Analysis of Stockpile Management Alternatives

July 1996

In support of the
Stockpile Stewardship and Management
Programmatic Environmental Impact Statement

United States Department of Energy
Albuquerque Operations Office

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I. INTRODUCTION

On June 14, 1995, the Secretary of Energy issued a Notice of Intent (NOI) to prepare a Stockpile Stewardship and Management (SSM) Programmatic Environmental Impact Statement (PEIS). In this NOI, the secretary stated that, despite the end of the Cold War, DOE's responsibilities for ensuring the safety and reliability of the Nation's nuclear weapons stockpile remain unchanged. The DOE intends to continue to fulfill its nuclear weapons responsibilities through the Stockpile Stewardship and Management Program. The DOE Defense Programs directed the Manager, DOE Albuquerque Operations Office (AL) to lead the effort to provide technical and cost information which, in combination with the SSM PEIS, would allow DOE to identify a Preferred Alternative for the Stockpile Management portion of the SSM PEIS. In support of the SSM PEIS, on December 23, 1994, the Manager, AL tasked a group to analyze alternatives for satisfying future Stockpile Management requirements.

A. Purpose & Scope of Document

This report presents the results of the analysis of options for the conduct of the Stockpile Management program. Stockpile Management activities include dismantlement, maintenance, evaluation and repair or replacement of nuclear weapons. This report provides programmatic source data for determining environmental impacts for the Stockpile Stewardship and Management Programmatic EIS. It also provides cost, schedule, and technical risk data to assist DOE in the identification of a programmatic preferred alternative. Sixteen mission alternatives for eight DOE sites were addressed. These alternatives are shown below.

Stockpile Management Alternatives

	Site Alternatives							
Technology	**PX**	**Y-12**	**KCP**	**SRS**	**LANL**	**SNL**	**LLNL**	**NTS**
Pit Fabrication				*	*			
Pit Requalification and Reuse	*							*
HE Fabrication	*				*		*	
Secondary and Case Fabrication		*			*		*	
Nonnuclear Component Fabrication			*		*	*	*	
Weapon Assembly and Disassembly	*							*

B. Facilities Included for the Stockpile Management Mission

1. Lawrence Livermore National Laboratory (LLNL), Livermore, Ca.
2. Los Alamos National laboratory (LANL), Los Alamos, NM
3. Sandia National Laboratories (SNL), Albuquerque, NM

4. Nevada Test Site (NTS), Las Vegas, NV
5. Pantex Plant (PX), Amarillo, TX
6. Kansas City Plant (KCP), Kansas City, Mo.
7. Y-12 Plant, Oak Ridge, TN
8. Savannah River Site (SRS), Aiken, SC

C. Functions Included for the Stockpile Management Mission:

- Nuclear Components - (1) Nonintrusive modification pit reuse - inspect, make minor modifications and recertify existing plutonium pits, (2) Pit Fabrication (and intrusive modification pit reuse) - fabricate replacement pits (or make major modifications and recertify existing pits), and (3) Secondaries and Cases - manufacture uranium/lithium parts and assemble into weapon secondaries.

- High Explosive Components - high explosive formulation, synthesis, and fabrication (includes high explosive testing and characterization).

- Nonnuclear Components - fabricate nonnuclear components including electronics, power supplies, and firing systems.

- Weapons Assembly/Disassembly - dismantle weapons; assemble high explosive, nuclear, and nonnuclear components into nuclear weapons; perform nuclear weapons surveillance; store strategic reserves of nuclear components.

D. Methodology

A Stockpile Management Steering Group was formed by DOE AL. The Steering Group established six working groups to address various activities in support of the SSM PEIS. The Steering Group met periodically beginning in January 1995, and provided policy direction to the execution of the work. The Steering Group consisted of participants from: DP-11, DP-14, DP-20, AL, KCAO, NV, OAK, OR, SR, LANL, LLNL, SNL, ASKCD, RS-NV, M&H/PX, WSRC, and MMES/Y-12. The Steering Group sought to provide information to allow DOE Defense Programs to perform the following activities:

1. Define future Stockpile Management program requirements,

2. Define and justify the production capabilities necessary to meet these program requirements,

3. Define a set of reasonable alternatives which satisfy the required production capabilities, and

4. Define and justify the preferred alternative based on relevant economic, technological, safety, health, and environmental factors.

The Steering Group divided all Stockpile Management activities into six working teams. The chair for each working team was a DOE representative. Each working team's mission was to provide technical and cost data necessary to support DOE's identification of preferred alternatives for the Stockpile Management portion of the SSM PEIS. The working teams were responsible for gathering, defining, and analyzing information which would serve as source data for this report. The teams and participants are identified below.

Working Team	Participants
Requirements	DP, AL, NV, SR, LANL, LLNL, SNL, KC, SRS, PX, RS-NV, Y-12
Pits	DP, AL, SR, LANL, LLNL, SRS, PX, RS-NV
Secondaries	DP, AL, OR, SR, LANL, LLNL, SRS, RS-NV, Y-12
High Explosives	AL, OAK, LANL, LLNL, SRS, PX
Nonnuclear	DP, AL, KCAO, SNL, KC
Assembly/Disassembly	AL, NV, SNL, LANL, LLNL, PX, RS-NV

E. Assumptions

The Steering Group provided the following standard set of assumptions to the working teams.

1. Workload
   - Draft NWSM for FY 1995 (consistent with START II and NPR)
   - No LLC support for inactive stockpile
     - Will quantify sprint capacity
   - Capability based capacity
     - Additional capacity driven by demand
   - 120 surveillance weapons per year
   - Capacity sized for single shift operations
   - Known dismantlements processed at present site (others wait for new site, if necessary)
   - Strategic reserve of Pu and HEU stored at DP site separate from excess
     - Pits and CSAs at assembly site
     - All forms at fabrication site
     - Navy assumed to manage storage of Navy HEU

2. Capability Requirements
   - Underground nuclear test readiness capability maintained
   - Production collocation alternatives consistent with Stewardship
   - Production capability consistent with enduring stockpile

3. Operating Constraints
- Allowed production capability gaps between donor and receiver sites
  - Y-12 and KCP - 4 yrs.
  - Pantex - l yr.
- Pu fabrication, processing, and/or storage (in forms other than Pits) considered only for sites with existing infrastructure for these materials
- HEU fabrication, processing and/or storage (in forms other than CSAs) considered only for sites with existing infrastructure for these materials
- Pit reuse capability not requiring bare Pu operations (nonintrusive modification pit reuse) assessed at pit fabrication and weapon assembly sites
- Where ongoing DOE actions are removing capabilities from a site, alternatives not assessed which reintroduce those capabilities

4. Cost Estimating Constraints
- D&D costs are not decision costs
- Facility landlord costs during D&D are a decision cost
- Estimated time to accomplish D&D
  - Y-12 30 yrs.
  - PX and KCP 5 yrs.
- Safe shutdown and work force restructuring costs identified
- Relevant ES&H, S&S, and COO requirements satisfied

These assumptions were confirmed in correspondence dated September 26, 1995 from DOE Defense Programs to the Manager, AL.

F. Independent Estimate Validation Report

An independent cost estimate review of the data developed by the working teams was performed by Stone & Webster Engineering Corporation (SWEC). The purpose of the independent cost estimate review was to provide DOE an independent opinion of the completeness, reasonableness, and comparability of the alternative cost reports. The results of the SWEC analysis are documented in a report dated August 31, 1995. The conclusions of the report were that the source data was “valid, complete, comparable, and reasonably meet the minimum acceptable criteria ... and would adequately support a Key Decision “0”. The DOE authors of this report have taken into consideration the information provided in the SWEC *Independent Estimate Validation Report* in developing the DOE conclusions.

G. Ranking Criteria

The Ranking Criteria are definitions and scoring rules approved by the Steering Group which were used in evaluating the Stockpile Management Alternatives. They are similar to the criteria used by DOE Source Evaluation Boards. A panel which included representatives from each of the candidate sites was formed to develop the ranking criteria.

As part of the analysis of alternatives, each of the sites ranked their own proposal, as well as the proposal of the alternative sites(s). In this report, a final score for each criteria was assigned by DOE AL taking into account the site self-assessments and the assessments from other sites. Due to this process, a site might have inconsistent numerical scores across alternative production missions. The relative scores of different sites for a given production mission should be consistent, however.

The Ranking Criteria document used for evaluating the Stockpile Management Alternatives is provided as an appendix to this report.

II. STOCKPILE MANAGEMENT (SM) SUMMARY ALTERNATIVE REPORTS

The following sections contain the *SM Summary Alternative Reports* prepared by each working team leader. The reports cover Stockpile Management missions; alternative sites to perform the mission; costs and schedules necessary to implement the alternatives; and an assessment of technical risks.

Section A.

Workload Requirements Report

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1. Executive Summary

This section presents the assumed Stockpile Management workload for 2004 and beyond. The workload is based on Draft Nuclear Weapons Stockpile Memorandum FY 1995-2000. The base workload was used for evaluating site alternatives for the Stockpile Management activities. In addition to the "base case" workload, workloads associated with alternative stockpile sizes are presented. These alternative workloads ("low case" and "high" case) were used for determining the sensitivity of the site alternative rankings for higher or lower stockpile sizes. The assumed workloads for the alternative stockpile sizes are summarized in the following table.

Alternative Stockpile Size Workload Assumptions

	Low Case	Base Case	High Case
Stockpile Size Criteria	< START II	START II	START I
Strategic Stockpile Size (Accountable Warheads)	1,000	3,500	6,000
Weapon Disassembly Capacity			
Weapon Rebuilds	50	150	300
Stockpile Evaluation	120	120	140
Disassembly Total	170	270	440
Weapon Assembly Capacity			
Weapon Rebuilds	50	150	300
Stockpile Evaluation	110	110	140
Assembly Total	160	260	440
High Explosive Components	50	150	300
Nonnuclear Components			
Factory and field retrofits	up to 100	up to 300	up to 600
Nuclear Components	50*	50*	100

* The facilities and equipment required to manufacture one component for any stockpile system provides an inherent capacity of up to 50 units per year. This capacity is sometimes called Capability Based Capacity.

2. Introduction

This document presents the assumed Stockpile Management workload for 2004 and beyond. For purposes of assessing alternative configurations for the Stockpile Management program, the strategy of the NPR was used, i.e. a START II-sized stockpile while retaining both a lead and a hedge capability. The Stockpile Management stockpile composition for 2004 and beyond was based on the 1995 Draft Nuclear Weapons Stockpile Memorandum and the associated Long Range Planning

Assessment. The considerations for developing a production workload based on the assumed stockpile level include national security policy, historical stockpile defect and change data, and the quantities and types of weapons in the future stockpile. The assumed Stockpile Management workload was prepared by representatives of DOE, the three weapons laboratories, and the four production plants based on the draft NWSM. Assistance was provided by a representative from the Office of the Assistant to the Secretary of Defense for Atomic Energy (ATSD (AE)). In addition to a base case workload, workloads associated with alternative stockpile sizes are presented. These alternative workloads (a hypothetical "low case" or lead option and "high case" or hedge option) were used for determining the sensitivity of site alternative rankings for higher or lower stockpile sizes.

There is no direct relationship between stockpile size and required production capacity for most elements of the nuclear weapons production complex. However, assumptions can be made for required capacities to accomplish weapon refurbishment and stockpile support based on historical experience. The production capacity was defined by identifying requirements for supporting the reliability, safety, and security of the weapons in the stockpile and assessing probable workload based on future stockpile quantities and historical defect data.

The DOE approach for supporting the stockpile consists of three essential parts:

- Repair defects as required to maintain safety and reliability requirements. Defects are identified through the testing activities of the Stockpile Evaluation Program and the inspection of the weapon during routine maintenance. (The terms "stockpile evaluation" and "stockpile surveillance" are used interchangeably in this report.)

- Requalify components for use in the stockpile beyond their originally certified design life. Traditionally, weapon systems were replaced with new systems before they reached their minimum design lifetime of 20-to-25 years. Limited data is available for components or systems beyond 25 years.

- Replace components as necessary on a scheduled replacement interval to assure component failure does not adversely effect the availability, reliability, safety or security of weapons in the future stockpile.

Implementation of this management philosophy will require enhancements to the DOE surveillance program to include collection and analysis of component aging data. This enhanced surveillance activity is expected to allow improved prediction of component lifetime.

Facility capacities assume single shift operations in supporting the "base case" workload. Some increase in requirements beyond the base case workload could be accommodated by multiple shift facility operations. If workload requirements exceed the capacity with multiple shift operations, facility expansion would be needed. Any decision to expand facilities for greater capacity would be made after the requirements were identified through weapon surveillance.

3. National Nuclear Weapons Policy Requirements

The deterrent role of nuclear weapons has been a key element of United States national security policy for decades. In July, 1994, President Clinton reemphasized this national security strategy by saying,

> "We will retain strategic nuclear forces sufficient to deter any future hostile foreign leadership with access to strategic nuclear forces from acting against our vital interests and to convince it that seeking a nuclear advantage would be futile. Therefore, we will continue to maintain nuclear forces of sufficient size and capability to hold at risk a broad range of assets valued by such political and military leaders."

Due to their strategic importance, the numbers and types of nuclear weapons in the United States inventory are carefully established, reviewed, and approved.

A. Nuclear Weapons Approval Process

The nuclear weapons stockpile is approved annually by the President based upon a joint request from the Department of Defense (DOD) and Department of Energy (DOE). The document used to request this approval is the Nuclear Weapons Stockpile Memorandum (NWSM) which forwards the six-year Nuclear Weapons Stockpile Plan (NWSP) from the Secretaries of Defense and Energy.

The development of weapon requirements is a multi-step process that is the responsibility of the DOD. The NWSM is coordinated through a variety of DOD offices that include the Joint Staff, the Services, the Office of the Assistant to the Secretary of Defense (Policy), and the ATSD (AE) as well as the Department of Energy (DOE). The DOE coordination is necessary because the DOE is the federal agency authorized to develop and produce nuclear weapons and nuclear and nonnuclear materials for nuclear weapons. This authority comes from Chapter 9, Section 91 of the Atomic Energy Act of 1954.

DOD/DOE coordination is formalized through approval of the NWSM by the joint Nuclear Weapons Council (NWC)--the highest interagency government body responsible for nuclear weapons. Once the NWSM is approved by the NWC, it is signed by the Secretaries of Defense and Energy and submitted to the President for approval. The President approves the NWSP by issuing a Presidential Decision Directive.

B. Nuclear Stockpile Quantities

The weapon quantities in the NWSM are governed by a variety of factors. These include DOD requirements, arms control limitations, availability of nuclear delivery forces, policy guidance, and infrastructure limitations. For example, the draft NWSP for the period 1995-2000 complied with the provisions of the START I Treaty, begins implementation of the START II Accord, (that will limit the United States to no more than 3500 deliverable strategic nuclear weapons by 2004), is consistent with DOE and DOD budget targets for FY 1995 and 1996, and is consistent with the nuclear delivery force structure of the Nuclear Posture Review (NPR).

The Nation's nuclear weapons stockpile contains two components, an Active Stockpile (AS) and an Inactive Stockpile (IS). The AS is in place to meet DOD operational requirements. Strategic weapons supporting operational requirements are accountable in accordance with the START II Accords, i.e., the 3500 deliverable nuclear weapons. Some Stockpile Evaluation Program weapons and logistics spares are designated nondeliverable and are not treaty limited, but are necessary to support operational needs and are included in the AS. There is also a nonstrategic portion of the AS, which is not limited by either treaty or protocol. This yields a total AS of more than 3500 weapons in FY 2004 when the START II Treaty is assumed to be fully implemented.

Warheads in the IS are retained for two reasons:

- To provide the capability to replace warheads in the AS--should major safety or reliability problems be identified or should changes in the international security environment warrant a US response.
- To replace AS weapons consumed in stockpile surveillance

Weapons in the IS are not counted or declared under the terms of the START Accords, however, their existence is officially acknowledged. For example, during a September 22, 1994, press conference, Deputy Secretary of Defense Deutch stated in response to a question on nuclear force reconstitution capability that, "both countries have warheads in reserve, warheads out of the military stockpile . . . both of us keep some warheads in reserve." The DOD has developed a plan for reactivating IS weapons in case AS augmentation or reliability replacement is required.

C. Long Range Planning Assessment

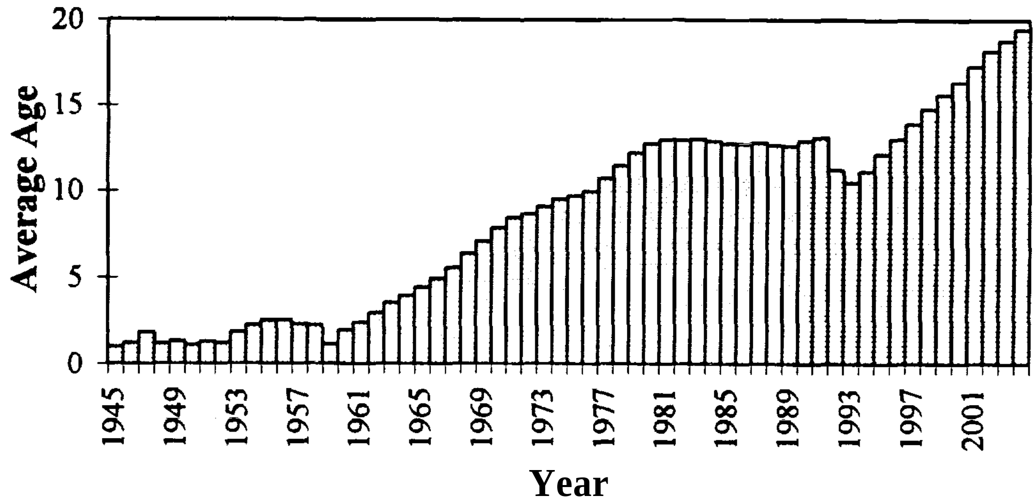
The June 1992 Bush-Yeltsin Summit laid the groundwork for the START II stockpile levels. Under START II, the stockpile quantity would decline until FY 2004, no new weapons would be required for the foreseeable future, and current weapons would be retained longer than originally envisioned.

The joint DOD and DOE Long Range Planning Assessment (LRPA) was implemented to document long term planning for nuclear weapon requirements. Weapons slated for retention above operational requirements were placed in the IS. Weapons would be taken out of the IS and placed into the AS as the stockpile evaluation draws down operational quantities. Thus, the LRPA identifies support of operational quantities for an extended period beyond that addressed in the NWSM.

D. Stockpile Age

Until recently there has been no expectation that weapons would remain in the stockpile longer than they have in the past. Continuous modernization of weapons to improve safety and reliability kept the stockpile young as new weapon types replaced old ones. Now, with no new weapons production, the United States will have a steadily aging stockpile. The average age of the stockpile has never approached the typical lifetime specified in the weapon requirements (20 years for the most modern US nuclear weapons). The stockpile reached its oldest average age in 1991 after all new production ceased. Following Presidential decisions to retire many of the older nonstrategic weapons, the average age dropped in 1992. However, the average age of the stockpile, currently about 13 years, will climb roughly 1 year per year and as shown below will reach 20 years by 2005, at which time the oldest weapons will be about 35 years old. In the near term this does not appear to be a problem. However, as time passes the discovery of defects in the stockpile may cause unacceptable decreases in stockpile reliability or safety unless positive preventive actions are taken. Therefore, a DOE support infrastructure that can correct defects in the stockpile and replace weapons, if required, is necessary to ensure there is not an unacceptable decline in the effectiveness of the nuclear weapons stockpile.

Average Weapon Age



E. Nuclear Posture Review

The Nuclear Posture Review (NPR) was a 1994 review of nuclear forces and policies led by the DOD Joint Chiefs of Staff that looked at doctrine, force structure, operations, safety and security, and arms control. A major conclusion was that while great strides have been made in reducing nuclear forces, the United States must continue to be prepared for a potential reversal of recent trends within Russia. In light of this uncertain future, the NPR recommended that the United States maintain its flexibility, a hedge, to reconstitute nuclear forces if required.

The main recommendation of the NPR was a realignment of nuclear forces.

Strategic forces were aligned as follows:

- Possess no more than 20 B-2 bombers
- Reduce the B-52 bomber force from 94 to 66 aircraft
- Reduce the Trident submarine force from 18 to 14 submarines and equip all submarines with D-5 missiles
- Maintain up to 500 single warhead Minuteman III ICBMs
- Maintain flexibility to reduce forces further or to reconstitute, if necessary

Nonstrategic forces were aligned as follows:

- Maintain European commitment at current level
- Eliminate nuclear weapons capability from US Navy surface ships
- Retain nuclear cruise missile capability on submarines
- Retain land-based dual-capable nuclear aircraft capability

The President endorsed the recommendations of the NPR in September 1994.

In addition, the NPR had specific recommendations for DOE in terms of stockpile support requirements. These requirements are summarized below:

- Maintain nuclear weapon capability (without underground nuclear testing or fissile material production)
- Develop stockpile surveillance engineering base
- Demonstrate capability to refabricate and certify weapon types in the enduring stockpile
- Maintain capability to design, fabricate, and certify new warheads
- Maintain science and technology base
- Ensure tritium availability
- No new-design nuclear warhead production

The NPR recommendations regarding force structure do not result in changes to stockpile quantities at this time. However, the NPR specifically left open options for either decreasing or increasing the size of the weapons stockpile in response to changing international environments.

F. National Nuclear Weapons Policy Conclusions

Nuclear weapons will remain an essential element of United States national security for the foreseeable future. As such, the DOE must ensure appropriate planning is performed and necessary infrastructure is in place to support the stockpile. A base case stockpile consistent with the START II protocol is to be assumed, however a capability is to exist to support reconstitution to START I levels, or to make faster and deeper stockpile reductions.

4. Historical Stockpile Data

The DOE Stockpile Evaluation and the Shelf-Life Programs are maintained to assess the reliability and safety of the nuclear weapons stockpile. Stockpile Evaluation (also referred to as stockpile surveillance) consists of two main activities: laboratory testing and flight testing. Laboratory testing emphasizes subsystem-level testing to ensure that each operational option, attainable environmental condition, safety and control feature, and each end event or final process required for nuclear detonation is verified and the data to support reliability assessments are obtained. Flight testing is conducted to test and verify the operational interface between the weapon and the delivery platform and to verify overall weapon system reliability and function.

The Shelf-Life Program includes the storage and testing of weapon components for long term evaluation activities. The components in the Shelf-Life Program were usually produced prior to production of associated components in the stockpile. Testing of these components assists in the early detection of age related defects, however, these components have not experienced stockpile environments.

Results of the Stockpile Evaluation and the Shelf-Life Program serve as a basis for modification of weapons in the stockpile to maintain the high reliability and safety requirements. In addition to these programs, active research, development, and testing programs at the weapon laboratories have led to discovery of additional defects in the stockpile. In some cases, these defects have been found directly in nuclear tests; in other cases, calculations or results from an independent development effort have led to recognition of a problem in a stockpile weapon.

At this time, it is not technically possible to predict, with high confidence, when the individual components in stockpiled weapons will require replacement. Most nuclear weapons in the stockpile were designed for a minimum lifetime of 20 years. However, experience indicates that weapons can remain in the stockpile well beyond their minimum design lifetime. Two nuclear weapon systems remained in the stockpile for more than 30 years. The historical rates of problems and safety, security and use control upgrades provides insight into the workload that can be expected in the future. Projections based on this history provide a rationale for the production complex sizing requirements.

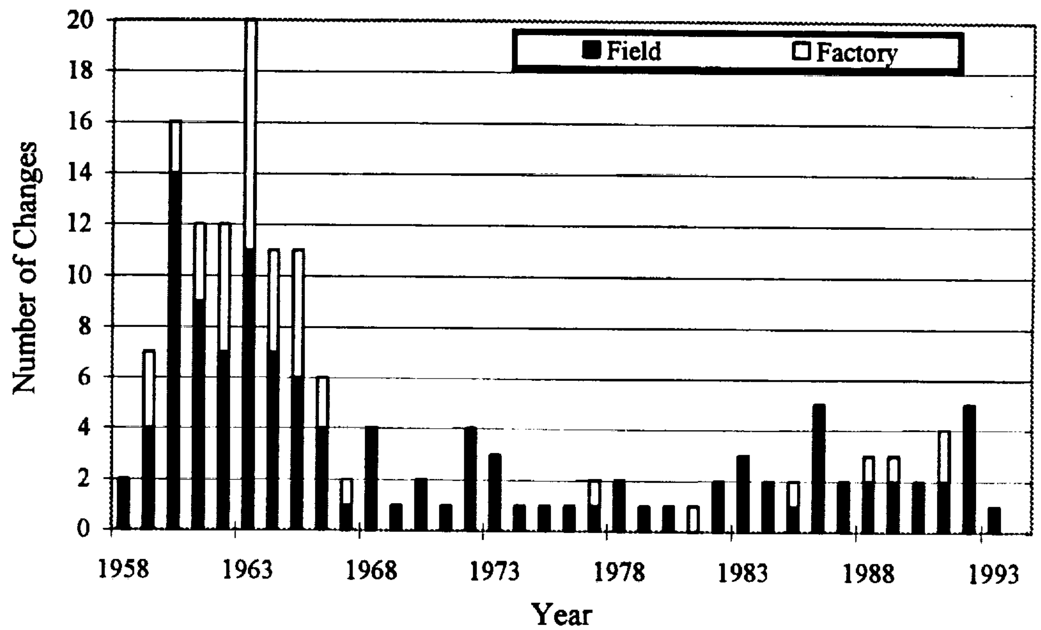
Weapon modifications can involve field changes or factory changes. There is an important distinction between field changes and factory changes in sizing the future complex. A field change is performed at the weapon's operational location by DOD or DOE personnel. A factory change is performed at the DOE weapon assembly facility. Any change that can be done in the field reduces the workload and required operational capacity at the assembly/disassembly plant.

When a change is deemed necessary, the first choice is to make the change in the field. This reduces the number of weapon movements, which minimizes safety and security risks. The ability to make a change in the field has largely been determined by available field facilities and equipment. Historically, the majority of the changes not involving the nuclear explosive package have been made in the field while the majority of the nuclear explosive package changes have been conducted at the DOE assembly/disassembly facility.

There have been more than 400 "actionable" findings since 1958, the year weapons with sealed pits were first produced. An "actionable" finding is defined as one that resulted in corrective action (not necessarily a change to the weapon, but sometimes a change to the procedure causing the problem) or a decrement to the weapon reliability.

In this same time period, there have been about 400 changes made to the stockpile. These changes include corrective actions (~37%) and improvements in the operations and maintenance of weapons (~63 %). Some of these corrective actions were relatively minor (such as painting all unpainted bombs, adding additional markings to weapons, etc.). These minor corrective actions do not represent any component production; therefore, they are not used for projecting a workload for the future complex. The number of changes (excluding minor changes and changes made to a weapon system while it was in production) made in the factory and in the field is shown by year in Figure 4-1.

Figure 4.1 Number of Changes by Year and Location



As the stockpile grew dramatically in the late 1950s and early 1960s, a significant number of changes were made to the weapons entering the stockpile. Plutonium pit design technology was not yet mature and no underground nuclear testing was conducted during the moratorium from 1958 to 1961. This had a dramatic effect on the number of problems introduced into the stockpile. Nuclear component design was more mature during the development of modern nuclear weapons and underground tests were performed for each weapon. Thus, the rate of changes to the stockpile during the 1950s and 1960s is not expected to be representative of the rate in the future. The time period from 1970 to the present appears to be an appropriate indicator of the rate of future problems. The average number of changes to the stockpile initiated per year during this time was 2.2. The smaller quantity of weapon systems in the enduring stockpile is expected to require the initiation of a change at the average rate of one to two per year.

Over the last 25 years, field changes outnumber factory changes by almost 9 to 1. Since 1970 there have been 47 changes in the field (an average of about 2 per year) affecting 19,000 weapons (an average of about 750 per year). Some of these changes were done at the same time that scheduled limited life component exchange (LLCE) was performed to further limit the operational and safety impact. Field changes have covered changes to a variety of components and include three Stockpile Improvement Programs (SIPs) which were performed in the 1980s to upgrade the safety of older weapons. A significant number of components in the weapon electrical system of these older weapons were changed.

Between 1970 and 1976, no changes were made to nuclear weapons at the factory. However, since 1977, there have been seven changes done in the factory. These changes have involved about 5,000 weapons producing an average workload of about 300 nuclear weapons modifications per year at Pantex. Thirteen production process changes have been made since 1970. These changes were made to new production weapons, but did not affect the same weapon types in the stockpile.

The technical capability to predict with high confidence which type of component may need to be changed in the future is not currently available. Historical data provides some insight into the more frequently changed components; however, the DOE must be able to investigate and resolve a problem with any component in the stockpile in the future.

Since 1970, field changes have been made to weapon systems of all ages, from weapons that have just entered the stockpile to weapons that have been in the stockpile 30 years. About 20% of these changes were made to weapon systems with stockpile lives over 20 years, a relatively large number given that the average age of the stockpile has ranged from 8 to 13 years since 1970. The factory changes have been made for weapon systems that had been in the stockpile between 4 and 13 years. The in-process changes were implemented while the weapon system was still in production but after some individual weapons had entered the stockpile.

Review of historical data is helpful in projecting future workload; however, the applicability of this data is limited. Historical data only spans weapon lifetimes of up to about 30 years and relatively few weapons older than 25 years have been tested by the stockpile evaluation program. Many of the weapons in the stockpile are expected to remain in the stockpile for much longer than this. The rate of discovering problems and making corrective changes is expected to increase as the stockpile ages beyond this historical experience. In addition, the materials and component technology in the enduring weapons stockpile are different and generally more complex than those in older weapons. A higher rate of problem identification could occur due to this complexity.

The historical record is highly influenced by the mode in which the weapons program operated during the past 45 years. New weapon systems were continually introduced into the stockpile. Correction of recognized deficiencies could sometimes be deferred since these deficiencies would soon be eliminated by the replacement of affected weapons with new weapons. There are no new weapons systems planned to replace the ones currently in the stockpile and deficiencies cannot be addressed in the old manner. Finally, the fact that production lines were continuously operating made changes relatively quick and easy to accomplish.

5. Nuclear Component Requirements

Nuclear components for a nuclear weapon consist of the plutonium pit (called a primary when assembled with high explosives and other nonnuclear components) and the secondary (including the case). This section briefly discusses the composition of these nuclear components and documents requirements for the production of nuclear components to assure the reliability, safety, and security of the stockpile of 2004 and beyond.

The DOE must determine the expected lifetime of nuclear weapon components to determine the required production capacity for the refurbishment of the future stockpile. An informed long term estimate for most components is not possible because of insufficient component aging data. Historically, nuclear components have not experienced many aging defects and additional data are required for the determination of the required replacement interval(s).

The approach used for defining production capacity requirements for nuclear components is based on a review of available aging data; the planned destructive testing of nuclear components as a part of stockpile evaluation; and the expected levels of the future stockpile.

Known nuclear component production requirements are one or two nuclear components per year per weapon system to replace the units destructively tested by stockpile evaluation activities. Historically, production plans included the fabrication of some extra nuclear (and other) components prior to the end of new production. With extended stockpile lives, the supply of rebuild nuclear components is depleted.

In addition, the flight testing program requires one set of high fidelity joint test assembly components for most warheads every three to four years. High fidelity nuclear components are manufactured using the same production processes as those used for nuclear components intended for the stockpile. The difference is that high fidelity components contain substitutes for the fissile materials.

A. Primary Requirements

The primary consists of four major categories of parts: detonators, plastic components, high explosive components, and pits. Life expectancy and production capacity requirements are addressed for these four categories.

Known aging effects of high explosive components results in an estimated stockpile life of 30 to 40 years based on current understanding of high explosive aging. This estimated life of high explosive components results in a fabrication requirement of an average of 150 sets of high explosive components, detonators, and plastic components per year to support the START II stockpile (about 300 for the START I sized stockpile). In addition, up to 110 sets of high explosive components, detonators, and plastic components will be required each year to support the Stockpile Evaluation rebuild activities.

The planned and expected workload for the fabrication of new replacement pits is small irrespective of stockpile size. Only replacement of pits destroyed in routine surveillance testing is expected until a life limiting phenomenon is observed in stockpile pits. Most pit requirements during weapon refurbishment are expected to be satisfied by requalification and reuse of existing pits with no, minor, or extensive modification of the pits based on refurbishment requirements.

The technological capability to manufacture all plutonium pits in the weapons stockpile provides an inherent capacity to manufacture about 50 pits per year in single shift operations. Up to 20 pits per year are required to replace pits destroyed in routine surveillance testing. During weapon refurbishment to replace other components, most pits are expected to be requalified and reused. A capacity of about 50 pits per year is, therefore, judged to be sufficient for the next ten or more years.

In sizing the plutonium fabrication capability for the future nuclear weapons program, consideration was given to establishing a larger fabrication capacity in line with the capacity planned for other portions of the nuclear weapons complex. Larger capacity was rejected, however, because of the small demand for the fabrication of replacement pits, and the significant, but currently undefined, time period before significant additional pit production capacity would be needed.

A larger pit production capacity may be required in the future, however, should a life limiting phenomenon be observed in stockpile nuclear weapons. Pits in the enduring nuclear weapons stockpile were built during the 1978-1989 time frame. No age related problem has been observed in pits up to 30 years in age; though very little data exists for pits older than 25 years. In addition, no age related problem is expected until well past the START II implementation date.

For these reasons, this programmatic analysis limits plutonium pit fabrication facility analysis to a facility sized to meet expected programmatic requirements over the coming decades. It is not sized to have sufficient capacity to remanufacture new plutonium pits in a time frame commensurate with the time period of their original manufacture. DOE will perform development and demonstration work at its operating plutonium facilities over the next five years to study alternative facility concepts which could be utilized in the future in the construction of a larger fabrication capacity.

B. Secondary and Case Requirements

1. Secondaries

Secondaries may contain uranium and other components within a sealed environmental can. Other components are manufactured using various materials including metals, ceramics, special materials, plastic parts, and adhesives. Isolated from the external environment by the sealed cans, these materials can still interact with each other. Careful monitoring is required to assure these material interactions do not cause reliability problems. Historically, material degradation and aging problems have occurred.

2. Case Components

Secondaries and associated components are assembled in a case. Case corrosion has been observed, but there has been no degradation or concern for performance for any of the weapons in the stockpile of 2004 and beyond. If parts within the case need to be accessed to effect a design modification or replacement, some case parts may have to be replaced due to disassembly damage.

3. Secondary and Case Component Summary

As with plutonium pits, available data does not support the precise determination of the lifetime of secondary components. The compatibility of the various secondary materials is being monitored closely through the stockpile evaluation program. There may also be aging issues associated with secondary organic materials (plastics and adhesives) that are yet to be discovered. It is also possible that additional design modifications, not yet foreseen, could be required. Any action required on secondary components could result in requirements for cases.

C. Capability Based Capacity

DOE must have the capability to fabricate, in a production environment, each nuclear component in the enduring stockpile. This production capability has an inherent single shift production capacity of up to 50 components per year. This small inherent single shift capacity is sometimes referred to as capability based capacity.

Additional requirements greater than that available with capability based capacity could be accommodated by increasing facility operations on multiple shifts, or by the reactivation of standby facilities.

6. Nonnuclear Component Requirements

History shows that nonnuclear components are modified or replaced at a greater frequency than are nuclear components. Past modernization and improvement of non-nuclear components occurred when new weapons entered the stockpile and older weapons were retired. New weapon production is not expected in the foreseeable future; consequently, DOE does not have this opportunity to replace degrading nonnuclear components or to incorporate enhanced safety and security features. The opportunity in the future will be during field or factory refurbishment activities.

Parts and services must be supplied to support stockpile evaluation rebuild components and all other currently committed alterations and modifications to the active stockpile. In addition, it is expected that refurbishments will be necessary in the future to fix detected problems. Historical rates of problem detection, scaled to the size of the future stockpile, and committed refurbishment requirements are the basis for determining expected production requirements for nonnuclear subsystems and components.

Roughly 750 weapons per year were modified in the field from 1970 to 1990. Scaling this rate to the future stockpile results in an expected average rate of 150 weapons per year that will need nonnuclear components for field retrofits.

Historical data indicates that all nonnuclear components should be considered equally likely to require replacement. Consequently, DOE must be prepared to provide any combination of nonnuclear components for about 150 factory retrofits as weIl as 150 field retrofits per year. A START I sized stockpile would double these required capacities.

Planning to support this workload would assume single shift operations. For additional workload requirements, multi-shift operations would provide about twice this capacity.

7. Limited Life Component Requirements

Limited life components are those components with a known service life in the stockpile. Today, tritium reservoirs, gas generators, power sources, and neutron generators are considered limited life components. As more aging data becomes available additional components are expected to be considered limited life components.

A. Reservoirs

The annual tritium reservoir fill workload for FY 2004 and beyond is directly related to stockpile size and will be performed at the Savannah River Site, which has adequate capacity.

B. Neutron Generators

Neutron generator (NG) requirements and requirements for replacement of NGs destructively tested in the stockpile evaluation program are also directly related to stockpile size. The NG production responsibility was assigned to Sandia National Laboratories in 1993. A facility sized to support requirements for the future stockpile is currently under construction.

C. Gas Generators

Gas generator replacement requirements are defined and will be met by procurement of components from commercial sources by Sandia National Laboratories.

D. Power Sources

Some weapon systems have power sources that must be replaced periodically. The quantities and schedule requirements are based on stockpile size and will be satisfied by procurement of replacement power sources.

8. Weapon Assembly/Disassembly Requirements

The workload for the Weapon Assembly/Disassembly facility includes the disassembly, inspection and rebuild of weapons for the Stockpile Evaluation Program and the refurbishment of weapons to correct deficiencies.

Workload requirements for the Weapon Assembly/Disassembly facility are derived based on an expected lifetime of 30 to 40 years for the high explosives in the nuclear explosive package, the historical stockpile defect rate for other components, and the 2004 stockpile quantity. An average of 300 factory refurbishments per year were required for the larger cold war stockpile. This refurbishment workload was primarily driven by defects in components other than high explosives. Scaling this historical workload to the future active stockpile size suggests an average workload of about 50 weapons per year for components other than high explosives. The DOE expects this workload can be accommodated as a part of the refurbishment activities for renewal of high explosives components. In addition disassembly, inspection, and rebuild of Stockpile Evaluation Program sample quantities require assembly capacity.

Facility capacity is based on accomplishing the workload using single shift operations. Future workload changes, such as activation of inactive stockpile weapons or further dismantlement of the stockpile, could be accommodated with multi-shifi operations.

A. Workload Requirements:

The DOE Weapons Assembly/Disassembly facility is assumed to be sized to disassemble and assemble 150 weapons per year for the purpose of replacing/renewing subsystems and components within active stockpile weapon systems. Support of a START I stockpile would double these numbers. In addition, the Weapons Assembly/ Disassembly Facility will disassemble about 120 weapons per year for stockpile evaluation and subsequently rebuild about 110 of these weapons each year.

9. Alternative Stockpile Size Workloads

This section describes the assumed workloads for stockpile sizes significantly larger and smaller than the START II stockpile. The "high case" shown below corresponds to implementation of the Nuclear Posture Review (NPR) "Hedge" alternative for retaining or reconstituting a larger stockpile if world events warrant such action. The "low case" represents a hypothetical case for the NPR "Lead" alternative of faster or deeper reductions in the stockpile to a size lower than the START II accountable strategic warhead level. No specific DOD Force structure projection corresponds to the low case assumed stockpile. However, stockpile sizes in this range have been proposed by others (see for example *Foreign Affairs*, Spring 1993).

Alternative Stockpile Size Workload Assumptions

	Low Case	Base Case	High Case
Stockpile Size Criteria	< START II	START II	START I
Strategic Stockpile Size (Accountable Warheads)	1,000	3,500	6,000
Weapon Disassembly Capacity			
Weapon refurbishment	50	150	300
Surveillance testing	120	120	140
Disassembly Total	170	270	440
Weapon Assembly Capacity			
Weapon refurbishment rebuilds	50	150	300
Surveillance testing rebuilds	110	110	140
Assembly Total	160	260	440
High Explosive Components	50	150	300
Nonnuclear Components			
Factory and Field Retrofits	up to 100	up to 300	up to 600
Replacement Nuclear Components	50*	50*	100

* Capability Based Capacity -- the facility capacity (up to 50 per year) inherent with the facilities and equipment required to manufacture one component for any stockpile system.

10. Conclusion

The DOE has extensive historical data for the reliability and safety of weapons in the stockpile. These data are not adequate for determining when specific components will reach the end of their safe and reliable life. However, this data provides useful information for sizing future production facilities to meet the range of expected production requirements to satisfy future weapon refurbishments.

Improvements in stockpile evaluation are expected to increase the ability to understand and/or predict aging effects. This will facilitate prediction of when component types need to be replaced. This predictive capability is expected to provide time to assure that component or weapon refurbishment can occur without adversely affecting stockpile safety or reliability.

Nuclear components (pits and secondaries) are expected to have service lives significantly in excess of their minimum design life of twenty to twenty-five years. In the meantime, production capability will be maintained to satisfy requirements to replace components destroyed during stockpile evaluation and to maintain production competence. Contingency options will be developed and maintained to allow timely reconstitution of a larger nuclear component production capacity should an aging concern be identified.

Nonnuclear components are also expected to have longer lives than their minimum design lives. However, historical data indicates that, over the short-term (20-25 years), defects will be encountered at a rate that will require approximately 150 sets of components of varying combinations to be produced each year to support field retrofits and an additional 150 sets of different components to support factory retrofits. A START I stockpile size would double these requirements.

The Weapon Assembly/Disassembly facility workload requirements are expected to average about 150 factory refurbishments per year (for a START II sized stockpile) plus a stockpile evaluation requirement of up to 120 weapon disassemblies and reassemblies per year.

Limited life component exchange requirements for reservoirs, neutron generators, gas generators, and power sources are based on the size of the stockpile and preestablished replacement intervals. Production capacity currently exists or is being established that will satisfy production requirements.

Section B, C

Section B.

Manufacturing and Reusing Pits Report

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1. Executive Summary

This report analyzes alternatives for supplying pits for the nuclear weapons stockpile. Alternative processes include manufacture of pits from feed stock, reuse of existing plutonium components, reuse of intact pits, requalification of pits that are aged beyond their original design lifetime, and recertification of pits that are within their original design lifetime.

The analysis for pit manufacture deals with two operating, fully staffed sites, the Los Alamos National Laboratories (LANL) and Savannah River Site (SRS). Maintenance and operation of the LANL plutonium facility is currently funded by the Stockpile Management budget. For SRS, funding for plutonium related activities is provided by the DOE Office of Environmental Management. This analysis of the mission assignment for pit manufacturing considers the incremental cost to the DOE Defense Programs budget as the appropriate basis for cost comparisons. Because relocation of the LANL R&D program is not part of the scope of this study, the two configurations to be compared are (1) SRS doing pit production and LANL doing R&D, and (2) LANL doing both missions.

The initial investment cost is approximately $490 million (M) for SRS and $310 M for LANL. Both costs include approximately $200 M in capital maintenance upgrades for TA-55 to sustain the Defense Programs mission at LANL. The SRS steady state operating cost is approximately $60 M per year, and the LANL steady state incremental operating cost is about $30 M per year. To avoid double-counting the infrastructure costs already paid by Defense Programs, the incremental cost at LANL is used as the basis of comparison.

Using these figures, the two-site steady-state cost is

Current LANL SM Program	$95M
SRS Pit Build Mission	$ 60 M
Total	$155 M

The single-site steady-state cost, assuming LANL is chosen as the single site is

Current LANL SM Program	$95M
LANL Pit Build Mission Increment	$ 30 M
Total	$125M

Projecting these costs over 25 years, noting that operating costs in the one-site alternative start in 2003 versus 2006 in the two-site alternative, and including capital investment, the difference in cumulative net present value cost between the one-site and two-site alternatives is about $300 M.

The analysis for pit reuse deals with facilities at the Pantex Plant and the Nevada Test Site (NTS). For Pantex, existing facilities would need to be modified at a capital cost of approximately $14 M. Annual operating costs for the defined workload would be approximately $1.8 M. The NTS alternative would require new construction adjacent to an existing facility. However, locating the pit reuse mission at NTS is contingent upon NTS also being selected for assembly/disassembly missions (see Section 2.F). The capital and annual operating costs for the NTS alternative are approximately $31 M and $2.3 M, respectively. Projecting these costs over 25 years, the cumulative net present value (NPV) cost for the Pantex Plant is about $28 M versus $54 M for the NTS. The cumulative NPV costs are displayed in Figures at the end of Section B.

The ranking of the alternatives (see Appendix for definition of ranking criteria) against risk and cumulative net present value cost criteria is collected in the following tables.

Ranking of Pit Manufacturing/Plutonium Reuse Alternatives

Ranking Criteria	Score	
	LANL	SRS
Basic Production Capability	90	70
Capability of Production Infrastructure	92	50
Minimize Cost	100	86

Ranking of Intact Pit Reuse, Recertification, and Requalification Alternatives

Ranking Criteria	Score	
	Pantex Plant	NTS
Basic Production Capability	85	50
Capability of Production Infrastructure	100	50
Minimize Cost	100	51

The analysis relies on utilization of technology that has been proven at a number of facilities in the Nuclear Weapons Complex and was further baselined in the Complex 21 studies. Nevertheless, there remains some technical risk in that neither LANL, SRS, Pantex, nor NTS have participated fully in all aspects of pit supply activities.

There is no experience base in the Weapons Production Complex upon which to base evaluations and estimates for pit reuse. In addition, neither LANL nor SRS has experience in producing pits for the stockpile, although LANL has in the past fabricated pits for the nuclear explosive testing program. Consequently, there is some uncertainty about the information that forms the basis for the site cost estimates.

It should be noted that build rates above 100 per year would adversely impact LANL’s ability to perform their surveillance, research and development missions. The sensitivity analysis indicated that installation of equipment at SRS to support a capacity of 100 pits per year on single-shift operations, 5 days per week, would have a multi-shift capacity of 250 pits per year. The annual operating cost for this capability would be about $170 M.

2. Introduction

With the formal cessation of pit manufacture at the Rocky Flats Plant in 1992, the Department of Energy eliminated its capability to supply significant quantities of pits for assembly into new or rebuilt weapons. Consequently, the situation for pits is different than for the other weapon component analyses in that there is no currently operating pit fabrication activity to downsize or consolidate. Proposed new capability alternatives provide a smaller capacity than what was at Rocky Flats, hence a cost reduction from historical levels will be realized. However, resumption of pit fabrication will be an increase to current Defense Programs budgets. This report analyzes the alternatives for resumption of pit supply operations, including new pit fabrication, and provides estimates of the cost to restore and operate that capability.

2.1 Summary of Working Team Function

The mandate of the Pit Working Team (PWT) was to develop and characterize alternatives for the supply of pits for the nuclear weapons stockpile. Under this charter the Team examined:

- New-build pit fabrication using bulk metal or oxide feed stock
- Reuse of existing plutonium components
- Reuse by modification of existing intact pit subassemblies
- Reuse by recertification or requalification of existing intact pit subassemblies
- Related direct production support and infrastructure support

3. Assumptions And Requirements

Manufacturing process assumptions, major design assumptions, Steering Group assumptions, and interpretations of requirements in the Requirements Report are included in this section.

3.1 Steering Group Assumptions

The top level assumptions governing this analysis were published in the management charter from Defense Programs to the Manager, AL dated September 26, 1995. The assumptions applicable to pit supply activities were carried forward into the analyses summarized in this report.

3.2 Working Team Assumptions

- Levels of current programs and program sponsorship at candidate sites remain as they are today
- Pit surveillance, research and development, and nuclear materials management activities continue at LANL and contribute to the base cost to Defense Programs

- Residues from manufacturing and metal purification processes will be stabilized and packaged for interim storage
- Wastes will be treated and disposed in accordance with applicable standards and regulations

3.3 Reuse of Plutonium Components and New Pit Fabrication

The baseline technologies for new pit fabrication, reuse of plutonium components, and balance of functions including recovery, waste treatment, and support functions, are derived from mature technologies already developed at LANL and further defined by the Complex 21 study.

Major assumptions are:
- Existing facilities utilized to minimize capital investment
- Capital investment basis accommodates production rate of 50 pits per year, with single-shift operations, 5 days per week
- Operating basis is production of 20 pits per year
- Capability to support weapon types in the stockpile of 2004 and beyond
- All plutonium alloy capabilities provided
- Capability to reuse plutonium components and intact pits
- Production runs campaigned (no more than two pit types in production each year)
- Feed material available from dismantled pits
- Non-nuclear components are government furnished equipment
- Compliance with current applicable codes, standards, and requirements
- Residues processed to a stable form, packaged, and stored
- No backlog accumulation of residues or wastes
- International safeguards not considered in facility design

3.3.1 LANL

Following are key assumptions that drive the approach taken by LANL:
- Existing facilities, including TA-55-PF4 and TA-3-CMR, utilized
- Capital cost of maintenance upgrades to TA-55-PF4 included
- Cost of TA-3-CMR compliance upgrade, in progress, not included
- Nuclear Material Storage Facility (NMSF) available and funded separately
- Existing on-site waste management capabilities available
- Waste Isolation Pilot Plant (WIPP) available for final disposition of TRU waste
- Impacts of continuing LANL programs analyzed in site-wide EIS (in preparation)

3.3.2 SRS

Following are key assumptions governing the SRS alternative:
- Existing facilities, including Building 232-H and areas of F canyon, utilized
- Facility upgrades as needed to comply with DOE Orders are costed

- Existing on-site waste management capabilities available
- WIPP available for final disposition of TRU waste
- Upgrades or reissue of safety analysis reports and environmental impact documents included in schedule

3.4 Recertification, Requalification, and Reuse of Pit Subassemblies

The baseline technologies for recertification and balance of functions including recovery, waste treatment, and support functions, are derived from mature technologies already developed and in use by Pantex and further defined by the Complex 21 study. Program requirements for reuse and requalification are under development, and the best available information obtained from Pantex, LLNL, and LANL was used in developing and analyzing these alternatives.

Major assumptions are:

- Existing facilities utilized to minimize capital investment
- Activities are collocated with assembly/disassembly
- Packaging will accommodate all pit configurations
- Process qualification rate for reuse is minimum production of 20 pits a year
- Capable of supporting weapon types in the stockpile of 2004 and beyond
- Facilities will be designed and operated as nonreactor nuclear facilities
- No work involving exposed plutonium
- Compliance with current applicable codes, standards, and requirements
- No backlog accumulation of wastes
- International safeguards not considered in facility design

The two candidate sites for reuse, recertification, and requalification of existing pits are the NTS and Pantex. Analysis was performed of locating this mission with the pit fabrication mission at either LANL or SRS. It was found that this capability was inherent in the pit fabrication capability, but that it was unrealistic programmatically to move pits from the weapon assembly site to the fabrication site for this relatively minor operation.

3.4.1 Nevada Test Site

Site specific assumptions that drive the analysis for the NTS alternative include:

- No facility exists that could be used for pit reuse
- New construction adjacent to the Device Assembly Facility (DAF)
- Extension of existing utilities at the DAF site to support reuse facility
- NTS would not perform pit reuse, recertification and requalification functions without also receiving assembly/disassembly mission assignment

3.4.2 Pantex Plant

Site specific assumptions that drive the Pantex Plant alternative include:

- Existing facilities and infrastructure will be right sized and modified for this mission
- New equipment required for reuse of existing intact pits
- Pantex would not perform pit reuse, recertification and requalification functions without also receiving assembly/disassembly mission assignment

4. Description of Proposed Alternatives

The proposed alternatives establish production lines capable of supplying pits for the nuclear weapons stockpile. Process block flow diagrams and work breakdown structures are provided in individual site reports that illustrate the individual steps and processes required to satisfy the production requirement, and provide for analytical support, storage of feed and in-process materials, storage and preparation of non-nuclear components, storage and staging of product items, treatment of residues, nondestructive evaluation, and waste management. The basis operating level capacity for recertification and requalification supports the surveillance (120 per year) and retrofit (150 per year) programs. The expected operating rates for production of new pits (20 per year) and reuse of existing pits (20 per year) are based on the requirement to rebuild pits destroyed during surveillance testing and to maintain certification of the process and operators. All sites anticipate reductions in programs in the future, and some credit is taken for utilizing existing personnel that would otherwise have to be new hires.

4.1 Full Rebuild and New Build

4.1.1 Los Alamos National Laboratory (LANL)

The key elements of the LANL plan areas follows:

- Establish a just-in-time production capability
- Modify the 300 Area of TA-55 PF-4 to accommodate the required functions
- No interruption of the pit surveillance function
- Retain as much of the existing equipment as possible
- Upgrade some equipment to production quality
- Use the existing trolley system to move parts
- Use analytical laboratory support that exists in the CMR Building
- Production rate of 80 pits per year (estimated) in sprint mode
- Metal purification done by molten salt extraction process
- Residue stabilization using existing chloride and nitrate aqueous process lines
- Aqueous waste disposed in existing facility at TA-50
- Solid waste disposed at existing TA-54, Area G

The 300 Area of the TA-55 plutonium facility currently is used for plutonium and pit technology development and has most of the equipment required to provide a pit fabrication capability. TA-55 is a self-contained facility capable of supporting disassembly of pits for reuse of the plutonium, metal purification, fabrication product inspection and certification and treatment of plutonium residues. The capability to perform pit evaluation activities under the stockpile surveillance program will be consolidated and reestablished in Room 114 prior to beginning removal of existing equipment. Because analytical support will continue to be provided in TA-3-29 (CMR Building), alternatives for transporting samples between the plutonium facility and CMR Building are being considered.

The LANL alternative supports the following capacities:

Operating Basis:	20 per year
Installed Capacity Basis:	50 per year (single-shift, 5 days per week)
Sprint Capacity:	80 per year (multi-shift, limited by in-line storage)

The LANL would be capable of completing the facility modifications in five years, beginning with removals in October 1997, and ready to produce pits in October 2002. The LANL is currently capturing as much of the Rocky Flats equipment, processes, and expertise as possible under the Pit Rebuild Program. Transition to the new configuration can be accomplished with no impact to the surveillance mission; however, pit technology development programs, including the pit rebuild program, would be in hiatus during the three years of construction. Alternative construction modes which would reduce this hiatus would need to be addressed. The remaining programs in the plutonium facility, including the stabilization and repackaging of residues, metal, and oxides would be largely unaffected by the reconfiguration of the 300 Area.

Most of the mission activities would be performed at TA-55 (PF-4 and the NMSF) and the CMR facility. Upgrades to PF-4 are considered necessary for either production alternative and are costed in this study. The CMR upgrade and NMSF renovations are separate projects that support broad laboratory R&D missions and are funded by separate projects.

Sprint capacity is limited by the amount of adequate in-line storage area. Technical risks associated with this alternative are low because the processes have already been developed to maturity at either LANL or Rocky Flats. The ES&H risks are also considered manageable because TA-55 is an approved facility for handling and processing plutonium.

4.1.2 Savannah River Site (SRS)

The key elements of the SRS plan areas follows:

- Equip existing 232-H Building (37,000 sq. ft. area) with all new equipment

- Plutonium purification and residue stabilization performed using the existing New Special Recovery line and a new reduction line
- Use the existing Plutonium Storage Facility
- Use existing support functions within the site infrastructure
- Disposal of aqueous waste in existing Defense Waste Processing Facility
- Use existing analytical laboratories for process control and product certification
- Production rate of 120 pits per year in sprint mode

The SRS has no ongoing DP plutonium mission work related to weapon R&D or surveillance; therefore, facility modifications and upgrades are necessary for this new mission and are costed in this analysis. The large available area for pit fabrication supports the SRS ability to provide a manufacturing facility with flexibility, as shown by the sprint mode capacity of 120 new pits per year.

Although no operations of the type required for fabrication of pits and reuse of plutonium components have ever been done at SRS, hardened facilities with adequate space are available for modification and occupancy. The area chosen for pit fabrication is the 232-H Building, which provides 24,500 square feet of hardened space, and 12,500 square feet non-hardened space for support functions. This area can support a large capacity while maintaining acceptably low radiation exposure and efficient material flow. Establishing the pit fabrication capability at SRS requires procurement and installation of new equipment.

Pit disassembly, plutonium purification, and residue processing would be performed in existing hardened facilities in the F-Area. The facilities include New Special Recovery which is equipped to dissolve and purify plutonium, a new reduction (metal preparation) facility in Building 221-F, and the Plutonium Storage Facility. Existing facilities in F-Area are sized for a large throughput (2 - 5 metric tons per year) if required. Also available on-site is the Defense Waste Processing Facility which would be used for disposal of americium that is a by-product of plutonium purification. Analytical laboratories in the F-canyon area are available to support process control requirements. These facilities in F-area are operated by the DOE Environmental Management (EM) program, and would require new operating arrangements between DOE DP and DOE EM.

The SRS alternative supports the following capacities:

Operating Basis:	20 per year
Installed Capacity Basis:	50 per year (single-shift, 5 days per week)
Sprint Capacity:	120 per year (multi-shift)

The SRS is capable of establishing the pit supply capability in eight years, beginning with project authorization in October 1997, and achieving readiness to produce pits in March 2006.

4.2 Recertification, Requalification, and Reuse of Pit Subassemblies

Requalification and reuse are intended to be cold operations, and would have the capacity to supply 370 units annually.

4.2.1 Nevada Test Site (NTS)

The key elements of the NTS plan for pit reuse and requalification are as follows:
- Build new nonreactor nuclear facility adjacent to the DAF
- Procure and install all new equipment
- Use the Pantex Plant flow sheet and equipment list

The NTS proposal addresses siting and construction of a new, hardened, nonreactor nuclear facility adjacent to the Device Assembly Facility (DAF) and within the DAF PIDAS for performing pit reuse operations. No previous production work of this kind has ever been done at the NTS, although nuclear explosive devices have been assembled and disassembled by design laboratory personnel at the site. Consequently, all equipment and qualified operations personnel must be obtained from outside the current resources available at the NTS. The Pantex Plant flow sheet would be utilized. The NTS has the capability to dispose of low-level radioactive waste on site.

The reuse facility would be considered only as part of an assembly/disassembly mission assignment to NTS, and the DAF would require extensive modification to support the reuse function in a production mode. The facility's original intent was to assemble nuclear devices for testing at NTS, a capability that must continue to be maintained, though on a reduced scale.

The NTS infrastructure personnel must be trained in production techniques. Tapping in power, water, and sanitation from existing facilities is part of the new construction project, but its costs are included in the estimate for the assembly/disassembly alternative. Material for reuse processing will be pits only; no HE handling capability will be required in the reuse facility.

As the new facility would be constructed to specification, there are no constraints imposed by modification of existing facilities. The proposal supports the following capacities:

Operating Basis:	150 pits per year requalification
	120 pits per year recertification
	20 pits per year reuse
Installed Capacity Basis:	150 pits per year requalification and reuse
	120 pits per year recertification
Sprint Capacity:	250 pits per year requalification and reuse
	200 pits per year recertification

The NTS is capable of establishing the pit reuse and requalification capability in five years, beginning with project authorization in October 1997 and achieving readiness to supply product in October 2003.

4.2.2 Pantex Plant

The key elements of the Pantex Plant reuse and requalification alternative are as follows:

- Existing facilities and infrastructure would be rightsized and modified
- Existing equipment would be utilized, and augmented to support the requalification and reuse missions

Existing modern weapon assembly bays in Buildings 12-64, 12-84, 12-104, and 12-104A and the Special Nuclear Material (SNM) Facility, Building 12-116, are available to accommodate the required operations. Many recertification functions are currently being performed at the site, and these would be relocated and consolidated in the SNM Facility. Four bays in Building 12-104 would be modified to meet nonreactor nuclear facility requirements; the SNM Facility is already in compliance. The site infrastructure which currently supports assembly, disassembly, and recertification operations is in close proximity to the identified facilities and would be utilized to support the expanded mission. Equipment for the reuse capability and some recertification functions would need to be procured. Pantex has experience in glovebox operations and maintenance which would be required for some of the reuse functions. Transition to the new configuration can be accomplished with no impact on current missions.

The Pantex proposal supports the following capacities:

Operating Basis:	150 pits per year requalification
	120 pits per year recertification
	20 pits per year reuse
Installed Capacity Basis:	150 pits per year requalification and reuse
	120 pits per year recertification
Sprint Capacity:	250 pits per year requalification and reuse
	200 pits per year recertification

Pantex is capable of establishing the pit supply capability in 5 years, beginning with project authorization in October 1997 and achieving readiness to supply product in October 2003.

5. Process Descriptions

5.1 New Pit Fabrication and Reuse of Plutonium Components

The SRS and LANL plan to utilize the same basic process flow sheet for pit manufacture. The process begins with casting a plutonium part to near final shape, heat treating, confirmation of density, machining, radiography to confirm absence of internal defects, dimensional inspection, and cleaning. Pits supplied for reuse of the plutonium components would be disassembled and the plutonium components inspected as for new components. After passing inspection, the plutonium components (both new and reuse) are subsequently assembled with other non-nuclear components followed by welding, leak testing, final machining, application of various cleaning techniques, backfilling with specification gas, application of various inspection procedures, and certification of the final pit. Variations in the process may be employed to accommodate unique design features of the various types of pits.

Significant differences exist between the processes utilized at LANL and at SRS for balance-of-plant operations, including metal purification and treatment of residues.

5.1.1 LANL

Metal purification at LANL is accomplished by molten salt extraction to remove americium followed by electrorefining of some of the feed material to remove other impurities. Less pure metal may be blended with pure electrorefined metal to achieve purity standards for acceptance in the foundry, or electrorefined metal may be used in the foundry directly. Residues generated in the metal purification, foundry and fabrication processes are treated to produce a stable oxide using aqueous nitrate or chloride processes or roasting, as appropriate. The LANL demonstrated in June 1995 the capability to package material to specification that meets the new DOE standard (DOE-STD-3013-94) for long-term storage.

5.1.2 SRS

Metal purification at SRS is accomplished by dissolution of feed metal followed by ion exchange purification, precipitation, calcination of the dried precipitate, conversion to plutonium tetrtiuoride, and reduction to pure plutonium metal using calcium as the reducing agent. Manufacturing residues follow essentially the same flow, except that for residues, the oxide collected from the calcination process would be packaged and stored. The large F-Canyon facilities that had previously been used for separation of plutonium from irradiated targets would not be used in the processing of pit feed materials and residues.

5.2 Reuse of Intact Pits, Recertification, and Requalification

The NTS and Pantex would use the same process flow sheet. The process for pit reuse consists of performing various inspections, removal and replacement of external tubulation, and in some cases assembling an additional shell around the existing intact pit. Following modifications of external hardware, backfill with specification gas, and final welding, pits would be subjected to a variety of inspections to recertify conformance to design specifications. Recertification consists of a record search to verify the condition of the pit followed by a series of measurements and inspections (such as surface evaluation, gamma spectroscopy, leak testing, radiography). Requalification procedures remain to be defined by the weapon laboratories, but it is anticipated that the suite of recertification procedures will be expanded to include examination of interior surfaces and other nondestructive tests that confirm the integrity of the metallurgical structure of the plutonium components. All required destructive tests would be performed at the LANL plutonium facility.

6. Facility Descriptions

6.1 Los Alamos National Laboratory

Pit Production Facility

- TA-55, PF-4 (Plutonium Facility)
- Located 1.5 miles from area occupied by public businesses
- Located 3 miles from residential area
- Construction completed in 1977
- Cast-in-place, reinforced concrete (seismic hardened) construction
- Three-stage radioactive material confinement system in place
- Area enclosed by existing PIDAS
- Currently in operation, all utilities in place
- 1978 safety analysis report (SAR) in place, new SAR in preparation
- Approximately 20,000 square feet available in 300 Area for pit fabrication

Other Facilities

- CMR
  - Analytical support for process control and product certification
  - Construction completed in 1952 with subsequent additions
  - Upgrade to meet current life safety codes in progress
- Sigma Complex
  - non-nuclear parts preparation
  - main construction in 1959-1960
- TA-3 Machine shops - non-nuclear machining
- TA-8 Nondestructive evaluation (radiography)
- TA-35 Non-nuclear parts preparation
- TA-50 Radioactive liquid waste treatment
- TA-54 Waste disposal and interim waste storage

6.2 Savannah River Site

Pit Production Facility

- Building 232-H
- Located about 7 miles from site boundary
- Seismic hardened construction
- Pit fabrication area distributed over 2 floor levels

- Three-stage radioactive material confinement system will be installed
- Area enclosed by existing PIDAS
- Preparation of new SAR and environmental documents required
- Approximately 24,500 square feet Class I hardened space available
- Currently free of plutonium contamination

Other Facilities (F-Area)
- Plutonium Storage Facility - capacity for 338 shipping containers and nondestructive assay
- New Special Recovery
  - Class I seismic hardened construction
  - Three stage confinement system
  - Some existing equipment to be replaced
- F-Canyon, Room 307 - Selected for Reduction Operations area
- All identified areas are radiologically clean

6.3 Nevada Test Site

Pit Reuse Facility
- All new construction adjacent to the DAF
- Design compliant with nonreactor nuclear facility requirements
- Utilities extended from the DAF
- Enclosed within the DAF PIDAS
- Located 20 miles from site boundary

Other Facilities
- DAF - assembly/disassembly operations
- Low-level waste disposal facility

6.4 Pantex Plant

Pit Reuse Facility
- New capability established in four modified bays in existing Building 12-104
- Will be upgraded to nonreactor nuclear facility standards
- Will tie into existing site utilities
- Enclosed within existing PIDAS
- Located 1 mile from site boundary, agricultural land use surrounds site

Other Facilities
- Building 12-116
  - Recertification and requalification functions
  - Meets nonreactor nuclear facility standards

7. Engineering and Technical Assessments

7.1 General Engineering and Technical Uncertainties

The technical uncertainties associated with pit manufacturing and reuse are:

- Need improved methods/solvents for cleaning pit components
- Need method for packaging and bagless transfer of stabilized residues
- Need improved plutonium density measuring method
- Need definition of requirements, processes, and equipment for requalification and reuse of intact pits

7.2 Los Alamos National Laboratory

The LANL has not produced pits for stockpile. The several dozen pits that LANL did produce over the years were intended for use in nuclear explosive test devices and did not have production certification. The LANL has hired Rocky Flats personnel with pit manufacturing experience personnel to support other missions. These personnel would help to minimize plant layout and startup problems. The LANL has also produced plutonium metal (1980s) and Pu-238 heat sources (currently) to specification and on schedule.

The LANL production capacity is limited by radiation exposure and in line storage capacity because of space constraints. An industrial engineering study is in progress to provide alternatives for making the most effective use of the existing space.

7.3 Savannah River Site

The SRS assumes that much of the technology and processes can be transferred from LANL. SRS has never produced pits, and lacks experience and understanding of the requirements for precision machining, process control, inspection, and certification. The DOE believes that the times and costs allotted by SRS for proof-of-development, process prove-in, and start-up will be greater than projected. Adjustments were made to the site data to account for these greater uncertainties. Plutonium purification and stabilization processes that are in the current baseline technology should be replaced in order to achieve waste minimization objectives. Development and demonstration of new processes are required. The SRS proposal would result in introducing plutonium contamination into Building 232-H, which is presently free of plutonium contamination, and also into areas of F-Area which are presently radiologically clean.

7.4 Nevada Test Site

The NTS has never had a production mission and, therefore, lacks experience in the requirements for nonreactor nuclear facility design and operation, precision machining, process control, inspection, and certification as they apply to pit subassemblies. There are no on-site technical resources available to staff the functions associated with recertification, requalification, and reuse of intact pits. Qualified resources would need to be imported or local workers trained.

7.5 Pantex Plant

Pantex is currently performing all of the recertification functions required to return existing pits to the nuclear weapons stockpile. Anticipated requirements beyond those for recertification include replacement of pit tubes, addition of external shells, internal surface inspection, and backfill with specification gas. All of these functions have not been performed at Pantex and would require development of equipment, procedures, and worker qualification programs.

8. Cost, Transition, and Implementation Schedules

8.1 Pit Fabrication and Plutonium Component Reuse

The analyses of cost data for LANL and SRS alternatives are summarized in Table 8.1 and detailed in Tables A-1 and A-2. Table A-1 shows the cost of pit manufacturing that would be incremental to existing Stockpile Management (SM)-funded plutonium activities at LANL. Table A-2 reflects the DOE cost for the pit manufacturing mission at SRS. Because the SM Program is not currently funding plutonium operations or infrastructure at the SRS, this cost is incremental to the SM Program. As discussed above, the SRS allowance for process prove-in was adjusted by adding time and cost. The cost values parallel the LANL approach, and are the costs of the midyear staffing levels for the three years preceding first production. It is assumed that the end-of-year levels are 10%, 50%, and 100% of the steady-state levels for those three years. The rationale for these substitutions is that staffing should increase to the steady-state level as all parts of the program progress toward maturity. Additional cost was added in the "proof of development" category, again parallel to the LANL approach, to cover the task of getting the equipment and processes up to performance standards prior to attempting process prove-in. In addition, the costs for the maintenance upgrade project for TA-55 and the SM Program at LANL were also added to the capital and project management costs of both alternatives because these are costs associated with continuing the SM mission. The LANL incremental cost was used in the analysis to avoid double-counting infrastructure costs already paid by the SM Program.

The costs incremental to Defense Programs are shown below.

Incremental Program Costs Pit Manufacture/Plutonium Reuse

Site	Total Project Cost	First Production	Steady-State Operating Cost	Total Cost Over 25 Years	Net Present Value
LANL	$312 M	2003	$28.9 M	$3,264 M	$1,876 M
SRS	$488 M	2006	$58.9 M	$3,864 M	$2,169 M

8.2 Reuse of Intact Pits, Recertification, and Requalification

The data submitted by NTS and Pantex are summarized in Tables A-3 and A-4. These tables reflect fully burdened cost to DOE to establish and perform the mission at the respective sites. The allowances for process prove-in were judged to be too short and understaffed, especially considering that reuse and requalification functions have never been performed previously at any site. As described in Section 8.1, new values were developed. Included in the costs for NTS are the estimates for packing and shipping equipment (10% of equipment value) and for sampling, leak testing, packaging, and shipping the strategic reserve pits to the NTS.

The steady-state operating costs derive from a relatively small activity that will be colocated with assembly/disassembly operations. Approximately 20 personnel would be involved in these pit-related functions at the assembly/disassembly site.

The steady-state operating costs presented in Tables A-3 and A-4 are the sum of the full-time-equivalent staffing and other program costs for only the pit supply option. Benefits of resource sharing with other site programs are assumed in preparing estimates of infrastructure costs. The results of the analysis are presented below.

Total Program Cost Analysis
Intact Pit Reuse, Recertification, and Requalification

Site	Total Project Cost	First Production	Steady-State Operating Cost	Total Cost Over 25 years	Net Present Value Cost
NTS	$31.1 M	2004	$2.3 M	$87.9 M	$54.4 M
Pantex Plant	$14.2 M	2004	$1.8 M	$47.7 M	$27.9 M

9. Ranking Criteria Summary

Ranking factors and attributes were developed by the Steering Group and provided to the sites for analysis. This section summarizes the DOE rankings of the site alternatives. The sites provided self-assessments against these criteria, as well as site ranking of competitive alternatives. DOE used all of these data sources in developing its site ranking.

9.1 Description of Ranking Factors

Basic Production Capability to Support Scheduled Work - represents a measurement of technical risk for the site alternative, as reflected in the maturity of current production-related technologies. Technologies that have been used previously or are in current use score high.

Capability of Production Infrastructure to Support Scheduled Work - also represents a measurement of technical risk for the site alternative, as reflected in maturity of the production support infrastructure. Infrastructure elements that currently support production activities, such as numerical control machining, product engineering, precision tooling and gaging, NDT/NDE, precision assembly and joining score high.

Minimize Cost - measures the overall cost of an alternative to provide the specified product. Low investment and steady-state operating cost score high. The cost ranking algorithm to develop the ranking is:

Rank value = (Lowest Site NPV Cost / Site NPV Cost) x 100.

Ranking of Pit Manufacturing/Plutonium Reuse Alternatives

Ranking Criteria	Score	
	LANL	SRS
Basic Production Capability	90	70
Capability of Production Infrastructure	92	50
Minimize Cost	100	86

Ranking of Intact Pit Reuse, Recertification, and Requalification Alternatives

Ranking Criteria	Score	
	Pantex	NTS
Basic Production Capability	85	50
Capability of Production Infrastructure	100	50
Minimize Cost	100	51

10. Analysis of Ranking

10.1 Pit Manufacturing/Plutonium Reuse

Basic Production Capability to Support Scheduled Work: This criterion addresses technical risk with respect to the present situation at the site. The LANL currently has technology elements applicable to plutonium fabrication in operation or in use in development programs, and was scored high on this criterion. The SRS has never manufactured pits and although the site assumed a process flow sheet which employs proven technology, lack of experience in the exercise of that technology poses a technical risk with respect to timely startup if SRS were selected. The SRS was assigned a lower score on this basis.

Cauability of Production Infrastructure to Support Scheduled Work: This criterion addresses risk associated with past and present demonstration of competency in production management. Both sites have demonstrated production management skill. In the case of SRS, scheduling of fuel fabrication, reactor charging and discharging, separations, and product purification were critical to the success of the site mission. These activities are considered to be sufficiently different from the functions required for foundry management, fabrication, and assembly of precision components that a lower score was assigned to SRS in this area.

The LANL fabricated pits and other device components to specification and schedule for nuclear explosives tests, supplied substantial quantities of purified plutonium metal to Rocky Flats in the 1980s and currently is manufacturing encapsulated heat sources to specification and schedule in support of the NASA Cassini mission. The LANL was assigned a relatively higher score in this area.

Minimize Cost: Discussions of the adjustments to cost data are presented in Section 8. The algorithm for ranking is shown in Section 9. Because Defense Programs is not finding a plutonium production mission at SRS currently, all costs for the SRS pit mission are incremental to the Defense Programs budget. In contrast, Defense Programs currently funds essentially all of the infrastructure cost of plutonium operations at LANL, much of which is capable of supporting a small pit manufacturing mission without augmentation.

10.2 Reuse of Intact Pits, Recertification, and Requalification

Basic Production Capability to Support Scheduled Work: This criterion addresses technical risk with respect to the present situation at the site. Of the three mission elements, Pantex has performed one and NTS, none. The processes associated with recertification and reuse of intact pits have not been fully defined or performed at any site, consequently there is expected to be some risk of timely startup at either site, but substantially more at NTS because of the lack of experienced personnel.

Capability of Production Infrastructure to Support Scheduled Work: This criterion addresses risk associated with past and present demonstration of competency in production management. Production is and has been the mission at Pantex, and is scored high in this area. Missions at NTS have been largely related to support of nuclear explosive test programs, and although scheduling and cost management are clearly a competency of NTS, the lack of experience in production management incurs a sizeable risk, as reflected in the NTS score in this area.

Minimize Cost: Discussions of the adjustments to cost data are presented in Section 8. The algorithm for ranking is shown in Section 9.

11. Stockpile Sensitivity Analysis

An analysis of the sensitivity of the cost estimates to production rates was performed to investigate the relationships between capital investment, workforce strength, and production quantities. The results show that, as with any factory, most capacity increments are gained by eliminating single choke points in the production network.

These may be very small items, such as an analytical balance, or a major item such as a hot isostatic press.

11.1 Pit Manufacturing/Plutonium Reuse

The analysis for pit manufacturing consists of estimating the procurement and installation of sufficient equipment to produce 100 pits per year with single-shift, five days per week operations, versus an equipment capacity of 50 pits per year for the baseline case. The steady-state operating costs are the same as the base case reported in Section 8.

LANL The high case pit manufacturing capacity would require locating additional equipment in three rooms in the 100 Wing of PF-4. The burdened cost for this increment consists of:

Strip out existing equipment	-	$ 5.4 M
Relocate displaced programs	-	$ 9.4 M
Procure and install new equipment	-	$ 29.0 M
Total:		$ 43.8 M

SRS The high case pit manufacturing capacity would involve facility rearrangement and installation of additional equipment in Building 232-H. The project cost estimate for this increment is:

Direct labor and materials	-	$ 12.0 M
Other project costs	-	$ 7.6 M
Total Project Cost		$ 19.6 M

It should be noted that this capital increment has the capacity to manufacture up to 250 pits per year, utilizing continuous multi-shift operations, with an annual operating cost increment of $98.1 M above the base case (20 pits per year).

11.2 Reuse of Intact Pits, Recertification, and Requalification

The low and high case excursion analysis for Pantex is presented in Tables A-5 and A-6 in Appendix A and summarized below. Data from the NTS for the excursion cases was not available, however, like Pantex, NTS would equip a fourth bay and add personnel to provide additional capacity.

Sensitivity Analysis for Pantex Plant

Case	Total Project Cost	First Production	Steady-State Operating Cost	Total Cost	Net Present Value Cost
Low	$13.5 M	2004	$1.2 M	$38.0 M	$23.6 M
High	$17.9 M	2004	$1.4 M	$47.4 M	$29.5 M

Figure 1 - Cumulative Pit Manufacturing NPV Costs

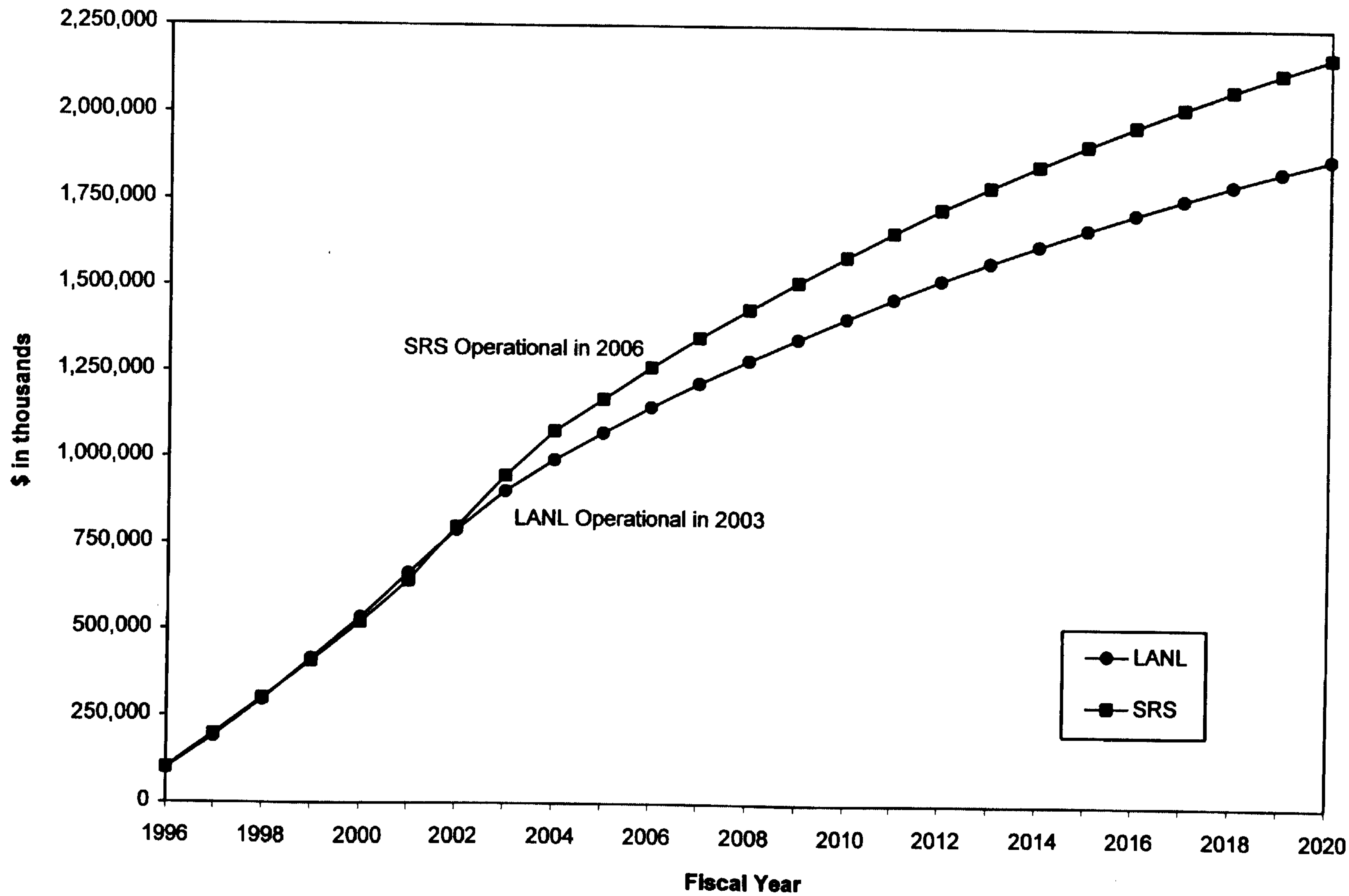


Figure 2- Cumulative Pit Reuse NPV Costs

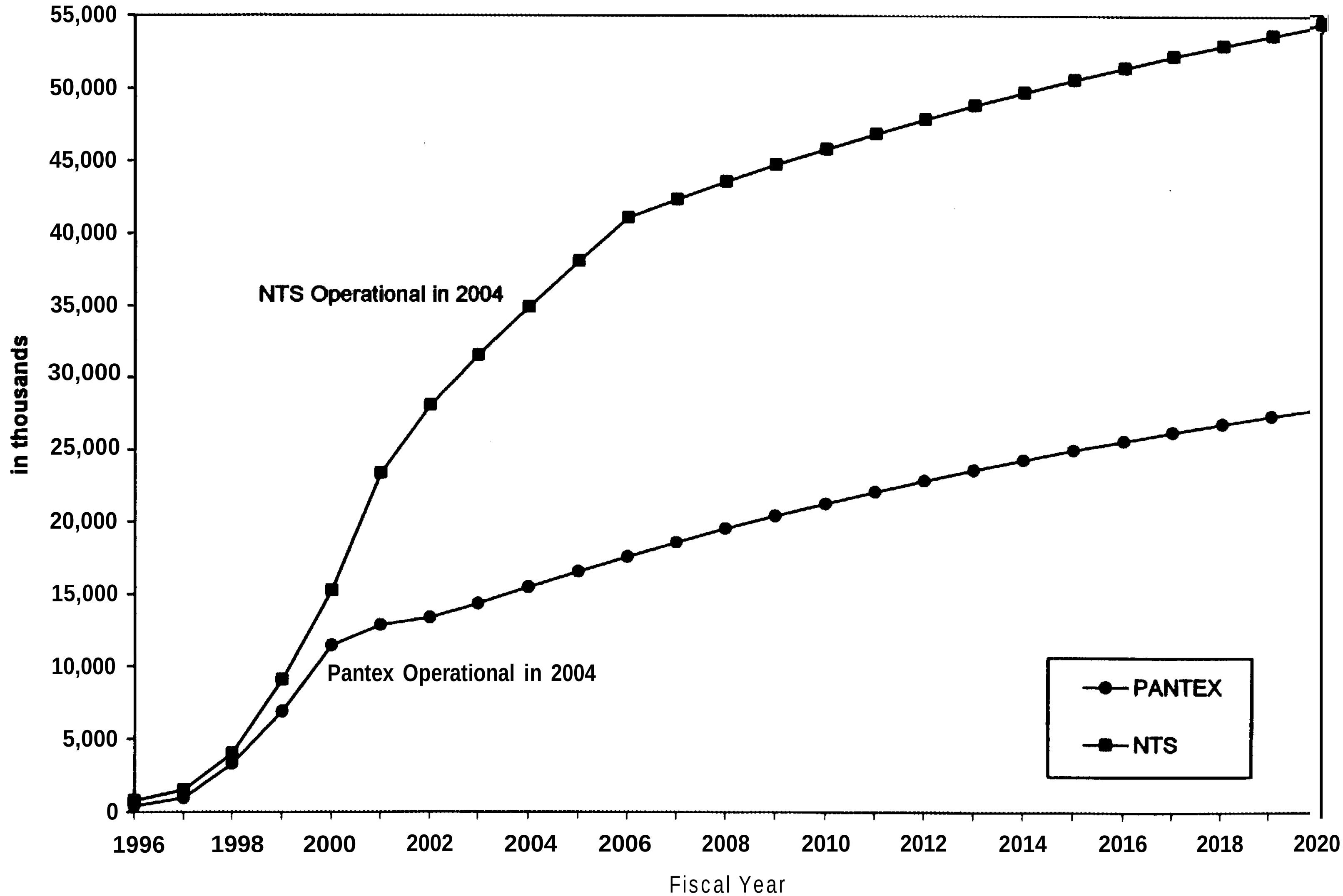


Table A-1 - Incremental Costs for Pit Manufacturing/Plutonium Reuse at LANL

12/1/95 13:15 - Date and time of this run

8/28/95 10:10 a.m. - Date and time of last change

(In thousand of dollars)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																											0
Capital Investment				24,252	45,001	46,780	49,107	50,844	39,406	10,142																	265,532
Project Support		6,380	6,105	2,550	800	1,615	5,315	6,065	4,820	5,915	3,840	3,065															46,470
Pre-Title I																											0
Component Prebuild																											0
Proof of Development					1,323	6,578	13,312																				21,213
Process Development		1,508	862	862	646	485	162																				4,525
Qualification & Process Prove-in						1,443	8,662	21,656																			31,761
Workforce Restructure																											0
Facility Shutdown																											0
Site Overhead during D&D																											0
Donor Project Support																											0
Annual Op. Cost - Transition																											0
Annual Op. Cost - Steady State									28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	28,874	519,732
																											0
TA-55 Stockpile Mgt. Prog.		95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	2,375,000
TOTAL COST		102,888	101,967	122,664	142,770	151,901	171,558	173,565	168,100	139,931	127,714	126,939	123,874	123,874	123,874	123,874	123,874	123,874	123,874	123,874	123,874	123,874	123,874	123,874	123,874	123,874	3,264,233
NPV Discount Rate = 4.9%	0.049																										
	n =	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV	=	98,082	92,663	106,265	117,906	119,587	128,753	124,175	114,647	90,978	79,156	75,001	69,771	66,512	63,405	60,443	57,620	54,928	52,363	49,917	47,585	45,362	43,243	41,223	39,298	37,462	1,876,345

Table A-2 - Costs for Pit Manufacturing/Plutonium Reuse at SRS

12/1/95 13:18 = Date and time of this run

8/28/95 10:00 a.m. = Date and time of last change

(In thousand of dollars)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																											0
Capital Investment				16,221	34,967	45,528	62,886	108,166	97,268	41,448	1,500																407,984
Project Support		6,780	6,505	4,750	1,380	1,210	2,340	9,027	14,420	21,515	8,980	3,065															79,972
Pre-Title I																											0
Component Prebuild																											0
Proof of Development								4,000	12,000	25,000																	41,000
Process Development		3,500	5,500	3,200																							12,200
Qualification & Process Prove-in									2,945	17,670	44,174																64,789
Workforce Restructure																											0
Facility Shutdown																											0
Site Overhead during D&D																											0
Donor Project Support																											0
Annual Op. Cost - Transition																											0
Annual Op. Cost - Steady State												58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	58,898	883,470
LANL Stockpile Mgt. Prog.		95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	95,000	2,375,000
TOTAL COST		105,280	107,005	119,171	131,347	141,738	160,226	216,193	221,633	200,633	149,654	156,963	153,898	153,898	153,898	153,898	153,898	153,898	153,898	153,898	153,898	153,898	153,898	153,898	153,898	153,898	3,864,415
NPV Discount Rate = 4.9%	0.049																										
n =		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV	=	100,362	97,242	103,239	108,472	111,586	120,249	154,673	151,158	130,444	92,754	92,740	86,682	82,633	78,773	75,093	71,586	68,242	65,054	62,015	59,118	56,357	53,724	51,215	48,823	46,542	2,168,774

Table A-3 - Costs for Reuse of Intact Pits at NTS

2/29/96 9:25 = Date and time of this run

8/28/95 9:45 a.m. = Date and time of last change

(In thousand of dollars)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																											0
Capital Investment		550	625	2,843	6,043	7,836	7,751	2,345	92																		28,085
Project Support					52	57	906	946	1,069																		3,030
Pre-Title I																											0
Component Prebuild																											0
Mission Transfer							280	899	1,787																		2,966
Process Development		300	200				475	475	475																		1,925
Qualification & Process Prove-in							113	676	1,690																		2,479
Workforce Restructure																											0
Facility Shutdown																											0
Site Overhead during D&D																											0
Donor Project Support																											0
Annual Op. Cost - Transition																											0
Annual Op. Cost - Steady State										2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	38,318
Pantex Equipment Shipping Cost							1,250	1,250																			2,500
Pantex Strategic Reserve Shipping										2,875	2,875	2,875															8,625
TOTAL COST		850	825	2,843	6,095	7,893	10,775	6,591	5,113	5,129	5,129	5,129	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	2,254	87,928
NPV Discount Rate = 4.9%	0.049																										
n =		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV =		810	750	2,463	5,034	6,214	8,087	4,715	3,487	3,335	3,179	3,030	1,270	1,210	1,154	1,100	1,048	999	953	908	866	825	787	750	715	682	54,371

Table A-4 - Costs for Reuse of Intact Pits at Pantex Plant

12/1/95 13:17 = Date and time of this run

8/28/95 14:30 p.m. = Date and time of last change

(In thousand of dollars)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																											0
Capital Investment				1,725	3,700	5,200	1,600	200	100																		12,525
Project Support		475	600	600																							1,675
Pre-Title I																											0
Component Prebuild																											0
Mission Transfer																											0
Process Development				349	621	621	155																				1,746
Qualification & Process Prove-in							88	525	1,314																		1,927
Workforce Restructure																											0
Facility Shutdown																											0
Site Overhead during D&D																											0
Donor Project Support																											0
Annual Op. Cost - Transition																											0
Annual Op. Cost - Steady State										1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	29,784
Other (Identify)																											0
Other (Identify)																											0
TOTAL COST		475	600	2,674	4,321	5,821	1,843	725	1,414	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	1,752	47,657
NPV Discount Rate = 4.9%	0.049																										
	n =	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV	=	453	545	2,317	3,568	4,583	1,383	519	964	1,139	1,086	1,035	987	941	897	855	815	777	741	706	673	642	612	583	556	530	27,904

Table A-5 - Low Case Costs for Reuse of Intact Pits at Pantex Plant

12/1/95 13:17 = Date and time of this run

8/28/95 15:00 p.m. = Date and time of last change

(In thousand of dollars)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																											0
Capital Investment				1,725	3,700	5,200	1,600	200	100																		12,525
Project Support		475	600	600																							1,675
Pre-Title I																											0
Component Prebuild																											0
Mission Transfer																											0
Process Development				349	621	621	155																				1,746
Qualification & Process Prove-in							76	457	1,142																		1,675
Workforce Restructure																											0
Facility Shutdown																											0
Site Overhead during D&D																											0
Donor Project Support																											0
Annual Op. Cost - Transition																											0
Annual Op. Cost - Steady State										1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	25,891
Other (Identify)																											0
Other (Identify)																											0
TOTAL COST		475	600	2,674	4,321	5,821	1,831	657	1,242	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	1,523	43,512
NPV Discount Rate = 4.9%	0.049																										
n =		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV =		453	545	2,317	3,568	4,583	1,374	470	847	990	944	900	858	818	780	743	708	675	644	614	585	558	532	507	483	461	25,955

Table A-6 - High Case Costs for Reuse of Intact Pits at Pantex Plant

12/1/95 13:16 = Date and time of this run

8/28/95 15:15 p.m. = Date and time of last change

(In thousand of dollars)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																										0
Capital Investment			1,725	3,700	8,200	2,600	350	100																		16,675
Project Support	475	600	600																							1,675
Pre-Title I																										0
Component Prebuild																										0
Mission Transfer																										0
Process Development			349	621	621	155																				1,746
Qualification & Process Prove-in						102	609	1,524																		2,235
Workforce Restructure																										0
Facility Shutdown																										0
Site Overhead during D&D																										0
Donor Project Support																										0
Annual Op. Cost - Transition																										0
Annual Op. Cost - Steady State									2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	34,527
Other (Identify)																										0
Other (Identify)																										0
TOTAL COST	475	600	2,674	4,321	8,821	2,857	959	1,624	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	2,031	56,858
NPV Discount Rate = 4.9% 0.049																										
n =	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV =	453	545	2,317	3,568	6,944	2,144	686	1,108	1,320	1,259	1,200	1,144	1,091	1,040	991	945	901	859	818	780	744	709	676	644	614	33,499

Section C.

Secondary Factory Report

Table of Contents

1. Executive Summary

This report summarizes the information contained in the Secondary Factory Alternative Site Reports submitted by the Y-12 Plant, Los Alamos National Laboratory, and Lawrence Livermore National Laboratory. In addition, the DOE evaluation of these reports is presented including the analysis of costs and ranking of the proposals based on the SSM PEIS Stockpile Management Steering Group evaluation criteria.

The secondary factory is required to include the minimum equipment to assure that one of any weapon secondary in the future nuclear weapons stockpile can be fabricated. The secondary factory will operate at a level of activity that insures production competence. This sizing and production approach is called capability based capacity, and is consistent with known production requirements. All secondary factory alternatives are for a capability based capacity using proven production processes currently at the Y-12 plant. The exceptions to the use of proven production processes are either new processes or the reliance on commercial vendors for materials or components.

Los Alamos National Laboratory (LANL) proposes to reestablish production processes within existing facilities while integrating the design, engineering, materials, and production capabilities using the existing support infrastructure. The LANL is proposing a flexible work force with technicians performing multiple similar tasks for production as well as for research and development activities.

Lawrence Livermore National Laboratory (LLNL) proposes to duplicate most production processes currently used at the Y-12 plant in existing LLNL facilities One new building would be required for enriched uranium storage. The LLNL proposes to use the existing infrastructure (with additional staffing and or equipment) to provide health, and safety support; fire protection; human resources management; material control and accountability; waste management; and safeguards and security. The LLNL would establish a separate management structure to perform the needed production operations, quality assurance, and certification activities. The LLNL further proposes to establish a flexible workforce dedicated to the production mission with about 10% of this workforce to be hired from outside the laboratory.

The Y-12 plant proposes to downsize and consolidate secondary factory functions into about 10% of the current plant foot print. The remaining production facilities and most support facilities would be brought to a safe shutdown for transition to environmental restoration. The Y-12 plant further proposes to staff the production operations with a flexible workforce that is much smaller than the workforce required for capability maintenance today. Implementation of this proposed flexible workforce would require restructuring existing bargaining agreements at the Y-12 plant.

For each secondary factory alternative, the transition cost to the receiver site was estimated by the receiver site (except the EU Strategic Reserve transportation costs were estimated by DOE) while transition costs at the donor site were estimated by the Y-12 plant. Annual steady state operating cost at the receiver site were also estimated by the receiver site. The DOE made some adjustments to the cost estimates based on various independent DOE evaluations to ensure comparable cost comparisons. In addition each proposal was ranked by DOE for technical risk in the areas of basic production capability and capability of the proposed production infrastructure. Ranking scores are shown below.

Ranking Criteria	Score		
	Y-12	LANL	LLNL
Basic Production Capability	98	87	88
Capability of Production Infrastructure	100	80	78
Minimize Cost	100	94	88

A stockpile sensitivity analysis (cost) was performed to determine if either a larger or smaller stockpile size would result in differences in the rankings of the three secondary factory alternatives. The results of this analysis, summarized below, indicate the size of the stockpile does not change the cost ranking order for the secondary factory alternatives.

	Low Case and Base Case			High Case		
	LANL	LLNL	Y-12	LANL	LLNL	Y-12
Total transition cost	$2,912.8	$3,073.7	$2,325.4	$2,739.0	$3,144.2	$2,330.6
Total annual operating costs*	$200.1	$204.7	$199.9	$207.1	$211.0	225.2
25 year NPV cost	$6,384.6	$6,623.0	$5,922.8	$6,477.7	$6,698.9	$6,355.2

* Includes steady state operating cost at receiver site and overhead during D&D at donor site

2. Introduction

This report summarizes the information contained in the Secondary Factory Alternative Site Reports submitted by the Y-12 Plant, LANL, and LLNL. In addition, the DOE evaluation of these reports is presented including the DOE analysis of costs and the DOE ranking of the proposals based on the SSM PEIS Stockpile Management Steering Group evaluation criteria.

The Secondary Factory Alternative Site reports address those functions currently assigned to the Y-12 Plant in Oak Ridge, Tennessee. These functions include the material preparation, fabrication and waste management of highly enriched uranium components, depleted uranium components, special materials components (including lithium salt, Fogbank, Seabreaze, and other components), nonnuclear components (including steel, aluminum, ceramic, and tungsten-nickel-iron components). In addition the disassembly, assembly, and stockpile surveillance of secondary assemblies of the above components is included in the functions of the secondary factory.

The Secondary Factory Alternatives were developed by the SSM PEIS Secondary Working Team. The team was chaired by DOE, AL and included representatives from DOE-DP, OR, SR, LANL, LLNL, Y-12 Plant, Pantex Plant, and Savannah River Site.

3. Assumptions & Requirements

Assumptions used for preparing the Secondary Factory Alternative include applicable Stockpile Management Steering Group assumptions, Secondary Working Team assumptions, and site specific assumptions.

Stockpile Management Steering Group Assumptions applicable to Secondary Factory Alternatives are listed below.

Workload

- NWSM for FY 1995 (consistent with START II and Nuclear Posture Review)
- Capability based capacity would be established at any alternative site. Additional capacity will be established if driven by demand
- 120 surveillance weapons per year
- Capacity sized for single shift operations
- Known dismantlement processed at existing sites (others wait for new site)
- Strategic reserve HEU will be stored at a DP site separate from excess HEU
  - CSAs at the assembly/disassembly site
  - All forms at fabrication site
  - Navy assumed to manage storage of Navy HEU

Capability Requirements

- Production and R&D collocation alternatives will be consistent with any Stewardship Alternatives
- Production capability will be consistent with the enduring stockpile

Operating Constraints

- The assumed production capability gaps between Secondary Factory donor and receiver sites is 4 years
- HEU fabrication, processing and/or storage (in forms other than CSAs) will be considered only for sites that have existing infrastructure for these materials

Cost Estimating Constraints

- D&D costs are not decision costs
- Facility landlord costs during D&D area decision cost
- Estimated time to accomplish D&D at Y-12 is 30 years
- Safe Shutdown and work force restructuring costs identified

- Relevant Environment, Safety & Health, Safeguards and Security; and Conduct of Operations requirements will be satisfied for each option

Secondary Factory Working Team Assumptions. The secondary factory will have the following basic capabilities.

- Enriched uranium capability including casting, metal working, machining, chemical recovery, testing, inspection, assembly, disassembly, quality evaluation, material storage, and waste management.
- Depleted uranium and binary alloy capability including casting, metal working, machining, plating/finishing, testing, inspection, material storage, and waste management.
- Special Materials factory capability including Lithium chemistry, metal and salt production, Seabreaze, Fogbank, and DAP production. In addition, the special materials capabilities include forming, machining, inspection, testing, material salvage/recovery, material storage, and waste management for all special materials.
- Nonnuclear material and component capabilities for steel, aluminum, polyvinyl chloride, graphite, tungsten-nickel-iron, ceramics, assembly, plating/finishing, container refurbishment, tooling, inspection testing, and waste management of all nonnuclear material streams.
- In addition to meeting workload requirement for the enduring stockpile, components will be fabricated for approximately five hydrodynamic tests per year.

The Y-12 specific assumptions are that capability will be maintained by one of the following approaches:

- Operation of processes within the reduced factory footprint
- Commercial procurement of services or materials
- Subcontract services from other DOE facilities
- Preproduction and storage of materials

Los Alamos National Laboratory (LANL) specific assumptions are that production and research and development (R&D) processes will be collocated and that costing will be based on incremental staffing required over and above the staffing required for the LANL R&D mission. In addition, LANL will use a flexible work force with production workers cross trained to perform multiple functions for the multiple material and component capabilities.

Lawrence Livermore National Laboratory (LLNL) specific assumptions are:

- Production operations would be housed in existing buildings
- The LLNL Health and Safety, Materials Management, Waste Management, and Safeguards and Security infrastructures are adequate to support production needs with some additional staffing or equipment

- A storage facility for HEU strategic reserve of all forms must be added within the "Superblock" protected area (most of the HEU strategic reserve will be stored at the assembly/disassembly site)
- A separate management structure will be required to implement production operation and quality assurance activities

The defined workload requirements for the secondary factory is one replacement secondary annually; evaluation of secondary components from the nuclear weapons stockpile; and the fabrication of joint test assembly secondaries for use in the stockpile evaluation flight test program. This base workload level could continue for the foreseeable future; therefore the secondary factory would be equipped and sized to insure that one of any secondary in the post START II nuclear weapons stockpile could be fabricated and delivered to the assembly/disassembly facility if required. Operations of the secondary factory in FY 2005 and beyond are planned for single-shift operation with a workload that insures the DOE is capable of manufacturing secondary components.

4. Description of Proposed Alternative

All secondary factory alternatives propose establishing with, few exceptions, a capability based capacity using proven production processes in use at the Y-12 plant. The exceptions to use of proven production processes are defined new processes or the reliance on commercial vendors for materials or components.

Los Alamos National Laboratory (LANL)

The LANL proposes to reestablish production processes within existing facilities while integrating the design, engineering, materials, and production capabilities. The LANL is proposing a flexible work force with technicians performing multiple similar tasks for production as well as for research and development activities. In addition, LANL proposes to use existing infrastructure capabilities for such functions as environmental, safety, and health management; program management; production control; logistics support; nuclear materials control and accountability; safeguards and security; and waste management.

LANL "does not equate baseline technologies with exact duplication of production equipment, floor plans, work plans, or work force. " LANL proposes to use the following modified processes:

- Enriched Uranium
  - Vacuum induction casting using existing furnaces with noncarbon crucibles without an argon lance
  - Near net shape casting of enriched uranium blanks
  - Argon furnaces for preheating billets prior to rolling

- Depleted Uranium
  - Vacuum induction casting using existing furnaces with noncarbon crucibles without an argon lance
  - Double Vacuum Arc Remelting for binary alloy ingot production
  - Plasma torch melting for recycle of scrap binary metal
  - Commercial procurement of large rolled plate
  - Argon furnaces for preheating blanks prior to forming

- Special Materials
  - Elimination of the lithium salt salvage and wet chemistry operations. LANL would demonstrate production capability with pure feed materials, but would evaluate direct recycle of lithium salts with scrap being disposed by LANL Waste Management
  - Hot isostatic pressing (HIP) with argon pressurization and annealing during the HIP cool-down process

- Nonnuclear Components
  - LANL proposes to use commercial and government furnished (i.e., the DOE nonuclear component factory) products to the maximum extent possible

Lawrence Livermore National Laboratory (LLNL)

LLNL proposes to duplicate production processes currently used at the Y-12 plant (with some exceptions) in existing LLNL facilities. One new building would be required for enriched uranium storage. LLNL proposes to use the existing infrastructure (with additional staffing and or equipment) to provide health and safety support; fire protection; human resources management; material control and accountability; waste management; and safeguards and security. LLNL would establish a separate management structure to perform the needed production operations, quality assurance, and certification activities. LLNL also proposes to establish a flexible workforce dedicated to the production mission with about 10% of this workforce to be hired from outside the laboratory.

LLNL proposes to use the following processes instead of the current Y-12 plant production processes:

- Enriched Uranium
  - Use of coated refractory metal crucibles and molds rather than graphite crucibles and molds for casting operations
  - Argon furnaces for preheating billets prior to rolling
  - CSA assembly in a super-dry box rather than a dry room

- Depleted Uranium
  - Use of electron beam melting for production of binary alloy instead of the current vacuum induction melting followed by two vacuum arc remelting operations
  - Commercial procurement of rolling services for depleted and binary uranium plate

- Special Materials
  - Use of a hi-polar cell for production of lithium metal from lithium chloride rather than the current electrolytic cell process
  - Elimination of the lithium salt salvage and wet chemistry operations LLNL proposes direct recycle with disposal of scrap and the capability to replace process losses with new salt materials

- Nonnuclear Components
  - Commercial procurement of tungsten-nickel-iron fabrication services
  - Commercial procurement of ceramic forming and machining services
  - Commercial procurement or procurement from the DOE nonnuclear factory of steel and aluminum components
  - Commercial procurement or procurement from other DOE production facilities of plasma sprayed components

Y-12 Plant (Y-12)

The Y-12 plant proposes to downsize and consolidate secondary factory functions into about 10% of the traditional plant footprint. The remaining production facilities and most support facilities will be brought to a safe shutdown for transition to environmental restoration activities. Some portion of the buildings not used for the secondary factory is assumed to be used by environmental restoration activities until the environmental restoration is completed. The Y-12 plant proposes to consolidate and use existing production processes with the following exceptions:

- Enriched Uranium
  - Preproduction of purified enriched uranium feedstock sufficient to support the defined workload for 100 years and the placing of the uranium metal production process in cold standby.

- Special Materials
  - Elimination of the lithium salt salvage, wet chemical recycle and purification, and lithium hydride and deuteride production operations. The Y-12 plant proposes to preproduce purified lithium hydride and lithium deuteride in sufficient quantity to support the defined workload for 100 years. The Y-12 plant proposes the use of direct recycle of lithium salts with disposal of scrap and the replacement of process losses with preproduced materials. The Y-12

plant further proposes to use commercial vendors for any lithium salt requirements should the workload increase in the future.

Y-12 plant also proposes to staff the production operations with a flexible workforce that is much smaller than the workforce required for capability maintenance today. Implementation of this proposed flexible workforce will require restructuring existing agreements with the various unions at the Y- 12 plant.

5. Process Descriptions

All three proposals use the same basic production processes with minor variations (i.e., the use of material preproduction or procurement of certain materials, components, or services from commercial firms or from another DOE factory). General process descriptions are provided below.

Enriched Uranium (EU) Process

The EU process provides finished EU components and products. The production of EU components and products requires the following five primary operations:

- Melting and casting
- Metal working including forging, rolling, and forming
- Machining, inspection and certification
- Chemical recovery of EU residues from various process areas
- Secure feedstock and in-process storage

Depleted Uranium (DU) Process

The DU process produces unalloyed and alloyed depleted uranium material and provides finished parts. The DU process uses the following four primary operations:

- Melting and casting of unalloyed material
- Melting and casting of binary alloy (Uranium, 6% niobium) material
- Metal working including forging, rolling, and forming
- Machining, inspection, and certification

Special Material Process

The special materials process provides finished lithium hydride and lithium deuteride, DAP (diallyl phthalate), Fogbank and Seabreaze components. The Fogbank and Seabreaze materials and operations descriptions are not presented here because of classification.

The primary operation for special materials (except for Fogbank and Seabreaze) are given below.

Lithium Process

- Lithium metal recovery from lithium chloride
- Lithium hydride and lithium deuteride production
- Lithium hydride and lithium deuteride powder production and forming
- Machining, inspection and certification
- Disposal of waste lithium hydride and lithium deuteride
  storage of deuterium gas, lithium, lithium chloride, lithium deuteride, lithium hydride, and in process components

DAP Process

- Formulation of DAP based molding compound
- Compression or transfer molding of DAP components
- Machining, inspection, and certification

Nonnuclear Process

The nonnuclear process fabricates certain components and supplies materials for use in the EU, DU, and Special Materials processes. The primary product streams are urethane foams, steel and aluminum, stainless steel cans, ceramics, PVC, and tungsten-nickel-iron. The principle operations include the following:

Urethane foams

- molding, curing, and trimming
- machining, inspection, and certification

Steel and Aluminum

- heat treating
- machining, inspection, and certification

Stainless steel cans

- metal working, including forming and heat treating
- welding
- machining, inspection, and certification

Ceramics

- hot and cold isostatic pressing
- machining, inspection, and certification

PVC

- dipping, casting and curing

Tungsten-nickel-iron
- powder blending
- isostatic pressing
- sintering
- machining, inspection, and certification

Assembly/Disassembly/Quality Evaluation Process

Assembly operations assemble piece parts into subassemblies using joining techniques such as welding, adhesive bonding, and mechanical joining. Disassembly takes retired weapons apart and prepares the piece parts for recycle or disposal. Quality evaluation receives subassemblies from the stockpile evaluation facility at the weapons assembly plant, disassembles these units and performs test and evaluation activities relevant to reliability and safety.

Waste Management Process

Each secondary factory alternative site has proposed using established infrastructure processes for management of solid waste, wastewater, and organic liquid waste treatment, storage, and disposal as well as management of airborne pollutants.

6. Facility Descriptions

Lawrence Livermore National Laboratory (LLNL)

The LLNL proposes to establish secondary factory operations in existing facilities with some construction required for equipment installation.

Enriched Uranium (EU), Assembly, Disassembly, and Surveillance
The LLNL proposes to perform EU operations including assembly, disassembly, and surveillance in portions of buildings 332 and 334. These buildings are within the Superblock of special nuclear materials facilities within the Perimeter Intrusion Detection and Alarm System (PIDAS). Nondestructive evaluation (radiography) of EU components and subassemblies would be performed in Building 239. The PIDAS would be expanded to include building 239. Other buildings to be used for mass spectrometry and laboratory analysis of small EU samples include buildings 177, 222, 235, 251, and possibly building 331. A new "Butler type" building would be constructed within the PIDAS zone for storage of EU metal in modular storage vaults.

Depleted Uranium (DU)
LLNL would prepare binary alloy billets in building 175. Most DU and binary operations for component fabrication would use buildings 231, 321, and 322. Nondestructive evaluation of material samples and components would be performed in buildings 177, 222, 229, 235, 251, and 327.

Special Materials

Special materials fabrication would be performed in buildings 231 and 241. Nondestructive evaluation would be performed in buildings 177, 222, and 235. Minor seismic retrofits would be required for building 241.

Nonnuclear

LLNL proposes to conduct nonnuclear component operations in the "extended building 321 area complex" consisting of wings A, B, and C of building 321 and buildings 327, 329, and 322. The security fences and booths for controlling access would be reactivated for support on nonnuclear manufacturing activities. In addition, some nonnuclear fabrication would be performed in building 231.

Y-12 Plant (Y-12)

The Y-12 plant proposes to consolidate secondary factory production processes in seven major facilities. Currently, many of the material processes are housed in those facilities. Nondestructive evaluation and physical testing operations would be performed in building 9204-2E. Storage of tooling would be in building 9996.

Enriched Uranium (EU), Assembly, Disassembly, and Surveillance

The EU operations would be conducted in buildings 9212, 9215, and 9998. Assembly, disassembly, and surveillance (quality evaluation) operations would be performed in building 9204-2E.

Depleted Uranium (DU)

Y-12 proposes to consolidate DU operations including binary alloy operations in buildings 9201-5N, 9212, 9215, and building 9998.

Special Materials

Special materials operations would be conducted in buildings 9204-2 and 9204-2E.

Nonnuclear

Nonnuclear operations would be conducted in buildings 9201-5N, 9215, and 9998.

Los Alamos National Laboratory (LANL)

LANL proposes to establish secondary factory operations in existing facilities with some construction required for equipment installation.

Enriched Uranium (EU), Assembly, Disassembly, and Surveillance

LANL proposes to conduct EU operations in three wings of building SM-29. Significant modifications to this building are required. Costs of facility security upgrades for CMR ($12 M) are also included in the LANL Pit Factory Proposal.

Should LANL be selected for both secondary fabrication and pit fabrication, the cost of the security upgrades would be deleted from one of the estimates.

Depleted Uranium (DU)
LANL proposes to conduct DU operations in buildings SM-35, SM-66, and SM-102. Nondestructive analysis would be conducted in facilities in TA-8 while chemical analysis would be performed in SM-29.

Special Materials
LANL proposes to conduct special materials operations in buildings SM-35, SM-66, and SM-141. Nondestructive analysis would be conducted in facilities in TA-8 while chemical analysis would be performed in SM-29.

Nonnuclear
LANL proposes to conduct nonnuclear operations in buildings SM-39, SM-66, and SM-141. Nondestructive analysis would be conducted in facilities in TA-8 while chemical analysis would be performed in SM-29.

7. Engineering and Technical Assessments

Y-12 Plant (Y-12)

The Y-12 plant has identified two areas requiring process development activities. Vacuum arc remelting (VAR) for production of binary alloy billets, and direct recycle of lithium hydride and deuteride.

Process development and characterization of VAR is currently underway and lacks only additional characterization of machined parts from the binary alloy produced with the VAR process. The risk is considered to be low.

Process development and characterization of direct recycle of lithium hydride and lithium deuteride needs to be performed. Material properties must be determined for mechanically reprocessed salts. If heavy metal contamination is a problem, some means of reducing this contamination must be developed. This process development and characterization activity is not considered to be a major barrier to implementation of direct recycle of lithium salt parts.

Los Alamos National Laboratory (LANL)

The LANL proposes to do minimal process development (no process development costs were identified) though they plan to modify several processes:

- Enriched Uranium
  - Vacuum induction casting using existing furnaces with noncarbon crucibles without an argon lance

  - Near net shape casting of enriched uranium blanks
  - Argon furnaces for preheating billets prior to rolling

- Depleted Uranium
  - Vacuum induction casting using existing furnaces with noncarbon crucibles without an argon lance
  - Double Vacuum Arc Remelting for binary alloy ingot production
  - Plasma torch melting for recycle of scrap binary metal
  - Argon furnaces for preheating blanks prior to forming

- Special Materials
  - Hot isostatic pressing (HIP) with argon pressurization and annealing during the HIP cool-down process

LANL believes these process modifications have been demonstrated on a R&D scale. However, DOE believes additional process development, qualification and prove-in would be required for the above processes. DOE also believes additional unquantified process qualification and prove-in would be required to assure the reestablished processes are useable in a production mode.

Lawrence Livermore National Laboratory (LLNL)

LLNL proposes process development activities for the following processes:

- Enriched Uranium
  - Use of coated refractory metal crucibles and molds rather than graphite crucibles and molds for casting operations
  - Argon furnaces for preheating billets prior to rolling
  - CSA assembly in a super-dry box rather than a dry room

- Depleted Uranium
  - Use of electron beam melting for production of binary alloy instead of the current process of vacuum induction melting followed by two vacuum arc remelting operations

- Special Materials
  - Use of a hi-polar cell (instead of an electrolytic cell) for production of lithium metal from lithium chloride

In addition, LLNL has identified alternate processes to be investigated for possible production use including the following:

- Enriched Uranium
  - Independent temperature control for casting molds for near net shape casting
  - Development of near net shape casting using dilute alloy EU

- Dry machining of EU in an inert atmosphere to allow direct recycle of machining chips

- Depleted Uranium
  - Use of spin forming for fabrication of case parts

- Special Materials
  - Long term storage of lithium salts from weapons returns in a safe manner free from thread of ignition or chemical reaction

8. Cost, Transition, and Implementation Schedules

For the secondary factory alternatives, the receiver site transition costs were estimated by the receiver site (except the EU Strategic Reserve transportation costs were estimated by DOE) while transition costs at the donor site were estimated by the Y-12 plant.

Transition costs at the receiver site include capital investment; mission transfer-receiver; process development, qualification and process prove-in; provide staff-receiver; annual operating cost during transition-receiver; and EU strategic reserve transportation costs. For the Y-12 downsizing option, Y-12 is both the receiver site and the donor site.

Transition costs at the donor site include component prebuild (applicable to the Y-12 option only); mission transfer-donor; workforce restructuring costs; donor support for transition; annual operating cost during transition-donor; retired CSA dismantlement costs; facility shutdown costs; and site overhead during D&D. Because the assumed D&D period for Y-12 is 30 years and the cost analysis only covers a 25 year interval (FY 1996 through FY 2020) that portion of overhead during D&D cost occurring after the receiver site begins steady state operation are considered an annual operating cost. That portion of overhead during D&D that is expended prior to the receiver site reaching steady state operations are included in the transition cost for purposes of cost analysis of the alternatives.

Transition costs were estimated using the following transition schedules.

Table 8-1 – Proposed Transition Schedules

	LANL		LLNL		Y-12	
Event	Start FY	End FY	Start FY	End FY	Start FY	End FY
Facility Mods including equipment installation	1998	2003	1998	2000	1997	1999
Inventory and Records transfer	1997	2002	1998	2002	N/A	N/A
Process Development						
Qualification & Process Prove in - QE process	2000	2000	1999	2000	1998	2003
Qualification & Process Prove in - All other processes	2000	2003	2001	2003	1998	1999
Facility Shut Down	1996	2008	1996	2008	1996	2004
First Production Unit	FY 2004		FY 2004		FY 2003	

Annual steady state operating costs at the receiver site were also estimated by the receiver site. The following table summarizes the staffing and materials costs estimated by each site. DOE has revised the LANL FTE costs by adding 12%, as was recommended in the independent cost evaluation report.

LANL and LLNL site alternatives require the EU strategic reserve in the form of CSAs to be moved to the assembly/disassembly site for long term storage. Two alternatives were considered for the assembly/disassembly site--the Pantex Plant and the Nevada Test Site. For this evaluation, the cost of transporting the strategic reserve is considered to be the average of the two estimates (i.e., costs to move the reserve to Pantex + cost to move the reserve to NTS divided by 2). Detailed cost analysis for each of these options was also performed and documented by DOE AL.

Table 8-2. – Staffing and Materials Cost Estimates
Steady State Operations after Transition
(FY 1995 $ in Millions)

	Y-12		LANL		LLNL	
	FTE	$	FTE	$	FTE	$
Direct						
Labor	81	$9.5	99	$8.3	78	$7.0
Materials		1.8		5.2		3.6
Direct Support	26	2.9	19	1.70	76	7.6
Operations Support	71	7.0	41	3.6	31	2.9
Facilities Support	36	8.9	114	12.9	53	5.2
Overhead Application	243	38.7	150	11.1	236	21.1
TOTAL BURDENED	**457**	**$68.8**	**423**	**$42.8**	**474**	**$47.4**
Date Steady State Achieved	**FY 2003**		**FY 2004**		**FY 2004**	

Dismantlement of CSAs that will be retired in order to reach START II stockpile quantities represents a significant workload. This workload would result in any secondary factory site alternatives including an excessively large dismantlement capacity. Therefore, two dismantlement options were considered for dismantlement of retired CSAs. The first option assumes that CSA dismantlement will end at the end of FY 2000. Weapon dismantlement activities would continue at the assembly/ disassembly facility to meet START II stockpile limits. CSAs that are removed from retired weapons after FY 2000 would either 1) be declared excess and turned over to the Fissile Materials Disposition facility for disposition, or 2) be stored at the assembly/disassembly facility for later shipment to the secondary factory for dismantlement as workload and facility capacities permit. The second dismantlement scenario assumed that CSA dismantlement work would be completed at Y-12. If Y-12 is the selected site, dismantlement will continue through FY 2007. If Y-12 is not the selected secondary factory, dismantlement would be accelerated to be completed at Y-12 by the end of FY 2004. Cost estimates for both dismantlement scenarios have been developed by Y-12 and accepted by DOE. CSA dismantlement option 2 is the option presented in this report.

Table 8-3--Transition Cost Estimates
(FY 1995 $ in Millions)

	LANL	LLNL	Y-12
Donor transition cost	$2,734.3	$2,734.3	N/A
Receiver transition cost	178.5	339.4	$2,325.4
Total	**$2,912.8**	**$3,073.7**	**$2,325.4**

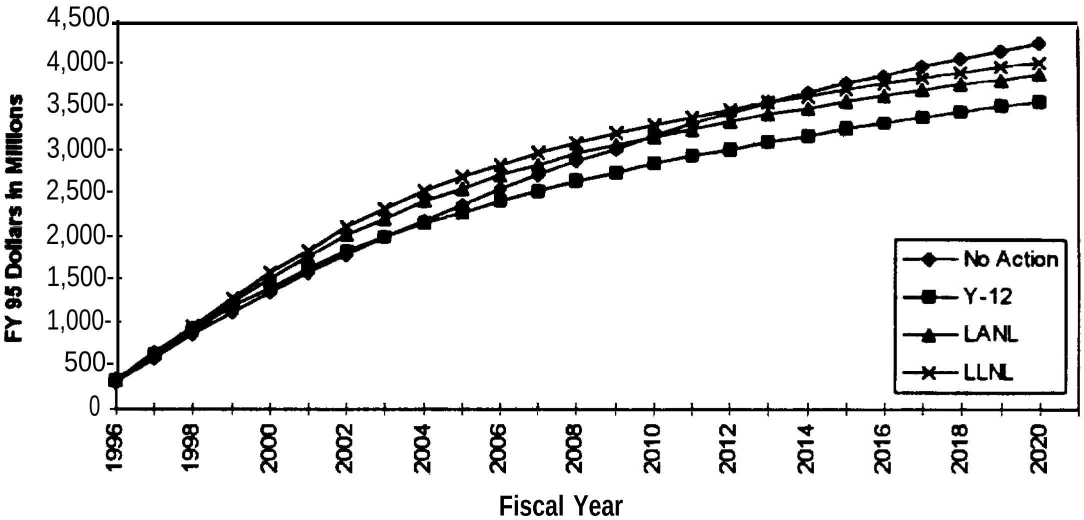
Table 8-4 -- Steady State Operating Cost Estimates
(FY 1995 $ in Millions)

	LANL	LLNL	Y-12
Annual overhead during D&D costs	$ 157.3*	$157.3*	$ 131.10
Annual operating costs	42.8	47.4	68.75
Total annual costs	**$ 200.1**	**$ 204.7**	**$ 199.8**

* The overhead during D&D is $154.10 in FY 2004; and $157.30 beginning in FY 2005

Figure 8-1 depicts the net present value of the cumulative costs (transition costs plus annual operating costs) for each of the site alternatives and the No Action Alternative. The No Action Alternative assumes that no downsizing of the Y-12 plant would occur and that the workload described above is the workload beginning in FY 2004. The Net Present Value (NPV) cost was calculated by year for 25 years for each alternative using the latest Office of Management and Budget discount rate for comparing alternative projects.

Figure 8.1 – Secondary Factory Cumulative NPV Costs



9. Ranking Criteria Summary

The ranking criteria for the SSM PEIS were provided to each working team. The criteria are used to assess technical risks (Basic Production Capability and Capability of Production Infrastructure) and relative costs. Table 9-1 summarizes the criteria and ranking of secondary factory alternatives.

Table 9-1 – Summary of Ranking Criteria Scores

Ranking Criteria	Score Assigned		
	Y-12	**LANL**	**LLNL**
Basic Production Capability	98	87	88
Capability of Production Infrastructure	100	80	78
Minimize Cost	100	94	88

10. Analysis of Ranking

Basic Production Capability

The Y-12 is currently performing the secondary factory mission for the DOE. Consolidation into a smaller footprint would not create additional risk to the mission. Y-12 does propose to modify two major processes, which adds minimal risk. Therefore, Y-12 was assessed a rating of 98 for basic production capability.

LANL proposes to reestablish most of the processes currently in use at Y-12. They have identified ten process areas that would be slightly modified from the Y-12 processes. LANL has not demonstrated these processes, which increases their risk relative to Y-12. A score of 87 has been assigned to the LANL proposal.

LLNL proposes to reestablish all but three processes currently in use at Y-12. Of the three proposed process changes, the use of the bi-polar cell for lithium metal production has only been demonstrated on a laboratory scale and represents the greatest risk. In addition, LLNL does not have production experience in the other processes to be reestablished. For these reasons, a score of 88 was assigned by DOE to the LLNL proposal.

Capability of the Production Infrastructure to Support Scheduled Work

Y-12 has a proven production infrastructure that will be downsized to support the capability based capacity workload. This is a very low risk approach; therefore, a ranking of 100 was assigned to Y-12.

LANL proposes to incrementally add staff to the existing research and development prototype fabrication infrastructure to support production. Because of the different requirements for the production infrastructure, especially in the areas of production control, conduct of operations, and production quality assurance, the incremental approach will carry added risk. Therefore, LANL was assigned a rating of 80 for this evaluation factor.

LLNL proposes to provide the production infrastructure in a manner similar to LANL. LLNL was rated lower than LANL because LLNL has less experience in production. Therefore, LLNL was rated 78 for this evaluation element.

Minimize Cost

The alternatives were ranked relative to each other based on the results of the NPV cost analysis performed for a 25 year interval. The rating was calculated by dividing the alternative cost NPV by the lowest alternative cost NPV and multiplying by 100. The NPV analysis spreadsheets are attached in Appendix A to this section.

11. Stockpile Sensitivity Analysis

The stockpile sensitivity analysis was performed to determine if either a larger or smaller stockpile size would result in differences in the rankings of the three secondary factory alternatives. The basis for the proposed secondary factory alternatives is the START II stockpile. The sensitivity analysis assumed a higher stockpile level in line with the “hedge” option of the Nuclear Posture Review. For a lower stockpile option that would align with the “lead” option of the Nuclear Posture Review, a stockpile size of about 1,000 warheads was assumed.

The secondary factory alternatives were proposed to support a workload requirement of one secondary per year to replace units destroyed by stockpile evaluation testing. In addition, the secondary factory was required to include the minimum equipment required to insure that one of any secondary in the post START II nuclear weapons stockpile could be fabricated and to operate at a level of activity that would insure production competence. This approach is called capability based capacity. The secondary factory would be sized, equipped, and operated to a capability based capacity basis; therefore, support of a stockpile size less than the base START II stockpile would also result in the need for capability based capacity. For the high case, the assumption was made that the secondary factory would be equipped for a single shift operational capacity of 100 secondaries per year. The factory would be operated at a rate of about 20 secondaries per year.

Table 11-1 Stockpile Sensitivity Analysis Cost Comparison (FY 1995 $ in Millions)

	Low Case and Base Case			High Case		
	LANL	LLNL	Y-12	LANL	LLNL	Y-12
Total transition cost	$2,912.8	$3,073.7	$2,325.4	$2,739.0	$3,144.2	$2,330.6
Total annual operating costs*	$200.1	$204.7	$199.9	$207.1	$211.0	225.2
25 year NPV cost	$6,384.6	$6,623.0	$5,922.8	$6,477.7	$6,698.9	$6,355.2

* Includes steady state operating cost at receiver site and overhead during D&D at donor site

NOTE: LLNL believes they would not need to add additional director direct support staff to accommodate the high case workload. Based on its independent evaluation, DOE increased the LLNL operating cost estimate by about 15 % to accommodate additional direct and direct support staff for the high case.

The Y-12 estimate for the high case assumes reactivation of the lithium recycle capability and the EU metal recovery capability. Operation of these additional process capabilities would require the proposed increase in operating costs.

Costs for Secondary Factory - from Y-12 to LANL

Fully Burdened Funding
Dismantlement through 2004

Base Case Workload
PX/NTS assembly site ave.

[illegible] - Date and time of file run
[illegible] - Date and time of last change

(In thousand of dollars)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																											
Capital Investment																											
Receiver			5,014	11,292	35,219	32,335	32,335	10,844	2,416																		129,495
Donor																											0
Project Support - Receiver																											0
Pre-Title I																											
Receiver																											0
Donor																											0
Component Prebuild																											0
Mission Transfer																											
Receiver			739	1,517	3,055																						5,311
Donor			547					37,553																			38,100
Process Development - Receiver																											0
Qualification & Process Prove-in						4,553	6,072	7,590	9,107																		27,322
Workforce Restructure - Donor								25,000					12,500														37,500
Facility Shutdown - Donor		9,224	15,141	21,040	20,852	24,725	38,847	29,042	22,097	38,736	47,917	40,632	30,234	32,234													370,722
Site Overhead during D&D - Donor									154,100	154,100	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	2,825,000
Donor Support for Transition																											0
Provide Staff - Receiver																											0
Annual Op. Cost - Transition - Donor		290,703	288,250	268,997	260,851	244,444	234,544	214,544	35,944	35,944																	1,874,222
Annual Op. Cost - Transition - Receiver																											0
Annual Op. Cost - Steady State - Receiver										42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	42,837	728,229
Overhead Increase																											0
Other (CSA Dismantlement)		39,097	38,550	38,303	36,849	36,356	36,356	36,356	36,356	36,356																	334,578
Other (SST Costs Stg. Rsrv--PX /NTS Ave.)								7,078	7,078																		14,155
TOTAL COST		339,024	348,261	341,149	356,806	342,433	348,175	368,007	267,098	307,973	248,054	240,769	242,871	232,371	200,137	200,137	200,137	200,137	200,137	200,137	200,137	200,137	200,137	200,137	200,137	200,137	6,384,634
I(NPV) = 4.9%	0.049																										
No Action Alternative Operating Cost		317,500	314,500	311,500	308,500	305,500	302,500	299,500	296,500	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	7,487,425
n =		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV =		323,188	316,485	295,540	294,666	269,586	261,303	263,286	182,166	200,232	153,742	142,256	136,795	124,767	102,440	97,655	93,094	88,745	84,600	80,648	76,881	73,290	69,866	66,603	63,491	60,526	3,921,839
Savings NPV =		-20,319	-30,690	-25,685	-39,893	-29,076	-34,279	-49,012	20,053	-7,768	29,732	32,647	29,939	34,171	49,090	46,789	44,602	42,519	40,533	38,639	36,834	35,114	33,474	31,910	30,420	28,999	368,547

Costs for Secondary Factory - from Y-12 to LLNL

Fully Burdened Funding
Dismantlement through 2004

Base Case Workload
PX/NTS assembly site ave.

(In thousand of dollars)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Initial Investment													
Capital Investment													
Receiver			21,030	72,069	66,674								
Donor													
Project Support - Receiver	300	3,000	3,107	8,342	8,633								
Pre-Title I													
Receiver													
Donor													
Component Prebuild													
Mission Transfer													
Receiver			619	1,372	959								
Donor							37,805						
Process Development - Receiver					717								
Qualification & Process Prove-in				1,125	3,212	42,862	43,203	45,477					
Workforce Restructure - Donor							25,000					12,500	
Facility Shutdown - Donor	9,224	15,141	21,040	20,852	24,725	38,847	29,042	22,097	38,736	47,917	40,632	30,234	32,234
Site Overhead during D&D - Donor								154,100	154,100	157,300	157,300	157,300	157,300
Donor Support for Transition													
Provide Staff - Receiver													
Annual Op. Cost - Transition - Donor	290,703	288,250	268,997	260,851	244,444	234,544	214,544	35,944	35,944				
Annual Op. Cost - Transition - Receiver													
Annual Op. Cost - Steady State - Receiver									47,410	47,410	47,410	47,410	47,410
Overhead Increase													
Other (CSA Dismantlement)	39,097	38,550	38,303	36,849	36,356	36,356	36,356	36,356	36,356				
Other (SST Costs Stg. Rcvr--PX to A/D)							7,198	7,198					
TOTAL COST	339,524	344,941	353,096	401,460	385,720	352,609	393,147	301,172	312,546	252,627	245,342	247,444	236,944
I(NPV) = 4.9%													
No Action Alternative Operating Cost	317,500	314,500	311,500	308,500	305,500	302,500	299,500	296,500	296,025	296,025	296,025	296,025	296,025
n =	1	2	3	4	5	6	7	8	9	10	11	12	13
Cost NPV =	323,665	313,468	305,091	331,544	303,665	264,631	281,272	205,405	203,205	156,576	144,958	139,370	127,222
Savings NPV =	-20,996	-27,664	-36,035	-76,771	-63,154	-37,607	-66,999	-3,186	-10,741	26,890	29,945	27,363	31,723

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment													
Capital Investment													
Receiver													159,773
Donor													0
Project Support - Receiver													23,382
Pre-Title I													
Receiver													0
Donor													0
Component Prebuild													0
Mission Transfer													
Receiver													2,950
Donor													37,805
Process Development - Receiver													717
Qualification & Process Prove-in													135,879
Workforce Restructure - Donor													37,500
Facility Shutdown - Donor													370,722
Site Overhead during D&D - Donor	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	157,300	2,825,000
Donor Support for Transition													0
Provide Staff - Receiver													0
Annual Op. Cost - Transition - Donor													1,874,222
Annual Op. Cost - Transition - Receiver													0
Annual Op. Cost - Steady State - Receiver	47,410	47,410	47,410	47,410	47,410	47,410	47,410	47,410	47,410	47,410	47,410	47,410	805,970
Overhead Increase													0
Other (CSA Dismantlement)													334,578
Other (SST Costs Stg. Rcvr--PX to A/D)													14,395
TOTAL COST	204,710	204,710	204,710	204,710	204,710	204,710	204,710	204,710	204,710	204,710	204,710	204,710	6,623,892
I(NPV) = 4.9%													
No Action Alternative Operating Cost	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	7,488,425
n =	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV =	104,781	99,806	95,221	90,773	86,533	82,491	78,637	74,964	71,463	68,124	64,942	61,909	4,090,596
Savings NPV =	46,740	44,556	42,475	40,491	38,600	36,797	35,078	33,439	31,877	30,388	28,969	27,616	209,892

Costs for **Secondary Factory** - Downsizing at **Y-12**

3/23/94 12:21 - Date and time of this run

6/3/93 - 8:00am - Date and time of last change

(In thousand of dollars)

Fully Burdened Funding
Dismantlement through 2007

Base Case Workload
PX or NTS is assembly site

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																											0
Capital Investment		1,136	7,000	13,265	9,612																						31,013
Project Support		1,420	2,800	1,380	1,360	2,025																					8,985
Pre-Title I																											0
Component Prebuild					3,726																						3,726
Mission Transfer																											0
Process Development																											0
Qualification & Process Prove-in				138	340																						478
Workforce Restructure								25,000																			25,000
Facility Shutdown		9,224	15,141	21,040	18,245	17,324	24,861	12,207	7,004	11,382																	136,428
Site Overhead during D&D									131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	131,100	2,359,800
Donor Project Support																											0
Annual Op. Cost - Transition		295,951	293,253	274,054	265,524	248,944	258,100	248,100																			1,883,926
Annual Op. Cost - Steady State									68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	68,754	1,237,572
Other (CSA Dismantlement)		21,549	21,247	20,946	19,476	19,057	19,057	19,057	19,057	19,057	19,057	19,057	19,239														235,851
Other (Identify)																											0
TOTAL COST		329,280	339,441	330,823	318,283	287,349	302,018	304,364	225,915	230,293	218,911	218,911	219,093	199,854	199,854	199,854	199,854	199,854	199,854	199,854	199,854	199,854	199,854	199,854	199,854	199,854	5,922,780
I(NPV) = 4.9%	0.049																										
No Action Alternative Operating Cost		317,500	314,500	311,500	308,500	305,500	302,500	299,500	296,500	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	296,025	7,488,425
	n =	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL
Cost NPV	=	313,899	308,470	286,595	262,852	226,221	226,662	217,753	154,078	149,727	135,679	129,341	123,402	107,308	102,295	97,517	92,962	88,620	84,480	80,534	76,772	73,186	69,767	66,508	63,402	60,440	3,598,471
Savings NPV	=	-11,230	-22,665	-16,740	-8,079	14,290	362	-3,480	48,141	42,737	47,795	45,562	43,331	51,637	49,225	46,926	44,734	42,644	40,652	38,753	36,943	35,218	33,572	32,004	30,509	29,084	691,927

Section D, E

Section F.

Weapons Assembly/Disassembly Report

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1. Executive Summary

The Weapon Assembly/Disassembly (A/D) Team, as a subgroup of the SSM PEIS steering group, was charged with developing and assessing viable alternatives for the A/D mission. This study indicates that only two sites have the necessary infrastructure to perform operations associated with nuclear explosives; the Nevada Test Site (NTS) and the Pantex Plant.

The operations considered as part of the assembly/disassernbly mission are the following:

a) Weapon Assembly
b) Weapon Disassembly
c) Joint Test Assembly and Post Mortem
d) Test Bed Assembly and Disassembly
e) Storage of Strategic Reserves of Plutonium (Pu) and Highly Enriched Uranium (HEU) in the form of pits and canned subassemblies (CSAs)
f) Pit Recertification

A summary table comparing the results of the assessment of the two options for all workloads considered is shown below.

Table 1-1
Comparison of Options for All Workloads
(Costs in FY 95, M $)

Area	Low Case		Base Case		High Case	
	Pantex Option	NTS Option	Pantex Option	NTS Option	Pantex Option	NTS Option
Annual Operating Cost	55.4	46.1	57.1	47.7	62.6	53.7
Life Cycle Costs	1,298	1,607	1,311	1,648	1,352	1,742
Life Cycle Savings	1,195	885	1,182	845	1,141	751
Ranking Criteria						
Basic Production Capablity	100	80	100	80	100	80
Capability of Production Infrastructure	100	65	100	60	100	50
Minimize Cost	100	75	100	73	100	68

2. Introduction

The Weapon Assembly/Disassembly (A/D) Team is a subgroup of the SSM PEIS steering group. The A/D Team was formed to provide the data necessary to define and defend the DOE's preferred alternative for the assembly/disassembly mission in support of the SSM PEIS. The A/D Team consists of individuals from the DOE Operations Offices in Albuquerque and Nevada; the Sandia, Los Alamos, and Lawrence Livermore National Laboratories; Mason and Hangar-Silas Mason, Pantex; and Raytheon Services Nevada.

The scope of the A/D Team effort includes:

a) Identification of a set of alternative sites to perform the A/D mission;

b) Definition of facilities and operations necessary to support the defined workloads;

c) Specification of activities at the donor and receiver sites necessary to implement the alternative, e.g., prebuilds, transfers of documents, inventories and equipment, relocation of personnel, etc.;

d) Estimates of costs and schedules necessary to achieve the above; and

e) Assessment of technical risks associated with each alternative.

Two sites are considered reasonable alternatives for the assembly/disassembly missions: 1) the Nevada Test Site (NTS) which has been the site for assembly of nuclear test devices and 2) the Pantex Plant which currently performs assembly, disassembly, and surveillance of nuclear weapons. These are the only sites which have the necessary infrastructure and relative experience to support the A/D mission. The following capabilities, technologies, and processes are considered in the A/D mission at either site:

- Weapon Assembly
  - assembly of replacement or refurbished weapons
  - retrofits, stockpile improvement programs, and repairs of existing weapons
  - staging of active weapons/components and high explosives
  - pit re-certification

- Weapon Disassembly
  - dismantlement of retired weapons and trainers and disposition of associated components
  - staging of retired weapons and associated components

- Weapon Surveillance
  - disassembly of weapons and assembly of joint test assemblies (JTAs) from the disassembled weapon
  - post mortem examination of the tested JTAs
  - reassembly of the weapon
  - assembly and disassembly of test beds
  - surveillance of components currently manufactured at Pantex, with the exception of high explosive (HE) components

- Storage of Special Nuclear Material (SNM)
  - storage of the nation's strategic reserve of SNM, in the form of pits and CSAs
  - transportation of components to other sites
  - support of the AT 400A pit container

- Support Functions
  - metrology
  - procurement
  - analytical laboratories
  - maintenance of the safe secure transport (SST) vehicles
  - training and certification of personnel
  - safeguards and security

3. Assumptions & Requirements

The following assumptions apply in the development of the site alternatives for the A/D mission:

a) The Nuclear Weapons Complex must have the capability to maintain a START II size stockpile as well as the flexibility to maintain or reconstitute a larger size stockpile if necessary.

b) Pantex will have completed the scheduled large dismantlement quantities by the year 2000. Any other large dismantlement requirements would be handled on extra shifts at the consolidated or downsized site

c) Damaged weapons will be handled consistent with alternatives in the NTS site-wide EIS.

d) Only the storage of the strategic reserve of SNM (in the form of pits and CSAs) is addressed by the A/D Team. Storage of excess nuclear material is being addressed in a separate PEIS and is not part of this study.

e) Nonintrusive pit reuse and HE fabrication/disposition at the A/D site will be addressed by the Pu and HE teams, respectively. However, pit recertification is considered as part of the core A/D mission.

f) The concepts of seamless safety will be incorporated into the assembly/disassembly processes. Once this is institutionalized, it is expected that a significant increase in operational efficiency will be realized.

The defined base case workload requirements for the assembly/disassembly mission are as follows:

1) Up to 150 factory retrofits/year (50 bombs and 100 warheads). Factory retrofits are required when the nuclear components are removed from the case.

2) 120 evaluation disassembles and inspections, divided as follows: 36 new material tests (6 of which are joint test assemblies) and 81 stockpile laboratory or flight tests (34 of which are joint test assemblies).

3) 110 weapon rebuilds.

4. Description of Proposed Alternatives

The NTS and Pantex alternatives included in this report describe the sites as they currently exist and identify changes necessary to meet the defined workload as specified above. The following defines the different options considered for this study.

Pantex Alternative

No Action Alternative

Pantex is the existing assembly/disassembly site for the nation’s nuclear weapons stockpile, and as such, has the required capabilities and infrastructure necessary to perform the mission. Under the no action alternative the site would remain in its current configuration; however, due to the expected decrease in workload there would be a resulting downsizing of the work force.

Downsizing of Pantex

To meet the defined workload, operations would be consolidated into existing modem facilities, primarily within Zone 12 by FY 2004. There would be no gap in production capability while the consolidation activities occurred. Facilities that are excess would be put into a low maintenance, standby condition. Existing provisions for safeguards, security, safety, health, and environmental requirements are adequate and proven.

Nevada Test Site Alternative

No Action Alternative

Under the no action alternative NTS would remain in its current configuration and maintain readiness for supporting underground nuclear testing.

Transfer of the Assembly/Disassembly Mission

The Device Assembly Facility (DAF) at NTS is nearing completion and would serve as the main facility for A/D operations. In addition to the DAF, there are existing facilities in

Areas 6 and 23 that would be needed for support operations. To meet the base case workload, an additional 459,629 ft^2 of new construction would be needed at NTS.

In addition to extra facilities, it would also be necessary to relocate and reestablish the assembly/disassembly capabilities from Pantex to NTS. This would include activities such as: relocation of personnel, training of new personnel, qualification of production processes, prebuild and testing of JTAs at Pantex, and transfer of the strategic reserve of SNM and other inventories. Under this option Pantex woulid complete its production mission one year prior to NTS being fully operational.

5. Process Descriptions

The basic processes for assembly, disassembly, and surveillance of nuclear weapons are identical for either site. Common activities and supporting systems for weapon assembly and disassembly, JTA assembly, test bed assembly and disassembly, storage of strategic reserves of plutonium and highly enriched uranium, pit recertification, and supporting systems are described below.

Weapon Assembly

Weapon assembly is performed to refurbish or replace weapons or to rebuild a weapon that has been disassembled for surveillance or modification/replacement of a component. The process includes multiple verification and quality control steps.

Complete weapon assembly is accomplished in three stages: physics package assembly, mechanical weapon assembly, and ultimate user (UU) package assembly.

Physics package assembly entails bonding or mating the main charge subassemblies to a nuclear pit with final enclosure in a case. Multiple tests are performed both prior to and after assembly to assure nuclear authenticity and integrity, electrical continuity, and correct alignment.

When the main charge is composed of conventional HE, the physics package assembly must be conducted in a specialized structure called an assembly cell which has been designed and tested to mitigate the release of radioactive material in the event of an accident. After casing, the physics package can then be moved to an assembly bay. For a weapon system that uses insensitive HE, the physics package can be assembled in a bay.

Mechanical weapon assembly entails placing the physics package in a warhead case and installing additional components. Throughout the assembly process, leak testing, radiography, and measurements for center of gravity and moments of inertia are performed.

The UU package assembly involves installing some additional components, and packaging the weapon for shipment to the Department of Defense (DOD) via an SST.

Weapon Disassembly

The weapon disassembly process is approximately the reverse of the assembly process. The disassembly process has additional verification tests to assure the weapon is in a safe condition and internal components are intact. This operation is performed to dismantle, modify, or evaluate a weapon. The operations conducted for each type of disassembly are similar, but the extent of the disassembly and procedures used vary.

During dismantlement disassembly a retired weapon is torn down to subassemblies and components which can be returned to the original production agency. Such items may be recertified as reusable parts, or sanitized and demilitarized.

A weapon that is disassembled for modification or retrofit is only dismantled to the extent necessary to gain access to the components of interest. The weapon is then reassembled and returned to the DOD.

The process of disassembly for stockpile surveillance supports the required evaluations and tests defined by the weapon laboratories to assure the safety and reliability of the weapon system. The extent of the disassembly depends on which components require testing. Typically the components are removed in connected groups that are then used in further system testing in test beds or Joint Test Assemblies (JTAs).

JTA Build and Post Mortem

As part of the ongoing stockpile evaluation program, weapons are randomly selected frorn the stockpile or the weapon assembly line for conversion into JTAs. These assemblies generally contain most of the original weapon parts except for the nuclear components and main charge subassemblies. The telemetry components and mock materials that simulate the size and weight of missing components are added.

After flight testing, bomb JTAs (and where possible, warhead JTAs) are returned for a post-mortem disassembly and evaluation. The parts obtained from disassembly may be recertified and staged for reassembly, shipped to the original production site for evaluation or disposition, or dispositioned at Pantex.

Test Bed Assembly and Disassembly

A test bed is an apparatus used for bench testing weapon systems, subsystems, and components. It is composed of parts removed from an evaluated weapon along with an explosive box that contains the blast energy and associated fragments from the small explosive charges that detonate during the testing.

Testing of the apparatus is performed by personnel from Sandia National Laboratories at either Pantex or Sandia, or by the DOD.

Storage of Pits and CSAs

Strategic reserves of plutonium and HEU were considered to be stored at the A/D site in the form of pits and CSAs. The items would be packaged and stored in appropriate containers and periodically monitored for safety and security.

Pit Recertification

The A/D site will have the capability to recertify pits to rebuild a weapon that has undergone testing or modification. This will require the ability to perform leak testing, weighing, radiography, gamma spectrometry, dimensional inspection, and purge and backfill operations. Similar operations using the same or similar facilities and equipment could also be performed to recertify CSAs.

Process Support Systems Descriptions

The activities necessary to support the assembly/disassembly operations include accelerated aging, pit laser sampling, leak detection and back fill, and nondestructive evaluation.

6. Facility Description

Both the Pantex Plant and the NTS exercise four levels of security access. In descending level of security these are: the Material Access Area (MAA); the Protected Area (PA); the Limited Area (LA); and, the Property Protection Area (PPA). Generally, facilities to perform the assembly/disassembly work are located in an MAA and include assembly bays, assembly cells and special purpose bays. Ancillary support facilities are distributed throughout the four security areas.

The estimated numbers and types of facilities required to support the A/D mission were based on operational experience at Pantex. There are some differences in the gross square footage required, primarily due to the estimating methods used at each site. Since NTS has experience in constructing similar facilities and the estimated costs to build these new facilities are considered reasonably accurate, the difference in estimated floor space is not significant.

Pantex Alternative

The Pantex Plant is located in the Texas Panhandle, 17 miles northeast of Amarillo, Texas. The site is located on 14.2 square miles owned by the DOE. An additional 9.1 square miles are leased by DOE on the southern edge of the site to provide additional security and safety buffer zones.

Downsizing and consolidation of the assembly/disassembly operations at Pantex would consist of an in situ decrease in foot print and relocation into modern, existing facilities, all within the Zone 12 MAA. Support functions would remain within the currently established facilities, some of which are outside Zone 12. No new construction would be necessary; however, relocation and reinstallation of equipment would be required.

Support facilities at Pantex are well established and fully capable of meeting any envisioned mission requirement. These facilities were built, maintained, and upgraded to meet regulatory requirements, as identified. In addition, a complete multi-layered protection system and support infrastructure are currently in place and operational. No motivations to this system are envisioned under the A/D proposal.

NTS Alternative

The Nevada Test Site is a 1,350 square mile reservation located 65 miles northwest of Las Vegas, Nevada.

The NTS facilities to support assembly/disassembly operations would center on the existing Device Assembly Facility (DAF) in Area 6, which is located within an MAA. In addition, existing and new facilities would be needed outside Area 6 for supporting operations. Major construction (459,629 ft^2) would be needed to both expand the DAF and to provide operational support inside and outside the MAA. The security measures and operations that are currently utilized at the DAF, and which support the A/D mission, would need to be extended to the new facilities.

Table 6-1
Comparison of Facilities Requirements
(Costs in FY 95, M $)

	Pantex	NTS
Total Project Cost	13.2	252.1
Standard Bays	31	31
Cells	4	4
Gross Square Feet		
Total	1,291,336	980,987
Existing	1,291,336	521,358
New	0.0	459,629

7. Engineering/Technical Assessments

Process Development Needs and Uncertainties

No process development work is required to continue the weapon assembly/disassembly mission at the Pantex Plant.

The production operations that would be transferred and established at NTS are identical to those at Pantex, therefore, there is no need for process development. Since additional facilities will be needed to support the workload at NTS it is possible to effect process flow improvements by facility design and layout. No additional technical risk would be associated with such changes since A/D operations would not be modified.

Equipment Development Needs and Uncertainties

Proven technologies exist and are operational at Pantex that accomplish the A/D fuction. No equipment development is required for the consolidated A/D mission.

NTS plans to use the same equipment, tools, gauges, and fixtures as those used at Pantex. There is no expected need for development of new items of this nature, nor is there any concern for being able to attain these items when needed.

8. Cost, Transition, and Implementation Schedules

Cost Analysis of Alternatives

A discussion of the costs, the reasonableness of the costs, and any adjustments made to the site proposals is presented in this section. Table 8-1 shows the costs associated with each of the different alternatives evaluated. In addition, a net present value (NPV) analysis of costs was performed and is shown in Figure 8-1. That analysis covered a twenty-five year period, with a comparison of the Pantex no action, the Pantex downsizing and NTS alternatives.

Down Size Pantex

Of the two alternatives, downsizing Pantex has the least cost uncertainty. Pantex has performed the A/D mission for many years and the costs of operations, facility modification and maintenance, and other overhead applications are well understood. The costs presented for this alternative were considered reasonable and were not adjusted to reflect additional DOE uncertainty.

Transfer to NTS

Operations

Although the management and operating (M&O) contractor at NTS was responsible for providing an extensive amount of support operations necessary for the underground testing mission, the actual assembly of test devices was accomplished by personnel from the weapon laboratories. In addition, there has been a significant change in the way assembly and disassembly of weapons is performed, primarily in the areas of ES&H and conduct of operations since the end of nuclear testing. Because of this, there was a great deal of interchange of information within the working group which resulted in the proposals being comparable in the number of direct FTEs required.

An adjustment made to the NTS proposal by DOE was an increase of $337,000 per year for materials associated with PCAP activities. There is a moderate difference in the amount of annual costs associated with equipment replacement due to the relative ages of equipment at each site. This is considered reasonable, therefore, no adjustment was made.

Mission Transfer and Qualification

The costs associated with mission transfer and qualification of production operations are similar to those experienced for the Nonnuclear Reconfiguration Program (NRP). Under NRP, the average receiver site cost is 31.3 M ($41.5 with NRP burden) and the average donor site cost is $6.3 M ($10.6 M burdened). Under this alternative the NTS costs are $44.1 M and the Pantex donor costs are $13.7 M. Although it would seem that the cost to transfer a mission related to nuclear explosives should be higher than a nonnuclear mission transfer, the projected funding requirements are considered appropriate for the following reasons: 1) NTS is assuming that trained, experienced personnel would transfer from Pantex, 2) NTS would use processes identical to those at Pantex, and 3) the numbers and types of technologies transferred under NRP are much greater than what is being considered here.

Facilities

As stated earlier, there is a difference in gross square footage between the two site proposals. The cost estimates were based on the methods normally employed at NTS and are considered reasonable. However, the phasing of funding was adjusted to reflect FY 1998 funding for the project. This does not change the total project cost, but it does cause the construction Schedule to become compressed.

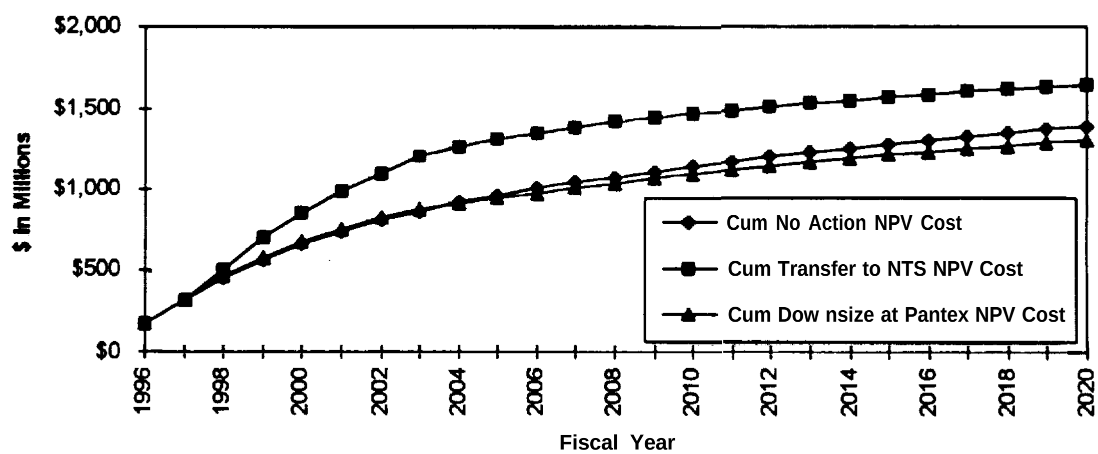
Facility Shutdown and Overhead during D&D at Pantex

The annual overhead costs ($18.2 M) at Pantex during decontamination and decommissioning (D&D) were compared with known costs at the Pinellas Plant. The Pinellas overhead costs projected for FY 1996 and FY 1997 are $24.6 M and $18.5 M, respectively. Although D&D was proceeding prior to these years, there were other activities occurring as well; therefore FYs 1996 and 1997 provide a good comparison for overhead costs strictly related to D&D. Since Pinellas is much smaller than Pantex, the Pantex annual overhead costs appear to be too low. However, the time frame to D&D Pantex is estimated at five years, as compared to the three years at Pinellas. Since Pantex and Pinellas have similar degrees of contamination, it is possible Pantex could be cleaned up faster than estimated. To summarize, the low annual costs are offset by the longer period for clean up which results in a total cost that is considered reasonable.

Table 8-1
Summary of Costs for Base Case Workload (in FY 95, M $)

Activity	No Action Pantex	Down Size Pantex	Transfer to NTS
Annual Operating	66.0	57.1	47.7
Total Investment Costs			
Facilities	0.0	13.2	251.1
Prebuilds	0.0	0.0	5.7
Mission Transfer	0.0	0.0	35.3
Qualification	0.0	0.0	31.7
Total Other Costs			
Shutdown and D&D Overhead	0.0	1.2	128.3
Work force Restructure	21.7	2.3	10.1

Figure 8-1
Cumulative Present NPV Costs for Base Case Workload



Transition and Implementation Schedules

As stated earlier, the funding profile for the NTS option was shifted to reflect the proposed funding schedule. The realignment of the tiding also creates a change in the construction schedule. In addition, the schedule for qualification at NTS was changed to show a time period of 3.5 years. This is considered reasonable since each weapon system will need to be qualified individually and the production qualification process is extremely rigorous.

Figure A-1 of the appendix shows the schedules for transition and implementation for both options.

9. Ranking Criteria Summary

The ranking criteria for the SSM PEIS were developed by a separate team and provided to each working team. The criteria were then used to assess technical risks and relative costs. Table 9-1 summarizes the criteria and ranking of both alternatives.

Table 9-1
Summary of Ranking Criteria Scores for Base Case Workload

Ranking Criteria	Score Assigned	
	Pantex	NTS
Basic Production Capability	100	80
Capability of Production Infrastructure	100	60
Minimize Cost	100	73

10. Analysis of Ranking

Basic Production Capability

Pantex is currently performing the assembly/disassembly mission within the nuclear weapons complex. Consolidation into fewer facilities would not create additional risk to the mission.

The production technologies that would be transferred and established at NTS are identical to those currently at Pantex. Therefore, the technical risk of developing new processes is not an issue; however, the processes would need to be established and qualified. According to the guidance for the ranking criteria this would normally result in a score of 90. The score assigned NTS was decremented an additional amount because the management and operating (M&O) contractor at the site has no direct experience in assembly/disassembly operations. Assembly of nuclear devices at NTS has always been performed by personnel from the weapon laboratories, with supporting operations provided by the M&O. Also, a great deal of support would be required from the laboratories to assist in the qualification of the production operations. In addition to the uncertainty associated with the availability of laboratory personnel, the cost of laboratory support was not included in the costs for transferring the mission to NTS. Therefore, the additional risk is reflected in this criterion.

Capability of Production Infrastructure to Support Scheduled Work Attribute

An infrastructure to support production is fully implemented at Pantex. There is no expected risk associated with this option.

As stated above, the NTS contractor provided supporting operations to the weapon laboratories as part of the underground testing mission. Inherent in that support are multiple management systems that would be needed for production operations, such as: quality assurance and control, ES&H programs, scheduling, budgeting and cost accounting, analytical laboratories, safeguards and security, training, and similar support functions. Although the infrastructure in place to support testing is not identical to that needed for weapons, it is similar.

The NTS score was decremented from what the guidance would indicate (a score of 75) for the following reasons: 1) the significant amount of facility instruction needed at the site adds additional risk to this option 2) a somewhat compressed schedule for construction, 3) with the cessation of underground testing, the opportunity to fully exercise these infrastructure capabilities on a continuous basis is limited.

Minimize Cost Attribute

The two alternatives were ranked relative to each other based on the results of the net present value (NPV) analysis of costs for a twenty-five year life cycle shown in Table A-1. Relative to Pantex, the NTS costs were 24% greater and the savings were 29% less. Since Pantex has the lesser cost and higher savings that option was scored 100. Relative to Pantex, NTS would score 73.

11. Stockpile Sensitivity Analysis

Variation of Stockpile Size

The sensitivity analysis is based on three stockpile levels: a low case, the base case and a high case. The annual workload that the assembly/disassembly site would experience from these three stockpile sizes is shown in Table 11-1.

Table 11-1
Annual Workloads for Sensitivity Analysis

Operation	Low Case	Base Case	High Case
Retrofits	50	150	300
D&Is	120	120	140
Rebuilds	110	110	140

Effects of Workload on Alternatives

Pantex resource estimates are relatively insensitive to the proposed workloads. As there are existing facilities at the site, it becomes a matter of occupying either less or more space compared to the base case. The effects of workload are primarily reflected in the costs associated with work force restructuring and facility shutdown; however, these are small. There would be no expected changes in the risks associated with technical capabilities.

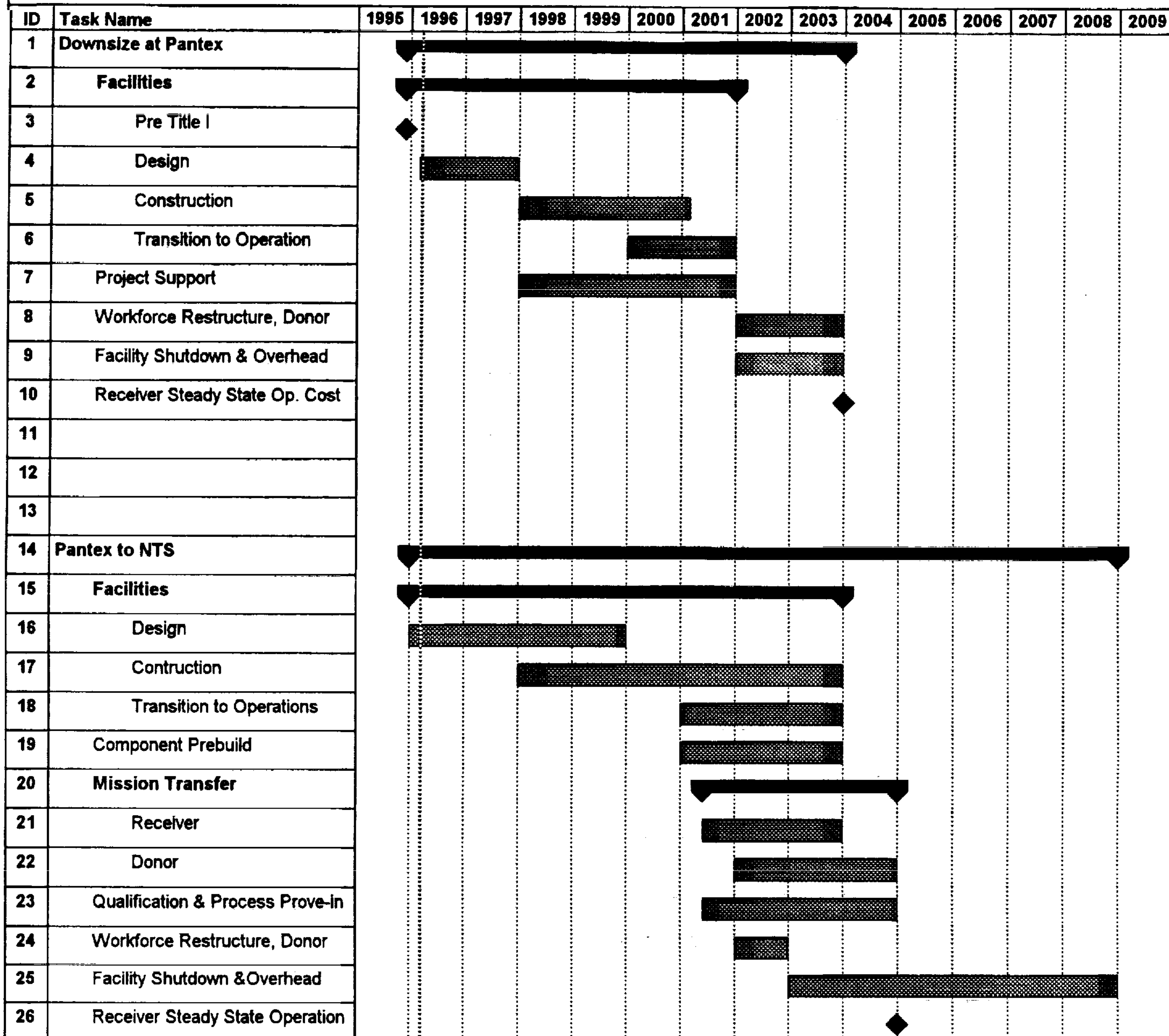
Unlike Pantex, the NTS alternative is very sensitive to workload level which is due almost entirely to the amount of new instruction needed to support the mission and its associated cost. As discussed in the previous section, the amount of instruction needed at NTS creates technical risk in the area of production infrastructure and that risk would vary from the base case. It should be noted that at the high case workload there are an estimated 5.6 cells required to support operations; however, there are only five cells currently at NTS. Rather than build an additional cell, the NTS option assumes some additional operational efficiency and occasional off-shift work to compensate for the missing partial cell. However, this adds additional technical risk to the NTS alternative.

A summary of workload effects on the two alternatives is given in Table 11-2.

Table 11-2
Summary of Workload Sensitivity
(Costs in FY 95, M $)

Area Affected	Low Case		Base Case		High Case	
	Pantex Option	NTS Option	Pantex Option	NTS Option	Pantex Option	NTS Option
Costs						
Annual Operating	55.4	46.1	57.1	47.7	62.6	53.7
Worker Restructure	2.6	10.1	2.3	10.1	1.1	10.1
Shutdown & Overhead	2.1	128.3	1.3	128.3	0.4	128.3
Life Cycle Costs	1,298	1,607	1,311	1,648	1,352	1,742
Life Cycle Savings	1,195		1,182		1,141	
Facilities						
Cells	3	3	4	4	6	5
Standard Bays	23	23	31	31	48	48
Feet^2 (000s)						
Existing	1,291	512	1,331	521	1,363	526
New	0	373	0	460	0	601
Total Project $	13.2	215.4	13.2	251.1	13.7	312.9
Ranking Criteria						
Capability	100	80	100	80	100	80
Infrastructure	100	65	100	60	100	50
Cost	100	75	100	73	100	68

Figure A-1
Cost for Assembly/Disassembly
by Fiscal Year



Project: Assembly/ Disassembly

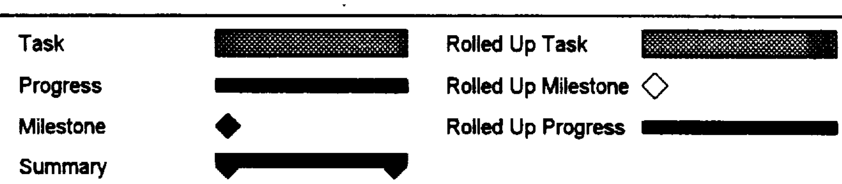


Table A-1

NET PRESENT VALUE COSTS AND SAVINGS
Cost in 000s

Costs for Downsizing Assembly/Disassembly at Pantex

Fiscal Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Period, n =	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Initial Investment																										0
Capital Investment	600	100	6,900	3,700			1,875																			13,175
Project Support																										0
Component Prebuild																										0
Mission Transfer																										0
Process Development																										0
Qualification & Process Prove-in																										0
Workforce Restructure							450	1,830																		2,280
Facility Shutdown								1,250																		1,250
Site Overhead during D&D																										0
Donor Op Cost During Transition	175,102	169,849	153,614	137,577	121,144	104,909	88,680	72,439																		1,023,314
Annual Op. Cost - Steady State									56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	955,468
TOTAL COST	175,702	169,849	160,514	141,277	121,144	104,909	91,005	75,519	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	56,204	1,895,487
Cost NPV =	167,495	154,443	139,055	116,673	95,373	79,734	65,108	51,505	36,542	34,835	33,208	31,656	30,178	28,768	27,424	26,143	24,922	23,758	22,648	21,590	20,582	19,620	18,704	17,830	16,997	1,303,781
Savings NPV =	-572	4,683	12,638	27,934	42,479	52,679	60,166	67,917	77,303	73,692	70,250	66,968	63,840	60,858	58,015	55,306	52,722	50,259	47,912	45,674	43,540	41,508	39,567	37,718	35,957	1,188,013

Costs for Transfering Assembly/Disassembly to NTS

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL
Initial Investment																										0
Capital Investment			47,420	76,991	46,546	36,020	21,128	2,505																		230,610
Project Support	1,037	559	434	453	453	5,953	5,785	5,832																		20,506
Component Prebuild						1,890	1,890	1,900																		5,680
Mission Transfer																										0
Receiver						6,934	5,378	8,047	1,167																	21,526
Donor							4,000	5,738	4,000																	13,738
Process Development	1,251	973																								2,224
Qualification & Process Prove-in						3,000	9,000	15,000	4,735																	31,735
Overhead Increase																										0
Workforce Restructure at PX							10,080																			10,080
Facility Shutdown at PX								12,000	12,000	13,186																37,186
PX Site Overhead during D&D									18,228	18,228	18,228	18,228	18,228													91,140
Donor Op Cost During Transition	175,102	169,849	161,356	153,815	138,433	124,590	112,131	100,918																		1,136,194
Annual Op. Cost - Steady State									47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	811,223
TOTAL COST	177,390	171,381	209,210	231,259	185,432	178,367	169,392	151,940	87,849	79,133	65,947	65,947	65,947	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	47,719	2,411,842
Cost NPV =	169,104	155,744	181,241	190,984	146,965	133,878	121,189	103,626	67,116	49,046	38,964	37,144	35,409	24,425	23,284	22,196	21,160	20,171	19,229	18,331	17,475	16,656	15,880	15,138	14,431	1,647,809
Savings NPV =	-2,181	3,381	-29,546	-46,377	-8,132	-2,465	4,065	15,797	56,726	59,481	64,493	61,481	58,609	65,201	62,155	59,252	56,484	53,846	51,331	48,933	46,647	44,469	42,391	40,411	38,523	844,895

NPV Discount Rate = 4.9%   Year 2004 Baseline Cost = 175,102

NPVNTSPX.XLS

Appendix A.

Ranking Criteria

RANKING CRITERIA

The SSM PEIS Steering Group established the following Ranking Criteria to be used for evaluating alternatives. Criterion **Ia** measures the technical maturity of the proposer's weapons production capabilities. Criterion **Ib** is a measure of the maturity of the proposer's production infrastructure as it relates to the new production activities to be transferred to the proposer's site. Criterion **II** was developed to measure the ability to the proposer to sustain production competence through other site work in time periods when weapons production was insufficient to maintain production competence. The Steering Group decided to not use this criteria after it became clear that the defined workload was sufficient to retain production competence without the need for extraordinary actions. Criterion **III** measures the cost effectiveness of the alternatives.

Ia

BASIC PRODUCTION CAPABILITY TO SUPPORT SCHEDULED WORK

This attribute is intended to provide a measure of risk for the site alternative. It measures the maturity of the weapons production capabilities that comprise the site's proposal. It will be important to sustain, or ensure timely start up, of production capability, and to minimize downtime due to operating disruptions and process upsets during any downsizing or relocation of production missions. Capabilities (i.e. technicians, processes, procedures and equipment) that have been used previously for weapons production either at the Donor site or some other site would score high. Capabilities that require significant development or scale up would score low.

SCORING RULE

1a. Weapons production capability--this portion of the scoring rule is used to measure the maturity of the weapons production capability. It evaluates the weapons production capabilities as they stand at this point in time (June 9, 1995). Decrease the applicable score below by 10% if that level of capability does not currently exist at the site being evaluated.

100 Fully demonstrated weapons production capabilities of interest. Actual demonstrated experience with full-scale operation.

80 Fully demonstrated weapons production capabilities similar to those of interest. Actual demonstrated experience with full-scale operation.

60 Pilot production demonstrated; next step is process qualification.

40 Bench scale demonstrated; next step is plant design/production process development

20 Feasibility demonstrated in laboratory, requires scale up and pilot plant demonstration.

10 Demonstrated in laboratory with simulated product.

0 At conceptual stage.

Ib

CAPABILITY OF PRODUCTION INFRASTRUCTURE TO SUPPORT SCHEDULED WORK

This attribute is intended to provide an additional measure of risk for the site alternative. It measures the maturity of the production support infrastructure that comprises the site's proposal. This attribute is important to support the timely startup or continuation of production capability, and minimize downtime due to operating disruptions and process upsets. Existing production support infrastructure that has the ability to support the production related activities in the site's proposal would score high. Production support infrastructure programs that require significant expansion would score low.

SCORING RULE

lb. Production Support Infrastructure--this portion of the scoring rule is used to measure the maturity and adequacy of the basic production support infrastructure to sustain the production activities proposed in the alternative. It evaluates the production support infrastructure as it exists at this point in time (June 9, 1995).

100 Fully demonstrated production support infrastructure capabilities for the production technologies proposed to be transferred. Actual demonstrated experience with full-scale operation.

75 Fully demonstrated production support infrastructure for production technologies similar (but not identical) to those proposed to be transferred. Actual demonstrated experience with full-scale operation.

50 Some production support infrastructure exist at the site.

25 Support infrastructure for activities similar to production exists at the site.

0 Minimal support infrastructure for production-like activities exists at the site.

II

CAPABILITY TO SUPPORT TECHNOLOGIES IN THE STOCKPILE FOR WHICH THERE IS NO SCHEDULED WORK

This attribute is also intended to provide a measure of technical risk. It measures the alternative's capability to maintain competency for components in the stockpile when there is no scheduled requirement. This attribute is important to ensure timely startup of production capability, and minimization of downtime when unanticipated problems require production start-up. It would also measure the added risk/cost of maintaining technical competence during periods when production workload does not assure competency maintenance. Both buy and make capabilities must be assessed. Approaches that can provide components quickly and do not require continuous exercising would score high. Approaches that require significant "practice activity", start-up time or delivery time would score low.

SCORING RULE

2. Ability to protect technologies in the future stockpile --this portion of the scoring rule measures the alternative's capability to protect technologies not needed for scheduled production without excessive expense. (Number and complexity of technologies must be considered.)

100 Inherent R&D capability or similar production activity that maintain competence for unscheduled production capability needs.

75 Significant capability is supported with inherent activity.

50 R&D or production activity not sufficient to maintain full capability, but complementary activities partially maintain the capability.

25 Significant capability is not supported with inherent activity.

0 Unscheduled production capability not supported.

III

MINIMIZE COST

This attribute measures the alternative's overall cost to provide the capabilities described above. Low investment costs and low steady-state operating cost will be scored high.

SCORING RULE

3. Minimize Cost -- The site with the best overall Net Present Value of costs (based on current Office of Management and Budget guidance) will be scored the highest. Other sites will be scored proportional to the best proposal. Life cycle duration (25 years.), initial costs and pay back periods will be considered.

Appendix B.

Acronym Listing

A/D	assembly/disassembly
AAO	Amarillo Area Office
AL	Albuquerque Operations Office
APD	advance planning document
BFD	block flow diagram
COO	conduct of operations
CSA	canned subassembly
CSM	core stockpile management
D&D	decontamination and decommissioning
DA	design agency
DAF	Device Assembly Facility
DARHT	Dual-Axis Radiographic Hydrodynamic Test
DNA	Defense Nuclear Agency
DOD	Department of Defense
DOE	Department of Energy
DOE-DP	Department of Energy, Defense Programs
DOE HQ	Department of Energy, Headquarters
DOT	Department of Transportation
DP	Defense Programs
DP-XX	Offices within the DOE Defense Programs organization
DU	depleted uranium
ES&H	environment, safety and health
EU	enriched uranium
FTE	full time equivalent
FY	fiscal year
GSF	gross square feet
HE	high explosive
HEAF	High Explosives Applications Facility (LLNL)
HEU	highly enriched uranium

HIP	hot isostatic pressing
JTA	joint test assembly
K	thousand (dollars)
KCAO	Kansas City Area Office
KCP	Kansas City Plant
LANL	Lost Alamos National Laboratory
LLC	limited life component
LLCE	limited life component exchange
LLNL	Lawrence Livermore National Laboratory
M	Million (dollars)
M & H	Mason & Hanger Silas Mason Company
M & O	management and operating (contractor)
MAA	material access area
MSD	molten salt destruction
NASA	National Aeronautics & Space Administration
NEPA	National Environmental Policy Act
NMSF	Nuclear Material Storage Facility
NDE	non destructive evaluation
NOI	Notice of Intent
NPR	Nuclear Posture Review
NPV	net present value
NTS	Nevada Test Site
NV	Nevada Operations Office
NWC	Nuclear Weapons Complex
NWSM	Nuclear Weapons Stockpile Memorandum
OAK	Oakland Operations Office
OR	Oak Ridge Operations Office
Pantex	Pantex Plant
PBX	plastic bonded explosive

PCAP	Production Capability Assurance Program
PEIS	Programmatic environmental impact statement
PIDAS	perimeter intrusion detection alarm system
PVC	polyvinyl chloride
PX	Pantex (Pantex Plant)
QA	quality assurance
R & D	research and development
RD&T	research, development and test
RFETS	Rocky Flats Environmental Technology Site (formerly Rocky Flats Plant)
ROD	record of decision
RS-NV	Raytheon Services, NV
S & S	safeguards and security
SAR	Safety Analysis Report
SM	Stockpile Management
SNL	Sandia National Laboratories
SNM	special nuclear material
SR	Savannah River Operations Office
SRS	Savannah River Site
SSM	Stockpile Stewardship and Management
SST	safe secure transport
START	Strategic Arms Reduction Treaty
SWEC	Stone & Webster Engineering Corporation
T2	tritium
TA	technical area (generally at Los Alamos)
TPX	polymethylpentene
TRU	transuranic
TSSG	trajectory sensing signal generator
UU	ultimate user

WIPP	Waste Isolation Pilot Project
WRD&T	weapons research, development, and testing
Y-12	Weapons Production Facility at Oak Ridge, TN