the southern boundary of the Nevada Test Site (NTS) to the intersection of Rainier Mesa Road to Area 3. These repairs will consist of removing existing debris from pavement cracks, filling cracks with asphalt sealant, installing a stress absorbing membrane, and applying a new asphaltic-concrete overlay. In addition, the 2.3 miles of the Rainier Mesa Road from the intersection of Mercury Highway to the intersection of road 4-04 in Area 4 will be reconstructed. Repairs will consist of total reconstruction of the roadbed and the application of the asphalt pavement. The renovated road will have two-inch-thick overlay; the reconstructed road will have three-inch-thick paving. Aggregate shoulders will parallel each side. All required traffic signs, striping, and markers will be included in this project. No buildings or utilities are included in this project.

Project 96-D-102-03, 138kV Modernization Substation, NTS

Mission/Scope/Status:

This project will modernize one major substation (Frenchman Flat Substation), one switching center (Mercury Switching Center), and one tap station (Valley Tap) on the 138 kilovolt (kV) transmission system loop at the Nevada Test Site (NTS).

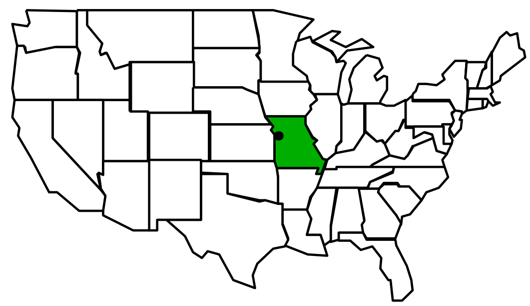
It will also provide for the installation of a SCADA fiber-optics communication loop.

The Mercury Switching Center serves as a termination point for the incoming power line from Nevada Power Company (NPC).

Kansas City Plant

MISSION

- Production, Procurement, & Dismantlement of NonNuclear Components
- Limited Life Components
- Retrofits/Modifications
- Evaluation/Surveillance
- TSD Support
- Stockpile Support Center
- Work for Others



Location	Kansas City, Missouri
Contractor	AlliedSignal Corporation
Established	1949
Area	122.1 Acres

UNIQUE ASSETS — KEY TO DEFENSE PROGRAMS:

The Kansas City Plant (KCP) is situated on approximately 122 acres of the 300-acre Bannister Federal Complex located within the city limits, 12 miles south of downtown Kansas City, Missouri. The plant shares the site with seven other Federal agencies: Federal Aviation Administration, Defense Finance and Accounting Service, National Archives and Records Administration, General Services Administration (GSA), Internal Revenue Service, National Oceanic and Atmospheric Administration, and the National Logistics Support Center.

The majority of the offices and manufacturing areas are under one roof, with additional outbuildings for support operations such as treatment of industrial wastewater, storage of process chemicals, storage of containerized waste, and certain other specialized operations.

Manufacturing Facilities and Infrastructure:

The KCP is housed in a 57 year-old building. Currently the plant occupies approximately 3 million square feet at this site. The SMRI project will reduce that to approximately 2.4 million square feet. The FY 1998 Maintenance Study described the overall condition of the facility as "good." A backlog of almost $100M in deferred maintenance exists. Additionally, Capital, GPP and Expense Funds are used to address aging and deteriorating facilities. Typical projects are roofing replacements, boiler replacements, structural upgrades, air-handlers replacement, etc. Total facility related expenditures have not kept pace with requirements. A Ten-Year Site Plan will be developed to establish the future facility investment strategy for the KCP.

Manufacturing Processes and Technologies:

To assess the ***short-term*** (through FY05) status of manufacturing capability and capacity, sixteen production areas/departments were compared to the P&PD/SLEP workload. Some capacity issues exist with six of the sixteen production areas/departments. The six are Detonator Cable Assembly, Fireset Assembly, Final Assembly (two areas), Case Assembly, and ACORN Technology. These issues can be resolved by either expanding physical capacity at minimal cost, or by adding additional shifts.

For the ***long-term***, the following **Major Technical Efforts (MTE)** will be pursued in the Nonnuclear Readiness campaign to close critical gaps between existing capabilities and the level of performance required in the future (see table below).

The resources and timelines associated with these MTEs are described in the Non-nuclear Production Readiness Program Plan.

Manufacturing Workforce:

Staffing levels at KCP will need to be adjusted to match the workload projected for both the short and long terms. In general, insufficient funds have been made available to support all of the activities identified by the M&O as being necessary to accomplish all direct and indirect objectives. Like other DP facilities, the KCP is also concerned about an aging workforce talent pipeline, and skills mix.

Construction:

Project 99-D-127, Stockpile Management Restructuring Initiative Kansas City Plant, Kansas City, Missouri

The Stockpile Management Restructuring Initiative will allow the KCP's infrastructure to be altered and greatly reduced from the current plant profile, substantially reducing costs to operate the KCP. The restructuring initiative consists of changing the existing plant and operational approach in four major aspects: 1) physically reducing the size of the facility, 2) changing the approach to manufacturing from product-based to process-based, 3) reducing the support infrastructure appropriate for the right-sized operation, and 4) further

Project 99-D-125, Replace Boilers and Controls, Kansas City Plant Kansas City, Missouri

This project will renovate and upgrade the existing steam generating facility located at the West Boilerhouse. This project removes four 100,000 PPH (Pound per Hour) boilers, boiler control panels and boiler annunciator panels, water softeners, polisher, pumps, forced draft fans, deaerator, piping, controls, and other existing ancillary boiler support equipment, and replaces them with new equipment including new microprocessor-based control panels and a boiler control room containing annunciator panels and system status indicators, in the same general location.

Goal	*Major Technical Effort*
Reduce production responses for required technologies to the shortest time possible (with a goal of 19 months) after final design for all SLEP plans	**E**lectronic Component Miniaturization **G**as Transfer Systems Productivity Improvements **E**ngineered Materials Supply Chain Assurance
Create readiness for unanticipated emergency hardware replacement	**S**cience Based Manufacturing Implementation **C**ommercial Components Qualification **L**ean Manufacturing Streamlining
Eliminate existing threats to current production capability	**R**eplace Obsolete Testers **M**odernize Flexible Manufacturing System **U**pgrade Materials, Analysis, and Testing Sciences
Deploy technologies from the ADAPT Campaign into production readiness	**W**eaponize Lasers and Electro-optics **D**evelop and Characterize Microsystems Technologies (LiGA)

Project 99-D-122, Rapid Reactivation, Various Locations

This project will increase the complex's capability to protect START I (START II with Hedge) requirements. Minor facility modification and additional equipment is required, and therefore, included under this line item, to increase capacity to provide START I (START II with Hedge) requirements.

Kansas City Plant: Reservoir Assemblies and Testing

The Kansas City Plant subproject consists of rearranging existing space in, and adding additional space to, the current Reservoir Assembly Facility, and the procurement of additional production/process equipment.

Project 97-D-123 Structural Upgrades, Kansas City Plant, Kansas City, Missouri

This project is required to correct structural overstress caused by gravity loads and will reinforce masonry walls to resist seismic loading within the DOE controlled portion of the Bannister Federal Complex to ensure life safety.

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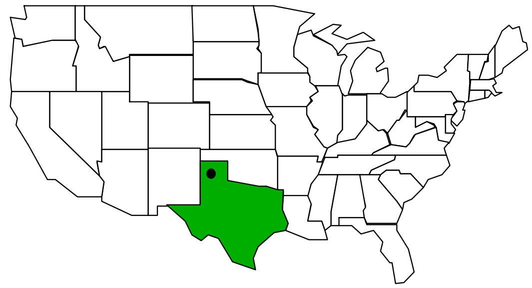
Pantex Plant

MISSION

- Stockpile Evaluation and Testing
- Assembly/Disassembly of JTA Units
- Weapons Repair/Modification
- PIT Storage
- Interim Weapon Storage
- Dismantlement



Location	Amarillo, Texas
Contractor	Mason & Hanger
Established	1951
Area	10.2K Acres

UNIQUE ASSETS - KEY TO DEFENSE PROGRAMS:

The Pantex Plant is located in the Texas Panhandle, approximately 17 miles northeast of Amarillo, Texas. The Pantex Plant mission functions include the fabrication of chemical explosives; development work in support of the design laboratories; pit storage; and nuclear weapons assembly, disassembly, testing, quality assurance, repair, retirement, and disposal. The bulk of the Pantex operations are located in Zone 4, Zone 11, Zone 12 Nonnuclear and Zone 12 Nuclear.

- **Zone 4** is used primarily for the storage of pits and nuclear weapons, primary structures are weapons staging igloos and magazines.
- **Zone 11** is used primarily for Chemical explosive operations. It includes activities such as: HE testing, Analytical and chemical laboratories, HE staging, test fire, HE synthesis, and HE formulation.
- **Zone 12 Nonnuclear** primarily houses the production and site support staffs and activities in support of the stockpile missions.
- **Zone 12 Nuclear** primarily houses the nuclear and nuclear explosive activities that comprise weapon HE, assembly/disassembly, pit storage, *etc*.). Primary structures are the weapon assembly/disassembly cells and bays.

<u>Balance of Plant</u>:

Balance of Plant includes additional site support activities, not covered previously in the zones, necessary for Pantex to perform its mission functions. These include such things as: warehousing, water treatment, sewage treatment, TSD support facilities, *etc*.

<u>Facilities & Infrastructure</u>:

The Pantex Plant was originally constructed by the U.S. Army as a conventional bomb plant during the early days of World War II and was deactivated and vacated after the war. In 1949 Texas Technological College purchased the full 16,000-acre site for $1 for use in experimental agriculture. However, in 1951 the AEC asked the Army to "recapture" the main plant and 10,000 surrounding acres for use as a nuclear weapons production facility. Some of the existing facilities are greater than 40 years old. The average age of the Pantex facilities is 28 years. The older facilities were not built for today's missions, constructed to today's standards, nor designed to meet today's environmental, safety, and health requirements. As these facilities continue to age, the maintenance and operating costs continue to rise and it becomes increasingly difficult (and subsequently expensive) to meet the current ES&H standards. During the peak years of weapons production, a significant capital investment was made each year to upgrade existing facilities and infrastructure. However, since the end of the cold war in 1989, this capital investment has decreased significantly causing a growth in the maintenance backlog, faster-than-expected deterioration in many areas, and quickly increasing operating costs. A backlog of greater that $100 million in deferred tasks exist. This does not include recapitalization and modernization capital costs. Capital equipment and GPP budgets for FY 2000 are zero. A factor that also effects the suitability of existing Pantex facilities for nuclear weapons work is the changes that have taken place with regard to nuclear explosive operations. The tightening of requirements has impacted the operating efficiency and suitability of facilities. For example, the 12-64 bay complex, which at one time was utilized for nuclear explosive operations, is no longer appropriate for such activities without an upgrade to make it suitable for such operations. The change in and addition of new process and operational requirements have added more than 40% to the operating costs in the past 8 years. Pantex has developed a ten-year site plan to support stockpile requirements identified in the P&PD. However, with a declining budget and increasing mission requirements the decline of infrastructure has been predictable.

As Pantex prepares to perform its Stockpile Stewardship mission into the 21^{st} century, it is important to 1) enhance the affordability of production operations; 2) ensure that plant operations and facilities continue to meet current ES&H standards; 3) optimize the manufacturing complex and configuration consistent with current NWC requirements; 4) ensure adequate longevity (*e.g.* 50 years) for primary facilities and infrastructure; and 5) provide for safe and secure interim storage of pits. This can be accomplished by making both near-term and long-term investments in Pantex facilities and infrastructure. In the near-term, investments are needed that would reduce the maintenance backlog, repair facilities and infrastructure that place continued production operations at risk, and establish needed production capabilities/capacities not currently available. For example, Pantex needs to establish the capability to do pit requalification activities and has proposed that a portion of Building 12-86 be modified to allow for the characterization, refurbishment, and reacceptance of pits in support of the stockpile rebuild. In the long-term, investments are needed to migrate production operations from aging facilities into new facilities having appreciable longevity and to augment capacity for long term workload. For example, it may be necessary in the long term to provide for more bays and cells to support the production workload.

Processes & Technology:

Pantex has met and continues to meet directive schedule work, and is meeting ever-increasing needs for more detailed examination and documentation. However, a number of factors threaten the ability of Pantex to perform its future missions in a safe, timely, and cost-effective manner. As with Pantex facilities and infrastructure, many of the manufacturing processes and support equipment are aging and in need of repair or replacement.

In examining the health of Pantex's manufacturing processes, there are a number of key issues driving the need for an investment in these processes. First, there are needs associated with fulfilling the requirements of the Stockpile Life Extension Program. As noted, Pantex has processes that currently do not exist and are needed to support the SLEP schedules. Actions are needed to establish these processes. An example of this is the previously mentioned need for a process to requalify pits in the rebuild process. Secondly, many of the processes in operation today are using systems and equipment that are aging. It is becoming increasingly difficult to operate these aging processes in ways that are cost effective, that meet ES&H standards, and that meet the process control and quality requirements of the Stockpile Stewardship Program. For example, one of the milestones of the High

Explosive Manufacturing and Weapon Assembly/Disassembly Campaign Plan is to implement improvements to the explosive component fabrication process to reduce costs and increase component quality. Thirdly, in the absence of funding to upgrade aging processes, Pantex has not been able to take advantage of new technologies which would improve quality and efficiency, reduce ES&H risks, improve mission flexibility and response time, and align production processes with the demands of a science-based Stockpile Stewardship Program. For example, one of the milestones of the High Explosive Manufacturing and Weapon Assembly/Disassembly Campaign Plan is to reestablish formulation capability and increase capacity for various explosives by moving from Building 12-19 to Building 11-50.

In preparing to support the Stockpile Stewardship Program, Pantex also needs to make long-term investments in production processes and technology. Such investments would allow migration into a modern, long lasting manufacturing complex that is right-sized for current and projected requirements. There, production operations would be performed at lower cost, with tighter process control and enhanced quality, and with real time transmission of assembly/disassembly data to the design labs (needed for modeling and simulation). For example, one of the milestones of the High Explosive Manufacturing and Weapon Assembly/Disassembly Campaign Plan is to implement high-speed data transmission from bays and cells.

Without campaigns, process and technology improvements will not be achieved. Keeping the enduring stockpile active will require improvements in the detection and prediction of aging effects before adverse safety and reliability impacts occur. Gaps in the HE manufacturing and weapon assembly/disassembly process capability or capacity must be validated and filled through reconstitution and improvement of processes previously used, or through the development and/or establishment of alternative processes that meet current design requirements and standards for quality, safety, and health. Science basis models must be established for the HE manufacturing and weapon assembly/disassembly operations and used to develop process simulations that drive these operations and allow flexibility to modify them as necessary. For example, one of the milestones of the High Explosive Manufacturing and Weapon Assembly/Disassembly Campaign Plan is to develop 3-D rapid prototype capability for new tooling. Appropriate process data must be collected and transmitted in real time to permit weapon performance and lifetime assessment by the design labs through predictive models and simulations in the absence of nuclear testing. Control of the HE manufacturing and weapon assembly/disassembly process stability must be improved, monitored, and documented to provide assurance that remanufactured weapons remain within the performance envelope previously validated through nuclear testing.

Workforce:

Like other sites in the complex, the Pantex Plant has an aging workforce. Loss of critical skills presents the most immediate risk to continued viability of the HE manufacturing and weapons assembly/disassembly in support of stockpile stewardship objectives. Revitalization of the workforce requires the addition of new technical and craft workers with the requisite critical skills. This is significantly hampered by the inability to fund both experienced and new workers simultaneously for a period of knowledge transfer. The problem is made worse by the cyclical demand for workers with particular skills, driven in part by the mix of materials in each weapon system. These problems will be minimized through working with the design agencies to minimize the material mix, by developing workers who are multi-skilled, and through the use of reimbursable complementary work to level the workload.

The skilled HE manufacturing and weapon assembly/disassembly workforce must be revitalized through programs that capture and preserve historical knowledge, that enrich skills with challenging and load leveling, complementary work, and that attract new workers. Through this initiative Pantex will develop a robust, integrated program that has not only the proper skill mix but will also include a more proper blend in workforce age.

Pantex also has responded to the Chiles Commission recommendations with a plan to improve recruitment and retention in key skill areas. Specific points include:

- Critical skills have been identified.
- A "variable pay" program has been developed with options such as lump-sum merit increases, retention bonuses and increased base salaries in specialty areas to retain critical skills.
- Enhancement of the Recognition and Awards program.
- Development of recruitment strategies in partnership with regional universities that target critical skill areas.
- Implementation of student work programs for interns and co-op students.
- Conducting a Benefits Value Study to benchmark Pantex benefits with similar industries.
- Formulation of a Retiree Corp Program to allow return of critical skills when needed.
- Development and distribution of a plant-wide employee survey; and joint training initiatives where labor and management learn together how best to work as a team.

Construction:

Project 99-D-128, Stockpile Management Restructuring Initiative Pantex Plant, Amarillo, Texas

The Pantex Plant Stockpile Management Restructuring Initiative (SMRI) Project will provide for the design and construction for various relocation and upgrades and for the shutdown of obsolete structures. The project will help to reduce the plant footprint by consolidating functions into fewer and more modern facilities.

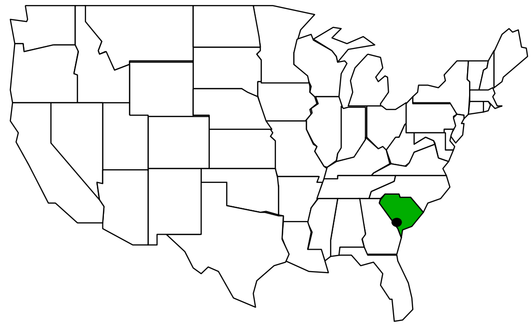
Project 88-D-123 Security Enhancement, Pantex Plant, Amarillo, Texas

This project will enhance Pantex's physical protection, detection alarm systems, safeguards of Sensitive Nuclear Materials (SNM), access controls, and security training.

Savannah River Plant

MISSION

- Loading and Unloading of Reservoirs
- Reservoir Surveillance Operations
- Reconfiguration
- Life Storage Program
- Recycle and Recovery of Tritium



Location	Aiken, South Carolina
Contractor	Westinghouse Electric Corp.
Established	1950 (Tritium Operations in 1962)
Area	13 Acres (Tritium Operations)

UNIQUE ASSETS - KEY TO DEFENSE PROGRAMS:

The mission of the SRS Tritium Operations is to provide tritium and non-tritium loaded reservoirs to meet the requirements of the Nuclear Weapons Stockpile Memorandum, to conduct Reservoir Surveillance Operations and Gas Transfer System testing, and to manage existing tritium inventories and facilities to support the DOE Weapons Complex. It is the single storage location for bulk quantities of tritium by consolidation of tritium operations from other DOE sites.

- **Building 232** is primarily used for tritium extraction, tritium recovery, reservoir life storage, weapons materials R&D function test facility, and He-3 storage.
- **Building 233** is primarily used for tritium recycle, tritium loading, tritium unloading, reservoir surveillance operations, and He-3 recovery.
- **Building 234** is primarily used for reservoir finishing, tritium storage, non-tritium loading, and as shipping/receiving for the tritium operations.
- **Building 238** is used primarily for reservoir reclamation and hydraulic burst testing.

Balance of Plant:

Balance of plant includes additional site support activities, not covered previously in the specific buildings, necessary for SRS Tritium Operations to perform its mission functions. These include such things as: office building for site staff, miscellaneous storage, utility support buildings, miscellaneous production support, *etc*.

Facilities & Infrastructure:

SRS was established in 1950 as a nuclear materials production site and occupies approximately 198,000 acres south of Aiken, SC. The current DP mission at SRS is to process tritium and conduct tritium recycling and filling in support of nuclear weapons stockpile requirements. For the most part, the SRS facilities associated with DP tritium operations are relatively new and in good shape. In late 1993, the new Replacement Tritium Facility (RTF), Building 233-H, assumed the tritium functions of Building 234-H. The RTF incorporates state-of-the-art technology for tritium storage, enrichment, and pumping to enhance safeguards and security and to prevent significant tritium losses to the environment.

The Complex 21 Nonnuclear Reconfiguration project resulted in the movement of products from the Mound plant to SRS. Actual construction activities associated with this project started in FY 1995. The areas renovated to accommodate the transferred product lines were appropriately sized and upgraded to meet current commercial construction, DOE ES&H, and security codes, orders, and regulations. Additionally, modifications were made to utilities and support infrastructure as appropriate.

The Stockpile Management Restructuring Initiative (SMRI), Tritium Facility Modernization and Consolidation started in FY 1998 will result in further modernization and consolidation of SRS facilities and infrastructure. The Tritium Facility Modernization and Consolidation project will relocate several process systems and equipment and/or process functions from Building 232-H into existing buildings within the Tritium Complex. High and Moderate hazard processes will be located into Building 233-H. Low hazard processes will be located to the north end of Building 234-H. The Building 233-H and 234-H service support systems will be upgraded to accommodate the additional loads. Consolidation of tritium processing activities into Buildings 233-H, 249-H, and the newer portion of 234-H will improve the safety of operations, reduce environmental releases, improve productivity, and reduce future operating costs. The consolidation of operations into fewer operating buildings will allow for the reduction of maintenance, operations, and support staffing. The closure of 232-H will further reduce the DP operating budget. The SMRI project also includes work that was transferred from the Tritium Extraction Facility project. This provides for increases in capacities and flows in the primary separation system, process stripper/tritium recovery system, and glovebox stripper/tritium recovery system.

Overall the SRS Tritium Operations facilities and infrastructure are in good shape. It is not anticipated that any major modification will be required in the foreseeable future beyond those that are currently underway.

Processes and Technology:

The SRS Tritium Operations processes and technologies for the most part are in good shape because of the projects described above. However, additional capacity will need to be established in two areas to support future workload. The existing function testing stations are at capacity. Because of the need for additional function tests associated with Acorn production sampling and life storage, additional capacity must be established.

Workforce:

Like other sites in the complex, SRS has an aging workforce. Loss of critical skills presents the most immediate risk to continued viability of tritium operations in support of stockpile stewardship objectives. Revitalization of the workforce requires the addition of new technical workers with the requisite critical skills. This is significantly hampered by the inability to fund both experienced and new workers simultaneously for a period of knowledge transfer.

The skilled Tritium Operations workforce must be revitalized through programs that capture and preserve historical knowledge, that enrich skills with challenging and load leveling, complementary work, and that attract new workers. Through this initiative SRS will develop a robust, integrated program that has not only the proper skill mix but will also include a more proper blend in workforce age.

Construction:

Project 98-D-125, Tritium Extraction Facility, Savannah River Site Aiken, South Carolina

The TEF will provide steady-state production capability to the Tritium Recycle Facility (Building 233-H) of as much as 3Kg of tritium per year, if needed. Final purification of gases containing tritium shall be performed in the augmented process equipment located in the Tritium Recycle Facility.

Project 98-D-123 Stockpile Management Restructuring Initiative Tritium Facility Modernization and Consolidation, Savannah River Plant, Aiken, South Carolina

The Tritium Facility Modernization and Consolidation project will relocate several process systems and equipment and/or process functions from Buildings 232-H into existing buildings within the Tritium Facility. High and Moderate hazard processes will be relocated into Building 233-H; Low Hazard processes will be relocated to the North end of Building 234-H; Building 233-H and 234-H service support systems will be upgraded to accommodate the additional loads; and the consolidation of Tritium processing activities into Buildings 233-H and 249-H.

Project 98-D-126, Accelerator Production of Tritium, Various Locations

This project is designed to demonstrate the integration of high-power operation of the Low Energy Demonstration Accelerator (LEDA) up to 8 MeV; prototyping of key elements of the radio-frequency (RF) power system and distribution, beam transport, and beam diagnostics; prototyping of a complete superconducting high energy linear accelerator unit; development and prototyping of RF and other high energy linear accelerator components; target/blanket performance and material studies, including measurements of neutron/proton/tritium data, radiation damage effects and transport code development; and Tritium separation facility studies to determine processing efficiencies at plant conditions.

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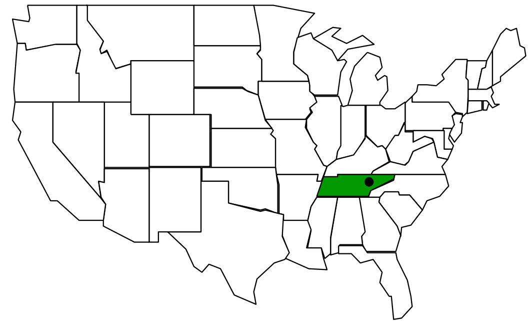
Y-12 Plant

MISSION

- Receive/Storage Uranium, Lithium
- Canned Subassemblies (CSA's) + Manufacture/Rework of Components for Secondaries
- Dismantlement of CSA's
- Processing Uranium & Lithium into safe/secure forms for storage
- Stockpile Evaluation/Surveillance Operations
- Other National Security Programs



Location	Oak Ridge, Tennessee
Contractor	Lockheed-Martin Energy Systems
Established	1947
Area	811 Acres

UNIQUE ASSETS – KEY TO DEFENSE PROGRAMS:

9201-1	Can shop
9201-5N	Depleted Uranium Operations
9203	BeO Research and Development
9204-2	Lithium Operations
9204-2E	Assembly/Disassembly Operations
9205	Quality Evaluations/Surveillance
9206	Old Enriched Uranium Operations
9212	Enriched Uranium Operations
9215	Enriched Uranium Machining/rolling/forming
9720-5	Warehouse
9995	Analytical Services
9998	Depleted Uranium rolling & Metallurgy

Balance of Plant:

Balance of Plant includes additional site support activities, not covered previously in the specific buildings, necessary for Y-12 Operations to perform its mission functions. These include such things as: office buildings for site staff, miscellaneous storage, utility support buildings, miscellaneous production support, etc.

Manufacturing Facilities & Infrastructure:

The Y-12 Plant was originally built as part of the World War II Manhattan Project, and over 70% of the existing facilities are greater than 40 years old. These facilities were not built for today's missions, constructed to today's standards, nor designed to meet today's environmental, safety, and health requirements. As these facilities continue to age, the maintenance and operating costs continue to rise and it becomes increasingly difficult (and subsequently expensive) to meet the current ES&H standards. During the peak years of weapons production, a significant capital investment was made each year to upgrade existing facilities and infrastructure. However, since the end of the Cold War in 1989, this capital investment has decreased significantly causing a growth in the maintenance backlog, faster-than-expected deterioration in many areas, and quickly increasing operating costs.

As Y-12 prepares to perform its Stockpile Stewardship mission into the 21st century, it is important to 1) enhance the affordability of production operations; 2) ensure that plant operations and facilities meet current ES&H standards; 3) optimize the manufacturing complex through the application of six sigma techniques; and 4) ensure adequate longevity (*e.g.* 50 years) for primary facilities and infrastructure. This can be accomplished by making both near-term and long-term investments in Y-12 facilities and infrastructure.

In the near-term, investments are needed that would reduce the maintenance backlog, repair facilities and infrastructure that place continued production operations at risk, and establish needed production capabilities/capacities not currently available. Although, there are current operations underway such as the Stockpile Management Restructuring Initiative (SMRI) and Facilities Assurance Capability Program (FCAP) most of these funds are associated with relocation of existing equipment and safety issues not the re-capitalization through purchase of new items. FCAP is now successfully nearing completion and SMRI is just underway.

In the long-term, investments are needed to migrate production operations from aging facilities into new facilities having appreciable longevity. Such an investment will allow Y-12 to rightsize its manufacturing footprint, shut down aging facilities, and optimize the plant configuration. In FY 1999, a conceptual effort was begun to determine the timeframe and requirements for modernization of the Y-12 plant. This effort is important in that it will tie into the on going Site Wide Environmental Impact Statement that is underway and provide a foundation for ensuring the ability to provide weapon components well into the next century. Preliminary indications are that the site modernization construction and process qualification could require several billion dollars and last several decades.

Manufacturing Processes & Technology:

Y-12 has met and continues to meet directive schedule work, and is meeting ever-increasing needs for more detailed examination and documentation. However, a number of factors threaten the ability of Y-12 to perform its future missions in a safe, timely, and cost-effective manner. As with Y-12 facilities and infrastructure, many of the manufacturing processes are aging and in need of repair or replacement. In many cases, key manufacturing processes have not been operated for more than 10 years and it is questionable whether they can be restarted economically or in compliance with today's ES&H standards. The gaps associated with the need to potentially restart these past processes have been identified as part of the campaigns and steps to remedy the situation proposed. A common example of this is related to special materials processes, which can be addressed through refurbishment of old facilities or through a modernization proposal as outlined in the previous section

In examining the health of Y-12's manufacturing processes, there are a number of key issues driving the need for an investment in these processes. First, there are significant near-term needs associated with fulfilling the requirements of the Stockpile Life Extension Program. As noted, Y-12 has a number of processes that are needed in the near-term to support the SLEP schedules that are not currently operable and have not been for many years. Actions are needed to upgrade, replace, or restart these processes. These actions represent a significant undertaking needed to ensure the reconstitution of these operations in a manner that is both cost effective and that meets ES&H standards. Secondly, many of the processes in operation today are using systems and equipment that are aging. It is becoming increasingly difficult to operate these aging processes in ways that are cost effective, that meet ES&H standards, and that meet the process control and quality requirements of the Stockpile Stewardship program. Thirdly, in the absence of funding to upgrade aging processes, Y-12 has not been able to take advantage of new technologies which would improve quality and efficiency, reduce ES&H risks, improve mission flexibility and response time, and align production processes with the demands of a science-based Stockpile Stewardship Program.

In preparing to support the Stockpile Stewardship program, Y-12 also needs to make long-term investments in production processes and technology. Such investments would allow migration into a modern, long lasting manufacturing complex that is right-sized for current and projected requirements. There, production operations would be performed at lower cost, with tighter process control and enhanced quality, and with real time transmission of manufacturing data to the design labs (needed for modeling and simulation).

Without Campaigns, process and technology improvements will not be achieved. Keeping the enduring stockpile active will require improvements in the detection and prediction of aging effects before adverse safety and reliability impacts occur. Gaps in the manufacturing process capability or capacity must be validated and filled through reconstitution and improvement of processes previously used, or through the development and/or establishment of alternative processes that meet current design requirements and standards for quality, safety, and health. Science basis models must be established for secondary manufacturing operations and used to develop process simulations that drive these operations and allow flexibility to modify them as necessary. Appropriate process data must be collected and transmitted real time to permit weapon performance and lifetime assessment by the design labs through predictive models and simulations in the absence of nuclear testing. Control of manufacturing process stability must be improved, monitored, and documented to provide assurance that remanufactured weapons remain within the performance envelope previously validated through nuclear testing. Materials used to build secondaries currently in the stockpile must be fully characterized and compared to current production. This will guide the determination as to whether current specifications are appropriate and to support a science-based approach to manufacturing.

<u>Manufacturing Workforce</u>:

Like other sites in the complex, the Y-12 Plant has an aging workforce of which 50 percent are eligible to retire within four years. Loss of critical skills presents the most immediate risk to continued viability of secondary manufacturing in support of stockpile stewardship objectives. Revitalization of the workforce requires the addition of new technical and craft workers with the requisite critical skills. This is significantly hampered by the inability to fund both experienced and new workers simultaneously for a period of knowledge transfer. The degrading physical condition of the site, as well as continued reliance on old technology, noted earlier, make it difficult to recruit new technical workers and is having a pronounced effect on the ability to retain existing workers. The problem is made worse by the cyclical demand for workers with particular skills, driven in part by the mix of materials in each weapon system. These problems will be minimized through working with the design agencies to minimize the material mix, by developing workers who are multi-skilled, and through the use of reimbursable complementary work to level the workload.

The skilled secondary manufacturing workforce must be revitalized through programs that capture and preserve historical knowledge, that enrich skills with challenging and load leveling, complementary work, and that attract new workers. Through this initiative Y-12 will develop a robust, integrated program.

<u>Construction</u>:

01-D-124, Highly Enriched Uranium Materials Facility, Y-12 Plant, Oak Ridge, Tennessee

This project includes one facility with two distinct areas, the Highly Enriched Uranium (HEU) Materials Area and the Strategic Arms Reduction Treaties (START) Materials Area**.** The new facility will be state-of-the-art and result in significant cost savings and feature storage in an earthen-bermed structure for enhanced security, an automated inventory system which minimizes inventory validation, new Safe Secure Trailer (SST) and SafeGuard Transport (SGT) shipping/receiving station, a central location near HEU processing facilities, an underground connector to allow direct tie-in to a future Enriched Uranium Operations (EUO) Modernization Facility which allows a reduced footprint for HEU activities, and a small administrative facility to house the building operators.

98-D-124, Stockpile Management Restructuring Initiative Y-12 Consolidation, Y-12 Plant, Oak Ridge, Tennessee

The primary purpose of this project is to complete the overall downsizing of the Y-12 manufacturing footprint. This project is part of a long-range consolidation plan that began in 1992. Along with previously completed projects and other currently funded consolidation projects, SMRI completes the consolidation of manufacturing operations into a smaller footprint area.