APPENDIX G
PROJECT NOTICES AND STUDIES

This appendix includes project notices and some of the studies that were either performed in relation to, or used as reference materials, in the preparation of the Modern Pit Facility Environmental Impact Statement (MPF EIS). These notices and studies are not intended to be an all-inclusive list. Chapter 8 of this EIS provides an all-inclusive list of the references used to prepare this EIS.

The following are included as part of this appendix:

- *Notice of Intent to Prepare a Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility*
- *Modern Pit Facility Site Screening Report*
- *Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as no Longer Required for Defense Purposes and Related Cooperation*
- *Summary of TA-55/PF-4 Upgrade Evaluation for Long-term Pit Manufacturing Capacity*
- *Plutonium Aging: Implications for Pit Lifetimes*

temporary items). Extra copies of fire reports and related documentation as well as electronic copies of documents created using electronic mail and word processing. Recordkeeping copies of these files are proposed for permanent retention.

2. Department of Defense, National Imagery and Mapping Agency (N1–537–02–2, 2 items, 2 temporary items). Individual procurement appointment files relating to participants in purchase card programs. Also included are electronic copies of records created using word processing and electronic mail.

3. Department of Justice, Federal Bureau of Investigation (N1–65–02–5, 1 item, 1 temporary item). Hard copy fingerprint cards generated in connection with background investigations of military enlistees.

4. Department of Justice, National Drug Intelligence Center (N1–523–02–1, 8 items, 6 temporary items). Staff meeting files, firearms training records, and training materials that do not pertain to law enforcement. Also included are electronic copies of records created using electronic mail and word processing. Proposed for permanent retention are recordkeeping copies of executive level meeting files and training materials for law enforcement training.

5. Department of Justice, National Drug Intelligence Center (N1–523–02–2, 6 items, 3 temporary items). Policy files that do not pertain to the agency's mission, including electronic copies of records created using electronic mail and word processing. Proposed for permanent retention are recordkeeping copies of mission-related policy files and records that pertain to agreements.

6. Department of the Navy, Agency-wide (N1-NU–02–03, 5 items, 4 temporary items). Records relating to international agreements accumulated by the International Programs Office. The records include Navy annexes to data exchange agreements, newsletters, and charts. Also included are electronic copies of records created using electronic mail and word processing. Recordkeeping copies of case files pertaining to agreements are proposed for permanent retention.

7. Department of the Navy, Agency-wide (N1–NU–02–04, 13 items, 13 temporary items). Records relating to security assistance policy accumulated by the International Programs Office. Included are budgetary documents, case files relating to such matters as foreign military sales and other assistance programs, and inter-service agreements for administrative services. Also included are electronic copies of records created using electronic mail and word processing.

8. Department of State, Bureau of Human Resources (N1–59–00–8, 23 items, 21 temporary items). Records accumulated by the Office of the Executive Director relating to administrative oversight and support. Included are such records as subject files, the personnel action handbook master, performance files, and several databases containing personnel data for employees, including Foreign Service Nationals. Also included are electronic copies of documents created using electronic mail and word processing. Proposed for permanent retention is the master file of the main personnel system and microfilm copies of employee service record cards from 1940 to 1975.

9. Department of State, Assistant Secretary for Intelligence and Research (N1–59–02–7, 2 items, 1 temporary item). Electronic copies of documents created using electronic mail and word processing that are associated with the office's subject files. Proposed for permanent retention are the recordkeeping copies of these files.

10. Department of State, Office of the Secretary of State (N1–59–02–8, 2 items, 1 temporary item). Electronic copies of documents created using electronic mail and word processing that pertain to memorandums of conversations. Recordkeeping copies of these files are proposed for permanent retention.

11. Department of State, Office of Information Technology Operations and Management for the Bureau of Educational and Cultural Affairs and the Coordinator of International Information Programs (N1–59–02–9, 26 items, 26 temporary items). Records relating to information technology operations and management, including such matters as the management of computer equipment and software, tape libraries, system backups, data security, and user support. Also included are electronic copies of records created using electronic mail and word processing.

12. Department of the Treasury, Financial Management Service (N1–425–02–2, 4 items, 4 temporary items). Electronic copies of documents created using electronic mail and word processing relating to foreign claim files and to closed court cases concerning forgery and alteration of government checks. This schedule also increases retention period for recordkeeping copies of these files, which were previously approved for disposal.

13. Court Service and Offender Supervision Agency, Community Supervision Services Division (N1–562–02–1, 3 items, 3 temporary items). Case files for offenders in the District of Columbia Superior Court system who are under parole, supervised release, and/or probation supervision. Included are electronic copies of documents created using electronic mail and word processing.

14. Peace Corps, Management Division (N1–490–02–1, 1 item, 1 temporary item). Electronic records accumulated by the Office of Information Resources Management that are used for tracking staff access to and use of agency automated systems.

Dated: September 12, 2002.

Michael J. Kurtz,

Assistant Archivist for Record Services, Washington, DC.

[FR Doc. 02–24038 Filed 9–20–02; 8:45 am]

BILLING CODE 7515–01–P

DEPARTMENT OF ENERGY

National Nuclear Security Administration

Notice of Intent to Prepare a Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility

AGENCY: Department of Energy, National Nuclear Security Administration.

ACTION: Notice of intent.

SUMMARY: The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is responsible for the safety and reliability of the U.S. nuclear weapons stockpile, including protection of production readiness to maintain that stockpile. Since 1989, the DOE has been without the capability to produce plutonium pits (the portion of a nuclear weapon which generates the fission energy to drive modern thermonuclear weapons). The NNSA, the Department of Defense (DOD), and Congress have highlighted the lack of long-term pit production capability as a national security issue requiring timely resolution. While an interim capability is currently being established at the Los Alamos National Laboratory (LANL), classified analyses indicate that this capability will not suffice to maintain, long-term, the nuclear deterrent that is a cornerstone of U.S. national security policy. Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*), and the DOE Regulations Implementing NEPA (10 CFR Part 1021), the NNSA is announcing its intent to prepare a Supplement to the Programmatic Environmental Impact Statement (EIS) on Stockpile Stewardship and Management (SSM) for

a Modern Pit Facility (MPF) in order to decide: (1) whether to proceed with the MPF; and (2) if so, where to locate the MPF. This NOI also sets forth the dates, times, and locations for public scoping meetings on the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility.

DATES: NNSA is inviting comments related to its intention to prepare a Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Comments should be submitted within November 22, 2002. Comments submitted during the 60-day comment period following publication of this NOI will assist the NNSA in developing the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Public scoping meetings to discuss issues and receive comments on the scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will be held in the vicinity of sites that may be affected by the proposed action, as well as in Washington, DC. The public scoping meetings will provide the public with an opportunity to present comments, ask questions, and discuss concerns with NNSA officials regarding the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. The locations, dates, and times for these public scoping meetings are as follows:

Pantex—October 8, 2002 , 7 p.m.–10 p.m., College Union Building, Oak Room, Amarillo College, Washington Street Campus, 24th and Jackson Streets, Amarillo, TX 79178, (806) 371–5100

Carlsbad, NM—October 10, 2002, 7 p.m.–10 p.m., U.S. Department of Energy, Carlsbad Area Office, 4021 National Parks Highway, Carlsbad, NM 88220, (505) 234–7227

Washington, DC—October 15, 2002, 2 p.m.–5 p.m., U.S. Department of Energy, 1000 Independence Avenue, SW., Room 1E–245, Washington, DC 20585, (202) 586–0821

Nevada Test Site—October 17, 2002, 7 p.m.–10 p.m., U.S. Department of Energy, Nevada Operations Office, Auditorium, 232 Energy Way, Las Vegas, NV 89030, (702) 295–3521

Los Alamos National Laboratory—October 24, 2002, 7 p.m.–10 p.m., Duane W. Smith Auditorium, 1400 Diamond Drive, Los Alamos, NM 87544, (505) 663–2510

Savannah River Site—October 29, 2002, 7 p.m.–10 p.m., North Augusta Community Center, 495 Brookside Avenue, North Augusta, SC 29841, (803) 441–4290

The NNSA will publish additional notices on the dates, times, and locations of the scoping meetings in local newspapers in advance of the scheduled meetings. Any necessary changes will be announced in the local media. Any agency, state, pueblo, tribe, or unit of local government that desires to be designated a cooperating agency should contact Mr. Jay Rose at the address listed below by October 15, 2002.

ADDRESSES: General questions concerning this Notice of Intent for the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility can be asked by calling 1–800–832–0885, ext. 65484, or by writing to: Mr. Jay Rose, Supplement to the Programmatic EIS on SSM for a Modern Pit Facility Document Manager, NA–53, Forrestal Building, U.S. Department of Energy/NNSA, 1000 Independence Avenue, SW., Washington, D.C. 20585. Comments can be submitted to Mr. Rose at the address above; or faxed to: 1–202–586–5324; or e-mailed to *James.Rose@nnsa.doe.gov*. Please mark envelopes, faxes, and E-mail: ''Supplement to the Programmatic EIS on SSM for a Modern Pit Facility Comments.''

FOR FURTHER INFORMATION CONTACT: For general information on the NNSA NEPA process, please contact: Mr. James J. Mangeno, NNSA NEPA Compliance Officer, NA–3.6, Forrestal Building, U.S. Department of Energy/NNSA, 1000 Independence Avenue, SW., Washington, D.C. 20585; or telephone 1–800–832–0885, ext. 6–8395. For general information on the DOE NEPA process, please contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance, EH–42, Forrestal Building, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, telephone 202–586–4600, or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION: Plutonium pits are essential components of nuclear weapons. Prior to the shutdown of its production activities in 1989, plutonium pits for the nuclear weapons stockpile were manufactured at the DOE Rocky Flats Plant in Colorado. No stockpile-certified pits have been produced by this country since that shutdown. During the mid-1990s, the DOE conducted a comprehensive analysis of the capability and capacity needs for the entire Nuclear Weapons Complex and evaluated alternatives for maintaining the Nation's nuclear stockpile in the Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS, DOE/EIS–0236). Issued in September 1996, the SSM PEIS looked extensively at pit manufacturing capability and capacity needs, and evaluated reasonable alternatives for re-establishing interim pit production capability on a small scale. A large pit production capacity—in line with the capacity planned for other manufacturing functions—was not evaluated in the PEIS ''because of the small current demand for the fabrication of replacement pits, and the significant, but currently undefined, time period before additional capacity may be needed.'' In the SSM PEIS Record of Decision (ROD) (61 FR 68014, December 26, 1996), the Secretary of Energy decided to re-establish an interim pit fabrication capability, with a small capacity, at LANL. That decision limited pit fabrication to a facility ''sized to meet programmatic requirements over the next ten or more years.'' In the ROD, DOE committed to ''performing development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity.''

Subsequent to the SSM PEIS ROD, a number of citizen groups filed suit challenging the adequacy of the SSM PEIS. In August 1998, the SSM PEIS litigation was resolved. As a result of that litigation, DOE agreed to entry of a court order that required, ''[p]rior to taking any action that would commit DOE resources to detailed engineering design, testing, procurement, or installment of pit production capability for a capacity in excess of the level that has been analyzed in the SSM PEIS [50 pits per year under routine conditions, 80 pits per year under multiple-shift operations], DOE shall prepare and circulate a Supplemental PEIS, in accordance with DOE NEPA Regulation 10 CFR 1021.314, analyzing the reasonably foreseeable environmental impacts of and alternatives to operating such an enhanced capacity, and shall issue a Record of Decision based thereon.'' This Supplement to the SSM PEIS is being prepared in part to satisfy that obligation.

Following the SSM PEIS, in January 1999, the Department prepared the LANL Site-Wide EIS (SWEIS) (DOE/EIS–0238), which evaluated site-specific alternatives for implementing pit production at LANL. Consistent with the SSM PEIS ROD, the LANL SWEIS evaluated alternatives that would implement pit production with a capacity up to 50 pits per year under single-shift operations and 80 pits per year using multiple shifts. In the ROD for the LANL SWEIS (64 FR 50797, September 20, 1999), DOE decided to produce up to 20 pits per year at LANL,

and deferred any decision to expand pit manufacturing beyond that level.

Consistent with the 1996 SSM PEIS ROD and the 1999 LANL SWEIS ROD, NNSA has been re-establishing a small pit manufacturing capability at LANL. The establishment of the interim pit production capacity is expected to be completed in 2007. However, classified analyses indicate that the capability being established at LANL will not support either the projected capacity requirements (number of pits to be produced over a period of time), or the agility (ability to rapidly change from production of one pit type to another, ability to simultaneously produce multiple pit types, or the flexibility to produce pits of a new design in a timely manner) necessary for long-term support of the stockpile. In particular, any systemic problems that might be identified in an existing pit type or class of pits (particularly any aging phenomenon) could not be adequately addressed today, nor could it be with the capability being established at LANL. Although no such problems have been identified, the potential for such problems increases as pits age. NNSA's inability to respond to such issues is a matter of national security concern. NNSA is responsible for ensuring that appropriate pit production capacity and agility are available when needed, and this Supplement to the SSM PEIS is being undertaken to assist NNSA in discharging this responsibility.

NEPA Strategy and EIS Alternatives

Currently, the NNSA envisions the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility as a ''programmatic document'' that will support two decisions: (1) Whether to proceed with the MPF; and (2) if so, where to locate the MPF. A tiered, project-specific EIS is expected to be prepared after the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility if the Secretary decides to proceed with such a facility. That tiered EIS, which would utilize detailed design information to evaluate site-specific alternatives at any site selected as a potential location for a MPF, would ultimately support a decision for construction and operation of the MPF. As described below, the NNSA has developed preliminary alternatives for the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility.

Alternatives: The NNSA has prepared, and will continue to prepare mission, requirements, and planning documents required to support an NNSA decision on whether to proceed with the MPF, and has conducted a site screening analysis to assure that potential sites meet program requirements. Initially, all existing, major DOE sites were considered to serve as potential host location for the MPF. The site screening analysis considered the following criteria: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA presence at the site, and infrastructure. The first two criteria were deemed to be ''exclusionary'' criteria; that is, a site either passed or failed on each of these two criteria. The sites that passed the exclusionary criteria were then scored against all criteria. Based upon results from the site screening analysis, the following sites were determined to be reasonable alternatives for the MPF: (1) Los Alamos National Laboratory at Los Alamos, New Mexico; (2) Nevada Test Site near Las Vegas, Nevada ; (3) Pantex Plant at Amarillo, Texas; (4) Savannah River Site at Aiken, South Carolina; and (5) the Waste Isolation Pilot Plant at Carlsbad, NM. The Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will also evaluate the no-action alternative of maintaining the current plutonium pit capabilities at LANL, and the reasonableness of upgrading the existing facilities at LANL to increase pit production capacity. Additionally, the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will evaluate a range of pit production capacities consistent with national security requirements.

Identification of Environmental and Other Issues

The environmental impacts of constructing and operating the MPF, including the impacts that might occur at each potential site, will be addressed in the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. These impacts will be presented along with environmental baseline information to enable the reader to discern the differences between alternatives. The NNSA has identified the following issues for analysis in the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Additional issues may be identified as a result of the scoping process.

1. Public and Worker Safety, Health Risk Assessment: Radiological and non-radiological impacts, including projected effects on workers and the public from construction, normal operations and accident conditions, and decommissioning and decontamination activities associated with constructing and operating the MPF.

2. Impacts from releases to air, water, and soil associated with constructing and operating the MPF.

3. Impacts to plants, animals, and habitats, including threatened or endangered species and their habitats, associated with constructing and operating the MPF.

4. The consumption of natural resources and energy associated with constructing and operating the MPF.

5. Socioeconomic impacts to affected communities from construction and operation of the MPF.

6. Environmental justice: Disproportionately high and adverse human health or environmental effects on minority and low-income populations associated with constructing and operating the MPF.

7. Impacts to cultural resources such as historic, archaeological, scientific, or culturally important sites associated with constructing and operating the MPF.

8. Impacts associated with transportation and storage of nuclear materials.

9. Status of compliance with all applicable Federal, state, and local statutes and regulations; required Federal, state, and tribe environmental consultations and notifications; and DOE Orders on waste management, waste minimization, and environmental protection.

10. Cumulative impacts from the proposed action and other past, present, and reasonably foreseeable actions at the alternative sites.

11. Potential irreversible and irretrievable commitments of resources associated with constructing and operating the MPF.

12. Pollution prevention and waste management practices, including characterization, storage, treatment and disposal of wastes associated with constructing and operating the MPF. NNSA anticipates that certain classified information will be utilized in preparing the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility and considered by the NNSA in deciding whether to construct and operate MPF, and if so, where the facility would be located. Accordingly, the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will likely contain a classified appendix. To the extent allowable, the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility will summarize this information in an unclassified manner.

Supplement to the Programmatic EIS on SSM for a Modern Pit Facility Schedule

The proposed Supplement to the Programmatic EIS on SSM for a Modern Pit Facility schedule is as follows:

Notice of Intent: September 2002.

Public Scoping Meetings: October 2002.

Publish Draft EIS: May 2003.

Draft EIS Public Hearings: June–July 2003.

Publish Final EIS: March 2004.

Record of Decision: April 2004.

Public Scoping Process

To assist in defining the appropriate scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility and to identify significant environmental issues to be addressed, NNSA representatives will conduct public scoping meetings at the dates, times, and locations described above under **DATES.** At these meetings, the NNSA will present a short summary of the project, indicate the alternatives to be considered, and present the proposed scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Following the initial presentation at each site, NNSA representatives will answer questions and accept comments, and the public will have a chance to offer their comments on the proposal, alternatives to be studied and the scope of the Supplement to the Programmatic EIS on SSM for a Modern Pit Facility. Copies of handouts from the meetings will be available to those unable to attend, by contacting the NNSA as described above under **ADDRESSES.**

Issued in Washington, DC, this 16th day of September 2002.

Spencer Abraham,

Secretary of Energy.

[FR Doc. 02–24076 Filed 9–20–02; 8:45 am]

BILLING CODE 6450–01–P

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50–237, 50–249, 50–254, and 50–265]

Exelon Generation Company, LLC; Dresden Nuclear Power Station, Units 2 and 3, Quad Cities Nuclear Power Station, Units 1 and 2; Environmental Assessment and Finding of No Significant Impact

The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of an exemption from certain requirements of 10 CFR 50.71(e)(4) for Facility Operating License Nos. DPR–19 and DPR–25, issued to Exelon Generation Company, LLC (the licensee), for operation of the Dresden Nuclear Power Station, Units 2 and 3, located in Grundy County, Illinois, and for Facility Operating License Nos. DPR–29 and DPR–30, issued to the licensee, for operation of the Quad Cities Nuclear Power Station, Units 1 and 2, located in Rock Island County, Illinois. Therefore, as required by 10 CFR 51.21, the NRC is issuing this environmental assessment and finding of no significant impact.

Environmental Assessment

Identification of the Proposed Action

The proposed action would grant a schedular extension for Dresden Nuclear Power Station (Dresden), Units 2 and 3, and for Quad Cities Nuclear Power Station (Quad Cities), Units 1 and 2, for submittal of revised Updated Final Safety Analysis Reports (UFSARs) from the regularly scheduled dates. 10 CFR 50.71(e)(4) requires that subsequent revisions to the UFSAR be submitted periodically to the NRC provided that the interval between successive updates does not exceed 24 months. The Dresden and Quad Cities UFSAR revisions are currently submitted on a 24-month cycle. The next scheduled date for submittal of the revised UFSAR for Dresden is June 30, 2003, and for Quad Cities is October 20, 2003. However, the licensee plans to submit revised UFSARs along with Operating License Renewal Applications (LRAs) for Dresden and Quad Cities in January 2003. The licensee plans to resume the established schedule for submittal of the UFSAR revisions in 2005 for both stations. The licensee requests a one-time exemption to postpone submittal of the revised Dresden and Quad Cities UFSARs until 2005.

The proposed action is in accordance with the licensee's application dated August 9, 2002.

The Need for the Proposed Action

The licensee proposes to submit revised UFSARs with LRAs in January 2003, and to resume the established schedule for submittal of UFSAR revisions for Dresden on June 30, 2005, and for Quad Cities on October 20, 2005. An exemption is required because 10 CFR 50.71(e)(4) requires that subsequent revisions to the UFSAR be submitted periodically to the NRC provided that the interval between successive updates does not exceed 24 months.

Environmental Impacts of the Proposed Action

The NRC has completed its evaluation of the proposed action and concludes that there are no significant adverse environmental impacts associated with the proposed action.

The proposed action will not significantly increase the probability or consequences of accidents, no changes are being made in the types of effluents that may be released off site, and there is no significant increase in occupational or public radiation exposure. Therefore, there are no significant radiological environmental impacts associated with the proposed action.

With regard to potential nonradiological impacts, the proposed action does not have a potential to affect any historic sites. It does not affect nonradiological plant effluents and has no other environmental impact. Therefore, there are no significant nonradiological environmental impacts associated with the proposed action.

Accordingly, the NRC concludes that there are no significant environmental impacts associated with the proposed action.

Environmental Impacts of the Alternatives to the Proposed Action

As an alternative to the proposed action, the staff considered denial of the proposed action (*i.e.*, the ''no-action'' alternative). Denial of the application would result in no change in current environmental impacts. The environmental impacts of the proposed action and the alternative action are similar.

Alternative Use of Resources

The action does not involve the use of any different resource than those previously considered in the Final Environmental Statement for the Dresden Nuclear Power Station, Units 2 and 3, dated November 1973, and for the Quad Cities Nuclear Power Station, Units 1 and 2, dated September 1972.

Agencies and Persons Consulted

On August 22, 2002, the staff consulted with the Illinois State official, Mr. F. Niziolek of the Department of Nuclear Safety, regarding the environmental impact of the proposed action. The State official had no comments.

Finding of No Significant Impact

On the basis of the environmental assessment, the NRC concludes that the proposed action will not have a significant effect on the quality of the human environment. Accordingly, the

Modern Pit Facility Site Screening Report

INTRODUCTION

Based on the May 24, 2002 approval of the critical decision on mission need (CD-0) by the Secretary of Energy, the National Nuclear Security Administration (NNSA) is planning to design, construct and operate a new modern pit facility (MPF) that will provide a significantly larger capacity than the interim production capacity being established at Los Alamos National Laboratory (LANL). As a key step in the planning, the NNSA will prepare a Supplemental Environmental Impact Statement (SEIS) to the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS) [hereafter, that SEIS will be referred to as the MPF EIS]. The MPF EIS will support the following decisions: (1) whether to proceed with the MPF; and (2) if so, where to locate the MPF. A tiered, project-specific EIS is expected to be prepared after the MPF EIS if the Secretary decides to proceed with such a facility. That tiered EIS, which would utilize detailed design information to evaluate site-specific alternatives at any site selected as a potential location for a MPF, would ultimately support a decision for construction and operation of the MPF. The purpose of this paper is to describe the results of the site screening process used to develop the reasonable site alternatives that will be evaluated in the MPF EIS.

OVERVIEW OF SITE SCREENING

The purpose of the site screening process was two-fold: (1) to identify reasonable site alternatives for the MPF EIS; and (2) to identify unsuitable site alternatives and document why these alternatives were not reasonable for the MPF EIS. A two-step screening process was employed: first, all potential sites were judged against Ago/no go@ criteria; and second, those sites satisfying the go/no go criteria were judged against desired, weighted criteria. The desired criteria and weights were developed by members of the MPF project office. Federal employees from the NNSA and other relevant DOE program offices then Ascored@ the potential sites using the desired criteria. Aggregate scores for the alternatives were then tallied, and the reasonable site alternatives were determined.

SITES UNDER CONSIDERATION

Existing, major Department of Energy (DOE) sites were considered to serve as the host location for the MPF. Non-DOE or new sites were not considered to avoid potential contamination issues at a new location that had not previously been associated with plutonium or plutonium-bearing waste operations. Many DOE sites did not satisfy the go/no-go criteria and were eliminated during the first step of the screening process. The seven sites that were evaluated through both steps of the screening process were: Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), Nevada Test Site (NTS), Pantex (PX), Savannah River Site (SRS), Waste Isolation Pilot Plant (WIPP) site at Carlsbad, and Y-12 on the Oak Ridge Reservation.

SITE SCREENING PROCESS

The first step in the site screening process was to develop go/no go criteria that any potential site had to satisfy to be judged further as a reasonable site alternative for the MPF. Sites not satisfying these

go/no go criteria were not judged any further in the screening process. Members of the MPF project office determined that security and safety to workers and the public were the two most important factors. Accordingly, population encroachment and mission compatibility were deemed the appropriate go/no go criteria for siting the MPF, as explained below.

With respect to population encroachment, two types of data were factored into the criterion: density of surrounding population and nearness to a major city. Sites surrounded by populations greater than 1,000,000 people (based on a 50-mile radius population) were determined to be unsuitable. Sites contiguous to major cities were also determined to be unsuitable, due to the potential for future population encroachment and economic disruption and deleterious health impacts in the unlikely event of a major accident.

With respect to mission compatibility, it was decided that sites not currently conducting ADOE nuclear operations@ were unsuitable for the MPF. Sites that currently conduct ADOE nuclear operations@ have an established nuclear facility Environment, Safety, and Health (ES&H) and security infrastructure that were determined to be essential. Non-DOE nuclear sites were eliminated from consideration because of concerns regarding long-term mission compatibility and the absence of an existing DOE ES&H and security infrastructure. Sites predominantly engaged in Aclean-up@ missions were also determined to be unsuitable for the MPF because proposing a major new nuclear facility had the potential to distract from efforts related to site clean-up.

Sites that satisfied the go/no go criteria were then judged against desired, weighted criteria to determine the comparative reasonableness of each site alternative. The following weighted criteria were utilized: population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA site, and infrastructure.

Technical judgments were utilized to establish criterion weighting. The most important criteria were assigned a relative weight of 5, the remaining criterion were assigned a weight of 3. Of the desired criteria, the NNSA determined that population encroachment, mission compatibility, margin for safety/security, and synergy with existing/future plutonium operations were of greatest importance and thus, were assigned the highest weighting of 5. Minimizing transportation of plutonium, current use as an NNSA site, and infrastructure were assigned a weighting of 3.

SITE SCREENING CRITERIA

Population Encroachment: Population encroachment considered the population density within a fifty-mile radius of the site. The population density near the site boundary and population centers within 10 miles of the site boundary were also considered. Because population encroachment has strong security implications, as well the potential to affect ES&H risks to the public, this criterion was rated one of the most important criterion and assigned a weighting of 5.

> Sites with the smallest population at the greatest distance from the MPF received the highest rating of 10.

Sites with the highest population closest to the MPF received the lowest rating of 0.

Sites in-between received a rating of 2.5, 5, or 7.5, depending upon the relative population encroachment

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Mission Compatibility: Mission compatibility referred to the capability of the MPF to be constructed and operated in harmony with a site=s existing missions. For example, a site conducting similar operations to those of the MPF, i.e., receipt and storage of Category I quantities of plutonium, large scale plutonium chemical processing operations, plutonium foundry, plutonium machining and joining, assembly, post assembly testing, extensive analytical and metallurgical laboratories, and waste handling of high level and TRU waste, was expected to be more suitable for constructing and operating the MPF compared to a site without such operations. Sites conducting similar missions were expected to have a higher likelihood of successfully accomplishing the MPF mission on schedule and on budget; thus, this criterion was rated one of the most important criterion and assigned a weighting of 5.

Sites with existing missions most similar to those of the MPF received the highest score of 10.

Sites with existing missions least similar to those of the MPF received the lowest score of 0.

Sites in-between received ratings of 2.5, 5, or 7.5, depending upon the relative similarity of their missions to those of the MPF.

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Synergy with Plutonium Operations: While similar to mission compatibility, this criterion took into account specific attributes associated with plutonium manufacturing and processing, including potential synergies with existing/future plutonium missions that have the potential to improve the efficiency/reduce the costs of constructing/operating the MPF. Factors such as the extent of existing/future plutonium manufacturing and processing, experience with plutonium manufacturing and processing, existing/future plutonium radiological labs and analytical capability, existence of emergency operation personnel and equipment are examples of factors that were considered. This criterion was rated one of the most important criterion and assigned a weighting of 5.

Sites which conduct the most plutonium manufacturing and processing, or which have the potential to conduct the most plutonium manufacturing and processing in the future, or which have or may have the greatest plutonium infrastructure received the highest score of 10.

Sites which conduct the least plutonium manufacturing and processing, or which have the potential to conduct the least plutonium manufacturing and processing in the future, or which have or may have the least plutonium infrastructure received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of plutonium manufacturing and processing/infrastructure afforded by the site.

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Margin for Safety/Security: Margin for safety and security referred to a site=s inherent ability to provide a safe and secure operating environment against threats and to minimize potential effects of accidents. Factors such as remoteness, terrain, proximity to military bases, controlled air space, proximity to commercial flight paths, and visibility from public highways are examples of factors that were considered. Sites with greatest margins for safety/security provided a higher likelihood of successfully accomplishing the MPF mission; thus, this criterion was rated one of the most important criterion and assigned a weighting of 5.

Sites with the greatest margin for safety/security received the highest score of 10.

Sites with the lowest margin for safety/security received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative margin for safety/security afforded by the site.

These scores were then multiplied by a factor of five to determine the final score for this criterion.

Minimization of Transportation: Candidate sites were scored, on a relative basis, according to their geographic location and the amount of hazardous material transportation that would be required to support the location of the MPF at that site. Reducing the total distance that plutonium feedstock, manufactured product, and radioactive waste are transported has potentially substantial operational, cost, safety, and security benefits. This criterion was assigned a weighting of 3.

Sites requiring the least plutonium transportation received the highest score of 10.

Sites requiring the most plutonium transportation received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of plutonium transportation associated with the site.

These scores were then multiplied by a factor of three to determine the final score for this criterion.

NNSA Sites: Existing NNSA sites (including non-NNSA sites that conduct a significant amount of NNSA work) with NNSA procedures, NNSA management, safety, security, and administrative procedures in place were deemed more desirable than sites that do not conduct a significant amount of NNSA work. This criterion was assigned a weighting of 3.

NNSA sites (including non-NNSA sites that conduct a significant amount of NNSA work) received the highest score of 10.

Non-NNSA sites that do not conduct a significant amount of NNSA work received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of NNSA work associated with the site.

These scores were then multiplied by a factor of three to determine the final score for this criterion.

Existing Infrastructure: Candidate sites were scored, on a relative basis, on the amount of existing relevant infrastructure. Factors such as existing security forces and structures, existing administrative facilities, existing safety equipment and personnel, available utilities, existence of on-site technical capability to provide applied R&D and manufacturing technical support, and existence of a waste handling infrastructure for both higher level and TRU waste are examples of factors that would make a site a more desirable location for the MPF. This criterion was assigned a weighting of 3.

Sites with the greatest existing infrastructure received the highest score of 10.

Sites with the least existing infrastructure received the lowest score of 0.

Sites in-between received scores of 2.5, 5, or 7.5, depending upon the relative amount of infrastructure at the site.

These scores were then multiplied by a factor of three to determine the final score for this criterion.

RESULTS OF SITE SCREENING PROCESS

All major DOE sites were initially considered. Many DOE sites did not satisfy the go/no-go criteria. For example, Hanford, although remote, did not satisfy the mission compatibility criteria. Hanford is clearly a remediation site which no longer has a weapons mission. Siting a new weapons production facility at Hanford would clearly conflict with the future plans for the site. Kansas City Plant did not satisfy either of the two go/no-go criteria as it is a non-nuclear facility located in the midst of a large urban setting. Both SNL and LLNL, due to their proximity to large, rapidly growing populations, did not satisfy the go/no-go criterion for population encroachment. Rocky Flats did not satisfy either of the go/no-go criterion. This facility is in close proximity to a large population, no longer has a weapons mission, and is considered to be a remediation site. Other major DOE sites, such as ANL-East or BNL, that do not have national security-related missions and/or are close to major urban centers were eliminated for similar reasons.

Seven DOE sites remained after initial go/no-go screening. These remaining DOE sites (Carlsbad, INEEL, LANL, Nevada Test Site, Oak Ridge Reservation (Y-12), Pantex and Savannah River site)

were then ranked, on a relative basis, using each of the site screening criteria and the weighting factors described above. Each of the DOE reviewing officials independently scored these seven sites using the criteria described above. Scores of each reviewer were then averaged for each criteria. Weighted scores for the sites were then tallied, yielding the results shown below:

Average Weighted Site Selection Scores

	LANL	SRS	NTS	Pantex	Carlsbad	INEEL	Y-12
Population Encroachment	23.5	14	50	23.5	47	40.5	0
Mission Compatibility	48.5	47	9.5	28	11	6.5	9.5
Margin for Safety/Security	20.5	29.5	50	17	33	31.5	8
Synergy With Pu Ops	48.5	47	12.5	19	11	6.5	0
Transportation Minimization	20.7	0.9	8.4	30	29.1	6.6	3.9
NNSA Site	28.8	28.2	28.2	28.2	3.9	3.9	25.2
Infrastructure	28.2	28.8	10.2	15.9	8.4	8.4	11.4
TOTAL WEIGHTED SCORE	**218.7**	**195.4**	**168.8**	**161.6**	**143.4**	**103.9**	**58**

CONCLUSION

Based on the weighted scores shown above, Y-12 and INEEL scored significantly less than the other five sites, thereby creating a significant break among the seven sites. Carlsbad, LANL, NTS, Pantex and SRS all received scores of at least 28% higher than INEEL, and at least 60% higher than Y-12. The average score for the five highest ranked sites was 178, and the five highest-scoring sites were within 20% of this average. INEEL and Y-12 were 42% and 67% below this average respectively.

In addition, the results of the site screening scoring process were reviewed to determine if one or more Avariant@ scores influenced the results. A sensitivity analysis was performed in which both the high and low scores were eliminated in an attempt to add more consistency to the average scores. The results determined that no single individual score influenced the final results of the process. Another sensitivity analysis was performed to examine the importance of the weighting factor for transportation that is a criterion that could have broad interest from citizens in several states. This criterion was assessed using a weighting factor of 5 instead of 3. The increased weighting yielded higher scores for Carlsbad and Pantex (which were already score the highest for this criterion based on a weighting factor of 3), while not changing the relative ranking of any of the sites. The net result was an even more significant break between the top 5 sites and the bottom 2 sites, thus, corroborating the original results.

The results of these sensitivity analyses confirmed both the relative rankings of the seven sites and the significant Abreak point@ between the top five sites and the bottom two sites. As a result of the site screening process, it was determined that Carlsbad, LANL, NTS, Pantex and SRS represented a reasonable range of alternatives sites that should be evaluated in detail in the MPF EIS.

AGREEMENT
BETWEEN
THE GOVERNMENT OF THE UNITED STATES OF AMERICA
AND
THE GOVERNMENT OF THE RUSSIAN FEDERATION
CONCERNING THE MANAGEMENT AND DISPOSITION
OF PLUTONIUM DESIGNATED AS NO LONGER REQUIRED
FOR DEFENSE PURPOSES AND RELATED COOPERATION

The Government of the United States of America and the Government of the Russian Federation, hereinafter referred to as the Parties,

Guided by:

The Joint Statement of Principles for Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes, signed by the President of the United States of America and the President of the Russian Federation on September 2, 1998, affirming the intention of each country to remove by stages approximately 50 metric tons of plutonium from their nuclear weapons programs and to convert this plutonium into forms unusable for nuclear weapons;

Taking into account:

The Agreement between the Government of the United States of America and the Government of the Russian Federation on Scientific and Technical Cooperation in the Management of Plutonium That Has Been Withdrawn from Nuclear Military Programs, signed on July 24, 1998 (hereinafter referred to as the Scientific and Technical Cooperation Agreement);

Continuation by the Parties of their cooperation within the framework of the Scientific and Technical Cooperation Agreement and the importance of that work for making decisions concerning technologies for plutonium conversion and mixed uranium-plutonium fuel fabrication, as well as for reactor modification for the use of such fuel;

The statement of the President of the United States of America on March 1, 1995, announcing that 200 tons of fissile material will be withdrawn from the U.S. nuclear stockpile and directing that these materials will never again be used to build a nuclear weapon;

The statement of the President of the Russian Federation to the 41st Session of the General Conference of the International Atomic Energy Agency, on September 26, 1997, on step-by-step removal from nuclear military programs of up to 500 tons of highly enriched uranium and up to 50 tons of plutonium released in the process of nuclear disarmament; and

The Joint Statement by the Parties concerning non-separation of weapon-grade plutonium in connection with the signing of this Agreement;

Have agreed as follows:

Article I

For the purposes of this Agreement, the terms specified below are defined as follows:

1. "Weapon-grade plutonium" means plutonium with an isotopic ratio of plutonium 240 to plutonium 239 of no more than 0.10.

2. "Disposition plutonium" means weapon-grade plutonium that has been

   a) withdrawn from nuclear weapon programs,

   b) designated as no longer required for defense purposes, and

   c) declared in the Annex on Quantities, Forms, Locations, and Methods of Disposition, which is an integral part of this Agreement.

3. "Blend stock" means any plutonium other than disposition plutonium that is received at a disposition facility for mixing with disposition plutonium.

4. "Spent plutonium fuel" means fuel that was manufactured with disposition plutonium and irradiated in nuclear reactors.

5. "Immobilized forms" means disposition plutonium that has been imbedded in a glass or ceramic matrix and encapsulated with high-level radioactive waste in a can-in-canister system suitable for geologic disposal, or any other immobilization system agreed in writing by the Parties.

6. "Disposition facility" means any facility that is constructed, modified or operated under this Agreement or that stores, processes, or otherwise uses disposition plutonium, spent plutonium fuel, or immobilized forms, including any such conversion or conversion/blending facility, fuel fabrication facility, immobilization facility, nuclear reactor, and storage facility (other than storage facilities specified in Section III of the Annex on Quantities, Forms, Locations, and Methods of Disposition).

Article II

1. Each Party shall, in accordance with the terms of this Agreement, dispose of no less than thirty-four (34) metric tons of disposition plutonium.

2. Each Party's declaration on quantities, forms, locations, and methods of disposition for disposition plutonium is set forth in the Annex on Quantities, Forms, Locations, and Methods of Disposition.

3. The Parties shall cooperate in the management and disposition of disposition plutonium, implementing their respective disposition programs in parallel to the extent practicable.

4. The reciprocal obligations set forth in paragraph 1 of this Article shall not prejudice consideration by the Parties of what additional quantities of plutonium may be designated by each Party in the future as no longer required for defense purposes.

5. The Parties shall cooperate with a view to ensuring that additional quantities of weapon-grade plutonium that may be withdrawn from nuclear weapon programs and designated in the future by the Parties as no longer required for defense purposes are:

   a) brought under and disposed of in accordance with the terms of this Agreement; or

   b) subject to other measures as agreed by the Parties in writing that provide for comparable transparency and disposition.

6. Each Party shall have the right to mix blend stock with disposition plutonium provided that for nuclear reactor fuel containing disposition plutonium the mass of blend stock shall:

   a) be kept to a minimum, taking into account the protection of classified information, safety and economic considerations, and obligations of this Agreement; and

   b) in no case exceed twelve (12) percent of the mass of disposition plutonium with which it is mixed.

   The resulting mixture of disposition plutonium and blend stock shall be weapon-grade plutonium.

7. Each Party's disposition plutonium shall count toward meeting the thirty-four (34) metric ton obligation set forth in paragraph 1 of this Article once the other Party confirms in accordance with agreed procedures that the spent plutonium fuel or immobilized forms meet the criteria specified in the Annex on Technical Specifications, which is an integral part of this Agreement. Blend stock shall not count toward meeting that thirty-four (34) metric ton obligation.

Article III

1. Disposition shall be by one or more of the following methods:

   a) irradiation of disposition plutonium as fuel in nuclear reactors;

   b) immobilization of disposition plutonium into immobilized forms; or

   c) any other methods that may be agreed by the Parties in writing.

2. The following are the nuclear reactors that may be used for irradiation of disposition plutonium under this Agreement: light water reactors in the United States of America and in the Russian Federation; the BOR-60 at Dimitrovgrad and the BN-600 at Zarechnyy in the Russian Federation; and any other nuclear reactors agreed by the Parties in writing.

Article IV

1. Each Party shall take all reasonable steps, including completion of necessary technical and other preparatory activities and feasibility studies, to complete construction and modification and to begin operation of disposition facilities necessary to dispose of no less than two (2) metric tons per year of its disposition plutonium in accordance with

Article III of this Agreement, if the assistance specified in the multilateral agreement referred to in paragraph 8 of Article IX of this Agreement for this disposition rate is being provided for achievement of milestones in the Russian Federation specified in the Annex on Schedules and Milestones, which is an integral part of this Agreement.

2. Each Party shall seek to begin operation of facilities referenced in paragraph 1 of this Article not later than December 31, 2007.

3. Pending conclusion of the multilateral agreement referred to in paragraph 8 of Article IX of this Agreement for the disposition rate specified in paragraph 1 of this Article, the Parties shall proceed with research, development, demonstrations, design and licensing activities under this Agreement, on the condition that assistance for such activities is being provided pursuant to paragraph 1 of Article IX of this Agreement.

4. Each Party shall notify the other Party whenever it reaches a milestone set forth in the Annex on Schedules and Milestones or, if not reached at the specified time, the reasons for that delay. If a Party does not reach a milestone at the specified time, it shall make every effort to minimize the delay. In these circumstances, the Parties shall establish in writing a revised mutually-agreed schedule of work for achieving the milestone.

5. Once facilities specified in paragraph 1 of this Article are constructed or modified and begin operations, each Party shall proceed to dispose of disposition plutonium to achieve a disposition rate of no less than two (2) metric tons per year at the earliest possible date.

6. If, prior to December 31, 2007, a Party begins to dispose of disposition plutonium, such plutonium may count toward meeting the thirty-four (34) metric ton obligation set forth in paragraph 1 of Article II of this Agreement if:

   a) the criteria specified in the Annex on Technical Specifications are met; and

   b) monitoring and inspection measures agreed in writing by the Parties are applied to such disposition activities.

Article V

1. Promptly upon entry into force of this Agreement, the Parties shall undertake to develop a detailed action plan, including efforts with other countries as appropriate, to at least double the disposition rate specified in paragraphs 1 and 5 of Article IV of this Agreement at the earliest practicable date. The Parties shall seek to complete this detailed action plan within one year after entry into force of this Agreement. The development of the action plan and the development of arrangements provided for in paragraph 7 of Article IX of this Agreement will, for the Government of the United States of America and the Government of the Russian Federation, proceed in the channels that have negotiated this Agreement.

2. In developing the action plan pursuant to paragraph 1 of this Article, consideration may be given to:

   a) expanding the capability of existing nuclear reactors to utilize mixed uranium-plutonium fuel or using such fuel in additional nuclear reactors, including nuclear reactors outside the Russian Federation, and using such fuel or other plutonium fuel in

advanced nuclear reactors within the Russian Federation, if they prove practical in light of available resources within the time frame of this Agreement;

b) consistent with the expansion of capabilities mentioned in subparagraph (a) of this paragraph, increasing the capacity of conversion or conversion/blending facilities, fuel fabrication facilities and/or immobilization facilities, or constructing additional facilities; and

c) any other approaches as the Parties may agree.

3. Each Party shall proceed at the earliest possible date to dispose of disposition plutonium at the disposition rate specified in the action plan referred to in paragraph 1 of this Article if the assistance specified in the provisions supplementing the multilateral agreement referred to in paragraph 8 of Article IX of this Agreement for this rate in the Russian Federation is being provided.

Article VI

1. Disposition plutonium and blend stock, once received at any disposition facility, shall not be:

a) used for the manufacture of nuclear weapons or any other nuclear explosive device, for research, development, design or testing related to such devices, or for any other military purpose; or

b) exported to a third country, including for disposition, except by agreement in writing of the Parties to this Agreement and subject to international safeguards and other applicable international agreements or arrangements, including INFCIRC/274/Rev. 1, The Convention on the Physical Protection of Nuclear Material.

2. Neither Party shall separate plutonium contained in spent plutonium fuel until such time as that Party has fulfilled the obligation set forth in paragraph 1 of Article II of this Agreement.

3. Neither Party shall separate disposition plutonium contained in immobilized forms.

4. Disposition facilities shall be utilized only in ways consistent with the terms and conditions of this Agreement.

5. Disposition plutonium and blend stock shall be the only plutonium received at or processed by disposition facilities that are conversion or conversion/blending facilities, or fuel fabrication facilities.

Article VII

1. Each Party shall have the right to conduct and the obligation to receive and facilitate monitoring and inspection activities in accordance with this Article and the Annex on Monitoring and Inspections, which is an integral part of this Agreement, in order to confirm that the terms and conditions of this Agreement with respect to disposition

plutonium, blend stock, spent plutonium fuel and immobilized forms, and disposition facilities are being met.

2. Disposition plutonium and blend stock shall become subject to monitoring and inspection under this Agreement, in accordance with the Annex on Monitoring and Inspections and procedures developed pursuant to that Annex, either (a) after receipt but before processing at a conversion or conversion/blending facility, or (b) upon receipt at a fuel fabrication or an immobilization facility, whichever (a) or (b) occurs first for any given disposition plutonium or blend stock.

3. Each Party shall begin consultations with the International Atomic Energy Agency (IAEA) at an early date and undertake all other necessary steps to conclude appropriate agreements with the IAEA to allow it to implement verification measures beginning not later in the disposition process than: (a) when disposition plutonium or disposition plutonium mixed with blend stock is placed into the post-processing storage location of a conversion or conversion/blending facility; or (b) when disposition plutonium is received at a fuel fabrication or an immobilization facility, whichever (a) or (b) occurs first for any given disposition plutonium.

4. If agreed in writing by the Parties, the exercise of each Party's right set forth in paragraph 1 of this Article may be suspended in whole or in part by the application of equivalent IAEA verification measures under the agreements referred to in paragraph 3 of this Article. The Parties shall, to the extent practicable, avoid duplication of effort of monitoring and inspection activities implemented under this Agreement and appropriate agreements with the IAEA.

Article VIII

1. Each Party shall be responsible within the territory of the United States of America and the Russian Federation, respectively, for:

   a) ensuring safety and ecological soundness of disposition plutonium activities under the terms of this Agreement; and

   b) effectively controlling and accounting for disposition plutonium, blend stock, spent plutonium fuel and immobilized forms, as well as providing effective physical protection of such material and facilities containing such material taking into account the recommendations published in the IAEA document INFCIRC/225/Rev. 4, The Physical Protection of Nuclear Material, or a subsequent revision accepted by the Parties.

Article IX

1. The Government of the United States of America shall make available up to two hundred (200) million United States dollars in assistance for the activities to be undertaken in the Russian Federation pursuant to this Agreement and such other amounts as may be agreed in writing by the Parties for these purposes in the future, subject to the availability of appropriated funds and the fulfillment of United States legal and administrative requirements. Assistance provided by the Government of the United States of America shall be for such activities as the research, design, development, licensing, construction

and/or modification of facilities (including modification of nuclear reactors), and technological processes, systems and associated infrastructure for such activities. This assistance will be in addition to any other assistance that may be provided by the Government of the United States of America under the Scientific and Technical Cooperation Agreement.

2. Assistance provided by the Government of the United States of America may include research and development, scientific and technical experimentation, design for facility construction or modification, general and specialized equipment, replacement and spare parts, installation services, licensing and certification costs, initial operations and testing, aspects of facility operations, and other assistance directly related to the management and disposition of plutonium in accordance with the provisions of this Agreement.

3. Equipment, supplies, materials, services, and other assistance provided or acquired by the Government of the United States of America, its contractors, subcontractors, and their personnel, for the implementation of this Agreement in the Russian Federation, are considered free technical assistance.

4. Assistance provided by the Government of the United States of America for activities to be undertaken in the Russian Federation pursuant to this Agreement shall be provided in accordance with the terms and conditions set forth in this Agreement, including the Annex on Assistance, which is an integral part of this Agreement.

5. The activities of each Party under this Agreement shall be subject to the availability of appropriated funds.

6. Activities to be undertaken in the Russian Federation pursuant to this Agreementmay be supported by contributions by the Government of the Russian Federation and by assistance provided by the Government of the United States of America and, as may be specified in the multilateral agreement referred to in paragraph 8 of this Article, by other countries or groups of countries (including equipment, supplies, materials, services, and other assistance provided by them). Activities may also be supported from other sources, including non-government and private sector funds, under terms and conditions agreed in writing by the Parties.

7. The Parties shall seek to develop near-term and long-term international financial or other arrangements for the support of activities to be undertaken in the Russian Federation pursuant to this Agreement sufficient, in combination with contributions by the Government of the Russian Federation and assistance provided by the Government of the United States of America, to achieve and maintain:

   a) the two (2) metric ton per year disposition rate specified in paragraphs 1 and 5 of Article IV of this Agreement; and

   b) the disposition rate resulting from the action plan developed pursuant to paragraph 1 of Article V of this Agreement.

8. For the disposition rate referred to in paragraph 7(a) of this Article, the Parties shall cooperate with a view toward concluding within one (1) year after entry into force of this Agreement a multilateral agreement that documents the assistance arrangements necessary for that rate. For the disposition rate resulting from the action plan developed pursuant to paragraph 1 of Article V of this Agreement, the Parties shall cooperate with a view to

supplementing such multilateral agreement with provisions recording assistance arrangements necessary for that rate.

9. As part of the multilateral agreement referred to in paragraph 8 of this Article, the Parties shall seek to provide for:

   a) notifications, explanations and immediate consultations in the event that a recorded assistance commitment is not fulfilled; and

   b) those consultations to include consideration of resumption of assistance, measures to mitigate any consequences of such non-fulfillment, including costs associated with nuclear safety, physical protection and facility conservation, and other measures as deemed appropriate by the participants in the consultations.

10. If conclusion of the multilateral agreement referred to in paragraph 8 of this Article for assistance arrangements necessary for the disposition rate set forth in paragraph 7(a) of this Article is not completed within eighteen (18) months after entry into force of this Agreement for any reason, the Parties shall consult on whether to adjust the schedules for their respective programs, including any necessary adjustments to the milestones set forth in the Annex on Schedules and Milestones, and any other steps, or whether to terminate the Agreement in accordance with Article XIII of this Agreement.

11. Pending conclusion of the multilateral agreement referred to in paragraph 8 of this Article and conclusion of necessary arrangements with the Government of the Russian Federation for the disposition rate set forth in paragraph 7(a) of this Article, neither Party shall be obligated to construct, modify or operate facilities to dispose of disposition plutonium pursuant to this Agreement. Notwithstanding this, each Party shall proceed under this Agreement with activities in accordance with paragraph 3 of Article IV of this Agreement necessary for construction, modification or operation of disposition facilities.

12. If one or more parties to the multilateral agreement referred to in paragraph 8 of this Article decide to terminate implementation of their assistance commitments recorded in that agreement, and as a result the Government of the Russian Federation is unable to fulfill its obligations with respect to the achievement of a milestone set forth in the Annex on Schedules and Milestones or of the annual disposition rate specified in paragraphs 1 and 5 of Article IV or paragraph 3 of Article V of this Agreement, whichever is applicable, the Government of the Russian Federation shall have the right, consistent with the requirements of paragraphs 13 and 15 of this Article, to suspend those implementation activities under this Agreement that are affected by such termination.

13. If the Government of the Russian Federation intends to exercise its right pursuant to paragraph 12 of this Article, it shall notify the Government of the United States of America through diplomatic channels at least fourteen (14) days prior to any such suspension of implementation activities and identify what activities are to be suspended, and the Parties shall immediately start consultations. In the event implementation of the recorded assistance commitments referred to in paragraph 12 of this Article is not resumed within one hundred and eighty (180) days after the start of consultations, the Parties will consider whether to resume implementation of or to terminate the Agreement in accordance with Article XIII of this Agreement.

14. In the event the Government of the Russian Federation suspends any implementation activities pursuant to paragraph 12 of this Article, the Government of the United States of

America shall have the right to suspend proportionately its implementation activities under this Agreement.

15. During the consultations referred to in paragraph 13 of this Article, unless otherwise agreed by the Parties in writing, neither Party shall take any action that:

    a) could break the continuity in the other Party's knowledge of disposition plutonium or disposition facilities, that had become subject to monitoring and inspection under this Agreement, in a manner that would prevent that Party from confirming that such disposition plutonium or disposition facilities are not being used in ways inconsistent with the Agreement; or

    b) would be inconsistent with the terms and conditions for assistance that had been provided under this Agreement.

Article X

1. Under this Agreement, no United States classified information or Russian Federation state secret information shall be exchanged, except as may be agreed in writing by the Parties for purposes of exchanging information pursuant to this Agreement related to the quantities and locations of disposition plutonium and blend stock at disposition facilities.

2. The information transmitted under this Agreement or developed as a result of its implementation and considered by the United States of America as "sensitive" or by the Russian Federation as "konfidentsial'naya" must be clearly designated and marked as such.

3. "Konfidentsial'naya" or "sensitive" information shall be handled in accordance with the laws of the state of the Party receiving the information, and this information shall not be disclosed and shall not be transmitted to a third party not participating in the implementation of this Agreement without the written consent of the Party that had transmitted such information.

    a) According to the laws and regulations of the Russian Federation, such information shall be treated as "limited-distribution official information". Such information shall be protected in accordance with the laws and regulations of the Russian Federation.

    b) According to the laws and regulations of the United States of America, such information shall be treated as "foreign government information," provided in confidence. Such information shall be protected in accordance with the laws and regulations of the United States of America.

4. Information transmitted under this Agreement shall be used solely in conformance with this Agreement.

5. The Parties shall minimize the number of persons having access to information that is designated "konfidentsial'naya" or "sensitive" information in accordance with paragraph 2 of this Article.

6. The Parties shall ensure effective protection and allocation of rights to intellectual property, transferred or created under this Agreement, as set forth in this Agreement, including the Annex on Intellectual Property, which is an integral part of this Agreement.

Article XI

1. The Parties shall designate Executive Agents for implementation of this Agreement. The Executive Agent for the United States of America shall be the U.S. Department of Energy. The Executive Agent for the Russian Federation shall be the Ministry of the Russian Federation for Atomic Energy.

2. With the exception of the notification referred to in paragraph1 of Article XIII of this Agreement, notifications between the Parties that are provided for by this Agreement shall be transmitted between the Executive Agents unless otherwise specified.

3. The Executive Agents may enter into implementing agreements and arrangements as necessary and appropriate to carry out the provisions of this Agreement. When appropriate, the Executive Agents may utilize other agencies or entities to assist in the implementation of this Agreement, such as government agencies, academies, universities, science and research centers, institutes and institutions, and private sector firms.

Article XII

1. The Parties shall establish a Joint Consultative Commission for this Agreement to:

   a) consider and resolve questions regarding the interpretation or application of this Agreement;

   b) consider additional measures as may be necessary to improve the viability and effectiveness of this Agreement; and

   c) consider and resolve such other matters as the Parties may agree are within the scope of this Agreement.

2. The Joint Consultative Commission shall meet within twenty-one (21) days of a request of either Party or its Executive Agent.

3. Each Party shall designate its Co-Chairman to the Joint Consultative Commission. Each Party shall notify the other Party of its designated Co-Chairman in writing within thirty (30) days after entry into force of this Agreement. Decisions of the Joint Consultative Commission shall be made on the basis of consensus.

Article XIII

1. This Agreement shall be applied provisionally from the date of signature and shall enter into force on the date of the last written notification that the Parties have fulfilled the national procedures required for its entry into force.

2. This Agreement may only be amended by written agreement of the Parties, except that the Annex on Schedules and Milestones may be updated as specified in Section II of that Annex.

3. Except as provided in paragraph 4 of this Article, this Agreement shall terminate on the date the Parties exchange notes confirming that thirty-four (34) metric tons of disposition plutonium have been disposed by each Party in accordance with this Agreement, unless terminated earlier by written agreement of the Parties.

4. If additional quantities of weapon-grade plutonium are brought under this Agreement pursuant to paragraph 5 of Article II of this Agreement, this Agreement shall terminate on the date the Parties exchange notes confirming that thirty-four (34) metric tons of disposition plutonium and all such additional quantities of weapon-grade plutonium have been disposed in accordance with this Agreement, unless terminated earlier by written agreement of the Parties.

5. Notwithstanding termination of this Agreement in accordance with paragraph 3 or 4 of this Article:

   a) neither Party shall use plutonium, once it is received at any disposition facility, for the manufacture of nuclear weapons or any other nuclear explosive device, for research, development, design or testing related to such devices, or for any other military purpose;

   b) neither Party shall export to a third country plutonium, once it is received at any disposition facility, except by agreement in writing of the Government of the United States of America and the Government of the Russian Federation and subject to international safeguards and other applicable international agreements or arrangements, including INFCIRC/274/Rev. 1, The Convention on the Physical Protection of Nuclear Material;

   c) neither Party shall (i) use any plutonium separated from spent plutonium fuel for the manufacture of nuclear weapons or any other nuclear explosive device, for research, development, design or testing related to such devices, or for any other military purpose, or (ii) export spent plutonium fuel, immobilized forms, or any plutonium separated from spent plutonium fuel to a third country, except by agreement in writing of the Government of the United States of America and the Government of the Russian Federation and subject to international safeguards and other applicable international agreements or arrangements, including INFCIRC/274/Rev. 1, The Convention on the Physical Protection of Nuclear Material;

   d) each Party shall continue to effectively control and account for spent plutonium fuel and immobilized forms, as well as to provide effective physical protection of such material taking into account the recommendations published in the IAEA document INFCIRC/225/Rev. 4, The Physical Protection of Nuclear Material, or subsequent revisions accepted by the Parties;

   e) the obligations set forth in paragraph 3 of Article VI of this Agreement, Article X of this Agreement, paragraphs 6 and 7 of this Article, paragraphs 5, 6, and 7 of the General Assistance Section of the Annex on Assistance, and the Liability Section of the Annex on Assistance shall remain in force unless otherwise agreed in writing by

the Government of the United States of America and the Government of the Russian Federation;

f) the Parties shall consult concerning implementation of existing contracts and projects between the Parties and settlement of any outstanding costs between the Parties; and

g) for any activities under this Agreement and any importation or exportation by the Government of the United States of America, its personnel, contractors and contractors' personnel of equipment, supplies, materials or services that had been required to implement this Agreement, no retroactive taxes shall be imposed in the Russian Federation.

6. At an appropriate early date, but in any event not fewer than five (5) years prior to termination of this Agreement, the Parties shall begin consultations to determine what international monitoring measures shall be applied, after termination, to spent plutonium fuel, immobilized forms, and disposition facilities that are conversion or conversion/blending facilities or fuel fabrication facilities, as well as to any reprocessing of spent plutonium fuel. In the event the Parties do not reach agreement on such monitoring measures prior to the termination of this Agreement, each Party shall:

   a) make such fuel and forms available for inspection by the other Party under established procedures, if the other Party has a question or concern regarding changes in their location or condition; and

   b) unless it can be demonstrated that such facilities have been decommissioned and can no longer be operated, make such facilities available for inspection by the other Party under established procedures, if the other Party has a question or concern regarding the use of such facilities.

7. No spent plutonium fuel shall be reprocessed by either Party after termination of this Agreement unless such reprocessing is subject to monitoring agreed by the Parties pursuant to paragraph 6 of this Article.

8. Nothing in this Agreement shall alter the rights and obligations of the Parties under the Scientific and Technical Cooperation Agreement.

DONE at _____ and _____, the ___ and ___ days of _____, 2000, in duplicate in the English and Russian languages, both texts being equally authentic.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:

FOR THE GOVERNMENT OF THE RUSSIAN FEDERATION:

List of Annexes

Annex on Quantities, Forms, Locations, and Methods of Disposition
Annex on Technical Specifications
Annex on Schedules and Milestones
Annex on Monitoring and Inspections
Annex on Assistance
Annex on Intellectual Property

ANNEX
ON
QUANTITIES, FORMS, LOCATIONS, AND METHODS OF DISPOSITION

This Annex to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth each Party's declaration of disposition plutonium.

Section I -- Quantities and Methods of Disposition

For the United States of America:

Quantity (metric tons)	Form	Method of Disposition
25.00	Pits and Clean Metal	Irradiation
0.57	Oxide	Irradiation
2.70	Impure Metal	Immobilization
5.73	Oxide	Immobilization

For the Russian Federation:

Quantity (metric tons)	Form	Method of Disposition
25.00	Pits and Clean Metal	Irradiation
9.00	Oxide	Irradiation

Section II -- Forms

1. Pits and Clean Metal: plutonium in or from weapon components or weapon parts, and plutonium metal prepared for fabrication into weapon parts.

2. Impure Metal: plutonium alloyed with one or more other elements in the form of a homogeneous metal, and unalloyed plutonium metal that is not clean metal.

3. Oxide: plutonium in the form of plutonium dioxide.

Section III -- Locations

The Government of the United States of America declares that:

1) all the "pits and clean metal" it declared in Section I of this Annex will be shipped to the Pit Disassembly and Conversion Facility in the United States of America directly from Zones 4 or 12 of the Pantex Plant in Texas, Technical Area 55 at the Los Alamos National Laboratory in New Mexico (LANL TA-55), the Plutonium Finishing Plant complex at 200 West Area the Hanford Site in Washington (Hanford PFP), the Plutonium Building at Lawrence Livermore National Laboratory in California (LLNL Plutonium Building), and the F and K areas at the Savannah River Site in South Carolina (Savannah River F and K Areas);

2) all the "oxide" it declared in Section I of this Annex to be irradiated in reactors as mixed uranium-plutonium fuel will be shipped to its fuel fabrication facility in the United States of America directly from LANL TA-55, LLNL Plutonium Building, and Savannah River F and K Areas;

3) all the "impure metal" it declared in Section I of this Annex will be shipped directly to its immobilization facility in the United States of America from LANL TA-55, Savannah River F and K Areas, Hanford PFP, and LLNL Plutonium Building; and

4) all the "oxide" it declared in Section I of this Annex to be immobilized will be shipped directly to its immobilization facility in the United States of America from LANL TA-55, LLNL Plutonium Building, Savannah River F and K Areas, and Hanford PFP.

The Government of the Russian Federation declares that:

1) all the "pits and clean metal" it declared in Section I of this Annex will be shipped to the conversion/blending facility in the Russian Federation under the Agreement directly from the Fissile Material Storage Facility at Mayak being constructed under the Agreement between the Department of Defense of the United States of America and the Ministry of the Russian Federation for Atomic Energy Concerning the Provision of Material, Services, and Training Relating to the Construction of a Safe, Secure and Ecologically Sound Storage Facility for Fissile Material Derived from the Destruction of Nuclear Weapons of September 2, 1993; and

2) all the "oxide" it declared in Section I of this Annex will be shipped directly to the conversion/blending facility in the Russian Federation from the places where such oxide was stored pursuant to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors, of September 23, 1997.

ANNEX
ON
TECHNICAL SPECIFICATIONS

This Annex to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth the criteria for determining that disposition plutonium is disposed.

Section I -- Light Water Reactors

Disposition plutonium irradiated under the Agreement in light water reactors shall be considered disposed when the resulting spent plutonium fuel meets the following criteria:

1. Each spent plutonium fuel assembly contains a unique identifier that demonstrates it to be a fuel assembly produced with disposition plutonium;

2. Each spent plutonium fuel assembly is irradiated to a fuel burn-up level of no less than 20,000 megawatt days thermal per metric ton of heavy metal; and

3. The radiation level from each spent plutonium fuel assembly is such that it will become no less than 1 sievert per hour one meter from the accessible surface at the centerline of the assembly 30 years after irradiation has been completed.

Section II -- Immobilization

Disposition plutonium in immobilized forms shall be considered disposed when the system meets the following criteria:

1. Each can containing disposition plutonium immobilized in a glass or ceramic form designated to be inserted into a canister is marked with a unique identifier that allows for confirming the presence of the can as it is inserted into the canister;

2. Each canister containing cans of disposition plutonium is marked with a unique identifier that allows it to be identified during and after the immobilization process;

3. Each canister does not contain more than 30 kilograms of disposition plutonium; and

4. The radiation level from each canister is such that it will become no less than 1 sievert per hour one meter from the accessible surface at the centerline of the canister 30 years after the canister has been filled with high-level radioactive waste.

Section III -- BN-600 Reactor

Disposition plutonium irradiated under the Agreement in the BN-600 reactor shall be considered disposed when the resulting spent plutonium fuel meets the following criteria:

1. Each spent plutonium fuel assembly contains a unique identifier that demonstrates it to be a fuel assembly produced with disposition plutonium;

2. Each spent plutonium fuel assembly is irradiated to an average fuel burn-up level of no less than nine (9) percent of heavy atoms, unless the Parties agree in writing for safety reasons to a lower average level; and

3. The radiation level from each spent plutonium fuel assembly is such that it will become no less than 1 sievert per hour one meter from the accessible surface at the centerline of the assembly 30 years after irradiation has been completed.

ANNEX
ON
SCHEDULES AND MILESTONES

This Annex to the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth schedules and milestones for each Party.

Section I -- Schedules and Milestones

For the program of the United States of America:

Date	Milestone
January 2002	Completion of the design of the Pit Disassembly and Conversion Facility
March 2002	Completion of the design of the mixed uranium oxide-plutonium oxide (MOX) Fuel Fabrication Facility
March 2002	Start of excavation for the Pit Disassembly and Conversion Facility
July 2003	Start of excavation for the Immobilization Facility
October 2003	Start of excavation for the MOX Fuel Fabrication Facility
June 2004	Completion of the design of the Immobilization Facility
March 2005	Completion of construction of the Pit Disassembly and Conversion Facility
March 2006	Start of industrial-scale operations of the Pit Disassembly and Conversion Facility
April 2006	Completion of construction of the MOX Fuel Fabrication Facility
December 2006	Completion of construction of the Immobilization Facility
March 2007	Start of operations of the MOX Fuel Fabrication Facility
September 2007	Start of MOX Reactor operations/Irradiation of first batch of MOX in Reactor
March 2008	Start of full-scale production-operations of Immobilization Facility

For the program of the Russian Federation:

Date	Milestone
January 2002	Completion of modification of the State-Scientific-Center Experimental-Research-Complex Research Institute of Atomic Reactors (OIK GNTs RIAR) for fabrication of VIPAC fuel for BN-600 (hybrid core)

October 2002	Completion of the test-fuel line for fabrication of initial VVER-1000 lead-test MOX assemblies (3 MOX LTAs)
January 2003	Completion of modification of the PAKET facility for fabrication of BN-600 pellet fuel (hybrid core)
January 2003	Completion of the Demonstration Conversion Facility (for weapon-grade plutonium to oxide)
July 2003	Start construction of industrial-scale Conversion Facility
July 2003	Start construction of industrial-scale MOX fuel Fabrication Facility
April 2004	Begin transition of BN-600 to a MOX hybrid core
April 2004	Fabrication of initial VVER-1000 MOX lead-test assemblies
August 2004	Completion of the design of industrial-scale Conversion Facility
October 2004	Completion of the design of industrial-scale MOX Fuel Fabrication Facility
July 2006	Completion of construction of industrial-scale Conversion Facility
July 2006	Start of operation of industrial-scale Conversion Facility
December 2007	Completion of construction of industrial-scale MOX Fuel Fabrication Facility
December 2007	Start of operation of industrial-scale MOX Fuel Fabrication Facility
October 2007	Decision on BN-600 life-extension
2008	Fabrication of an industrial batch of VVER-1000 MOX-fuel
2009	Beginning of operations of storage facility for BN-600 spent plutonium fuel

Section II -- Notification of Updates

1. Each Party shall update as necessary the information it has provided in Section I of this Annex in accordance with the following:

   a) the updating Party's Executive Agent shall notify the Executive Agent of the other Party in writing with explanation of the reason for such an update; and

   b) the updating Party's Executive Agent shall provide such notification in writing not later than 90 days after the associated change occurs.

Section III -- Completion Criteria

The Executive Agents will develop an agreed set of completion criteria for the milestones set forth in this Annex by not later than six (6) months after the signature of the Agreement.

ANNEX
ON
MONITORING AND INSPECTIONS

This Annex sets forth principles and provisions to govern the development of procedures for, and the implementation of, monitoring and inspection activities pursuant to Article VII of the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement.

Section I -- Definitions

For purposes of the Agreement, the following definitions shall apply:

1. "Monitoring" means a set of measures and activities, including inspections, use of special equipment, and review of documents (records and reports), that together provide data to the monitoring Party on disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, or disposition facilities.

2. "Inspection" means a monitoring activity conducted by the monitoring Party on-site at a facility in order to obtain data and make observations on disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, or disposition facilities.

Section II -- General Principles

1. *Scope*: Monitoring and inspection activities shall be conducted in accordance with the Agreement, this Annex, and procedures to be agreed by the Parties pursuant to Section V of this Annex.

2. *Purpose*: In accordance with paragraph 1 of Article VII of the Agreement, monitoring and inspection activities shall be designed and implemented to ensure that the monitoring Party has the ability independently to confirm that the terms and conditions of the Agreement with respect to disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, and disposition facilities are being met, specifically: paragraphs 1, 6 and 7 of Article II; paragraph 2 of Article III; Article VI; and paragraph 2 of Article VII of the Agreement.

3. *Systems of Control and Accounting*: The Parties shall implement national systems of control and accounting for nuclear materials to account for and keep records of disposition plutonium, blend stock, spent plutonium fuel, and immobilized forms. Operators of disposition facilities shall use this national system of control and accounting in order to prepare agreed data to be included in their reports. Such reports shall be provided to the monitoring Party according to procedures to be developed pursuant to Sections III and V of this Annex.

4. *Inspections*: The number, intensity, duration and timing of inspections, and the intensity of other monitoring activities, shall be kept to the minimum consistent with the effective

implementation of agreed monitoring activities pursuant to the Agreement and this Annex. Procedures for monitoring shall be designed so as to minimize, to the extent possible, interference with the operation of facilities, and to avoid affecting their nuclear safety or the safety of inspectors. Specific inspection procedures shall be developed pursuant to Section V of this Annex.

5. Inspectors shall be permitted access to disposition facilities sufficient for them to be able to attain the agreed goals of the inspection, using agreed procedures designed to avoid disclosure of United States classified information and Russian Federation state secret information in accordance with the provisions of paragraph1 of Article X of the Agreement. The monitored Party shall take every necessary measure, in accordance with agreed procedures, to ensure the access of the monitoring Party's inspectors to those facilities, and shall undertake to provide all necessary conditions for successful inspection implementation.

6. Each Party shall treat with due respect the inspectors of the other Party present on its territory in connection with monitoring activities under the Agreement and shall take all appropriate measures, consistent with its national law, to prevent any attack on the person, freedom and dignity of such personnel.

7. Each Party, in accordance with agreed procedures, shall facilitate the procurement of required services and use of equipment, the entry and exit of personnel of the other Party into and out of its territory, and the import into and export from its territory of materials and equipment for carrying out monitoring and inspection activities in accordance with the Agreement including this Annex.

8. *Relationship to Other Monitoring Regimes*: For disposition plutonium that comes from a facility subject to another U.S.-Russian bilateral monitoring regime, or an international monitoring regime that has been agreed by the Parties, monitoring under the Agreement shall take into account that other monitoring regime, and shall not conflict with the transfer requirements of that other monitoring regime. In developing monitoring and inspection procedures in accordance with the Agreement, the Parties should avoid duplicating the efforts of such other monitoring regimes.

9. *Pu-240/Pu-239 Ratio*: The monitoring Party shall be allowed to confirm, using an agreed method, that the Pu-240/Pu-239 ratio of the disposition plutonium is no greater than 0.10. Confirmation of this ratio shall occur after receipt but before processing of disposition plutonium at a conversion facility, or upon receipt at a fuel fabrication facility or immobilization facility, whichever occurs first for any given disposition plutonium.

10. *Protection of Information*: Measurements on plutonium, if required to protect United States classified information or Russian Federation state secret information from disclosure, shall be made by techniques using information barriers. Such measurements shall not be required, however, for any disposition plutonium in containers for which such measurements:

    a) had already been made under another agreement accepted by the monitoring Party; and

    b) are confirmed by the monitoring Party to remain valid.

11. *Blend Stock Measurements*: The monitoring Party shall have the right to confirm that the mass of any blend stock does not exceed what is allowed pursuant to paragraphs 6 and 7 of Article II of the Agreement, upon receipt of such blend stock at a disposition facility, using agreed procedures developed pursuant to Section V of this Annex. Information concerning the composition of the blend stock shall not be provided to, or obtained by, the monitoring Party.

12. *Procedures at Specific Facilities*: Each Party shall provide and update as appropriate a list of its disposition facilities as their specific locations are determined. The monitoring Party shall have the right to conduct monitoring activities, including inspections and other measures, at disposition facilities. These measures shall provide continuity of knowledge of disposition plutonium and blend stock necessary for the monitoring Party to determine whether the objectives of the Agreement are being met.

13. Pursuant to paragraph 1 of Article X of the Agreement, inspectors shall not have access to any parameters that are United States classified information or Russian Federation state secret information because of their relationship to nuclear weapon design or manufacturing.

14. *Conversion Product*: The blended or unblended plutonium-oxide at the post-processing storage location within a conversion or conversion/blending facility (hereinafter referred to as the "conversion product") shall have no characteristics that are considered classified by the United States of America or state secret by the Russian Federation.

15. The monitoring Party shall have the right to confirm the mass and relevant isotopic composition of the conversion product (even if it contains United States "sensitive" information or Russian Federation "konfidentsial'naya" information), using agreed measurement procedures, without the application of "yes/no" techniques or information barriers.

16. *Design Information*: For the purpose of developing agreed measures pursuant to Section V of this Annex, the Parties shall identify an agreed set of design information to be provided to the monitoring Party for disposition facilities. Once the set of design information is identified, that information shall be provided to the monitoring Party at an agreed time. The monitoring Party shall be allowed access to disposition facilities before operations and thereafter, as necessary to confirm design information, using agreed procedures.

17. *Unexpected Circumstances*: Procedures developed pursuant to Section V of this Annex shall include provisions, including monitoring activities as appropriate, concerning unexpected technical circumstances.

Section III -- Records and Reports

1. Based on its national system of control and accounting, each Party shall periodically submit to the other Party reports that were agreed upon in accordance with Section V of this Annex. Such reports shall at a minimum contain information on the quantity of plutonium at each disposition facility, as well as the quantities of plutonium received or shipped from that facility (including the plutonium in spent plutonium fuel, but not that in other spent fuel).

2. The Parties shall develop agreed methods of recording for disposition plutonium, blend stock, spent plutonium fuel, and immobilized forms, and the formats of reports to the monitoring Party on disposition activities.

Section IV -- General Approach to Confirm Disposition of Disposition Plutonium

1. The monitoring Party shall have the right, using agreed procedures, to confirm that spent plutonium fuel assemblies and immobilized forms meet the criteria specified in the Annex on Technical Specifications.

2. Monitoring rights on spent plutonium fuel and immobilized forms shall include procedures, designed with a view to minimize costs, that will allow confirmation that such fuel and forms remain in their declared locations.

Section V -- Development of Specific Procedures and Administrative Arrangements

1. The Parties shall seek to complete by December 2002 an agreed set of detailed measures, procedures, and administrative arrangements, consistent with the terms of the Agreement (including this Annex), for monitoring and inspections of disposition plutonium, blend stock, spent plutonium fuel, immobilized forms, and disposition facilities. This set of detailed measures, procedures, and administrative arrangements shall be completed in writing prior to beginning construction of industrial-scale disposition facilities in the Russian Federation. The development of these measures, procedures, and administrative arrangements shall be coordinated at an early stage with, and be made compatible with, the design effort for the disposition facilities.

2. Procedures agreed pursuant to paragraph 1 of this Section shall specify, among other things, the rights and responsibilities of the facility personnel and inspectors, types of and content of reports, how measurements are to be done, and how independent conclusions are to be arrived at, including, among other things, appropriate procedures for applying containment and surveillance measures, and technical goals for monitoring, with a view to minimizing costs. These agreed procedures shall include, but not be limited to, measures to:

   a) provide assurance that at all times prior to completion of the disposition of the thirty-four (34) metric tons of disposition plutonium under the Agreement: (i) conversion product resulting from the blending of those thirty-four (34) metric tons with the allowed additional quantity of blend stock under the Agreement is the only plutonium that enters disposition facilities that are fuel fabrication facilities in the United States of America and the Russian Federation; and (ii) all plutonium (including the plutonium in spent plutonium fuel, but not that in other spent fuel) entering or leaving disposition facilities does so in accordance with the Agreement, appropriately taking into account waste, as necessary;

   b) confirm the fulfillment of the criteria specified in the Annex on Technical Specifications; and

   c) allow each Party to distinguish spent plutonium fuel from other spent fuel that may be located in the same storage area.

ANNEX
ON
ASSISTANCE

This Annex to the Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth the agreed procedures and provisions to govern assistance provided by the Government of the United States of America for the activities to be undertaken in the Russian Federation as provided for in Article IX of the Agreement.

Section I -- General Assistance Provisions

1. The steps and estimated funding levels for assistance provided by the Government of the United States of America are set forth in the attachment to this Annex. The estimated allocation in that attachment may be revised and updated as the Executive Agents may agree in writing.

2. All equipment, supplies, materials or other assistance provided under the Agreement shall be delivered to mutually-agreed points of entry, unless otherwise agreed in writing. The provider of such equipment, supplies, materials or other assistance shall notify the recipient of the planned date of arrival and point of entry in advance. The recipient shall take possession of all such equipment, supplies, materials and other assistance upon its arrival at the point of entry, unless otherwise agreed in writing.

3. Title to all equipment and facilities provided under the Agreement to, and accepted by, the Government of the Russian Federation, or entities under its jurisdiction or control, shall pass to the Government of the Russian Federation or entities under its jurisdiction or control unless agreed otherwise in writing by the Parties.

4. Equipment, supplies, materials, services, technology or other assistance provided under the Agreement shall be utilized only in accordance with the terms and purposes of the Agreement.

5. Equipment, supplies, materials, services, technology, or other assistance provided under the Agreement shall not be used for the production of nuclear weapons or any other nuclear explosive device, for research or development, design or testing related to such devices, or for any other military purpose.

6. Equipment, supplies, materials, services, technology, or other assistance provided under the Agreement, or developed with assistance provided under the Agreement, shall not be exported, re-exported, or transferred from the jurisdiction of the recipient without the written consent of the Parties.

7. Prior to the export to a third party of any equipment, supplies, materials, services, technology, or other assistance provided under the Agreement, the Parties by mutual agreement in writing shall define the conditions in accordance with which such items will be exported, re-exported, or transferred from the jurisdiction of the third party.

8. The Government of the Russian Federation notes that the Government of the United States of America intends to seek accreditation, as administrative and technical staff of the Embassy of the United States of America in Moscow, of United States Government personnel present in the territory of the Russian Federation on a regular basis for activities related to assistance provided under the Agreement, and hereby confirms that the Government of the Russian Federation will accredit such personnel. Upon entry into force of the Agreement, the Parties will consult on the overall number of United States Government assistance-related personnel envisioned for activities under the Agreement. Each Party shall treat with due respect the unaccredited personnel of the other Party present on its territory in connection with activities related to assistance under the Agreement and shall take all appropriate measures, consistent with its national law, to prevent any attack on the person, freedom and dignity of such personnel.

9. Each Party shall facilitate the movement of persons and the transfer of currencies as necessary for implementation of the Agreement.

10. Facilities in the Russian Federation that have been constructed or modified using assistance provided under the Agreement shall be used only for mutually-agreed purposes.

11. A Party, its Executive Agent, or other agents authorized to act on behalf of a Party or its Executive Agent, that awards contracts for the acquisition of articles and services, including construction, research and development, licensing, design, or other activities to implement the Agreement, shall select suppliers or contractors in accordance with the laws and regulations of that Party.

12. The Executive Agents shall establish and maintain a register of equipment, supplies, materials, services, technology and other assistance subject to the provisions of this Annex.

Section II -- Liability

1. The Parties shall continue negotiations on liability provisions to apply to all claims that may arise from activities undertaken pursuant to the Agreement and shall seek to conclude an agreement in writing containing such provisions at the earliest practicable date, and, in any event, not later than entry into force of the multilateral agreement referred to in paragraph 8 of Article IX of the Agreement.

2. Until entry into force of the agreement containing liability provisions referred to in paragraph 1 of this Section:

   a) assistance activities under the Agreement shall be limited to appropriate pre-construction design work;

   b) neither Party shall be obligated under the Agreement to construct, modify, or operate disposition facilities, including reactors; and

   c) the Russian Federation shall not utilize in any way the pre-construction design work conducted under the Agreement including for the construction, modification, or operation of disposition facilities (including reactors).

Section III -- Taxation of Assistance

1. The Government of the United States of America, its personnel, contractors and contractors' personnel shall not be liable to pay any tax or similar charge by the Russian Federation or any of its instrumentalities on activities undertaken in accordance with this Agreement. The provisions of this paragraph shall not exempt any contractor's personnel who are nationals of or permanently resident in the Russian Federation, and are present in the Russian Federation in connection with such activities, from income, social security, or any other taxes imposed by the Russian Federation, or by any instrumentalities thereof, regarding income received in connection with the implementation of programs of assistance provided by the Government of the United States of America.

2. The Government of the United States of America, its personnel, contractors, and contractors' personnel may import into, and export out of, the Russian Federation any equipment, supplies, materials or services required to implement this Agreement. Such importation and exportation shall be exempt from any license fees, restrictions, customs duties, taxes or any other charges by the Russian Federation or any of its instrumentalities, but not from the procedures called for by the export control system.

Section IV -- Audits and Examinations

1. Upon request, representatives of the Government of the United States of America shall have the right to examine the use of any equipment, supplies, materials, training or other services provided under the Agreement, if possible at sites of their location or use, and shall have the right to inspect any and all related records or documentation during the period of the Agreement and for three (3) years thereafter.

2. Appropriate arrangements in support of the conducting of audits and examinations shall be developed by the Executive Agents. The right to conduct the audits and examinations set forth in paragraph 1 of this Section shall not be contingent upon the development of these arrangements.

Section V -- Equipment Certification

1. The Executive Agent or designated agent of the Government of the Russian Federation shall examine all equipment, supplies, and other materials in each shipment received pursuant to this Agreement and within ten (10) days of receipt shall provide written confirmation to the Executive Agent of the Government of the United States of America, its designated agent or contractor of acceptance or rejection based on whether the equipment, supplies, or other materials conform to specifications mutually coordinated in advance for said equipment, supplies or other materials. Upon request, one or more representatives of the Government of the United States of America or its designated agent may be present at the examination of the equipment, supplies, materials, or other assistance being delivered. Basic certification procedures shall be agreed in writing by the Executive Agents.

Attachment to Annex on Assistance

Provision of assistance in accordance with paragraph1 of Article IX of the Agreement will begin in calendar year 2000 and will continue thereafter to support disposition of disposition plutonium of the Russian Federation, in accordance with the steps and quantities below. Development of the disposition process will continue to be funded under the Scientific and Technological Cooperation Agreement.

Purpose	Funding Level	Time Frame
Design of Industrial-scale Facilities	Up to U.S.$70 Million	2000-2003
Construction of Industrial-scale Facilities	Up to U.S.$130 Million plus future appropriations including non-U.S. sources	2003-2007
Operation of Industrial-scale Facilities	Future appropriations including non-U.S. sources	2007 and onward

ANNEX
ON
INTELLECTUAL PROPERTY

This Annex to the Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, sets forth the procedures governing the protection and allocation of rights to intellectual property transferred or created under the Agreement.

The Parties shall ensure adequate and effective protection of intellectual property created or furnished under this Agreement. The Parties agree to notify one another in a timely fashion of all intellectual property created and results of scientific and technical work obtained under this Agreement and to seek protection for such intellectual property in a timely fashion. Rights to such intellectual property shall be allocated in keeping with the provisions of this Annex.

Section I -- Definitions

1. The term "intellectual property" shall have the meaning found in Article 2 of the Convention Establishing the World Intellectual Property Organization, which was signed in Stockholm on July 14, 1967.

2. The term "participants" shall mean natural persons or legal entities participating in joint activities within the framework of implementation of the Agreement.

3. The term "background intellectual property" shall mean intellectual property created outside the Agreement and belonging to the participants, the use of which is necessary for the implementation of activities under the Agreement.

Section II -- Scope

1. This Annex is applicable to all cooperative activities undertaken pursuant to the Agreement, except as otherwise agreed by the Parties or their Executive Agents.

2. This Annex addresses the allocation of intellectual property rights and takes into consideration the interests of the Parties.

3. Each Party shall ensure that the other Party can obtain the rights to intellectual property allocated in accordance with this Annex. If necessary, each Party shall obtain those rights from its own participants through contracts, license agreements or other legal documents. This Annex does not in any other way alter or prejudice the allocation of rights between a Party and its participants.

4. Disputes concerning intellectual property arising under the Agreement shall be resolved through discussions between the participants, or, if necessary, the Parties or their Executive Agents, which may for these purposes utilize the Joint Consultative Commission. Upon mutual agreement of the Parties or participants, a dispute shall be

submitted to an arbitral tribunal for binding arbitration in accordance with the Agreement and the applicable rules of international law. Unless the Parties or their designees agree otherwise in writing, the arbitration rules of UNCITRAL shall govern.

Section III -- Allocation of Rights

1. Each Party, its Executive Agent or other authorized representative designated by a Party shall be entitled to a nonexclusive, irrevocable, royalty-free license for non-commercial purposes in all countries to translate, reproduce, and publicly distribute scientific and technical journal articles, papers, reports, and books directly resulting from cooperation under this Agreement. All publicly distributed copies of a copyrighted work prepared under this provision shall indicate the names of the authors of the work unless an author explicitly expresses the desire to remain anonymous.

2. Rights to all forms of intellectual property created under the Agreement, other than those rights set forth in paragraph 1 of this Section, shall be allocated as follows:

   a) For intellectual property created during joint research, for example, if the Parties or their participants have agreed in advance on the scope of work, each Party, its Executive Agent or other authorized representative designated by a Party shall be entitled to all rights and interests in its own country. Rights and interests in third countries shall be determined in implementing agreements, taking into consideration the following factors, as appropriate:

      1) the nature of the cooperation,

      2) the contributions of each of the Parties and its participants to the work to be performed, including background intellectual property,

      3) the intentions, capabilities, and obligations of each of the Parties and its participants to provide legal protection of intellectual property created, and

      4) the manner in which the Parties and their participants will provide for the commercialization of intellectual property created, including, where appropriate and possible, joint participation in commercialization.

      In addition, each person named as an inventor or author shall be entitled to receive rewards in accordance with the policies of each Party's participating institution.

   b) Visiting researchers not involved in joint research, for example, scientists visiting primarily in furtherance of their education, shall receive intellectual property rights under arrangements with their host institutions. In addition, each such visiting researcher shall be entitled to receive rewards in accordance with the policies of the host institution.

   c) In the event either Party believes that a particular joint research project under the Agreement will lead, or has led, to the creation or furnishing of intellectual property of a type that is not protected by the applicable laws of the United States of America or the Russian Federation, the Parties shall immediately hold consultations to determine the allocation of the rights to the said intellectual property. Such joint activities shall be suspended during the consultations unless otherwise agreed to by the Parties. If no

agreement can be reached within a three-month period from the date of the request for consultations, the Parties shall cease the cooperation under the project in question.

3. Rights to background intellectual property may be transferred by the Parties and their participants through license agreements between individuals and/or legal entities. Such license agreements may reflect the following:

   a) definitions,

   b) identification of intellectual property being licensed and the scope of the license,

   c) royalty rates and other compensation,

   d) requirements for protection of business-confidential information,

   e) requirements to comply with the relevant intellectual property and export control laws of the United States of America and the Russian Federation,

   f) procedures for record keeping and reporting,

   g) procedures for dispute resolution and termination of each agreement, and

   h) other appropriate terms and conditions.

Section IV -- Business-Confidential Information

In the event that information identified in a timely fashion as business-confidential is furnished or created under the Agreement, each Party and its participants shall protect such information in accordance with applicable laws, regulations, and administrative practices. Information may be identified as "business-confidential" if a person having the information may derive an economic benefit from it or may obtain a competitive advantage over those who do not have it, if the information is not generally known or publicly available from other sources, and if the owner has not previously made the information available without imposing in a timely manner an obligation to keep it confidential. Neither Party nor its participants shall publish or transfer to third parties business-confidential information furnished or created under the Agreement without the prior written consent of the other Party or its participants.

JOINT STATEMENT
CONCERNING NON-SEPARATION OF WEAPON-GRADE PLUTONIUM
IN CONNECTION WITH
THE AGREEMENT BETWEEN
THE GOVERNMENT OF THE UNITED STATES OF AMERICA
AND
THE GOVERNMENT OF THE RUSSIAN FEDERATION
CONCERNING THE MANAGEMENT AND DISPOSITION OF PLUTONIUM
DESIGNATED AS NO LONGER REQUIRED FOR DEFENSE PURPOSES AND
RELATED COOPERATION

The Government of the United States of America and the Government of the Russian Federation, hereinafter referred to as the Parties, have already taken significant steps toward ending the production of fissile material for use in nuclear weapons. These steps include the signing of the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning Cooperation Regarding Plutonium Production Reactors (PPRA) of September 23, 1997, concerning the cessation of the generation of weapon-grade plutonium at United States and Russian plutonium production reactors.

One of the key objectives of the Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, hereinafter referred to as the Agreement, is to reduce irreversibly stockpiles of weapon-grade plutonium from each side's nuclear weapons programs. Both Parties recognize that this disposition will require significant resources. Both Parties also recognize that it would make little sense for either side to commit significant financial and other resources to dispose of such plutonium if either side were planning to continue to separate and accumulate new weapon-grade plutonium.

In this light:

- The Parties reaffirm their intentions not to produce any new weapon-grade plutonium, including by reprocessing of spent fuel or by any other technological process, for nuclear weapons or other nuclear explosive devices or for any military purposes.

- The Government of the United States of America also reaffirms its intention not to separate any new weapon-grade plutonium by any means for any other purposes.

- The Government of the Russian Federation also reaffirms its intention not to build up any stockpile of newly separated weapon-grade plutonium for civil purposes and not to produce any newly separated weapon-grade plutonium unless and until justified for civil power production purposes. In the event that spent fuel containing weapon-grade plutonium were to be reprocessed in the future, the Government of the Russian Federation will take all necessary measures to ensure that any such reprocessing and its products are as proliferation-resistant as possible. The Government of the Russian Federation also confirms its intention to ensure that separation of any plutonium through reprocessing or other technological processes will be keyed to the demand in the civil sector, so as to ensure no unnecessary build up of any civil plutonium stockpiles.

- The Parties note that, during the duration of the Agreement, the BN-600 blanket will be removed in stages to achieve its maximum reduction as quickly as possible, consistent with safety considerations, and that all fuel used in that reactor will not be reprocessed during the duration of the Agreement. After termination of the Agreement, any reprocessing of BN-600 spent fuel containing weapon-grade plutonium resulting from irradiation during the duration of the Agreement will be subject to international monitoring under agreed procedures.

- The Parties note their intention to intensify consultations concerning possible cooperation outside the Agreement on immobilization technologies, including immobilization of waste products containing weapon-grade plutonium, to develop alternatives to separation of such plutonium in the Russian Federation.

- The Parties affirm that, if any of these intentions should change in the future, the Parties will consult in advance of such change, for the purpose of reaching new understandings and agreeing on appropriate measures.

The Parties understand the term "reprocessing" to have its internationally agreed definition, that is, the "separation of irradiated nuclear material and fission products," and note that cleaning up existing separated weapon-grade plutonium to remove Am-241, minor alloying elements, or other impurities, does not constitute reprocessing or new production.

The Parties also note that this Joint Statement of intentions does not:

(1) affect the ongoing separation activities related to weapon-grade plutonium for small-scale research and development or clean-up efforts, or efforts to address urgent environmental or safety hazards, involving small numbers of kilograms; or

(2) alter or affect ongoing separation activities related to weapon-grade plutonium generated by the three plutonium production reactors still operating at Seversk and Zheleznogorsk prior to their being converted under the PPRA, provided that all such plutonium is subject to monitoring in accordance with that agreement.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:	FOR THE GOVERNMENT OF THE RUSSIAN FEDERATION:
_____	_____
_____, 2000	_____, 2000

LA-UR-03-2711

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Form 836 (8/00)

Summary of TA-55/PF-4 Upgrade Evaluation For Long-term Pit Manufacturing Capacity

Introduction

The National Nuclear Security Administration (NNSA) is responsible for the stewardship of the United States (U.S.) nuclear weapon stockpile. This accountability includes ensuring the production readiness of the U.S. to maintain that stockpile. The Department of Energy (DOE) has been without the capability to produce war reserve (WR) plutonium pits (the portion of a nuclear weapon that generates the fission energy to drive modern thermonuclear weapons) since the early 1990s. While the Los Alamos National Laboratory (LANL) is in the process of establishing a limited pit production capability (approximately 10 units per year) at the Technical Area 55 plutonium facility (TA-55/PF-4), this manufacturing capacity is insufficient to support the stockpile for the long term. The Departments of Energy and Defense (DoD), as well as Congress, have highlighted the lack of pit production capability as an issue of National Security interest that requires timely resolution. A new facility, known as the Modern Pit Facility (MPF), is proposed to reestablish the Nation's capability to manufacture pits. The key elements of the MPF Mission Need Statement are listed below:

1. A minimum single-shift production rate of 125 pits per year (ppy).

2. The flexibility and agility to produce two pit types simultaneously.

3. The ability to support all pit types in the enduring stockpile.

4. The capability to meet all future pit manufacturing requirements in an environmentally compliant manner.

A process, compliant with the requirements of the National Environmental Policy Act (NEPA), is being followed to make several key decisions related to the MPF. Two of these decisions are whether to build a new pit manufacturing facility and if the first decision is affirmative, where to site it. During this decision process, all reasonable alternatives need to be evaluated. One potential alternative for increasing the nation's pit manufacturing capability is to upgrade the TA-55/PF-4 at LANL to maximize its production capacity in a manner that is compatible with all of this facility's required missions.

A balanced, multi-organizational, multi-disciplinary team was formed in August 2002 to perform a six-month study on whether or not the upgrade of TA-55/PF-4 should be evaluated in the MPF environmental impact statement (MPF-EIS) as a reasonable alternative for meeting the Nation's long-term pit production requirements. This team examined the potential production rates that might be achieved with several upgrade options, estimated the implementation costs, and addressed the advantages and disadvantages of each approach. The outcome of this study was a technical assessment to support a decision on the "reasonableness" of the alternative of relying on an upgraded

TA-55/PF-4 to maintain the security of the nation's nuclear weapon stockpile. The team members included personnel from Kansas City Plant (KCP), LANL, Lawrence Livermore National Laboratory (LLNL), Savannah River Site (SRS), Sandia National Laboratories (SNL), Y-12 National Security Complex (Y-12), and NNSA.

Background

The study team defined three different options, described below, as a means of bounding the assessment. This report covers the underlying assumptions associated with all of the options, their nominal production capacity estimates, estimated implementation costs, and a general discussion of their advantages and disadvantages. It is readily apparent that with the upgrade of an existing facility some reduction in production capacity and agility, as well as infrastructure lifetime, will occur relative to a newly constructed, full-scale Modern Pit Facility. These impacts are discussed for each of the upgrade options.

A TA-55/PF-4 transition approach was developed for each option that incorporated an incremental series of small facility modifications that would be implemented over a period of years. This approach avoided imposing a disruptive, short-term major retrofit operation on the TA-55/PF-4 facility and personnel, and reduced the risk of causing serious disruptions to LANL missions, including the interim production of W88 pits. In addition, the ramping up of the production capability also facilitates the timely incorporation of new equipment and processes as they are demonstrated to be suitable for use in manufacturing plutonium components.

A preliminary analysis was made of the plutonium-related supporting infrastructure that could fit within the available floorspace. Infrastructure requirements, such as waste and residue processing, analytical chemistry resources, and materials characterization operations, were evaluated and addressed to identify differences between the various production options.

Differences between upgrade options and a new baseline facility are discussed with respect to difficult-to-define metrics such as agility. The pit production flowsheet, operation times, expected efficiencies, etc. used in this study are the same as have been used in MPF modeling activities. Additional supporting information was obtained by interviewing nuclear weapons complex (NWC) personnel with experience in special nuclear material (SNM) production operations and facility upgrade projects, as well as by reviewing previous assessments of site reconfiguration options. Manufacturing requirements for non-plutonium components necessary to support pit production, such as metal shell fabrication and mold production operations, were not addressed in this study.

The upgrading of the TA-55/PF-4 facility, as an alternative to the construction of the MPF, implies major strategic tradeoffs. These considerations include issues such as the inherent complications associated with the extended use of an older facility, the possibility of an earlier start-up date of an upgraded TA-55/PF-4 relative to the proposed MPF schedule, and stockpile refurbishment implications associated with a lower production rate than is achievable with the proposed MPF. This report does not directly

address these strategic issues, but instead focuses on the reasonable maximum production rate that could be achieved with different TA-55/PF-4 upgrade options.

Objective

The objective of this study was to provide a credible assessment of the costs, issues, impacts, and environmental considerations related to achieving a maximum reasonable pit manufacturing capability at the existing TA-55/PF-4 facility. The specific elements involved in the study are as follows:

1. Provide objective information on upgrade options for LANL plutonium facilities in TA-55 to support an NNSA decision on whether long-term use of an upgraded TA-55/PF-4 is a reasonable alternative to be considered in the MPF NEPA process.

2. If upgrading TA-55/PF-4 is determined not to be a reasonable alternative for detailed evaluation in the MPF NEPA process, document the data used for this determination.

3. If upgrading TA-55/PF-4 is determined to be a reasonable alternative for detailed evaluation in the MPF NEPA process, provide bounding data on the upgrade to support preparation of the MPF EIS.

Study Methodology

The study evaluated several different upgrade options to estimate the maximum number of pits that could be produced within TA-55/PF-4. The manufacturing options range from using only existing floor space available in TA-55/PF-4 for pit production, to shifting non-weapons missions in TA-55/PF-4 to other facilities, and finally, to adding floor space to TA-55/PF-4. The following assumptions were used during the evaluation of each upgrade option.

Assumptions

1. The TA-55/PF-4 manufacturing activities will continue during the upgrade; the facility will not halt pit production operations.

2. All required stockpile certification activities will be preserved.

3. The facility will continue to be operated in compliance with all applicable laws, regulations, DOE Orders, Laboratory requirements and permits, and within the authorization basis.

4. The requisite facility upgrade costs already planned to support existing production commitments at TA-55/PF-4 are presumed to occur as

scheduled. These expenses are not included as a portion of the upgrade costs.

5. Worker radiation exposure guidelines presently in use at TA-55/PF-4 will continue. (The present guideline is a maximum exposure of 2 Rem/yr.)

6. The estimated start date for operations in the upgraded portion of the facility will be as soon as is reasonable, and will be included in the discussion for each of the options.

7. Non-plutonium component fabrication will be supported by other NNSA suppliers and will not be a differentiating factor in the TA-55/PF-4 upgrade options.

8. An adequate supply of non-plutonium parts will be available to support the pit manufacturing operations.

9. Estimates of the "reasonable maximum production rate" will be based upon the production of a single pit type, under nominal 1-shift operating conditions.

10. Sufficient analytical chemistry and materials characterization capability will be available to support activities in the LANL Technical Area-55 complex, and that adequate space will be provided to accommodate this capability.

11. The upgraded facility will not necessarily support production of all weapons systems in the enduring stockpile. Specifically, the B-83 will not be supported in some options.

12. No provision is made to allocate space in TA-55/PF-4 for the present LLNL plutonium activities. This assumption implicitly means that the LLNL Superblock facility would be required to remain open until LLNL no longer requires a plutonium facility capability to support its national security projects.

Table 1 provides a brief summary of the three upgrade cases that were developed for this study. These options incorporate a range of potential scenarios for implementation, schedules, and funding profiles. Option 1 is an upgraded facility that takes advantage of optimized operations and equipment but only produces a minimal impact to the current range of TA-55/PF-4 missions. This option includes the necessary activities required to support all weapons systems within the enduring stockpile except for the B-83. It performs the appropriate equipment and facility upgrades without changing the present TA-55/PF-4 footprint or worker radiation exposure guidelines. Option 2 is based on the same set of conditions except that it allows a limited impact on the currently planned TA-55/PF-4 missions. Specifically, some existing non-weapons missions may be moved

elsewhere to provide about 3,000 square feet of additional floor space for pit manufacturing activities. Option 3 describes a case that produces a more significant impact on TA-55/PF-4 beyond what was considered in option 2. This case expands the option 2 criteria to include the construction of a new PF-4 wing and the incorporation of B-83 pit manufacturing activities.

Table 1: Summary of Upgrade Options

Option	Footprint Requirements	Mission Impacts	Weapons Systems
1	No New Floor space	Minimum impact: All existing missions are protected.	Enduring Stockpile less B-83
2	No New Floor space	Limited impact: Stockpile certification mission protected, other missions are shifted, eliminated or reduced.	Enduring Stockpile less B-83
3	Add ~12,000 sq. ft. to TA-55/PF-4	Significant impact: Stockpile certification mission protected, other missions are shifted, eliminated or reduced	Enduring Stockpile

A significant level of detail information on each option was developed and evaluated by the study team. For example, facility layouts, equipment lists, and transition approaches for implementation were developed to establish costs, impacts, projected pit manufacturing capacity, and advantages/disadvantages for each option. Computer models were used to estimate production capacities for various TA-55/PF-4 equipment layouts. Since detailed layout and configuration information on an operating nuclear facility (TA-55/PF-4) is classified as UCNI (unclassified controlled nuclear information) or higher, only summary information of study results is contained in this unclassified document.

Study Results

Table 2 provides summary results associated with an analysis of each option. Option 1 is estimated to be capable of a nominal production capacity of 50 pits per year. As such it falls within the production capacity bounds of the "no action" alternative being evaluated in the MPF EIS and previously evaluated in the Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (SSM PEIS). Option 2 makes use of extra space in PF-4 through non-weapon mission consolidation. With an estimated nominal production capacity of 80 pits per year, it does not meet the minimum pit production capacity (125 ppy) needed for long-term support of a stockpile consistent with requirements of the Nuclear Posture Review. While Option 3 is estimated to meet the minimum capacity target, it has a high execution risk.

Table 3: Top-Level Results of Analysis of Upgrade Options

Option	Nominal Single-shift Production Rate (ppy)	Start Date	Implementation Cost (M$)	Agility	Risk	Process Development (PD)
1	~50	2014	~ 500	Limited	Low	Limited, co-located PD Space
2	~80	2016	~700	Improved	Low	Improved, w/ some dedicated PD Space
3	~150	2020	1200-1600	Good	High	Dedicated PD Space, two pit-type operation

The transition plan for increasing the TA-55/PF-4 pit production capability for each of the three options is based on a strategy of doing a steady upgrade activity over an extended period of time. This minimizes the impact on the facility and enables the existing pit manufacturing operations to continue without serious disruption. The actions required to achieve success with Options 1 and 2 are believed to be manageable and therefore relatively low risk. However, the cost required to achieve Option 2 is higher that the cost of Option 1.

Options 2 and 3 offer the advantages of providing a measured approach to increased capacity. Option 2 has the advantage of being less costly than either Option 3 or a new MPF and being on-line sooner (around 2016). Option 3 has the advantage of providing a production capacity that is equivalent to a small MPF. Option 3 also entails a very significant challenge due to the possibility of an unforeseen event during the construction of new floor space that could disrupt both the upgrade and on-going TA-55/PF-4 manufacturing and certification activities. While Option 3 approaches the cost of a small, new MPF, it is judged to entail a high execution risk without the benefits of a fully newly designed and constructed facility.

The following conclusions are applicable to all of the upgrade options:

1. The TA-55/PF-4 facility will be approximately 40 years old when the planned upgrade capacity is achieved. Although significant facility upgrades are planned for, meeting future nuclear facility safety and operating requirements over an additional 50 years is uncertain without significant and currently unspecified, long-term financial commitments.

2. The TA-55/PF-4 facility was designed for plutonium research and development. For example, pit manufacturing equipment is not on grade in TA-55/PF-4 as would be preferred for a production plant. The additional floor space required for

an increased production mission will reduce the ability of the facility to support potential future plutonium research and stockpile support missions as well as the development of pit manufacturing technology.

3. The physical constraints of the existing facility limit the upgrade options, increase the cost of needed improvements (material handling, storage, ventilation, shielding, and power) and inhibit the introduction of improved manufacturing technologies. These constraints also reduce the opportunities for inclusion of new facility design approaches that can enhance production efficiency, reduce worker radiation exposures, and minimize safety and security risks.

4. Major modifications to an operational nuclear facility increase the risk of significant safety, contamination, or safeguards and security events during the transition period. While manageable, this increased risk is not realized with a new MPF.

5. The analyses for each upgrade option assumed external support for Analytical Chemistry operations (CMR or CMR-R) and the continued operation of existing facilities (Superblock).

Summary

Option 1 provides a nominal 50 pits per year production rate with relatively minimal impact to the current missions in TA-55/PF-4. However, this provides no greater pit manufacturing capacity than the "no action" alternative in the MPF EIS.

Option 2, provides a nominal manufacturing capacity of 80 pits per year. However, this option does not have the potential to reach the minimum production capacity (125 pits per year) or agility required by the current mission need for a long-term pit manufacturing facility. This option may be considered a reasonable EIS alternative to a new MPF since it could support the stockpile should substantial reductions in pit production requirements arise.

Option 3 requires construction of additional floor space in TA-55/PF-4 and has the hypothetical potential to achieve a capacity of approximately 150 pits per year. However, there is a high risk that Option 3 will not meet capacity, cost, or schedule projections. There is uncertainty that significant construction additions might affect the assumptions and regulatory framework for the facility that were originally established at the time of initial construction. In addition, the cost of Option 3 approaches estimates for a new facility that has much greater performance potential and would not be nearly 40 years old at the start of long-term pit production.

As a result of consideration of the summary information developed by the multi-disciplinary team, the NNSA Pit Project Office selected Option 2 as a reasonable alternative to be considered in the MPF-EIS. Option 1 was considered as bounded by the

No Action alternative. Option 3 was not considered reasonable. Subsequent to selection of Option 2 as a reasonable alternative to be considered, study team contributors assembled data on this TA-55/PF-4 upgrade option for inclusion in the MPF-EIS.

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DRAFT

Plutonium Aging: Implications for Pit Lifetimes

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Executive Summary

Planning for future refurbishment and manufacturing needs in the US nuclear weapons complex critically depends on credible estimates for component lifetimes. One of the key variables in planning both the size and schedule for the proposed Modern Pit Facility (MPF) is the estimated lifetime for stockpile pits, defined as the age at which a pit can no longer be certified to meet the military characteristics. In this report, we will describe the status of our understanding of pit aging, provide our current assessment of pit lifetimes, and describe in some detail the methodology we are using to improve this assessment over the next few years. At a high level, our lifetime assessment methodology is based on an evaluation of all potential aging mechanisms. The test matrix is a series of plutonium alloys ranging in age from newly processed reference alloys to old Pu taken from approximately 40 year old retired pits. Extensive experimental data obtained from these materials over the last three years, derived from microstructural characterization and property measurements, are applied to evaluate any age-related changes. Then, age-dependent, predictive models are developed based on experimental data. The predicted changes in properties are then inserted into design sensitivity calculations in order to quantify the effect of that specific property change on the performance and margin of a specific weapon system.

To date, only minor age induced changes have been observed and there is no direct evidence that these affect pit performance, reliability, and safety. The response of each system to potential changes is specific to each particular design. The current estimate of the minimum age for replacement of pits is between 45 and 60 years. This is based on observations of pit and plutonium aging taken from pits up to 42 years old and conservative extrapolation of this data combined with system-specific design sensitivity analysis. Additional data and analysis coupled with further design sensitivity studies are needed to refine our estimates of minimum lifetimes for each system. It is possible these studies may show that certain systems exhibit lifetimes shorter than the stated 45 years or longer than 60. In the most conservative case that lifetimes are found to be less than 45 years of age, mitigation methods currently exist to extend these lifetimes to a 45-year minimum. At the end of FY03 the Enhanced Surveillance Campaign has a key milestone to provide a pit lifetime assessment based on old pit data. In FY06, we will deliver a pit lifetime estimate based on old pit data and the accelerated aging program. Further experiments, modeling, and design sensitivity calculations on different weapon systems are required to gain greater confidence and reduce uncertainties in our lifetime estimates.

Background

Pits for nuclear weapons have been manufactured by the United States for nearly 60 years. Systematic aging studies on pits were initiated only a few years ago after the loss of the Rocky Flats manufacturing capability. During the past 60 years, designs, materials, and processes have changed dramatically. Throughout this history, refinements have been introduced such that pits of modern design are more robust, safer, and suited for longer storage times. Modern pits consist of hollow, metallic shells containing fissile material at their core. The outer, non-nuclear materials used in pits are selected for properties such as mechanical robustness and integrity as well as corrosion resistance. In practice, these materials remain remarkably pristine over decades. Further, modern designs rely on the boost process – the presence of deuterium/tritium mixtures into the interior – as an essential element of weapon function. Hence, the integrity of pits as gas-pressure vessels is another important element of weapon function. In this respect as well, the surveillance program has proven that pits are demonstrably robust over decades. Given this positive history with the non-nuclear materials in pits, most concerns with pit aging focus on the behavior and possible degradation of the plutonium.

Evaluation of the Aging Process

The approach used to address the aging of pits starts with an identification of the key plutonium properties required to ensure safe and reliable weapon function. These properties (such as density) are selected by knowledgeable design physicists who will ultimately use them in computer simulations as part of the certification process of a given weapon. This process is quite complicated because for years designers relied largely on testing the devices at the Nevada Test Site (NTS) to assess performance. Although a substantial amount of work has been done to relate performance to specific materials properties, our understanding is incomplete. We are in the process of developing a better fundamental understanding as to how key properties influence weapons performance using advanced tools such as improved codes. Once these properties have been identified, diagnostic tools are developed to measure them with sufficient precision as determined by the weapon designer. An important aspect of the aging program is the execution of experiments to measure baseline properties of new (zero-aged) material.[1]

Next, materials scientists and chemists identify the aging mechanisms that could potentially alter these properties over time. The three most important potential aging effects in plutonium are the radioactive decay of the various plutonium isotopes (and the impact of this decay on the chemistry, structure, and properties of the material), the thermodynamic phase stability of the plutonium alloy, and the corrosion of the plutonium during both storage and function. In many cases, these aging effects accumulate slowly over decades, and not necessarily in a linear fashion. Only when key properties have sufficiently changed would we anticipate a measurable impact on weapon safety or performance. Through the process of experiments, model development of the age-related changes, and design sensitivity studies, the weapon designers attempt to specify the limits

of acceptable change for each of these properties by evaluation of the margins associated with each system. By combining these limits with the measured or predicted rates of change due to aging effects, we will derive estimates for pit lifetimes.

Each of the three, principal aging mechanisms identified above is under intensive examination within the National Nuclear Security Administration's (NNSA's) Enhanced Surveillance Campaign. This program has four key elements/objectives: 1) measurement of actual properties and trends from the newest to the oldest materials available from the stockpile; 2) acceleration of the aging where possible and subsequent measurement of material properties; 3) modeling of aging effects for insertion into design sensitivity analyses; and 4) the development of new diagnostics to identify the signatures of aging as early as possible in order to provide lead time for refurbishment. In parallel, the Primary Certification Campaign in concert with ASC are developing the computational tools required to address design sensitivity, acquiring the test data (e.g., sub-crits) to quantify key parameters, and the expertise to complete the design sensitivity assessment.

In the following sections, we will describe our current understanding of the three principal aging mechanisms: radiation damage and the application of the accelerated aging methodology, phase stability, and corrosion. Then we will describe our efforts to reduce uncertainties and our current lifetime assessment.

Damage Mechanisms and Applicability to Evaluation of Old Pits

The oldest plutonium made in the United States and available for analysis is approximately 40 years of age. This plutonium was manufactured by processes slightly different from the materials in the enduring stockpile. As a result, a direct comparison of this oldest plutonium to modern alloys may invoke uncertainty, but has provided substantial insight to the aging behavior. Extensive, but incomplete evaluations of this material over the past three years have shown only modest changes in key properties. Nonetheless, these small changes are invaluable in helping to calibrate and refine our aging models. Our experience with this oldest plutonium has been crucial in another respect: we have yet to observe the onset of void-swelling, one of the potentially most troublesome manifestations of self-irradiation damage.

A fundamental aspect in the accumulation of radiation damage in materials is the existence of a threshold beyond which further damage results in rapid swelling and density decrease. Experience from all materials in reactor environments of similar crystal structure to the plutonium alloys in the stockpile shows that the damage results initially in little change in density, but after an "incubation period", void swelling begins. This void swelling can result in volumetric increases of about 1% per decade. The length of this incubation is unknown for weapon grade plutonium and presently cannot be predicted.

The principal decay mechanism for most plutonium isotopes is alpha-particle decay. The parent atom spontaneously decays into a doubly charged helium nucleus (i.e., alpha

particle) and a uranium atom. Both of these particles are highly energetic. This initial decay event is rapid and results in considerable, local disruption of the crystalline lattice. Based on theoretical considerations, this single decay energizes roughly 20,000 other atoms and displaces approximately 2400 atoms from their lattice sites. Within the first 200 nanoseconds, about 90% of these displaced atoms return to a normal lattice position. The remaining 10% of these atoms are retained in the lattice, where an atom now sits between regular positions on the lattice (known as an interstitial) and leaving the regular lattice positions empty (known as a vacancy).[2] The ultimate disposition of these more permanent defects is the principal concern in our evaluation. This accumulation of damage is significant within the time frames of interest: on average, each atom of plutonium has been displaced once every 10 years.

We have developed and deployed a number of advanced diagnostics to obtain data of early evidence of age-related changes. One of these, positron annihilation spectroscopy has recently provided data that indicates the newly formed helium atom immediately fills an unfilled vacancy. These helium filled vacancies have the potential to migrate in the lattice, eventually coalescing as small helium bubbles. This may result in a modest swelling of the material as well as changes in the mechanical properties of the plutonium. These changes can now be estimated with computer simulations supplied with age-dependent experimental data provided by another newly developed diagnostic technique, near atomic resolution transmission electron microscopy. It is found that the helium-induced changes are very small, and if they continue to increase at the predicted rate, will not affect weapons performance for pits in excess of 60 years of age. However, the vacancies also have the potential to migrate and accumulate into voids, the phenomenon of void swelling discussed above. These mechanisms are not necessarily independent: helium likely stabilizes the voids and assists in the accumulation of a critical number of these defects, which defines the incubation period for void swelling. Modeling of these processes requires detailed knowledge of the structure of the lattice and the energy required to nucleate and move these various defects within the crystal structure. These energies are derived from knowledge of the electronic structure of both individual plutonium atoms and the metallic bonds that form between them. The great complexity of interatomic bonding in plutonium has made this a particularly difficult problem to address. Although void swelling models do indeed exist for reactor materials, our best models for plutonium are still incomplete as they lack crucial materials parameters, which cannot easily be measured or computed from fundamental theories for plutonium. Although progress is being made, ultimately, experimental data will be necessary to establish confidence in these models and to reduce the uncertainty in their estimates.

A significant number of macroscopic measurements (such as density), microstructural measurements (optical microscopy, scanning electron microscopy, electron microprobe, transmission electron microscopy, positron annihilation spectroscopy, extended x-ray absorption fine structure, and resonant ultrasound spectroscopy), and dynamic property measurements have shown rather small or nonexistent changes over a period of time of 30 to 40 years. However, additional measurements coupled to model development and design sensitivity calculations are essential to extend these data to longer time frames and

to reduce the uncertainty in margin. This estimation requires considerable expertise in the modeling of aging effects in solid-state materials, particularly in the discipline of radiation damage modeling. It is largely the uncertainties in these models that drive uncertainties in the minimum estimates for pit lifetimes.

Accelerated Aging Methodology

The need for fundamental aging data helps to drive the second objective of the Enhanced Surveillance Campaign's technical element on pits: the accelerated aging of plutonium. The process of alpha decay within plutonium can be accelerated by the addition of isotopes with shorter half-lives. An alloy of normal weapon-grade plutonium mixed with 7.5% of the Pu-238 isotope will accumulate radiation damage at a rate 16 times faster than weapon-grade material alone. This is a useful tool to evaluate extended-aged plutonium (up to 60-years equivalent and possibly beyond) within a few years. Critically, acceleration of the input of radiation damage must be matched by acceleration of the subsequent annealing and diffusion of that damage. We accomplish this subsequent acceleration by raising the temperature at which the samples are stored. These processes are thermal in nature, and the activation energy (a term which describes the energy required to activate a process) is different for each specific mechanism. Unfortunately, there is no single temperature at which the thermal diffusion of this damage will be equivalently and perfectly matched to the initial acceleration of the damage input. As a result, the accelerated aging experiments are carried out at three different temperatures.

Thus, the accelerated aging method is only approximate and not a perfect match to the actual aging of materials in the stockpile. Hence, we focus a large portion of the accelerated aging work on comparing the accelerated-aged material with actual-aged plutonium in an effort to calibrate the technique and build confidence that our estimates (for things like storage temperature) are accurate. Nonetheless, findings from the accelerated aging program are essential in order to gather experimental data for key mechanisms such as void swelling and its associated incubation period. Even if the process isn't perfectly replicated, our models are sufficiently sophisticated to use data from the accelerated aging program to refine estimates of the incubation period and rate of void swelling for weapons-grade material.

Thermodynamic Stability of Plutonium Alloys

A secondary concern is the thermodynamic phase stability of the δ-Pu alloy. The δ-phase in unalloyed plutonium is stable between about 310°C and 415°C but can be "stabilized" to room temperature by the addition of small quantities of alloying agents such as aluminum or gallium. The δ-phase alloy is a ductile, copper-like material that is easily fabricated and is thus preferred for weapon use. Plutonium/gallium alloys have been widely studied since the earliest days of the Manhattan Project and have shown that the

δ-phase plutonium alloy is metastable, similar to steels in that it will not transform to thermodynamically stable phases in the time frame of thousands of years.[3] However, upon cooling to very low temperatures, the δ-plutonium will partially transform to α-plutonium, a phase that is 20% more dense than the δ-Pu. There has been no evidence of this phase transformation occurring in weapon material, but the severity of the transformation warrants detailed investigation.

A third advanced diagnostic technique has recently been applied to probe the plutonium alloys for early evidence of age-related changes. X-ray absorption spectroscopy is a technique that is ideally suited for determination of the local atomic environment of the major atoms (Pu) and the alloying atoms (Ga). In newly prepared δ-Pu alloys for example, x-ray absorption measurements reveal evidence for a second arrangement of atoms, or a minor amount of a second crystalline structure where there is a deficiency of Ga atoms. This second phase material disappears rapidly with age, and this discovery prompted Jeanloz to observe that the crystallinity of δ-plutonium actually increases with age.[4] More detailed study, using high resolution x-ray absorption and x-ray diffraction reveal that the main δ-phase retains good long-range order for ages exceeding 40 years, but that asymmetry in certain diffraction peaks is also growing in with age, presumably due to accumulated irradiation damage.

The influence of the radiation-damage processes (discussed previously) on phase stability is still unknown and therefore continues to represent an uncertainty in our evaluation of plutonium aging.

Corrosion of Plutonium Alloys

Finally, corrosion of plutonium is potentially the most catastrophic of all aging effects.[5] Fortunately, corrosion is both limited by the availability of corrosive agents and relatively easily studied. Whereas plutonium will readily oxidize given sufficient exposure to air or other oxidizing environments, it is hydrogen-catalyzed corrosion that is of greatest concern. Most importantly from a pit aging perspective is the maintenance of well-sealed pits and the exclusion of foreign contaminants during pit production. The employment and insurance of robust cleaning methods during the final stages of pit manufacture are essential. Experience from stockpile surveillance programs reflects this point: pits have remained remarkably pristine and free of corrosion, especially since the adoption of modern cleaning and sealing methods.

Reducing the Uncertainties

The current program is aimed at quantifying the margins and uncertainties and improving our fundamental understanding in order to increase our confidence in the lifetime assessment. The methodology for this is based on design sensitivity analyses. Extensive experiments are conducted on new and aged material. Age-dependent models are then

developed based on the experimental data, science-based computational methods and models, and conservative assumptions. These models are then inserted into the design codes to calculate the change in performance based on the predicted change in properties. The sensitivity calculations to date have indicated no performance impacts of aging under the most pessimistic assumptions. However, it must be noted that these calculations have been conducted on only one system and are not comprehensive. We expect there to be system-by-system variations in sensitivity to aging parameters as a function of design considerations.

To provide crucial data for the design sensitivity analysis and aid in focusing our efforts, extensive measurements of stockpile-aged plutonium are continuing. The assessment presented here will be thoroughly documented and reviewed (by internal and external reviewers), and lifetimes will be updated with data from old pit examinations, at the end of FY03. A series of additional experiments and measurements will occur between now and 2006. These include the conduct of various dynamic experiments (gas guns, laser shock experiments, Kolsky bar measurements, U1a experiments, etc.) to supplement our existing database as well as the careful, in-situ examination of the accelerated aged alloys (via dilatometry, resonant ultrasound spectroscopy, electron microprobe analysis, transmission electron microscopy, positron annihilation spectroscopy, and other techniques). All of this data serve the common goal of trending changes in key properties and understanding the evolution of micro-scale processes (ingrowth of decay product, buildup of radiation damage) that affect macro-properties of the material (density, mechanical properties, etc.).

Assessment of the Minimum Pit Lifetime

On the basis of careful evaluation of the effects described above through extensive characterization of old pits, modeling, and preliminary design sensitivity calculations (as well as a few other, less-prominent concerns), an initial assessment of minimum pit lifetimes has been derived. Evaluation of the oldest samples of plutonium metal, both metal of oldest absolute age (40 years) as well as the oldest samples most directly comparable to the enduring stockpile (25 years) have shown predictably stable behavior. The many properties that have been measured to date, such as density and mechanical properties have shown only small changes and detailed microstructural studies have been correlated to these changes in properties. The response of each system to potential changes is specific to each particular design. Based on this assessment, current estimates of the minimum age for replacement of pits is between 45 and 60 years. Additional data and analysis coupled with further design sensitivity studies are needed to refine our estimates of minimum lifetimes for each system. It is possible these studies may show that certain systems exhibit lifetimes shorter than the stated 45 years or longer than 60. In the most conservative case that lifetimes are found to be less than 45 years of age, mitigation methods currently exist to extend these lifetimes to a 45-year minimum.

The principal uncertainty in this assessment relates to the incubation periods inherent in radiation damage effects. Certain key variables in these models (such as the energy of defects and the nature of plutonium bonds) are still uncertain enough that future estimates will require benchmarking against more extensively aged samples and data. Additional uncertainty arises from the intrinsic scatter in much of the experimental data (necessitating a statistically-based analysis of much of this information) as well as uncertainties on the influence of certain changes on weapon performance. In our design sensitivity studies, we mitigate some of these uncertainties by applying pessimistic assumptions to our models. Thus, our bounding calculations are a valid tool for assessments of this type. In some specific circumstances, pit performance may be found to be extremely sensitive to slight changes in certain properties, more sensitive than current diagnostics can reliably detect. In this case, careful review of data combined with modeling can provide an estimate of change which is useful to designers in establishing acceptable limits. Continuing research is necessary and will strengthen the linkage between the plutonium microstructure and changes resulting from aging, key properties, and weapons performance as determined by prior nuclear tests.

Pit Aging Milestones for the Enhanced Surveillance Campaign

NNSA, through the Enhanced Surveillance Campaign, has a formal program to acquire this data and assess it on a time scale relevant to upcoming decisions such as the Modern Pit Facility. Several key milestones occur from now until 2006. At the end of FY03, we will provide a pit lifetime assessment based on old pit data. For the accelerated aging component of this assessment, we have successfully completed the milestone to produce the accelerated aging alloys at both LANL and LLNL. This material will be validated at both zero-age and against the oldest stockpile samples in the next two years. The comparison of baseline properties of this material to zero-age control samples will be substantially completed as of early 2003. By early 2006, these samples will have reached an equivalent age of 60 years, and measurements of their properties (and comparison to aging models) form a key milestone in our estimate of pit lifetimes.

Summary

We have made substantial progress in the past few years in our fundamental understanding of some of the age-related changes in plutonium. The theoretical, modeling, and experimental components are now in place to make significant progress over the next few years in order to quantify the margins and uncertainties.
We are encouraged that measurements to date have not shown any significant degradation of pits over approximately 40 years. The changes observed to date have been quite small, giving both LANL and LLNL investigators reasonable confidence in the 45 year minimum lifetime estimate based on the data collected to date, though further design sensitivity studies may show a shorter lifetime than 45 years for some systems and longer than 60 years for others. In the case that pit lifetimes are found to be less than 45 years using highly conservative assumptions, mitigation methods are available to extend these

systems back to a 45-year minimum life. Further experiments, modeling, and design sensitivity calculations on different weapon systems are required to gain greater confidence and reduce uncertainties in these estimates.

(For further information on the detailed aging processes in plutonium and the unique nature of this material in general, see "Challenges in Plutonium Science", volume 26 of *Los Alamos Science*, N. Cooper, ed (2000), "Plutonium Aging: from Mystery to Enigma", S.S. Hecker and J.C. Martz, proceedings of the Oxford Conference on Ageing Studies and Lifetime Extension of Materials (1999), or *MRS Bulletin*, "Challenges in Plutonium and Actinide Materials Science," L.J. Terminello, ed Volume 26, No. 9, September, 2001.

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[1] An example of these important measurements includes the series of subcritical tests at the U1a facility at the Nevada Test Site. These measurements help to describe the equation-of-state and other dynamic properties of plutonium.

[2] An interstitial/vacancy pair is known collectively as a "Frenkel pair". Calculations show that each Pu decay results in the generation of roughly 2200 Frenkel pairs – 2000 from the uranium recoil and 200 from the alpha particle itself. A more extensive account of radiation damage in plutonium is given by W.G. Wolfer, *Los Alamos Science* 26, Vol. 1, p. 274.

[3] S.S. Hecker and L.F. Timofeeva, *Los Alamos Science*, 26, Vol 1., p. 244.

[4] R. Jeanloz, "Science-Based Stockpile Stewardship", *Physics Today*, December 2000.

[5] J.M.Hashcke and J.C.Martz, "Plutonium Storage", in the Encyclopedia of Environmental Analysis and Remediation, John Wiley and Sons, 1999.