The Secretary of Energy
Washington, DC 20585

September 2, 1998

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700,
Washington, DC 20004

Dear Mr. Chairman:

We are enclosing a technical update of the Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 94-1. This technical update serves as a framework for supporting a comprehensive implementation plan revision, which we expect to provide to you in December of this year.

This technical update describes the current status and proposed changes to the Department's plans for stabilizing the nuclear materials covered by Recommendation 94-1, described in the February 1995 Implementation Plan in Sections 3.1 through Sections 3.6. We are also including an additional Section 3.0, 94-1 Implementation Plan Revision Planning. It describes the steps that we will take to finalize outstanding integration decisions regarding stabilization activities and incorporate them into the comprehensive revision.

We will continue to keep you apprised of our progress on all Recommendation 94-1 commitments. If you have any further questions, please contact me or have your staff contact Mr. John C. Tseng, Acting Director, Nuclear Materials Stewardship Program Office, at (202) 586-0383.

With best wishes,

Bill Richardson

Bill Richardson

Enclosure

3.0 94-1 Implementation Plan Revision Planning

3.0.1 General Overview

Implementation of the 94-1 program has been an evolving process. There have been many successes and some problems as work toward completing the stabilization actions described in the original Implementation Plan has progressed. Along the way, valuable lessons have been learned, and new, better ideas for mitigating risks to the worker, public and environment have developed. This 94-1 Implementation Plan Technical Update is envisioned as an interim step necessary to sustain the program's momentum while a comprehensive revision is prepared. It describes proposed changes to the existing 94-1 Implementation Plan and describes the processes that will be followed to make integration decisions where appropriate. The comprehensive revision is scheduled for completion by the end of December 1998.

The 94-1 Implementation Plan revision is being prepared within the context of a related effort, the Nuclear Material Integration (NMI) Project. The plans for stabilization called for by 94-1 will form a subset of a much larger plan, currently titled the *Master Materials Management Plan* (MMMP). The MMMP will seek to define risk mitigation processes and the paths to ultimate disposition for all of the nuclear materials for which the Office of Environmental Management (EM) is, and possibly will become, responsible.

The initiatives that follow should not be viewed as additional 94-1 Implementation Plan commitments. They are presented here to provide context to their relationship to the proposed changes in the following sections and the effort to prepare the comprehensive implementation plan revision.

3.0.2 Nuclear Material Integration Project

The ongoing Nuclear Material Integration (NMI) Project is developing integrated, technically-based, life-cycle material management plans for all nuclear materials of interest to EM that will subsequently be incorporated into the *Master Materials Management Plan* (MMMP). The MMMP will support the reduction of overall environmental, safety, and health risks, as well as costs. It will include all materials currently belonging to EM, those belonging to other programs but located at EM facilities or sites, and materials expected to be transferred to EM from other programs by 2015. The materials will include:

- All forms of transuranic isotopes including mixed oxides;
- All forms of uranium and thorium; and
- All other isotopes and nuclear materials including sources and standards.

Specific objectives of the NMI are to define the inventory of all nuclear materials excess to national security or beneficial uses; identify and evaluate baseline disposition paths for the inventoried nuclear materials; identify material integration opportunities and alternative disposition paths to optimize the management of nuclear material; integrate Department-wide analyses of mortgage reduction opportunities; link the material disposition plans to the annual Defense Programs sponsored Nuclear Materials Inventory Assessment; and finally, to produce the Master Materials Management Plan, which will include detailed material-specific management plans with links to additional topical plans such as Stewardship, Research and Development, Transportation, and Facilities which will be developed.

The materials covered by the Recommendation 94-1 Implementation Plan are a subset of the materials to be covered by the MMMP. As the breadth of individual materials management plans is extended to cover management of the materials through disposition, the activities detailed in the Recommendation 94-1 Implementation Plan will form a subset of the actions prerequisite to the disposal or disposition of the 94-1 materials. To facilitate the identification of those activities and materials related to 94-1, the MMMP will separate those materials into distinct disposition paths and indicate the point on each disposition path where stabilization is achieved. In this way accountability for the specific actions required to remediate the safety-related concerns of 94-1 will be maintained. Disposition maps for the 94-1 materials will be included as part of the material management plans.

As a topical plan integral within the Master Material Management Plan, the revised 94-1 Implementation Plan will be subject to annual review and update along with the other Stewardship Program plans in coordination with the annual Nuclear Materials Inventory Assessment.

3.0.3 Transitioning to Master Materials Management

The Master Materials Management Plan is being developed in parallel with working toward successfully completing the Recommendation 94-1 Implementation Plan milestones. The Nuclear Materials Integration Project has identified several recent 94-1 program activities undertaken to better facilitate meeting 94-1 program milestones that will benefit the planning for all of the materials that will be reflected in the MMMP. These activities are prerequisites for, or will be integrated as vital elements within, the Master Materials Management Plan.

Processing Needs Assessment

The Processing Needs Assessment is a Department-wide integration effort undertaken within the past year which was identified in the July 1997 Phased Canyon Strategy for using the F- and H-Canyons at Savannah River. The strategy calls for continuing canyon operations as follows:

- F-Canyon to process PUREX solutions into FY 2000.
- F-Area to remain operational through FY 2002.
- H-Area (HM Process) to remain operational to the end of FY 2003.

The Department has initiated a complex-wide review to ensure that any additional nuclear materials that could conceivably require the use of the Savannah River canyon facilities for stabilization or preparation for disposition are identified. An analysis of the data being collected will be completed by the end of 1998. Studies conducted thus far have identified a limited amount of materials for possible canyon treatment (e.g., plutonium-aluminum alloys and plutonium fluorides at Hanford and classified plutonium parts at Rocky Flats). Feasibility studies that will better define the schedule and cost of canyon processing versus implementing the current baseline for each material are planned. Should the final analysis identify additional materials for which Savannah River canyon processing appears appropriate, appropriate NEPA analysis would be conducted before a decision were made to process the material at the Savannah River Site.

Accelerated Plutonium Shipment

Department-wide inter-site stabilization planning and integration activities include options to accelerate consolidation of plutonium storage. These activities support early closure of the Rocky Flats Environmental Technology Site by FY 2006 and accelerated closure of the Plutonium Finishing Plant at Hanford. The analysis examined the feasibility of consolidating plutonium from Rocky Flats and Richland that is a candidate for stabilization for storage at the Savannah River Site. Savannah River is the preferred site for immobilization activities. Consolidation of the Rocky Flats and Hanford materials there in preparation for immobilization will provide significant cost reduction and non-proliferation benefits. Planning for accelerated shipment is being pursued aggressively, although no materials will be moved until Savannah River Site is chosen as the site for plutonium immobilization.

Several activities that are key to realizing the benefits of accelerated shipment are being concurrently worked:

- The Savannah River Site Actinide Packaging and Storage Facility development program is being expanded to include the potential upgrading of the Savannah River Site's K-Area facilities for interim storage consistent with the amended Record of Decision for *Storage and Disposition of Weapons-Usable Fissile Materials.*

- Design of the K-Area upgrades began in FY 1998.

- Capital expenditure for K-Area upgrades have been included in the FY 1999 budget.

- An environmental review was completed that will support the needed upgrades of the K-Area facilities. An amended Record of Decision for the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* was signed on August 6, 1998.

- Finally, this plutonium will not be shipped unless a decision is made to immobilize this material at the Savannah River Site as part of the *Surplus Plutonium Disposition EIS.* That Record of Decision is expected in February 1999.

Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site

The Rocky Flats plutonium residues and scrub alloy must either be stabilized and stored on site, or be prepared for disposal in the Waste Isolation Pilot Plant or be shipped to the Savannah River Site or the Los Alamos National Laboratory for processing prior to disposition. The *Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* is being prepared to evaluate alternatives for management of these materials, thus providing the basis for determining whether they should be processed to allow their disposal or other disposition. As has been discussed above, the Savannah River Site has many different processing capabilities and is the preferred site for immobilization of surplus weapons-useable plutonium prior to disposal in a deep geologic repository. Los Alamos National Laboratory also has processing capability and may have the capacity to process limited quantities of certain plutonium residues without impacting their ongoing 94-1 milestones or DP mission-related activities.

The choices of processes currently being studied for use at each site have been described in the *Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site.* The Record of Decision is expected to be issued in September 1998. The Environmental Impact Statement provides the basis for determining:

- Whether any processing beyond stabilization for on site storage should be conducted,
- What processing technologies should be used (if any), and
- Where such processing should occur (choosing among Rocky Flats, the Savannah River Site and Los Alamos).

New Storage Standard

Working in cooperation with the Office of Environmental Management, the Nuclear Materials Stewardship Project Office (NMSPO) at the Albuquerque Operations Office is sponsoring the development of a new DOE technical standard for storage of plutonium. This standard will supplement the existing standard, DOE-STD-3013-96, "Criteria for Preparing and Packaging Plutonium Metals and Oxides for Long Term Storage." The existing standard applies to metals and oxides with at least 50% plutonium, which were the materials in greatest need of storage criteria. However, Environmental Management's continued progress in cleaning up DOE sites that formerly produced or processed nuclear materials has created a need for a standard that would address materials with lower plutonium content. The new standard will address stabilization, packaging, and storage of such materials.

The population of materials that must be addressed by the new standard is large and diverse. Consequently, it is important that a comprehensive and systematic approach be taken in its development. Toward that end, a "systems engineering" approach is being used. Major and subordinate functions have been identified, and requirements for those functions have been identified. The new standard is expected to stress quantitative functional requirements, allowing the sites flexibility in selection of processes to meet those requirements.

Work on the new standard (DOE technical standard project number PACK-0011) began in January 1998. A core team was assembled at that time to collect the technical information to support the new standard. A Working Group was convened in March to begin drafting the standard. That work is still underway. At this time, further progress on the specific language in the standard awaits completion of several key research projects. The present goal is to have a draft standard ready for coordination by September so that a final standard can be available by March 1999.

3.1 Plutonium Solutions Stabilization

3.1.1 General Overview

Background

Approximately 412,000 L of Pu-239 solutions existed throughout the DOE complex, primarily at Rocky Flats, Savannah River, and Hanford, at the time the Plutonium Vulnerability Assessment was completed in 1994. These plutonium nitrate and chloride solutions were in the process of being converted to a purified plutonium metal or oxide, or in facility process system hold-up, when the facilities were shutdown. Table 3.1-1 compares the plutonium solutions inventories at the three major sites at the time the original Recommendation 94-1 Implementation Plan was promulgated with the changes in the inventories that have occurred since then. Some changes in total quantities to be stabilized have occurred, primarily due to completion of stabilization requirements and improved inventory accuracy.

3.1.2 Rocky Flats Plutonium Solutions

Note: **The following paragraphs concerning the processing of plutonium solutions at Rocky Flats retain the same plutonium solutions milestone completion dates submitted by the Department on September 30, 1997 and approved by the Board on December 8, 1997. Descriptions of plans and processes for stabilizing the solutions have been updated to reflect current status.**

Plutonium solutions originally existed in Buildings 371, 559, 771, 776/777, and 779, with the majority being in Buildings 371 and 771. Solutions are no longer being stored in Buildings 776/777 and 779. While the remaining solutions await stabilization, several interim measures have been taken to minimize the risks of continued storage. Solutions stored in plastic bottles have been transferred to gloveboxes and vented to decrease the rate of degradation and inspected to identify incipient failures in time to replace the bottles. Building 771 and Building 371 tanks have been drained, and tap and draining of installed systems has been initiated. Access to areas where the potential for leakage from tanks or pipes is strictly controlled. Alarm systems are in place to detect airborne contamination from spills or leaks, and alert personnel. Piping system flanges and valves have been encased in plastic shrink wrap to provide an additional barrier between the solutions and the workers.

All plutonium solutions handling and processing is being done in accordance with a NEPA analysis completed in April 1995. The plutonium in these solutions is surplus to DOE's needs; therefore, Rocky Flats is solidifying as many solutions as possible through cementation. Some higher level solutions will require an additional precipitation step to remove the plutonium from the waste stream in order to meet waste disposal acceptance criteria and waste minimization goals.

Table 3.1-1: Plutonium (Pu-239) Solutions Inventory Summary

Site	Plutonium Content (Kg)	Original Quantity (L)	Original Location	Adjusted Inventory (L)	Adjusted Plutonium Content	Remaining to be Stabilized	Plutoniu Stabilize (Kg)
Rocky Flats	143	30,000	Bldgs 371, 559,771, 776/777, 779	30,000	143 Kg	15,527+ L (as of 6/01/98)	100
Savannah River	Classified	320,000	F-Canyon	--*	--	0	Classifie
Savannah River	Classified	34,000	H-Canyon	34,000	Classified	34,000 L	0
Hanford	358	4,800	Plutonium Finishing Plant	4,690**	341	4,300 L	15
Hanford	9	22,700	PUREX	--	--	0	None***

* Stabilization of F-Canyon solutions by conversion to metal was completed in April 1996.

** Quantity adjusted from EIS bounding case to reflect correct quantity.

*** Neutralization and transfer of PUREX solutions to the tank farms was completed in April 1995.

The solutions that had been stored in Buildings 559, 776/777 and 779 have been transferred to Building 771 for batching or Building 371 for processing as appropriate. Building 559 continues to generate small quantities of low-level waste solutions. Low-level solutions in Building 771, including holdup drained from piping systems and low-points, are being batched and transferred to Building 774 for cementation. Cementing the low-level solutions began in October 1993 and to date over 6,100 L have been solidified. The high-level uranium and chloride solutions have been processed in Building 771 using a hydroxide precipitation method. The filtrates from that process were cemented in Building 774. The high-level (>6.0 gm/L) plutonium solutions in Building 771 tanks have been drained to bottles. The high-level solution bottles have been processed through the Caustic Waste Treatment System in Building 371, which is also a hydroxide precipitation process. The high-level solutions that are compatible with the Caustic Waste Treatment System process will be stabilized with the Building 371 solutions by June 1999. Delays resulting from unexpected conditions encountered during tap and draining of the first process system in Building 771 are expected to impact the current schedules and milestones. Plans are being developed to incorporate additional safety controls (primarily system venting and purging for hydrogen) during further tap and draining activities. Additional work scope is being developed to accelerate removal of process system piping immediately after system draining in Building 771. Detailed schedules are expected to be developed by July 1998, and revised milestones will be recommended for replacing the current milestones as the schedules are being finalized.

The solutions in Building 371 and remaining solutions from other buildings are being treated in the Caustic Waste Treatment System. The precipitate is being calcined and placed in temporary storage awaiting safe interim storage. The effluent is being transferred to Building 374 for further liquid waste processing. The solutions in Building 371 are currently scheduled to be stabilized by June 1999. However, the impact of delays in Building 771 tap and draining may result in processing liquids beyond the current schedule.

The liquid stabilization program will be integrated with current efforts to meet the safe storage criteria, DOE-STD-3013-96 for oxides in an effort to minimize handling the precipitates. However, the liquid stabilization activities will not be delayed to achieve this integration. The oxide, generated prior to obtaining the capability to meet the criteria in DOE-STD-3013-96 will be packaged to meet site storage requirements.

3.1.3 Savannah River Site Plutonium Solutions

Note: **The following paragraphs are the site's proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The currently approved milestone dates, which match the Department's Phased Canyon Strategy, are listed at the end of this section.**

The Pu-239 solutions located in the F-Canyon at Savannah River have been stabilized. Stabilization of the solutions in the H-Canyon remains to be completed. Until the solutions are stabilized the major area of concern is control of solution chemistry. Due to evaporation and radiolysis, solution chemistry requires periodic adjustments to avoid unanticipated concentration or precipitation of boron and ultimately the plutonium compounds, which may increase the potential for inadvertent criticality. Boron was added as a neutron poison and solution chemistry is adjusted to avoid precipitation of the boron and ultimately the plutonium. An increased sampling and surveillance program is in place to detect signs of deterioration. Minor leaks and spills are not a major concern since they will be contained within the canyons and fed back into the tanks without exposing the workers or posing a risk to the environment or public. Corrosion of tank cooling water coils poses a risk of environmental release. This risk is mitigated by the use of in-line radiation detectors and diversion pools, which would be employed in the event of a leak.

The plutonium metal produced by stabilizing solutions in the FB-Line is being packaged through the Bagless Transfer System in inner containers that meet the requirements of DOE-STD-3013-96. Outer container packaging will be completed when the Actinide Packaging and Storage Facility becomes available in FY 2002.

The *Interim Management of Nuclear Materials Environmental Impact Statement* identifies a preferred alternative for stabilization of the Pu-239 solutions in the H-Canyon. The action indicated in the Record of Decision is to process the solution in H-Canyon to remove decay products and other material that would interfere with subsequent stabilization steps followed by transfer of Pu-239 to HB-Line Phase II for conversion to a low-fired oxide. The plutonium oxide will be placed in temporary storage until the capability exists to meet the DOE storage standard.

Based on progress to date toward the multiple facility restarts required to implement the Phased Canyon Strategy, and incorporation of lessons learned from five successful Operational Readiness Reviews, H-Canyon plutonium solution stabilization is expected to begin by June 2000 and completed by September 2001. Safety of continued storage of the H-Canyon plutonium solutions until stabilization is complete has been enhanced through additional sampling and monitoring activities.

3.1.4 Hanford Plutonium Solutions

Note: The following paragraphs are the site's most recent proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. For comparison, the site's original IP milestones are listed at the end of this section.

The solutions at Hanford are located in the Plutonium Finishing Plant (PFP). Until stabilization of solutions in PFP is complete, compensatory measures will remain in effect to minimize the risk to the worker, public and environment. The solutions are stored in vault-type rooms restricting unnecessary worker access. Air in the storage rooms is monitored to assure compliance with Work Place Air Sampling Requirements, and is exhausted through a filtered system. To guard against sparks, every container is electrically grounded and only non-sparking tools are used to open the containers. Additionally, procedures require the workers to wear personal protective clothing and equipment (respirators) during any activity that involves opening the solution containers.

The PFP contains approximately 4,300 L of plutonium-bearing nitrate, chloride, fluoride, caustic, organic, and numerous plutonium solutions with other isotopes. The storage of plutonium solutions in polybottles and product receiver cans at PFP has not resulted in any solution container failures due to leaks or over pressurization caused by radiolysis or acid reactions. The PFP has completed near-term actions that have mitigated some risks associated with the continued storage of plutonium-bearing solutions. Solution containers at PFP are fitted with vent valves to prevent the build up of hydrogen gases. A review of the paper work associated with loading the containers with plutonium-bearing solutions indicated that all vent valves could not be documented as being in the open position. In May of 1995, PFP completed an inspection of all solution containers with suspect vent valve positions. This inspection verified the open position of the vents for the suspect containers. Continued storage of the chloride and fluoride solutions in polybottles was considered to be the greatest risk to container integrity and, therefore, received early attention. Another near-term mitigation activity was the precipitation of the plutonium by magnesium oxide followed by calcination at 1000°C in a muffle furnace of roughly 270 L of chloride and fluoride solutions was completed in September 1995. Approximately 16 containers of plutonium solutions containing hydrochloric acid, stored in PR cans, remain in the PFP solution inventory.

The Plutonium Process Support Laboratories' staff at PFP conducted solution technology development testing that resulted in the selection of direct denitration, via vertical calciner, to stabilize plutonium nitrate solutions and ion exchange as the solution pretreatment process. This solution technology development testing was completed in April 1996.

The PFP selected the vertical calciner to stabilize nitrate solutions. The ion exchange system was selected to pretreat plutonium-bearing solutions. The selection of these solution stabilization processes is consistent with the preferred alternatives identified in the *Plutonium Finishing Plant Stabilization Final Environmental Impact Statement* (PFP EIS) [DOE/EIS-0244-F] Record of Decision (ROD) issued June 1996. The issuance of the PFP EIS-ROD completed a commitment to the Hanford stakeholders to provide an objective technical basis for evaluating alternatives to 1) convert the plutonium-bearing materials at the PFP into a more stable, safer form; 2) reduce radiation exposure to PFP facility workers; and 3) reduce the cost of maintaining PFP and its contents.

Activities required to support the installation of the vertical calciner and stabilization of plutonium-bearing solutions in PFP were placed on hold in December 1996 pending resolution of conduct of operations issues. Hanford has proposed to begin stabilization of plutonium-bearing solutions in PFP in November 2000 after successful completion of an Operational Readiness Review consistent with DOE Order 425.1. Solution stabilization will take approximately 26 months. The resulting product will be an oxide heated to 1000°C, and greater than 50 wt % Pu. The oxide will be packaged in compliance with interim storage criteria until the stabilization packaging system (SPS) is available for repackaging into DOE-STD-3013-96 containers. The proposed Hanford schedule indicates completion of solution stabilization in December 2002. Hanford is examining acceleration of this schedule through use of the existing pilot scale calciner, which was used during technology development testing. The sites proposal to delay processing of its remaining solutions is being evaluated by DOE

PUREX had approximately 22,700 L of solution containing 9 kg of plutonium and 5 t of uranium. These solutions were neutralized, and beginning in June 1994, transferred into the double-shell waste tanks at the tank farms. The PUREX solution transfers were completed in April 1995.

3.1.5 Key Milestones

The following is list of the key milestones for stabilizing Pu-239 solutions. This is not intended to be an all encompassing list of milestones, but rather milestones that can be used as a rough measure of progress.

For Rocky Flats:	Original Due Date	Milestone/Status
• Begin cementing low concentration solutions in B774	October 1993	Completed October 1993
• Complete NEPA process (for solutions) - Actinide Solution Processing Environmental Assessment, dated 4/95)	April 1995	Completed April 1995
• Stabilize all solutions in B771	September 1998	Deleted
• Stabilize all solutions in B371	June 1999	Deleted
Building 771 Milestones		
• Start draining hydroxide tanks and begin processing	November 1996	Completed November 1996
• Complete draining four (4) hydroxide tanks	January 1997	Completed August 1996
• Complete hydroxide precipitation process	March 1997	Completed March 1997
• Start draining four (4) high level tanks* and begin processing (This milestone has been changed from five high level tanks to four high level tanks, since the first tank has been drained, and was less than 6 gm/L.)	November 1997	Completed September 1997
• Complete draining four (4) high level tanks	New milestone	Due/completed in December 1997
• Start tap and draining of rooms/system	New milestone	Due/completed in January 1998
• Complete processing liquids from high level tank and bottles	May 1998	Deleted
• Complete processing all liquids in B771	September 1998	Deleted
• Complete removal of all liquids in building	New milestone	September 1998

For Rocky Flats:	Original Due Date	Milestone/Status
Building 371 Milestones		
• Start draining tanks and begin processing	December 1996	Completed December 1996
• Complete draining six (6) Cat. B tanks	February 1997	Completed February 1997
• Complete draining two (2) criticality line tanks	June 1997	Deleted
• Complete draining one (1) criticality line tank	New milestone	Completed May 1997
• Complete processing liquids from eight (8) tanks	June 1997	Deleted
• Complete processing liquids from seven (7) tanks	New milestone	Completed June 1997
• Complete processing liquids from Building 771 high level tanks and bottles	New milestone	Due/completed July 1998
• Complete processing all B371 liquids	June 1999	Deleted
• Complete processing all liquids in B371 and B771	New milestone	June 1999
• Complete draining of remaining criticality line tank	New milestone	Completed February 1998
• Start tap and draining of rooms/systems	New milestone	Due/completed June 1998

Savannah River Site

F-Area:

ROD issued for F-Canyon Plutonium Solutions EIS . . . . Completed February 1995
Began F-Canyon processing operations . . . . Completed February 1995
Convert F-Canyon plutonium solutions to metal . . . . Completed April 1996

H-Area:

ROD issued for H-Canyon solutions section of Interim Management of Nuclear Materials EIS . . . . Completed September 1996
(Modified ROD issued October 1997)
Begin H-Canyon plutonium solution stabilization . . . . April 1999*
Complete H-Canyon plutonium solution conversion to oxide . . . . March 2000*

Hanford PFP

Plutonium Finishing Plant (PFP) solutions:

ROD issued for PFP Clean-out and Stabilization EIS . . . . Completed June 1996
Complete technology development . . . . Completed April 1996
Begin processing solutions . . . . June 1997**
Complete processing remaining 4,300 (of 4,800) L . . . . January 1999**

PUREX solutions:

Begin transfer to tank farms for disposal . . . . Completed June 1994
Complete transfer of 22,700 L to tank farms . . . . Completed April 1995

* Original Implementation plan dates for starting and completing H-Canyon solution Stabilization were February 1999 and February 2000 respectively. The current milestone dates are in accordance with the Savannah River Phased Canyon Strategy, which was accepted by the Board in their letter dated April 15, 1998.

** These completion dates may be delayed in the forthcoming December 1998 Implementation Plan change.

3.2 Plutonium Metals and Oxides (> 50% assay)

3.2.1 General Overview

Background

The DOE currently manages large quantities of plutonium metal and oxide, which are not adequately packaged for long-term storage. In general, the metal and oxide exists in several grades and forms, and are packaged in a multitude of configurations, most of which were prepared a number of years ago and are not suitable for long-term storage. Tables 3.2-1 and 3.2-2, respectively, summarize the quantities of plutonium metals and oxides identified as needing repackaging in the original 94-1 Implementation Plan and the number of items known to still require attention. Additional materials will be generated at processing sites from the stabilization of other material forms.

3.2.2 Rocky Flats Plutonium Metals and Oxides

Note: **The following paragraphs concerning the processing of plutonium metals and oxides at Rocky Flats support the original milestone to repackage all metal and oxide by May 2002. Descriptions of plans and processes for stabilizing the materials have been updated to reflect current status.**

Several activities have been or are being implemented at Rocky Flats to reduce the risk associated with plutonium metals and oxides until they can be placed in a form suitable for long term storage. The material has been consolidated into vaults with access limited to essential personnel equipped with protective clothing and respirators. Movement of containers is strictly controlled. The vaults are constructed with air monitors, alarms, and ventilation systems that are designed to minimize the spread of contamination and protect the worker.

All plutonium metal items that were not in compliance with the Site storage requirements (i.e., HSP 31.11) have been physically inspected. Originally, 1,858 items were identified as not in compliance; of these 256 items were suspected of being packaged in direct contact with plastic. Each one of these was opened, brushed, and repackaged by November 1995. An additional 100 items within the 1,858 total were later identified also to be suspect; these were repackaged by May 1997. The remaining items were brushed and repackaged by December 1996. All generated oxide, plus the existing backlog of unstabilized oxide, underwent thermal stabilization. All brushing and subsequent thermal stabilization activities occurred within Building 707.

At this time, all plutonium metal and oxide is in compliance with the storage requirements of HSP 31.11. For metal, there is a surveillance requirement of periodic weighing (every two years for unalloyed plutonium, every five years for alloyed plutonium) to detect a weight gain that would indicate the formation of potentially pyrophoric oxide. Oxides can be stored in inert atmospheres for limited time periods, or be thermally stabilized and stored indefinitely.

Table 3.2-1: Plutonium Metals

Site	Original SNM Inventory (kg)	Original Number of Items	Original Locations	Adjusted Number of Items	Remaining to be Stabilized
Rocky Flats	6,600	3,403	371, 559, 707, 771, 776/ 777, 779,991	3,403	3,403
Hanford	700	350	PFP, PNL*	352 (Note 2)	339
Los Alamos	1133	2000	TA-55, CMR, TA-18	0 (Note 3)	n/a
Savannah River	Classified	450	FB-Line, 235F, SRTC	450	450
Argonne-West	**	**	ZPPR, FMF, 752	**	**
Argonne-East	0.45	210	205, 212, 315	210	210
Lawrence Livermore	20	250	B 332	91*** (Note 4)	91
Mound	0.855	20	T, SW\R	20	0
Oak Ridge	0.3013	30	3027, 3038, 5505	30	30
Sandia	6.7	5	NMSF	5	5

* PNL had 254 packages of metal/oxide/residues in addition to the 350 shown for PFP.

** The major holdings are about 2,600 containers of metals/oxides.

*** Material in excess of programmatic needs.

Notes:
1. Material storage consolidat
2. 350 in original Implementat number.
3. See Section 3.2.5.
4. Programmatic activity has g and/or used some material v program, e.g., the Immobili some material for testing.

Table 3.2-2: Plutonium Oxides (> 50 % Assay)

Site	Original SNM Inventory (kg)	Original Number of Items	Original Locations	Adjusted Number of Items	Remaining to be Stabilized
Rocky Flats	3,200	3,296	371, 559, 707, 771, 776/ 777, 779,991	3,296	3,296
Hanford	1,500	2,500	PFP, PUREX, PNL*	2,611[2]	2,611
Los Alamos	721	2,000	TA-55, CMR, TA-18	0[3]	0
Savannah River	Classified	550	FB-Line, HB-Line, 235F, SRTC	950[4]	950
Argonne-West	**	**	ZPPR, FMF, 752	**	**
Argonne-East	0.48	695	200, 306, 315	695	695
Lawrence Livermore	102	154	B 332	92[5]	92
Mound	28.132	107	T, SW\R	107	0
Oak Ridge	1.706	83	3027, 3038, 5505, 7920, 7930, 9204-3	83	83
Lawrence Berkeley	0.014	354	70, 70A, 70-147A	354	354
Sandia	1.4	10	HCF, ACRR, NMSF	10	10

* PNL had 254 packages of metal/oxide/residues.

** The major holdings are about 2,600 containers of metals/oxides.

*** Material in excess of programmatic needs.

Notes:
1. Material storage consolidated to list
2. Better split between oxides >50% a
3. See Section 3.2.5.
4. More accurate inventory and chara
5. Programmatic activity has generate some material which was in the orig Immobilization Program used some

In order to meet DOE STD-3013-96, the long term storage standard, a packaging system with manual furnaces will be installed in Building 371. The system will feature the capability to brush loose oxide from metal, stabilize the oxide to meet the 0.5 percent LOI requirement, and package both metal and oxide in a welded stainless steel container, which is sealed within a second welded stainless steel container.

The Department of Energy is evaluating the possibility of accelerating the shipment of plutonium metal and oxides at Rocky Flats to the Savannah River Site (SRS) to allow accelerating Site closure from 2010 to 2006. The K-Area at SRS would be modified to allow storage of Rocky Flats' plutonium until disposition. The accelerated shipping scenario begins shipments to SRS in January 2000 and completes the shipping in June 2002. Adoption of this scenario is dependent on the selection of Savannah River as the site for immobilization as part of the *Surplus Plutonium Disposition Environmental Impact Statement*. The Record of Decision for that EIS is expected in February 1999.

Scrub alloy, an alloyed button of plutonium and americium from the scrubbing of salts from the molten salt extraction process, is being evaluated for shipment to Savannah River for processing in F-Canyon in the *Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy at the Rocky Flats Environmental Technology Site*. Processing of scrub alloy at Savannah River allows the americium to be extracted to the high-level waste processing system, and the by-product metal to be packaged to the long-term storage standard. A Record of Decision for that EIS is expected in September 1998.

3.2.3 Savannah River Plutonium Metals and Oxides

Note: **The following paragraphs concerning the processing of plutonium metals and oxides at Savannah River support the original milestone to repackage all metal and oxide by May 2002. Descriptions of plans and processes for stabilizing the materials have been updated to reflect current status.**

Savannah River has approximately 1,000 containers of high purity plutonium solids stored in F-Area vaults. Each container holds at least 100 g of fissile material that is predominantly Pu-239 with minimal impurities. The stored material includes alloys, compounds, oxides, and large metal pieces. Savannah River had accumulated these high grade plutonium solids as a result of both F-Area facility operations and shipments received from other DOE sites. These materials were stored in a variety of containers within F-Area vaults and present extended storage concerns because of their physical condition. The degree of concern varies depending on the material form and packaging configuration. Additionally, approximately 200 containers of high quality metal and oxide will be produced from the stabilization of solutions, targets, and residues and will also require packaging and treatment to meet the metal and oxide storage standard. The objective is to ensure that all pre-existing plutonium solids (metal and oxide) are in conformance with the DOE metal and oxide standard by May 2002.

Based on screening evaluations performed in support of the *Interim Management of Nuclear Materials Environmental Impact Statement*, these materials were identified as candidates for stabilization primarily due to the presence of plastic in the packaging. The EIS contains an evaluation of options for stabilizing these materials. The ROD issued in December 1995 provided the Department's decision to stabilize and/or repackage these materials.

Based on material and packaging information available in 1995, 12 containers of metal turnings where plutonium metal was in direct contact with plastic have been repackaged. These materials will be dissolved and processed to metal using the F-Canyon and the FB-Line facilities.

Several activities are underway to reduce the risk until the remainder of the material can be repackaged. Design features of the vault (e.g., monitors, ventilation, limited access, etc.), and radiological controls and procedures are in place to minimize the worker risk in the event of a container failure. Surveillance and monitoring programs include statistical sampling to check for weight gain and visual checks for bulging. To select the required treatment and the priority for treatment, the containers will be non-destructively characterized using digital radiography equipment. Sampling of containers using existing gloveboxes will also be performed as warranted.

A new Actinide Packaging and Storage Facility that will include the capability to repackage plutonium to meet the metal and oxide storage standard is being constructed. This facility, which will be available in FY 2002, incorporates bagless transfer and high temperature calcination technology for treating plutonium materials to meet the metal and oxide storage standard. This facility will include a new vault to permit consolidation of plutonium materials into a facility suitable for extended interim storage and facilitate international inspections.

To demonstrate the technology and to provide an interim capability to meet the metal and oxide storage standard where practical, Savannah River completed installation of a bagless transfer system in the FB-Line facility in August 1997.

3.2.4 Hanford Plutonium Metals and Oxides

Note: **The following paragraphs are the site's most recent proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. For comparison, the site's original IP milestones are listed at the end of this section.**

This material category includes the current inventory of approximately 2,963 items of plutonium metals and oxides stored at the Plutonium Finishing Plant (PFP). The inventory of approximately 352 plutonium metal items (typically fuels grade) is considered unstable due to the formation of plutonium hydrides and plutonium nitrides even though the plutonium metal was not stored in close proximity to plastic. The inventory of approximately 2,611 items of plutonium oxides is considered safe for interim storage pending restabilization and repackaging to DOE-STD-3013.

PFP's vault monitoring program has proven highly successful at identifying issues related to the storage of plutonium metals and oxides early enough to allow remedial actions to be taken before a container fails. The monitoring program is geared towards the detection of container deformation (bulging) and in most storage locations temperature increases. The monitoring program placed on top of the PFP's interim stabilization and storage criteria has prevented container from failing in storage resulting in a contamination spread for almost 19 years. PFP's thermal stabilization criteria for oxides called for heating to 450°C or greater for items packaged between 1981 and October 1995, and heating to 950°C or greater for items packaged after October 1995. Stabilized oxides were placed in food pack cans with a minimum of two contamination barriers. Prior to 1981, the storage criteria was not rigorously applied.

PFP has supplemented the vault monitoring program described above with a radiography program. This program has identified concerns with containers packaged prior to 1981. These concerns included plutonium metal in direct contact with and in close proximity to plastic, apparent corrosion of inner containers, plutonium stored in single contamination barrier packages, badly corroded plutonium metal, deformation (paneled or sucked in) of the inner most can (material container) on plutonium metal packages. Following radiography, some of the items were opened and stabilized. During opening of one of the plutonium metal items, an energetic reaction was observed and captured on video tape. Upon reviewing this reaction in slow motion, the reaction was determined to be the ignition of plutonium hydrides, plutonium nitrides, and small fines of plutonium metal.

Based on the discovery of significant quantities of plutonium hydrides and nitrides, PFP has determined that its entire inventory of plutonium metal must be stabilized on a high priority basis. Concern also exists that some of PFP's plutonium alloys may also exhibit similar hydride formation. PFP will, therefore, initiate thermal stabilization of plutonium metals using the two existing muffle furnaces in the 234-5Z Building. Stabilization will begin following the successful completion of an Operational Readiness Review (scheduled to be completed November 1998) and will take approximately 12 months. The resultant oxides will be packaged to PFP vault storage specifications pending availability of the PuSAP system (scheduled to be operational in October 2000) for packaging to DOE-STD-3013. Plutonium alloys exhibiting signs of hydride formation will be stabilized after plutonium metals. All repackaging is expected to be completed by July 2005.

Restabilization of plutonium oxides is a lower priority task than stabilization of plutonium metals, solutions, and selected alloys. The oxide stabilization campaign will need to wait until the PuSAP system is operational. The PuSAP system (Line Item Project W-460) is currently in the design phase. The system will be installed in the 2736-ZB Building and is scheduled to be completed in June 2000; start-up is scheduled for October 2000 following the successful completion of an Operational Readiness Review. Approximately 20 percent of PFP's inventory of plutonium oxides may not be suitable for stabilization through the PuSAP system. These oxides are scheduled for stabilization in the muffle furnaces in the 234-5Z Building. Oxide stabilization and packaging (including the repackaging of all plutonium oxides resulting from the stabilization of plutonium metals, alloys, solutions, polycubes and other items) is scheduled to be completed by July 2005.

NEPA documentation is in place for stabilization of plutonium bearing materials at PFP. Supplemental NEPA and air permitting documentation will be provided, as required, to support the installation and start up of the PuSAP System in the 2736-ZB Building as part of the W-460 project.

The following options are under consideration for this material category and will be addressed in the "Overall PFP Program Plan" to be developed by the site:

- Purchase of additional muffle furnaces to maximize through-put and increase system reliability.

- Shipment of plutonium oxides containing high levels of chloride to LANL for stabilization.

- Shipment of plutonium oxides containing fluorides, plutonium fluorides, and plutonium alloys to SRS for stabilization.

- Cementation and discard of plutonium oxides that are not suitable for transfer to LANL or SRS for stabilization and are not suitable for immobilization under the Materials Disposition Program.

3.2.5 Los Alamos Plutonium Metals and Oxides

Note: **Based on changing mission requirements for materials at the Los Alamos National Laboratory (LANL), the requirement to package all plutonium metal and oxide to a long-term storage configuration is no longer being applied to material at LANL. This decision was discussed with the Defense Nuclear Facilities Safety Board in April 1998.**

Metal Disposition

Los Alamos National Laboratory will continue to prepare weapons-grade plutonium metal for temporary storage in a fashion that will continue to address the potential worker-safety issues of improper packaging while still making the metal available for programmatic use if required. The items will be inspected, the oxide separated from the metal, and the metal will be encapsulated. In all cases, the temporary storage system adopted for weapons-grade plutonium metal will meet or exceed the safety requirements currently in effect (by written operating procedure) for existing packaging systems used for storage of materials in the TA-55 vault. To accommodate this change in end-state requested by DOE, the metal items will be packaged according to the following graded criteria:

- LANL plans to use a full DOE-STD-3013-96 package to store strategic reserve weapons-grade metal, excess weapons-grade metal, and non weapons-grade metal. Currently, LANL has generated about 100 packages meeting the STD-3013-94 criteria. Since the majority of this material is not currently assessed as excess to programmatic needs, nor is it destined for transfer to another site, LANL has no plans to repackage these items to meet DOE-STD-3013-96.

- To preserve the metallic state of metal feed for pyrochemical purification and manufacturing, LANL will use either reusable flanged containers with disposable knife-edge gaskets (ConFlat containers), or the welded inner STD-3013-94 storage container inside a bagout bag and a reusable secondary container suitable for vault storage. The preferred temporary storage container for metal feed for manufacturing is the ConFlat system.

Oxide Disposition

Preparing plutonium oxide for temporary storage consists of collecting the oxide from the burning of plutonium metal; from the separation of oxide during inspection, consolidation, and brushing of plutonium metal items; or from the recovery of plutonium as oxide from residue sources. Thermal stabilization will be performed on the oxide to assure complete oxidation of occluded metal fines if the source of the oxide is metal. Stabilized oxide will not be encapsulated for temporary storage as planned for the metal, but will be packaged in a system acceptable, by written procedure, for storage in the LANL vault. The current LANL vault packaging configuration consists of a stainless steel slip-lid material container (or equivalent) enclosed in a bagout bag, and finally contained in a stainless steel slip-lid secondary container (or equivalent). Vault personnel have stopped allowing galvanized or tin-plated mild steel cans for routine use as any container, and are pursuing the development and procurement of reusable stainless steel containers that have threaded closures equipped with radionuclide filter vents. LANL expects these containers to be available for routine use within the next 2–3 years.

Los Alamos will follow the fundamental requirement of the 94-1 Recommendation in addressing the worker-safety issues surrounding the packaging and storage of legacy materials. However, regarding the *temporary* packaging and storage of oxide and metal, the Laboratory will adopt and follow a path that provides an adequate level of safety considering the intended use of this material. In all cases, the temporary storage system adopted for either metal or oxide will meet or exceed the safety requirements currently in effect (by written operating procedure) for existing packaging systems used for storage of materials in the TA-55 vault. In the event plutonium metal or oxide packaged in a temporary storage system is determined to be excess to programmatic needs, it will be packaged for long-term storage according to DOE-STD-3013.

3.2.6 Lawrence Livermore Plutonium Metals and Oxides

Note: The following paragraphs concerning the processing of metals and oxides at Lawrence Livermore National Laboratory retain the same milestone completion dates submitted by the Department on July 21, 1997, and accepted by the Board on September 2, 1997. Descriptions of plans and processes for stabilizing the materials have been updated to reflect current status.

Lawrence Livermore National Laboratory (LLNL) has metal and oxide material in active programs in support of Defense Programs missions. The excess plutonium metal inventory includes about 91 containers that all use the aluminum foil barrier system. The plutonium oxide inventory consists of 92 containers. These materials are located in Building 332, which is a fully functioning plutonium processing and handling facility that meets federal, state, and local environmental regulations as outlined in the LLNL Environmental Impact Statement.

A project to ensure adequate packaging knowledge of all plutonium items (metal, oxide and residues) in inventory is identified in the plutonium ES&H Corrective Action Plan (LLNL/B322-02). This plan is in-process and was scheduled for completion by October 1997, however, a suspension of activities in Building 332 due to a criticality safety infraction is expected to delay completion until January 1999. In April 1995, Lawrence Livermore began to inspect all metal items to assure that none were in direct contact with plastic. This inspection was completed in November 1995, concluding that no items were in direct contact with plastic. Excess plutonium metal items are scheduled to be repackaged in compliance with DOE-STD-3013-96 by 2002.

LLNL has the means to repackage excess plutonium metal and oxide in compliance with the standard; however, the site is procuring a bagless transfer system incorporating improved methods for repackaging metal, and transferring and calcining oxide. These improved methods could reduce operator radiation exposure and potential worker contamination during decontamination of the storage cans. The bagless transfer capability was scheduled to be established in September 1997, but repackaging is not expected to begin until October 2000 due to delays in procurement of the equipment. Repackaging of material to meet the metal and oxide storage standard will be completed by May 2002.

3.2.7 Other DOE Site Plutonium Metals and Oxides

Many DOE sites that have small quantities of plutonium with a combined inventory less than 5 kg— most in the form of sealed sources. Metal, oxide, and solutions make up the remainder. Under this implementation plan, all metals and oxides that are excess to programmatic need will be considered for consolidation at the larger sites that have, or will have, capabilities for processing and repackaging the materials to the metal and oxide storage standard. This consolidation is being coordinated through the Nuclear Materials Integration Program.

3.2.8 Key Milestones

- Repackage all plutonium metals in direct contact with plastic:
  RFETS .... Completed November 1995
  RFETS additional items identified and repackaged .... Completed May 1997
  SRS (repackaging of metal turnings) .... Completed November 1995
  Mound .... Completed September 1996

- Thermally stabilize all existing backlog reactive plutonium oxide:
  RFETS .... Completed January 1997

- Conduct a sampling and inspection program to determine the relative risk and priority for repackaging plutonium metals and oxides in close proximity with plastic and other synthetic materials:
  RFETS .... Completed September 1995

- Repackage plutonium metals and oxides in close proximity with plastic depending on risk:
  RFETS . . . . Completed December 1996
  Stabilize all newly generated plutonium oxide . . . . Ongoing

- Repackage all plutonium metals and oxides to DOE-STD-3013-96:
  All sites . . . . May 2002

3.3 Plutonium Residues and Mixed Oxides (< 50% assay)

3.3.1 General Overview

Background

The DOE currently manages a significant quantity of bulk materials contaminated with significant quantities of plutonium, defined as solid process residues. The residues represented feedstock and materials-in-process to nuclear weapon fabrication and nuclear material production until fabrication ceased in 1989. The residues had been contaminated by materials such as impure oxides and metals, halide salts, combustibles, ash, dissolver heels, sludges, contaminated glass and metal, and other items. Since 1989, these residues have remained in packages in processing areas, vaults, and process lines awaiting disposition. They are not currently in a configuration suitable for long-term storage. Processing, treatment, stabilization, and/or repackaging are required to secure them in a safe, stable end-state. Table 3.3-1 summarizes the quantities of solid residues and mixed oxides (<50% assay) at the various DOE facilities.

3.3.2 Rocky Flats Plutonium Residues

Note: **The following paragraphs are the site's most recent proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. For comparison, the site's proposed and currently approved IP milestones are listed at the end of this section in Table 3.3-2.**

Background

The Rocky Flats Environmental Technology Site has an inventory of approximately 106 t of residues packaged in 3,930 55-gallon drums and 3,950 containers. These residues contain approximately 3 t of plutonium and are stored in buildings 371, 707, 776, 777 and 771. The following plans reflect the preferred alternative that DOE specifies in the *Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site (DOE/EIS -0277F,* currently under preparation). Two Records of Decision are expected to be issued by DOE following the release of the EIS.

Pyrochemical salts, graphite fines and incinerator ash have been considered to represent a safety risk to Site workers due to a potential for fire, explosion and degraded packaging integrity. The majority of the pyrochemical salt residues were originally classified as high risk. As a result, plans were developed to stabilize this material. Subsequent characterization results indicate that the hazards once associated with these materials are non-existent. Plans for the direct disposal to an appropriate storage repository are being developed for this material.

Table 3.3-1: Summary of Plutonium Residue and Mixed Oxides (<50% Assay)

Site	Original SNM Inventory (Kg)	Original Number of Items	Original Locations	Adjusted Number of Items	Number of Items Remaining to be Stabilized	Remaining Items' Locations
Rocky Flats	3,000	20,532	371, 559, 707, 771, 776/777, 779,991	20,532	7,840	371, 707, 771, 776, 777
Hanford	1,500	5,000	PFP, PUREX, PNL	4,034[1]	3,977	PFP
Los Alamos	1,400	6,300	TA-55, CMR	7,327[2]	4,757	TA-55, CMR
Savannah River	Classified	1,306	235-F, FB-Line, SRTC	1,216[3]	1,066	235-F, FB-Line, SRTC
Lawrence Livermore	35	182	B332	202[4]	202	B332
Mound	3	39	T Building	39	0	N/A
Argonne-East	<1	12		12	12	
Oak Ridge	0.1	12	3027, 7930	12	12	3027, 7930
Lawrence Berkeley	<1	250		250	250	

Notes:
1. Adjusted split between residues and oxides >50%.
2. Additional items were identified as needing stabilization.
3. More accurate inventory and characterization of material.
4. Programmatic activity has generated new material and/or used some material which was in the original program, e.g., the Immobilization Program used some material for testing.

Table 3.3-2: Crosswalk between current RFETS residue path forward and original DNFSB 94-1 IP

Residue / Quantities / IDCs	Path Forward	Crosswalk from original 94-1 IP
1. ***Direct Repack Salts*** **15,661 kg** IDC's 363, 364, 404, 405, 406, 407, 408, 409, 410, 411, 412, 414, 415, 416, 418, 426, 429 433, 434, 435, 473, 654, and low assay portions of IDCs 365, 413, 427	Repack into the pipe component and ship to WIPP (must pyro-oxidize the following IDCs: 365, 413, 414, 415, 427, 434, 473, 654; pending analysis of sample result, may have to pryo-oxidize the following IDCs: 412, 416, 426, 433, 435: must take additional samples to prove 95/5% confidence level for the following IDCs: 405, 406, 407, 409,411,418,429)	1. IDCs 333, 655 and 044 moved to the ash category 2. IDC 443, in figure 3.3-2 of the original 94-1 IP is a typo (should have been 433) and does not exist.
2. ***Salts with plans for further processing for safeguard reasons*** **306 kg** high assay portions of IDC's 365, 413 427; may also include IDC 417 (previously not included in 94-1 populations)	Pyro-oxidize and ship to LANL for Pu separation	3. Previously grouped with other salts
3. ***Ash*** **24, 509 kg** IDC's 044, 310, 333, 368, 372, 373, 374, 378, 419, 420, 421, 422, 423, 428, 601, 655	Size reduce, if necessary, and repack into the pipe component and ship to WIPP (IDC 333 will be stabilized)	4. SSC IDCs are reported as a separate category (387, 390, 391, 392, 393, 394, 395, 396, 398) 5. IDC 089 has been moved to combustibles category. 6. IDC 312 has been moved to dry repack category
4. ***Sand Slag and Crucible residues*** **3359 kg** IDC's 387, 390, 391, 392, 393, 394, 395, 396, 398	Repack and ship to SRS for Pu recovery	7. All SSC IDCs previously included in ash bucket.
5. ***Fluoride residues*** **316 kg** IDC's 090, 091,092, 093, 097	Repack and ship to SRS for Pu recovery	8. All fluoride IDCs previously included in wet/misc residue bucket.
6. ***Combustible residues*** **23,061 kg** IDCs 089, 099, 290, 291, 292, 299, 330, 331, 331G, 332, 335, 336, 337, 338, 339, 340, 341, 342, 376, 430, 431, 441, 490, H61	Treat for nitrate or organic contaminants, if necessary, or otherwise treat, and package for shipment to WIPP (Leaded rubber gloves, IDCs 339 and 341, have already been washed; IX resins, IDC 430 and 431 have been rinsed and will be cemented for WIPP)	9. Combustible and Wet miscellaneous categories have been combined to a single Combustible category. 10. IDC 373 has been moved to ash category 11. IDCs 301, 485, 486, 489 have been moved to the Dry Repack category
7. ***Dry Repack residues*** **39,328 kg** IDC's 197, 300, 301, 303, 312, 320, 321, 334, 360, 370, 371, 377, 438, 440, 442, 479, 480, 484, 485, 486, 489	Size reduce, declassify, if necessary, and repack for shipment to WIPP	12. IDCs previously categorized as Inorganic
9. **Other** **78 kg** IDCs 050, 080	IDC 080 will be packaged in 3013s	13. IDC 050 (skulls) have been dispositioned and no longer exist.

Characterization Insights

During 1997 and 1998, extensive characterization of the Rocky Flats residues was completed. For pyrochemical salts, characterization data indicates that there is an 80 percent confidence that a hazard exists in no more than 15 percent of the population. To reclassify these residues as low risk, additional characterization samples will be obtained to achieve a 95/5 percent confidence level. The results of these additional analyses are expected to be consistent with the data acquired to date, therefore, DOE expects that these materials will be classified as low-risk residues and disposed of without stabilization. Eight salt Item Description Code (IDC) residues have been characterized to the 95/5 percent confidence level, which supports reclassification as low risk residues.

Graphite fines were also considered to be high risk; however, characterization has been completed to a 95/5 percent confidence level that these materials are low risk. Incinerator ash and related residues with the exception of IDC 368 (MgO crucibles) were considered to be medium risk residues. Venting of the drums eliminated the only postulated hazard, accumulation of flammable gases and, therefore, incinerator ash and related residues can be considered low risk. In addition, characterization data at the 80 percent confidence level is nearly complete for incinerator ash and related residues and is confirming the absence of hazardous properties. Upon reclassifying high risk residues to low risk residues, the basis of reclassifying will be forwarded to the Board by the Department of Energy.

Implementation Plan Schedule Accelerations

Previous versions of the Implementation Plans did not support closure at the Rocky Flats Environmental Technology Site by 2006. For most categories of residues, some form of stabilization or separation was required for interim storage requirements, disposal requirements, or to meet termination of safeguards. Through characterization, innovations such as the pipe component, safeguards termination variances, and process refinements, acceleration in schedule has been possible. As a result, significant improvements in the IP milestone dates are proposed and the plan is now integrated to support Site closure. These improvements are dependent on safeguards termination variances being approved and the Rocky Flats Residues EIS/ROD being finalized.

Salts

The salt stabilization/repackaging activity has been accelerated from July 2001 to July 2000 through characterization and the use of the pipe component based on approval to terminate safeguards and the Residues Record of Decision being finalized by October 1998. Additionally, the removal and disposal of salts has been accelerated from 2006 to 2003. Under the Residues EIS preferred alternative, most salts will be blended as necessary to be below the 10 percent plutonium concentration limit, then repackaged into containers and placed in pipe components.

Graphite Fines and Ash

The repackaging of graphite fines and ash residues has been accelerated from May 2002 to December 2000 through characterization, and the use of the pipe component based on approval to terminate safeguards and the Residues Record of Decision being finalized by

October 1998. As with salt residues, the removal and disposal has been accelerated from 2006 to 2003. Under the Residues EIS preferred alternative, graphite fines and ash will be blended as necessary to be below the 10 percent plutonium concentration limit, then repackaged into containers and placed in pipe components.

Wet Combustibles and Dry/Repack

Under the Residues EIS preferred alternative, the wet combustibles would be washed with a neutralizing solution, excess liquid would be removed by filtration, and the remaining residues would be dried either by mixing with an absorbent material or by drying at low temperatures. Dry combustibles do not require stabilization but must be repackaged to meet interim safe storage criteria and disposal criteria. Removal and disposal has been accelerated from 2006 to 2004 by accelerating shipping of other residues to Waste Isolation Pilot Plant (WIPP), and by minimizing schedule risk through recharacterization and the implementation of additional repackaging stations.

Terminating Safeguards to Avoid Further Processing

Following dissemination of guidance by the Department of Energy for terminating safeguards on nuclear material, additional processing requirements were identified to either reduce the plutonium content of the residue or to make plutonium recovery more difficult in order to meet these Safeguards Termination Limits (STL). The Rocky Flats Environmental Technology Site has requested authority to terminate safeguards on selected salt, combustibles, dry/repack residues, graphite fines and incinerator ash without conducting this additional processing. With the implementation of additional safeguard controls and through lowering of the plutonium concentration during repackaging, a sufficient level of safeguards protection can be provided to these residues during the disposal process to WIPP. If approved and reflected in the Residues Record of Decision, over 40 t of residues can be considered as immediate candidates for repackaging for direct disposal at WIPP as transuranic waste.

Packaging Residues Into a Pipe Component

The DOE response to the Defense Nuclear Facilities Safety Board Recommendation 94-3 required that a strategy be developed to reduce risk to the public and to the worker from highly dispersible residues. The strategy, developed in April 1997, was to place dispersible residues into the pipe component. The strategy was based on testing of the pipe component at the Sandia National Laboratory using the Department of Transportation required testing for Type B shipping containers. This testing and a nuclear safety evaluation concluded that transuranic waste in a pipe component could be excluded from the material at risk associated with a seismic event. Thus, the expeditious repackaging of residues into pipe components prior to shipment to WIPP provides an additional measure of safety with regard to their storage, handling, transportation and disposal. This method of direct disposal of residues that are classified as low risk in a pipe component and have had safeguards terminated has been named the "Pipe and Go."

Although initial analyses indicate that salt residues can be classified as low risk, small quantities (nominally 1 wt%) of metallic species have been detected in approximately 50 percent of the salt residues sampled. The amount of elemental metals that can be contained within a pipe component and undergo instantaneous oxidation without compromising the O-ring gasket has been assessed. With one exception (IDC 333, Calcium Metal), all candidate IDCs for the Pipe and Go option can be safely contained within a pipe component without consequence. IDC 333 will be stabilized.

Direct repackaging of residues that have been classified as low risk and have had safeguards terminated yields several meaningful benefits: significant cost savings: the ability to accelerate closure of Rocky Flats by reducing residue processing time by two years; reduction in exposure of operating personnel to radioactive and hazardous materials; reduction in worker risk associated with industrial operations; reduction in the risk to the public through accelerated disposition of dispersible material; and the elimination of environmental hazards and emissions. Waste shipments of all repackaged and stabilized residue materials off site used the assumptions in the site's baseline shipping profile. Efficiencies in the demand and allocation of resources and efforts to increase the number of shipments to WIPP is being evaluated to improve the shipping end dates.

High Risk Combustible Residues

The term made disposition ready as applied to combustible residues, refers to stabilization, if required, and all activities needed to repackage and make the material WIPP- certifiable. The majority of the combustible residues continue to be considered as high-risk materials, due primarily to the presence of nitric acid or chlorinated solvents. However, if characterization can demonstrate that these materials are low risk, they will be directly repackaged for shipment to WIPP. Thus, the amount of combustible material that requires stabilization may be significantly reduced. Even when certified for WIPP, combustible residues will still retain the characteristic of being combustible; therefore, a high priority will be placed on shipping these residues to WIPP.

Other RFETS Residues

- Dry shape residues require no treatment, but must be repackaged to meet WIPP requirements. Additional repackaging stations and increased safeguard measurement capabilities will be used to accelerate the repackaging of these materials.

- Upon issuance of the Residues EIS Record of Decision, sand, slag and crucible will be repackaged and sent to the Savannah River Site for processing starting in FY 1998. All sand, slag and crucible will be shipped by September 2000, allowing for integration with Savannah River processing schedules.

- Currently fluoride residues are planned to be repackaged and shipped to Savannah River for processing starting in FY 2000 (pending completion of ongoing NEPA evaluation).

In light of characterization developments, the above modifications to the Defense Nuclear Facilities Safety Board Recommendation 94-1 Implementation Plan have been made to accelerate residue removal from the Site. Specifically, residues (i.e., pyrochemical salts, incinerator ash, and graphite fines) that have been determined or will be determined by characterization to be low risk are not required to be stabilized. Safeguards will be terminated and these residues will be repackaged to meet the WIPP waste acceptance criteria. The pipe component will be used for ash and salt residues to prevent dispersion of the residues, and to provide defense in-depth in case of an untoward reaction inside the container. Residues that remain classified as high-risk materials will continue to be stabilized and repackaged for disposal at WIPP. For residues that will be shipped off-site for further processing, the material will be stabilized as required to meet shipping requirements. A post-stabilization monitoring program for residues will be implemented to assure safe interim storage.

Table 3.3-2 RFETS Solid Residue Proposed Milestones and Commitments

	Milestones Rocky Flats	Previous Milestone	Proposed Milestone
Graphite Fines and Incinerator Ash			
1	Complete characterization of graphite fines to a 95/5% confidence	New	Complete
2	Approve safeguards termination for graphite fines and incinerator ash/Issue Record of Decision	New	October 1998
3	Begin stabilization of graphite fines	March 1998	Delete
4	Complete stabilization of graphite fines	September 1998	Delete
5	Complete repackaging graphite fines and incinerator ash into the pipe component	New	December 2000
6*	Complete shipping graphite fines and incinerator ash off site	New	September 2003
Salt Residues			
7	Approve safeguards termination for electrorefining and molten salt extraction salts/Issue Record of Decision	New	October 1998
8	Stabilize IDC 333, 365, and 427 residues	New	July 1999
9	Complete characterization of specified salt, combustible, and IDC 368 residues to a 95/5% confidence (Note: Does not include IDCs 365 and 427)	New	February 1999
10	Stabilize by pyrochemical oxidation and repackage 6,000 kg of higher risk plutonium containing salts	January 1999	Delete
11	Stabilize by pyrochemical oxidation and repackage 4,000 kg of remaining higher risk salts	September 1999	Delete
12	Complete salt stabilization	July 2001	Delete
13	Complete repackaging salt residues into the pipe component	New	July 2000
14*	Complete shipping salt residues off-site	New	September 2003
Sand, Slag and Crucible			
15*	Complete shipping sand, slag and crucible to Savannah River	New	September 2000
Wet Combustibles and Dry/Repack			
16	Make disposition-ready 11,000 kg higher risk combustibles	April 1999	April 1999
17*	Complete shipping fluoride residues to Savannah River (Pending resolution of RCRA issue)	New	September 2000
18	Complete repackaging wet combustibles and dry/repack	May 2002	May 2002
19*	Complete shipping wet combustibles and dry/repack off site	New	September 2004
20	Complete stabilizing of Ion Exchange Resins	New	March 1999

* Pending completion of ongoing NEPA evaluation.

3.3.3 Savannah River Plutonium Residues

Note: The following paragraphs are the site's <u>proposal</u> for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The currently approved milestone dates, which match the Department's Phased Canyon Strategy, are listed at the end of this section.

Savannah River Site identified residues in eight categories: 1) Pu sweepings (202 containers); 2) Pu turnings (37 containers); 3) Sand, Slag, and Crucibles (128 containers); 4) miscellaneous Pu metal (8 containers); 5) miscellaneous Pu alloy (18 containers); 6) mixed scrap (333 containers); 7) Pu scrap (485 containers); and 8)DU/Pu (5 containers [1200 rods, 2 MTU]). These materials are stored in the F-Area vaults and are considered to be possibly unstable, and therefore, are unsuitable for long-term storage. The degree of concern varies depending on the isotopic content, chemical impurities, and packaging.

These materials have been classified as at-risk or possibly unstable in the ES&H Pu Vulnerability Assessment. They are also identified as candidates for stabilization in the *Interim Management of Nuclear Materials Environmental Impact Statement* (IMNM EIS). The IMNM EIS Record of Decision, issued in December 1995, selected stabilization by dissolving material in F- or H-Area, purifying the plutonium, and transferring the solution to FB- or HB-Line for conversion to a metal or oxide.

The stabilization pathway for these materials is to repackage the items that are greater than 100 g to meet the long-term storage criteria and to stabilize the other materials via aqueous processing. Until the stabilization options can be exercised, the materials are under a surveillance and monitoring program that includes visual inspection and statistical sampling. The design features of the vault minimize worker risk in a packaging failure.

Where material and packaging properties are characterized incompletely, a program will be instituted to select the required stabilization process. Methods used will include NDA using digital radiography equipment installed in March 1997, and selected sampling of containers using existing gloveboxes with modification.

Current plans call for the repackaging of all existing high-grade, mixed plutonium solids (>100 g/can) to meet the new residue safe interim storage standard. These plans assume that the new Actinide Packaging and Storage Facility (APSF) will be available in FY 2002. This new facility will include a new vault to permit consolidation of plutonium materials into a single facility. A new technology bagless transfer system was demonstrated in the existing F-Area facility in August 1997.

The other possibly unstable residues are slated for processing in the canyons: the more reactive material in F-Canyon, such as SS&C; and the mixed, low-grade solids in the HB-Line. The material processed in F-Canyon will be transformed to metal in FB-Line for storage, while the material processed in HB-Line will be transformed to oxide. Dissolution of existing inventories of SS&C materials was completed in July 1998, and stabilization to metal in FB-Line will be completed by September 1999. Other activities will be completed to have all materials meet the requirements of the storage standard by September 2003

3.3.4 Hanford Plutonium Residues

Note: **The following paragraphs are the site's <u>proposal</u> for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The original approved milestone dates are listed at the end of this section.**

The Plutonium Finishing Plant (PFP) stores a diverse inventory of plutonium-bearing residues and mixed oxides totaling approximately 4,034 items, 7,142 kg bulk weight, and 622 kg of plutonium. These diverse materials will be dispositioned during the 94-1 program as outlined in Table 3.3-3. In addition, PFP and FFTF store 168 items of unirradiated fuel pins and assemblies containing approximately 711 kg of plutonium. These fuel pins and assemblies are considered safe for long-term storage as is. Surveillance on these items will continue until they are shipped for dispositioning (utilization or disposal).

Table 3.3-3: Hanford Plutonium Residues

RESIDUE TYPE	QUANTITY	STABILIZATION ACTION	STATUS
Reactive Sludge (High Risk)	236 items	Thermal Stabilization	Completed June 1995
Reactive Ash (High Risk)	46 items	Thermal Stabilization	Completed January 1996
Polycubes (High Risk)	260 items 179 kg bulk 34 kg Pu	Pyrolysis followed by thermal stabilization	R&D Stabilization scheduled for May 2003 thru February 2005
Alloys (Risk TBD)	126 items 165 kg bulk 34 kg Pu	Thermal stabilization (oxidization) for degraded items. Repackage to DOE-STD-3013 for non-degraded.	Additional radiography required. Selected items will be scheduled for stabilization starting October 1999 and completing March 2000.
SS&C (High Risk)	266 items 2422 kg bulk 43 kg Pu	Cementation and discard per WIPP/WAC	219 kg bulk cemented to date. Restart scheduled for March 2000. Completion October 2001.
Ash, Oxides <50 wt% Pu + U, Miscellaneous and Combustibles (includes stabilized reactive ash and sludge above)	857 items 1328 kg bulk 160 kg Pu	Cementation and discard per WIPP/WAC	Scheduled for June 2003 thru June 2004.
Compounds	26 items 13 kg bulk 4 kg Pu	Thermal Stabilization or cementation TBD based on type of material and assay	TBD. Materials Disposition acceptance criteria required. Additional characterization required.
Mixed Oxides	2297 items 2954 kg bulk 323 kg Pu	Thermal stabilization and packaging to DOE-STD-3013	Scheduled for October 2000 thru July 2005

Sources	202 items 81 kg bulk 24 kg Pu	Thermal stabilization or off-site shipment.	Scheduled for October 2000 thru July 2005.

Several concerns still exist with respect to PFP's plutonium-bearing residues and mixed oxides including:

- Off-gassing of polycubes (stored in vented containers)
- Deterioration of the filters on the polycube container vents
- Presence of reactive metals such as calcium in the Sand Slag and Crucible (SS&C)
- Potential for the formation of plutonium hydrides on the alloys
- Potential for corrosive materials in storage containers
- Age and/or deterioration of the storage packages
- Lack of characterization of many older items

Hanford's goal is to stabilize and store all PFP residues and mixed oxides (excluding fuel pins and assemblies) to DOE-STD-3013, or to discard the material to WIPP per WIPP/Waste Acceptance Criteria (WAC) governed by the safeguards termination limit (blended to less than 2 wt% plutonium in cement).

Since the inception of the 94-1 program, PFP has stabilized the high risk reactive sludges and ashes. These items are now awaiting cementation. PFP has also initiated cementation of sand, slag, and crucible (SS&C), illustrated in Table 3.3-3. To date, 219 kg of 2,422 kg of SS&C have been cemented and discarded per WIPP/WAC and the safeguards termination limit criteria. Cementing activities were placed on hold in December 1996 pending resolution of conduct of operations issues. Cementing is scheduled to restart after successful completion of an operational readiness assessment in March 2000. Polycube stabilization will be a two-step process. The first step will be pyrolysis of the polycubes using a design being developed by LANL. This step will oxidize the polycubes but will not result in sufficient thermal treatment to meet the 3013 standard. The second step will be thermal stabilization to 950°C in muffle furnaces. The resultant stabilized oxide will be packaged to DOE-STD-3013.

Plutonium alloys at PFP are typically unclad Pu-U or Pu-Al alloys and have been in storage for more than 20 years. As a result of the discovery of plutonium hydrides and nitrides in PFP's inventory of plutonium metal, a concern exists that the Pu-U alloys require stabilization. The radiography of three alloy items to date has not identified any specific problems; however, one alloy item that was not radiographed has since started to bulge. PFP will radiograph and/or oxidize 100 percent of the alloy items to determine if storage problems exist. The resultant material (oxide or good, stable alloy) will be packaged per the requirements of DOE-STD-3013.

PFP's inventory of compounds is small but diverse. The compounds include PuF_3, PuF_3/UF_6, and PuF_4, Pu-Zr, Pu-Be, and Pu-Th. This material will be stabilized per the requirements of DOE-STD-3013, or discarded per WIPP/WAC based on the assay of the items and material acceptability to the Materials Disposition Program.

PFP has a large inventory of mixed plutonium-uranium oxides in the form of loose pellets and oxides. These mixed oxides (MOX) are typically greater than 50 wt% Pu + U and, therefore, will be stabilized and packaged to DOE-STD-3013. The stabilization will take place in the PuSAP system (refer to Section 3.2.4) or the muffle furnaces in the 234-5Z Building. The same approach will be applied to PFP's inventory of sources.

Between now and when the entire inventory of PFP's plutonium is dispositioned, PFP will continue to perform routine surveillance of the inventory to detect problems with containers early enough to respond to a potential problem before a container breach occurs. This program has been successfully implemented at PFP for close to 20 years.

Options being considered for PFP's inventory of residues and mixed oxides include:

- Shipment of Pu-Be sources to LANL for dispositioning.
- Shipment of plutonium fluorides and alloys to SRS for stabilization.
- Cementing and discarding low-grade mixed oxides (< 50 wt% Pu+U)

Evaluation of these options will be addressed in the "Overall PFP Program Plan."

NEPA, in the form of the PFP EIS and ROD, is in place for the baseline program described above.

3.3.5 Los Alamos Plutonium Residues

Note: **The following paragraphs are the site's <u>proposal</u> for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The original approved milestone dates are listed at the end of this section.**

With this update, the original May 1994 legacy Los Alamos National Laboratory (LANL) residue inventory subject to stabilization and repackaging to meet the DOE-STD-3013 long-term storage criteria has been corrected to remove inaccuracies in the original Implementation Plan text. The corrected total for the LANL inventories of <50% assay plutonium residues is presented in Table 3.3-4. In addition, Table 3.3-5 shows the residue inventory remaining as of the end of February 1998. Included for completeness is the remaining pure metal and oxide inventories as well.

LANL operates a full suite of aqueous nitrate and aqueous chloride processes for plutonium separation and recovery from residue sources; as well as inspection, consolidation, and stabilization activities for small nuclear material items prior to aqueous recovery. With this aqueous processing capability, LANL intends to separate and recover plutonium as oxide from its associated matrix and package the oxide in a temporary packaging system for use in other DOE programs or for final packaging to meet the long-term storage standard (see the Oxide Disposition discussion in section 3.2).

Table 3.3-4: LANL Adjusted May 1994 Legacy Inventory of <50% Assay Plutonium Residues*

Residue Inventory	Pu Content (kg)	No. of Items
High-Risk SS&C	38	300
High-Risk Hydroxide Precipitate	22	313
High-Risk Silica Solids	4	52
High-Risk Cellulose Rags	2	113
Impure Metal	89	1448
High Priority Process Residues	106	589
Analytical Chemistry Sample Returns	7	194
Analytical Chemistry Solution Returns	4	480
High Priority Compounds	15	126
Other Combustibles	<1	72
Other Compounds	95	1540
Other Process Residues	350	1222
Non-combustible Items	62	864
Unsheltered Containers	21	13
Gases	<1	1
Total	815	7327

* Neptunium, americium isotopes, plutonium contaminated uranium isotopes, ^{233}uranium, and other non-plutonium transuranic materials are included in the item inventory, but their SNM value is not included in the plutonium total.

Prior to plutonium separation and recovery, each material category will be evaluated under the safeguards termination limits (STL) considering the criteria described in the plutonium disposition methodology (PDM). The anticipated outcome of this evaluation for each material category will be one of three possible disposition paths depending on the plutonium concentration and distribution within the material category: disposition as transuranic waste if the plutonium concentration is below the STL value for the matrix of interest; aqueous processing for plutonium separation and recovery if the plutonium concentration is above a certain value determined by the PDM; and immobilization in either cement or glass if the plutonium concentration is above the STL value but below the aqueous recovery value determined by the PDM.

Table 3.3-5: LANL Remaining May 1994 Legacy 94-1 Inventory of Pure Plutonium Metal, Oxide, and the <50% Assay Plutonium Residues (as of March 1998)

Material Category		Pu Content (kg)	No. of Items
Pure Plutonium Metal		36	149
Pure Plutonium Oxide		75	108
High-Risk SS&C		3	19
High-Risk Hydroxide Precipitate		1	46
High-Risk Silica Solids		1	15
High-Risk Cellulose Rags		<1	23
Impure Metal		246	744
High Priority Process Residues		103	513
Analytical Chemistry Sample Returns		2	66
Analytical Chemistry Solution Returns		<1	35
High Priority Compounds		9	83
Other Combustibles		1	14
Other Compounds *and Impure Oxide**		532	1451
Other Process Residues		294	945
Non-combustible Items		47	538
Unsheltered Containers		18	10
Gases		0	0
	Total	1368	4757

* Impure oxide requiring purification prior to programmatic use, has been included in this category

Los Alamos intends to utilize the *Criteria for Interim Storage of Plutonium-Bearing Materials* for the storage of plutonium-contaminated actinide oxide or metal with plutonium assay values <50 percent. Treatment and packaging of these materials will essentially follow the DOE-STD-3013 criteria for long-term storage, but because of the plutonium assay value (<50 percent), the Interim Storage Criteria will be the storage guidance document.

The remainder of the legacy inventory as presented in Table 3.3-5 is scheduled to be stabilized by the end of FY 2005. The completion of the original Los Alamos Implementation Plan Milestone, "Stabilize high-risk vault items and recover the plutonium as oxide" (originally due September 1997), is not straight-forward. The remaining high-risk inventory described in Table 3.3-5 is the Laboratory-wide inventory and includes uranium residues, approved designated waste, Pu-238 residues, and Pu-242 residues. Table 3.3-6 illustrates the distribution of residues among the various material types as of February 1998. The difficulty arises in that capability to stabilize Pu-238, Pu-242, and HEU residues is currently not available to meet the projected September 1998 schedule. In anticipation of this, the Pu-242 items have been inspected as part of the Los Alamos annual vault surveillance program, or are physically located in glovebox enclosures (thereby mitigating worker-safety concerns) and are scheduled for plutonium recovery within the next calendar year.

Los Alamos is currently developing and installing a small aqueous Pu-238 recovery sequence for oxide and residue processing. Current schedules indicate it will be not be available for routine residue recovery operations for at least a few years. In the meantime, the inventory of high-risk Pu-238 residues consists of six hydroxide cakes and two cellulose rags, which will be inspected annually as part of the vault surveillance and inspection program and repackaged if necessary. Regarding the HEU residues, it is unfair to apply the same risk designation to these residues and compare them to plutonium. These residues will be stabilized as appropriate when the ULISSES line is commissioned within the next several years.

It must be emphasized that the schedule for items in Table 3.3-5 does not include the stabilization of newly generated residues (items with a creation date after May 1994) and only presents the anticipated stabilization schedule for the remaining legacy inventory. The integrated response to plutonium residue stabilization and scrap recovery at Los Alamos incorporates the two inventories and anticipates parallel approaches to achieve stabilization of both inventories—the legacy inventory in 2005, and by 2011 to achieve an inventory of around 2000 items in the TA-55 vault with no item older than about three years.

Table 3.3-7: LANL Remaining Legacy High-Risk Inventory Among Various Material Types and Matrices

	SS&C	Hydroxide Precipitate	Silica Filter Residues	Cellulose Rags
Total Residue; Lab-Wide	19	46	15	23
Residue Requiring stabilization:				
94-1 residues*	19	10	4	2
^{242}Pu residues**	0	30	6	16
Other Material Types***	0	6	5****	5
Total Legacy Residue Requiring Ultimate Stabilization	19	46	10	23

* Residues scheduled to be stabilized by the end of September 1998.
** ^{242}Pu residues will be processed by December 1999.
*** ^{238}Pu residues, approved designated waste, or uranium residues (HEU) not currently scheduled for processing
**** NDA standards created from diatomaceous earth and plutonium oxide

3.3.6 Lawrence Livermore Plutonium Residues

Note: The following paragraphs are the site's <u>proposal</u> for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The currently approved milestone dates are listed at the end of this section.

Lawrence Livermore National Laboratory has residue material (<50 wt%) supporting DOE missions and residue material that is excess to the DOE missions. The plutonium residue inventory includes about 202 containers. In 1994, 111 of the ash/residue containers were considered unstable because 8 containers were found to be pressurized. LLNL has in process a remediation project for these cans of ash/residue.

A three phase plan has been formulated for residue materials. The first phase of this remediation project stabilized the pressure within the original cans, by venting and has been completed. In phase two, LLNL participated in a trade-off study to develop plans for the stabilization and packaging of ash/residues for long-term storage. The initial step was characterization of the materials. The next step was to determine a stabilization process that will allow this material to be packaged for long-term storage. Processes being considered were thermal processing, washing for removal of halides, vitrification, and conversion to a <50 wt% oxide. The trade-off study was completed in November 1996.

Phase three is the implementation of the stabilization and packaging methods developed in phase two. These methods will be applied for two residue categories, namely LLNL ash residue and other residues. The ash residue is material that is known as the batch (111 cans) that had a bulging problem in 1994. This material will be stabilized and packaged by May 2000. The stabilization and packaging of the second residue form (other residues), which will begin directly upon completion of the ash residues, will be complete in February 2001. The stabilization and packaging of other residues at LLNL is designated as a new milestone due to be completed in February 2001. LLNL has the means to repackage these materials in compliance with the standard.

The changes in milestone completion dates discussed above are primarily due to suspension of activities in Building 332 due to a criticality safety infraction. Currently LLNL is working toward resuming normal Building 332 operations by the end of 1998. The DNFSB has been briefed on the operations resumption plan and is monitoring the progress.

3.3.7 Other Plutonium Residues

A large number of DOE sites have small quantities of plutonium with a low potential for environment, safety, and health vulnerabilities. Most is in the form of sealed packages. Metals, oxides, and solutions make up the remainder. The DOE complex maintains a variety of packaged standards, encapsulated sources, and process-support or archival samples. The DOE also retains responsibility for many standards and sources that are loaned or leased to universities, hospitals, and industry. These items do not constitute a major liability as most are small, stable, sealed, and shippable. However, in aggregate, the future management of these technical materials is constrained by the few facilities that can receive the items and process them for disposal or reuse. DOE's Implementation Plan will ensure that small-quantity and unique items located at hundreds of sites do not interfere with those site's programs to reduce inventories of unneeded nuclear materials and comply with local radiological controls.

3.3.8 Key Milestones

Table 3.3-7: Key Milestones and Commitments

	Commitment	Action	Date
1	Develop risk-based, complex-wide categorization and prioritization decision criteria that all stored residues will be required to meet	LANL (lead), RFETS, SRS, Hanford, LLNL	Completed March 1996
2	Vent 2,045 drums with a potential for hydrogen gas generation	RFETS	Completed Sept 1995
3	Stabilize by pyrochemical oxidation, and repackage 6,000 kg of higher risk plutonium containing salts	RFETS	February 1998
4	Stabilize remaining higher risk salts (4,000 kg) via chemical oxidation	RFETS	June 1998
5	Stabilize all sand, slag, and crucible and graphite fines	RFETS	May 1998
6	Vent all inorganic residues	RFETS	Completed Dec 1995
7	Vent all wet/miscellaneous residues	RFETS	Completed Dec 1995
8	Stabilize higher risk combustibles (11,000 kg)	RFETS	November 1998
10	Identify and characterize the packaging of all plutonium items in the LLNL inventory, including residue materials.	LLNL	October 1997
11	Pressure-stabilize cans containing ash/residue materials	LLNL	Completed Sept 1994
12	Conduct trade studies for ash/residue materials	LLNL	Completed November 1996
13	Stabilize, process, and package all ash/residue materials	LLNL	April 1999
14	Stabilize, process, and package all other residues	LLNL	April 2000
15	Stabilize sludge in muffle furnaces	Hanford	Completed June 1995
16	Stabilize 46 cans of selected ash in muffle furnaces	Hanford	Completed January 1996
17	Stabilize and package all remaining residues to safe interim storage standards	Hanford	May 2002
18	Stabilize Polycubes	Hanford	January 2001
19	Perform 100 percent visual inspection of vault inventory	LANL	Completed April 1995

	Commitment	Action	Date
20	Recover 100 neutron sources	LANL	Completed April 1995
21	Process 90 percent of analytical solutions	LANL	Completed August 1995
22	Process 100 kg sand, slag and crucible	LANL	Completed April 1995
23	Process 70 kg hydroxide solids	LANL	Completed April 1995
24	Oxidize 50 kg of corroded metal items	LANL	Completed October 1995
25	Dissolution of existing inventories of SS&C in F-Canyon	SRS	Completed July 1998
26	Stabilize remaining residues	SRS	September 2002*

* Original Implementation plan date for completing residue stabilization was May 2002. The current milestone date is in accordance with the Savannah River Phased Canyon Strategy which was accepted by the Board in their letter dated April 15 1998.

3.4 Special Isotopes

3.4.1 General Overview

Background

The DOE manages inventories of a wide range of special transuranic isotopes, primarily derived as byproducts from previous defense reactor production and the chemical separation of large process streams of reactor targets. Many of the special radioisotopes have been widely used for medical, industrial, space exploration and other domestic and defense applications.

The primary "product" materials include Pu-238, used in compact power sources for NASA and terrestrial applications; Pu-242, an isotope that is valuable for defense research; and Cf-252, used as a medical isotope and in a variety of specialized uses such as non-destructive assay equipment. Feedstocks for the future production of heavy isotopes include neptunium, americium, and curium. In small amounts, many heavy isotopes are also useful as "tracer" elements in defense and non-defense research. Holdings that are relevant to Recommendation 94-1 are listed in Table 3.4-1.

Table 3.4-1: Special Isotopes Holdings

Inventory	Location	Original Quantity	Current Status
Americium-curium solution	Savannah River F-Canyon	14,400 L	Awaiting stabilization.
Pu-242 solution	Savannah River H-Canyon	13,300 L	Stabilization completed.
Np-237 solution	Savannah River H-Canyon	6,000 L	Awaiting stabilization.
Pu-238 solids with adverse packaging	Savannah River Building 235-F	14 containers	Stabilization completed.
Pu-238 materials in active programs	Los Alamos, Mound	A wide variety of container types	Management of excess materials being examined by Nuclear Materials Integration Program.
Wide inventory of in-use and small-mass items of other isotopes	Large number of DOE, university, medical, and industrial sites	A wide variety of container types	Management of excess materials being examined by Nuclear Materials Integration Program.

Some or all of the inventories of each special isotope are judged to be "programmatic" materials that DOE wishes to retain for future use. As the defense reactor production mission has stopped, the potential source for significant quantities of byproduct isotopes has disappeared. Isotopes that will be retained must be stabilized in a safe, storable form for uses that may arise decades in the future.

3.4.2 Savannah River Americium-Curium Solution

Note: **The following paragraphs are the site's proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The currently approved milestone dates, which match the Phased Canyon Strategy, are listed at the end of this section.**

Savannah River's inventory of special isotopes includes americium-curium (Am/Cm) in 14,400 L of aqueous solution in a single tank in F-Canyon. Stabilization of the solution could not be accomplished within the 3-year period recommended by the Board in 1994 because of the lack of capability and process. A process installed in F-Canyon was used in the early 1980s to convert small quantities of Am-241 to an oxide. However, the process equipment has not been maintained and requires extensive modification to restore it to use. New capability and process with the ultimate goal of stabilizing the Am/Cm solution as safely and as soon as possible at the most reasonable cost is being developed. In the interim, because of the urgency of the storage conditions, DOE has implemented compensatory measures to reduce worker and environmental risk to acceptable levels.

Several methods for stabilizing the americium-curium solutions were evaluated during the development of the *Interim Management of Nuclear Materials Environmental Impact Statement.* The vitrification alternative was selected and published in the subsequent EIS Record of Decision. Basically, the vitrification alternative is to encapsulate the Am/Cm in a glass form that will in turn be shipped to Oak Ridge for storage and eventual recovery of the americium and curium for future programmatic use.

An Americium/Curium Demonstration Project for vitrifying the Am/Cm solution has been in development since 1995, but development of a suitable melter has proven to be a more formidable problem than originally estimated. As a result, the project has had to be reassessed. Design and construction activities were suspended in the Fall of 1997, and the Research and Development (R&D) activities were reformulated to focus on a different method to achieve vitrification. The Resistance-Heated Bushing Melter: Continuous Feed-Semicontinuous Pour method has subsequently been replaced with an Induction-Heated Cylindrical Melter: Batch Feed-Batch Pour method. This R&D is in progress with design basis data/information planned to be available in the Fall of 1998.

If this R&D is successful as planned, the Design Basis Documents will be revised, project rebaselined, and design and construction restarted in the Spring of 1999. Meanwhile, the Savannah River Technology Center is examining potential alternatives to be used in case the Cylindrical Induction Melter process fails to mature. Alternatives that are available for consideration are an In-Can Process (mixing of low temperature frit with the oxalate precipitate within the can and directly heated) or Silica-Gel Process (absorption on Si-Gel and calcining to ceramic or calcining/vitrifying as a glass).

Stabilization, packaging, storage and shipping alternatives for the material have also been reevaluated. Vitrification has again been determined to be the most viable stabilization process, but options for packaging, storing, and shipping continue to be assessed. Storing the material at SRS (indeterminate final disposition), transporting it to the Oak Ridge National Laboratory (national resource-production of higher isotopes), or sending it to a final waste repository (waste-discardable) are being considered.

3.4.3 Savannah River H-Canyon Plutonium-242 Solution

Savannah River has completed stabilization of approximately 13,300 L of aqueous solution of Pu-242 in a single tank in the H-Canyon chemical treatment facility and three containers, with small quantities of oxide, that were in the F-Area Laboratory (Building 772-F).

3.4.4 Savannah River H-Canyon Neptunium Solution

Note: **The following paragraphs are the site's proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The currently approved milestone dates, which match the Phased Canyon Strategy, are listed at the end of this section.**

Savannah River has 6000 L of neptunium (Np-237) nitrate solution in H-Canyon. Np-237 has a potential for use as target material for production of Pu-238 to be used as a fuel for radioisotope thermo-electric generators in spacecraft as well as terrestrial applications.

The Offices of Environmental Management (EM) and Nuclear Energy (NE) are developing a Memorandum of Agreement that will formalize commitments for the stabilization of the Np-237 and its subsequent transfer from SRS. Under the terms of the draft agreement, the material will be stabilized and transferred to the site of NE's choice on a schedule consistent with EM's Recommendation 94-1 Implementation Plan commitments. In the event that NE is unable to provide direction and funding to effect the transfer consistent with EM stabilization schedules, EM may elect to stabilize the Np-237 to oxide and retain it in the APSF. If NE is ultimately unable to develop a viable Pu-238 production program that would allow transfer of the Np-237 from EM to NE, EM may elect to explore other means of dispositioning the material.

While the neptunium solutions await disposition, activities to reduce the potential for release to the environment include an expanded and formalized sampling and monitoring program; pressurization and monitoring of the cooling water supplied to the solution storage vessels; and physical isolation of the cooling system to ensure no radioactivity is released to external systems. Expanded treatment, chemical adjustment, agitation, and solution movement options are available in case deficiencies occur in current storage conditions.

During the neptunium solution stabilization, Savannah River also plans to solidify any neptunium recovered during stabilization of plutonium residues and mixed oxides, irradiated fuels, and from dissolving the unirradiated neptunium-aluminum reactor targets that are currently stored at the site.

3.4.5 Plutonium-238 Solids

The DOE is managing a program to recover, purify, solidify, and fabricate Pu-238 for use in radioisotope thermo-electric generators. The largest application for these generators is as power sources for NASA deep space missions.

The main inventories are effectively managed with active processing and production programs at Los Alamos. Pu-238 activities at Mound and Savannah River have been discontinued. However, one category of inventories was shown to be stored under significantly adverse conditions during the Plutonium Vulnerability Assessment performed by DOE's Office of the Environment, Safety, and Health. This category includes certain materials that were stored in Building 235-F at Savannah River where the primary containment vessel was found to be potentially susceptible to pressurization due to helium buildup from alpha decay. These materials were transferred to the Savannah River HB-Line facility in March 1995 where the primary containment vessel was vented into a protected glovebox line, and the containers repackaged.

3.4.6 Other Special Isotope Concerns

The Department manages many items that hold special isotopes, including a wide array of standards and sources. These items are not major safety drivers for the DOE Implementation Plan related to Recommendation 94-1. However, DOE expects that demand will continue for DOE to supply these materials and to accept items that are no longer needed by user programs. Many of the facilities and processes that traditionally serviced non-defense isotope requirements are located at former defense nuclear facilities. Future demands on those facilities are not completely defined.

Los Alamos is operating a program to receive and treat Pu-239-beryllium sources that are no longer needed, and programs are also being developed to deal with more than 10,000 excess americium and Pu-238 sources.

The Department commitments may be achievable using small, bench-scale and glovebox operations to support the reduced support missions for isotopes. Besides the isotopes listed above, DOE has also supported research involving curium, berkelium, californium, neptunium, thorium, and U-233. Any demands on the facilities used to treat the materials identified in Recommendation 94-1 will also be factored into the schedule and funding requirements for the complete program to deal with nuclear materials that are excess to national security needs. No major impacts would be expected on the DOE's support for the utilization of non-actinide materials, which have included Co-60, Ni-63, Sr-90, Cs-137, and a wide range of medical and research isotopes.

3.4.8 Key Milestones

- Start stabilization of Am/Cm solution at Savannah River in June 1999 and complete in November 1999.*

- Pending completion of Pu-238 campaign, begin stabilization of Pu-242 solution at Savannah River's HB-Line Phase III in May 1997, with all solution stabilized by November 1997. . . . . Completed August 1996 and December 1996, respectively

- Complete stabilization of Np-237 solution at Savannah River's HB-Line by the end of September 2003.*

- Transport Savannah River's Pu-238 solids currently in inadequate storage to the HB-Line by April 1995 for venting and repackaging . . . . Completed March 1995

* Original Implementation plan dates for starting and completing Am/Cm solution stabilization were March 1998 and September 1998 respectively. The original date for completion of neptunium stabilization was December 2002. The current milestone dates are in accordance with the Savannah River Phased Canyon Strategy which was accepted by the Board in their letter dated April 15 1998.

3.5 Highly Enriched Uranium Stabilization Requirements

3.5.1 General Overview

Background

The Department currently manages significant quantities of enriched uranium in a number of configurations, including materials left in a production cycle when the production facilities were shut down. Even though highly enriched uranium (HEU) was not a subject of the DNFSB's Recommendation 94-1, the risk represented by the HEU left in the production cycle presented sufficient risk that the Department considered it prudent to include plans for its stabilization in the original Recommendation 94-1 Implementation Plan.

Continuing Commitment

As illustrated in Table 3.5-1, much of the highly enriched uranium inventory included in the 94-1 IP has been stabilized. For the remaining HEU to be stabilized, a schedule for blending down the HEU solutions at Savannah River into a low enriched uranium configuration suitable for use as commercial reactor fuel has not yet been established. Stabilization of the HEU solids remaining in the Oak Ridge Molten Salt Reactor Experiment is expected to be completed by May 2002 as specified in the currently approved Implementation Plan. All other HEU milestones in the original Recommendation 94-1 Implementation Plan are complete.

3.5.2 Rocky Flats Uranium Solutions

Rocky Flats used the services of a contractor with a specialized uranium processing expertise to prepare and remove the approximately 2,700 L of highly enriched uranyl nitrate solution (HEUN) containing 569 kg of U-235 from eight Raschig ring tanks in Building 886. The solutions were shipped to the contractor's facility where the contractor converted the highly-enriched solution to a stable oxide and then delivered the material to an approved storage location. All Rocky Flats uranium milestones are complete.

3.5.3 Savannah River Uranium Solutions

Note: **The following paragraphs are the site's most recent update of its progress in its plan to blend down its highly enriched solutions into a form suitable for use as commercial reactor fuel. The site's plan remains consistent with its original Recommendation 94-1 Implementation Plan objectives.**

Prior to commencing dissolution of Mk-16/22 spent fuel, the H-Canyon processing facility at Savannah River held 230,000 L of highly enriched uranium in dilute nitrate solutions. This material is the remainder of active, "in-process" solutions left after chemical processing and separation of spent nuclear fuel were suspended. The solutions are not suitable media for long-term storage of excess uranium, however, an active monitoring and surveillance program is being used to maintain them in a safe condition until they can be treated for long term disposition.

Table 3.5-1: Highly Enriched Uranium Inventory Summary

Site	Type of Material	Original Quantity	Original Location	Quantity Stabilized as of 6/30/98	Remaining Materials Location
Rocky Flats	HEU Solutions	2,700 L containing 569 kg of U-235	Bldg 886	2,700 L	All solutions shipped to commercial processor, converted to oxide, and now stored at Y-12
Savannah River	HEU Solution	230,000 L	Bldg 221-H	0	Bldg 221-H
Oak Ridge	HEU Solids	Classified	K-25 and K-29*	All deposits identified for stabilization are completed	Packaged for interim storage in Y-12 awaiting final disposition
Oak Ridge	HEU Solids and UF_6 Gas	4,650 kg fuel salt and 4,265 kg of flush salt	MSRE	17.5 kg of uranium in the form of UF_6 gas	Stored in Building 3019

* Additional large deposits of low enriched uranium in Building K-29 were selected for removal and were added to the scope of the ETTP Deposit Removal Project.

DOE has entered into a Memorandum of Understanding with the Tennessee Valley Authority (TVA) for the conversion of at least 30 t of off-specification DOE highly enriched uranium (HEU) to low-enriched uranium (LEU) fuel for TVA power reactors. The 230,000 L of Savannah River HEU solutions are part of that project. The Department is planning to blend down the solutions to less than 5 percent U-235 and then transfer them to a TVA-designated commercial fuel fabricator for conversion to power reactor fuel. TVA issued a Request for Proposals for commercial support of this project, to which responses were provided by July 1, 1998. A decision leading to an Interagency Agreement between DOE and TVA for transfer of the uranium solutions (and other off-spec HEU) should be made by late 1998, at which time a schedule for blending down and shipping to a commercial facility will be published.

3.5.4 Oak Ridge Uranium Solids (Residues)

Note: **The following paragraphs concerning the processing of HEU solids at Oak Ridge retain the same HEU stabilization milestone completion dates submitted by the Department on October 29, 1997, and approved by the Board on December 8, 1997. Descriptions of plans and processes for stabilizing the remaining uranium have been updated to reflect current status.**

3.5.4.1 Molten Salt Reactor Experiment (MSRE)

The Molten Salt Reactor operated from 1965 through 1969 to investigate molten salt reactors for commercial power applications. The reactor fuel, uranium tetrafluoride, was a constituent in a molten salt mixture including lithium, beryllium, and zirconium fluorides that circulated through the reactor primary system. Initially the reactor was fueled with U-235, which was replaced with U-233 in 1968. Less than 1 kg of plutonium tri-fluoride was added in 1969. When the reactor was shutdown, the fuel salt was drained into two fuel drain tanks in the drain tank cell, where it cooled and solidified. Following a post-operation examination, the facility was placed in a surveillance and maintenance program to await eventual decommissioning. Radiolysis of the fuel salt was expected to slowly produce fluorine (F_2) gas. A procedure to annually heat the salt without melting was begun to recombine the F_2 into the salt.

In the late 1980s, radiological surveillance at the facility indicated elevated radiation in piping connected to the drain tanks. A visible release of an unidentified gas was also observed from the off-gas system piping during a maintenance action. Migration of stored fuel was suspected and an investigation was initiated. Gas samples taken in 1994 indicated significant concentrations of uranium hexa-fluoride (UF_6) and F_2. A significant solid deposit of uranium was also detected in the inlet section of a charcoal filter in the off-gas system. This filter, the Auxiliary Charcoal Bed (ACB) was located under water in a concrete cell outside the reactor building. If water were to have entered the ACB and migrated to the deposit, the potential for accidental criticality could not have been eliminated. In addition, the exposure of the activated charcoal in the bed to both F_2 and UF_6 was postulated, and later confirmed in laboratory testing, to have created a potentially explosive compound mixed with the uranium deposit.

A comprehensive plan was developed in 1994 to implement interim corrective measures, remove the reactive gases and uranium deposits, convert these materials to stable oxide for interim storage, and dispose of fuel and flush salts. The interim corrective measures to mitigate the criticality potential, stop continued uranium migration to the charcoal bed, and enhance the containment of the charcoal bed cell to prevent radionuclide releases from a potential explosion were completed in November 1995. During these first remediation actions, uranium migration into fuel processing equipment was discovered in additional cells at the facility. In early 1996 during preparations for removal of the UF_6 and F_2, off-gas system pressures near the drain tanks were measured at 10 psig and several internal plugs in the piping system were discovered. A chemical trapping system to depressurize the off-gas system and remove the UF_6 and F_2 started operation in November 1996. Initial operation removed small amounts of UF_6 and F_2, and non-volatile blockages were confirmed.

As a result of the new information on the extent of uranium migration and blockages in the MSRE piping, the original program scope was expanded and a revised plan of remediation developed. To date 17.5 kg of uranium in the form of UF_6 has been extracted from MSRE with the gas removal equipment. An estimated 5 kg of uranium remains in the MSRE in UF_6 form and is being actively removed. Chemical denaturing of the charcoal bed was added to eliminate the explosive potential of the fluorinated charcoal. Denaturing was completed in March 1998, and the charcoal bed uranium deposit will be removed in February 1999. Since the removal of fuel and flush salts is a Comprehensive Environmental Response Compensation and Liabilities Act (CERCLA) Interim Remedial Action, a Feasibility Study, proposed plan, and Record of Decision for the disposition of the fuel salt were submitted to and approved by the State of Tennessee and the Environmental Protection Agency. The fuel and flush salt will be removed by May 2002 in accordance with the approved CERCLA Record of Decision.

3.5.4.2 Deposit Removal Project at the East Tennessee Technology Park (ETTP)

All ETTP (K-25 and K-29) milestones have been completed. During the operating life of the ETTP facilities, isotopically enriched uranium accumulated inside gaseous diffusion equipment and piping as a result of wet air in-leakage. Building K-25 was initially shut down in 1964. In 1985 it was determined that other gaseous diffusion facilities at the site were in excess of uranium enrichment needs, and they were placed in standby. The decision was made to permanently shut them down in 1987. Deposits of enriched uranium remain in the piping and equipment. Based on non-destructive assay measurements and the openings in the process piping of Building K-25, it was determined that some of the HEU deposits presented an unacceptable criticality risk. In 1989, steps were taken to reduce the likelihood of a criticality event by welding closures over openings in the process piping that could have allowed water in-leakage, and by isolating specific piping and equipment of concern.

The Deposit Removal Project was initiated to remove HEU deposits in piping and equipment in Building K-25. Sixty-five HEU deposits containing U-235 masses above 500 gms were identified in target items such as pipes, compressors, cold traps, chemical traps, surge tanks, and converters (Whitehead and Type II). Mechanical removal of four of these deposits located in pipe sections was completed in March 1996. Knowledge gained during the removal activities and additional criticality safety analyses led to examination of the project scope and the need to remove all of the remaining 61 deposits. It has been concluded that all but nine of the 61 deposits are already in stable configurations that satisfy the double contingency principle for criticality safety and, therefore, do not require removal at this time. The nine deposits have been placed in safe configuration.

During the reevaluation of the deposits in the ETTP, additional deposits of concern were identified in Building K-29. Three of the deposits were of sufficient concern to be added to the scope of the K-25 Deposit Removal Project and have been placed in safe configuration.

3.5.5 Key Milestones

Rocky Flats

- Ship HEU solutions off-site for stabilization . . . . Completed November 1996

Savannah River

- Record of Decision for Interim
  Management of Nuclear Materials . . . . Completed December 1995
- Convert 230,000 L of HEU
  solutions to a stable oxide . . . . TBD*

* The original milestone date for completion of existing HEU stabilization was December 1997. The current milestone status is in accordance with the Savannah River Phased Canyon Strategy which was accepted by the Board in their letter dated April 15 1998.

DOE is evaluating a proposal to change this milestone into the following two milestones to reflect current initiatives to blend down the HEU and sell it to be used as commercial reactor fuel:

- Develop an Interagency Agreement with TVA for blending
  down HEU to Light Water Reactor grade LEU . . . . December 1998
- Blend 230,000 L of HEU solutions to Light Water
  Reactor Grade LEU . . . . To be determined

Oak Ridge

<u>Molten Salt Reactor Experiment</u>

- Complete corrective interim measures . . . . Completed November 1995
- Remove uranium deposit . . . . February 1999
- Complete fuel and flush salt removal . . . . May 2002

<u>K-25 Site</u>

- Complete mechanical removal of uranium deposits . . . . Deleted
- Complete chemical removal of uranium deposits . . . . Deleted
- Place Category 1 deposits in a safe configuration . . . . Completed December 1997
- Place Category 2 deposits in a safe configuration . . . . Completed January 1998

3.6 Spent Nuclear Fuel

3.6.1 General Overview

Background

This section addresses only specific concerns highlighted by the Board involving spent fuel located in the K-East Basin at the Hanford Site, the CPP-603 Basin at the Idaho National Engineering and Environmental Laboratory (INEEL), and the processing canyons and reactor basins at the Savannah River Site (SRS). This material represents a significant subset of the total inventory of spent nuclear fuel (SNF) managed under the DOE SNF Program. However, other major elements of the SNF Program are briefly described in order to place the concerns of the Board in context of the overall program.

SNF is nuclear fuel or targets containing uranium, plutonium, or thorium withdrawn from a nuclear reactor or other neutron irradiation facility following irradiation, the constituent elements of which have not been separated by chemical reprocessing. These materials include essentially intact fuel and disassembled or damaged units and pieces; irradiated reactor fuel, production targets, slugs, and blankets presently in storage or that will be accepted for storage at DOE facilities; and debris, sludge, small pieces of fuel, and cut up irradiated fuel assemblies subject to evaluation of their waste classification.

The inventory of DOE-owned SNF is composed of approximately 2,500 t of initial heavy metal as shown in Table 3.6-1. Planned additions to existing inventories will come from naval reactors, U.S. and foreign research reactors, and other government reactors. The combination of all of these possible additions to SNF inventories through the year 2035 is estimated to be 70 t, which represents less than three percent of the existing inventories.

Table 3.6-1: 94-1 Spent Nuclear Fuel Inventory Summary

Site	Original MTHM	Original Volume (m^3)	MTHM Requiring Stabilization (as of 6/30/98)	Volume Requiring Stabilization (m^3) (as of 6/30/98)
Hanford	2,132	256	2,133	238
Idaho	2.9*	64.4*	1.48	4.4
Savannah River	206	164	47	61

*The February 1995 94-1 Implementation Plan showed the values of 261 MT and 702 m^3 for the total SNF inventory at Idaho. The above values represent the 94-1 portion of that inventory.

3.6.2 Hanford Spent Nuclear Fuel

Note: **The following paragraphs are the site's proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The original approved milestone dates are listed at the end of this section.**

Hanford Facility Description

The K-East and K-West Storage Basins were constructed in the early 1950s to provide temporary storage of Single Pass Reactor fuel discharged from the K-Reactors until they were shut down in 1970. Subsequently, the basins were used for storage of N Reactor spent fuel. The basins are located approximately 1,000 ft from the Columbia River. They are unlined, concrete, 1.3 million gallon water pools with an asphaltic membrane beneath each basin. The K-East Basin presently stores approximately 1,152 t of initial heavy metal (MTHM). The spent fuel in K-East Basin has been stored underwater in open top canisters for periods ranging from 9 to 26 years. Fuel corrosion and environmental contaminants have produced an estimated 50 m^3 of highly radioactive sludge spread throughout the basin. The K-West Basin presently stores approximately 953 MTHM. Prior to storage in the K-West Basin, the spent fuel was placed in closed canisters. Fuel corrosion has occurred, but radioactivity and sludge has been largely contained in the closed canisters. About 20 m^3 of sludge is estimated to be in the K-West Basin. Leakage to the environment from K-East Basin has occurred, most likely at the basin discharge chute construction joint. The asphaltic membrane does not extend beneath this area. The K-West Storage Basin is not believed to be leaking. The discharge chute construction joints between the foundations of the Basins and the K-Reactors are not adequately reinforced, and a seismic event could trigger considerable leakage.

Hanford Issues

To address the urgent K-Basin issues, DOE and Hanford contractors have developed a K-Basin recommended path forward to remove the fuel from the basins, to stabilize it, and to place it in a safe, secure interim storage. Richland's decision concerning this action is consistent with the Record of Decision from the EIS for Management of SNF from the K-Basins at the Hanford Site, Richland, Washington, which was issued in March 1996. Several near term actions have been completed or are ongoing to minimize safety and environmental risks for the short time that the fuel remains in storage at the basins. These actions include installation of cofferdams to isolate the basin water from the suspected leakage site, implementation of several dose reduction measures to minimize worker exposure, upgrades to essential facilities, improvements of the conduct of operations, and characterization of fuel and sludge. The key elements of the K-Basins recommended path forward are described below:

- The K-Basins fuel and canisters will be retrieved from the current storage locations and cleaned, underwater, to remove corrosion products. The cleaned fuel will then be removed from the canisters, loaded into fuel baskets, transferred in baskets to multicanister overpacks (MCOs) and vacuum dried at low temperature to remove free water. The cold vacuum dried spent fuel contained in the MCOs will be shipped to 200 East Area for interim storage in the Canister Storage Building (CSB).

- The K-Basin sludge, in addition to corrosion products generated during fuel cleaning, will be accumulated at the K-Basins and later retrieved, characterized, conditioned and transferred to the Tank Waste Remediation System's 200 Area underground double shell tanks for interim storage with other waste, prior to processing and ultimate disposition. The sludge material will be managed as SNF while at K-Basins, and will be declared as waste as soon as it leaves K-Basins.

- The CSB spent fuel storage configuration will result in multiple barriers to ensure safe long-term interim storage. The spent nuclear fuel will be sealed in multicanister overpacks after appropriate monitoring to ensure worker and public protection and to minimize SNF corrosion. The CSB has been designed and constructed to current standards that result in nuclear safety equivalent to Nuclear Regulatory Commission licensed fuel storage facilities.

K-Basins Path Forward Near Term Objectives

Other activities that have been completed or are ongoing to improve the near term safety and environmental posture at the K-Basins include:

- Installation of seismic isolation barriers (e.g., cofferdams) between the basins and the discharge chute to isolate the basin from the suspected leakage site located in the unreinforced construction joint in the discharge chute is complete. This action minimizes the potential for environmental release of radioactive contaminants either directly through the leak into the ground or by airborne release, should the basin be drained as a consequence of a seismic event. Such events could also result in significant radiological exposure to personnel during recovery actions.

- Performance of fuel and sludge characterization to assess fuel condition, chemical constituents, physical properties, fuel behavior during vacuum drying, and methods for treating sludge. The data will be used to support safety analyses for all planned activities and in particular to ensure safe long term storage.

- Development of a path forward for basin sludge that considers the probable differences between sludge in the fuel canisters and sludge lying on the basin floor. While the sludge contained in the fuel canisters is primarily the result of fuel corrosion, the vast majority of the sludge on the basin floor is believed to consist of sand, metallic corrosion products, and concrete chips.

- Establishment and maintenance of a formal Conduct of Operations program at the K-Basins to improve safety of ongoing operations.

- Modification of essential facility systems necessary for continued safe operations and personnel protection, such as electrical, potable water, fire protection, and maintenance systems.

- Reduction of personnel exposure in keeping with As-Low-As-Reasonably-Achievable (ALARA) practices by improving dose reduction measures and reducing the radioactive source term from cesium contaminated concrete basin walls and pipe runs.

- Removal of debris from the K-Basins, e.g., unused and empty canisters, SNF storage racks and discarded tools. This waste will be cleaned and compacted, as necessary, prior to shipment to the solid waste management area to minimize the waste volume.

- Improvement of water cleanup, including minimizing transuranic (TRU) loading of the ion exchange modules and providing redundant systems to ensure that adequate ion exchange capability is always available.

- Preparations for operational readiness to support fuel removal activities.

K-Basins Recommended Path Forward Schedule

DOE Richland has revised the schedule and now proposes to begin fuel and sludge removal by January 2001 and August 2004, respectively, and to complete fuel and sludge removal by August 2003 and December 2005, respectively. A spent nuclear fuel integrated schedule has been developed, which includes the proposed key milestone dates supporting the K-basins path forward. This schedule will be validated by the Headquarters Program Office by September 1998. DOE is evaluating incentives to accelerate this schedule as much as possible.

3.6.3 Savannah River Spent Nuclear Fuel

Note: **The following paragraphs are the site's proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The currently approved milestone dates, which match the Phased Canyon Strategy, are listed at the end of this section.**

3.6.3.1 K and L-Reactor Disassembly Basins

The Reactor Disassembly Basins are unlined, concrete water pools that store spent fuel, target assemblies, and other radioactive material. The basins have been in operation since 1954 and hold 3.5 to 4.5 million gallons each. With the Mk31 targets having been stabilized, the inventory of SNF in the basins consists of approximately 1,800 Mk16 and Mk22 spent fuel elements containing 7.2 t of heavy metal. The extended duration of storage, poor water chemistry control, galvanic coupling, damaged cladding due to handling, and lack of appropriate water filtration systems all contributed to accelerated corrosion of the spent nuclear fuel and target materials and increased radioactivity levels in the water of the Basins. Additionally, the facilities were not designed to meet current seismic standards, and the current leak detection method is not sufficiently sensitive to detect small leaks.

3.6.3.2 Receiving Basin for Off-Site Fuels

The Receiving Basin for Off-Site Fuels (RBOF) Facility stores reactor fuel elements from off-site reactors and occasionally from on-site reactors. The RBOF is a concrete pool with a volume of approximately 500,000 gallons. Placed into operation in 1963, it has a stainless steel bottom and Phenoline resin-coated walls. The original design incorporated a basin water chemistry control system consisting of a filter and mixed ion-exchange resin deionizer system. The fuel elements in the RBOF, some of which have been in the basin for 30 years, show no visible signs of corrosion. The fuel assemblies, canisters of fuel, and targets are stored at RBOF in storage racks that provide the spacing required to preclude nuclear criticality. Fuel consolidation to provide approximately 1,250 additional RBOF storage spaces was completed in August 1996.

3.6.3.3 Savannah River Issues

Processing Enriched Uranium in H-Canyon (Baseline Planning Case)

Savannah River has traditionally processed highly enriched uranium (HEU) SNF in the H-Canyon and plutonium production targets, which are irradiated depleted uranium (less than 0.2 percent U-235), through the F-Canyon. The separated enriched uranium produced in H-Canyon was traditionally transported to Oak Ridge as enriched uranyl nitrate solution for recycling into new fuels for SRS reactors. The depleted uranium produced in the F-Canyon as a by-product of the plutonium separations process was traditionally converted to oxide in the F-Area A-Line facility.

Based upon the *Interim Management of Nuclear Materials Environmental Impact Statement* Record of Decision, Mk31 target stabilization was completed in March 1997, and stabilization of SRS Mk16 and Mk22 HEU SNF began in July 1997. The HEU SNF is being dissolved in the H-Canyon consistent with past practice. The resulting enriched uranium solutions are now transferred to the enriched uranium storage tank in the H-Area A-Line facility for temporary storage. When Mk16 and Mk22 processing is completed, miscellaneous aluminum-clad targets and fuels will be stabilized via dissolution and processing with waste transferred to the Waste Tank Farm. The eventual vitrification of radioactive material will occur in the Defense Waste Processing Facility. Sufficient tank volume exists to handle the projected waste steams.

Savannah River Near-Term Objectives

A structural assessment for the K- and L-Reactor Disassembly Basins exterior walls and foundations determined that only minor leakage could occur through an expansion joint or cracks in the retaining walls as the result of an earthquake. A detailed structural assessment for design basis hazards was performed for RBOF in order to upgrade the safety analysis reports.

Upgrades, necessary to permit extended storage of aluminum-clad SNF in both the K- and L-Reactor Disassembly Basins, have been completed. These changes have improved the Reactor Disassembly Basins water chemistry to levels approaching RBOF. Additionally, vertically stored fuel in K- and L-Reactor Disassembly Basins was reoriented to eliminate galvanic coupling and associated storage equipment corrosion.

The current SRS schedule is as follows:

- Complete vacuum consolidation of K-Reactor Disassembly Basin sludge in FY 1996. .... Deleted due to improvement in water chemistry control*

- Begin processing of Mk16 and Mk22 SNF in November 1996 ... Completed July 1997

- Remove consolidated basin sludge from K- and L-Reactor Disassembly Basins by September 1997 .... Deleted due to improvement in water chemistry control*

- Complete dissolution of Mk16 and Mk22 SNF by September 2002 and disposition of resultant uranium solutions by (to be determined). Current approach is to dissolve the spent fuel, blend it to Light Water Reactor Grade low enriched uranium, and sell the solution to TVA.

* Deletion of milestones accepted by the Board in their letter dated April 15, 1998.

3.6.4 Idaho Spent Nuclear Fuel

Note: **The following paragraphs are the site's proposal for the forthcoming Implementation Plan change. The proposals remain under consideration by the Department. The original approved milestone dates are listed at the end of this section.**

Idaho Facility Description

The CPP-603 Fuel Storage Facility is an underwater fuel storage facility that was built in two phases (1951 and 1959) for storage of metal-clad spent nuclear fuel elements pending reprocessing. It consists of three unlined concrete storage basins, two cask handling areas, a fuel element cutting facility, a structural steel/transite superstructure, and assorted basin water treatment areas that were added individually in the 1960s and 1970s. The two basins built in 1951 used a monorail and yoke storage system for fuel storage, and the basin built in 1959 used an open basin filled with free-standing underwater storage racks. The total volume of the three basins is approximately 1.5 million gallons. There are 1,141 units of spent fuel stored in the facility comprised of 2.7 t of heavy metal. This fuel is predominantly zirconium-, aluminum-, and stainless steel-clad, and some fuels are canned because of cladding breaches or for fuel handling economy.

Idaho Issues

A federal court order specifies a schedule for fuel movement from CPP-603. This includes 189 fuel units moved by September 1994, an additional 189 units by December 1995, all fuel moved from the North and Middle basins by December 1996, and all remaining fuel removed by December 2000. All fuel was to be moved to the CPP-666 wet storage facility in available transport casks unless an agreement was made with the State of Idaho to store specific fuel types in appropriate dry storage areas. Fuel subject to accelerated corrosion while stored underwater will be removed from wet storage and dried and stored in the CPP-603 Irradiated Fuel Storage Facility (IFSF). To date, the first 189 units were expedited to complete movement by July 1994, the second 189 units were moved by August 1995, and all fuel was moved from the North and Middle basins by August 1996.

An Agreement with the State of Idaho has been obtained to allow storage of spent fuel, some of which will be processed through the dry overpacking station in the IFSF dry storage area. Agreement with the State of Idaho has also been obtained to store the EBR-II inventory currently in the South basin in the IFSF dry storage area even though it will not be processed through the dry overpacking station. This agreement was sought because the detailed inspections of the EBR-II inventory completed in 1994 showed that water inleakage into a few of the storage containers had occurred, which could result in deterioration of the fuel. Movement to dry storage will eliminate the potential for future fuel deterioration, which could result from wet storage. The dry overpacking station was installed and accepted for operation in July 1997. A structural reinforcement of the IFSF facility was determined to be necessary in FY 1996, and this project was completed in December 1997. State approval to store spent fuel from the CPP-603 South basin in the IFSF was received in January 1998. Fuel movements from the South basin commenced in May 1995, and over half (395/744) of the fuel units were moved either to CPP-603 or through the dry overpacking station into the IFSF as of March 19, 1998. The remaining fuel inventory is scheduled to be removed from the South basin well ahead of the court ordered December 2000 completion date.

Installation of accurate level-monitoring instrumentation for the basin water and an accurate basin water balance program will partially compensate for the absence of leak detection systems. Several actions were completed by December 1994 to improve criticality safety, including storage yoke re-rigging, repackaging of some corroded canisters and spent fuel cladding, and fuel spacing. Complete underwater video inspections of all spent fuel and storage equipment have been completed. The EBR-II uranium metal fuels, which also contain metallic sodium for bonding, are canned because they are potentially reactive with water. The video inspections showed the potential for water inleakage in a few of the cans, and subsequent underwater ultrasonic examinations of those cans confirmed the presence of water and potential spent fuel deterioration. The identified cans of EBR-II fuel with water inleakage were removed from the South basin and transferred to the Argonne National Laboratory-West facility in January 1998 for examination and assessment of the deterioration process. The remaining EBR-II cans will be individually ultrasonically inspected for water inleakage before they are removed from the South basin.

Corrective actions taken to address corrosion include storage yoke re-rigging, fuel repackaging, and full implementation of a corrosion monitoring program. Structural analyses have determined the storage basins will meet the design basis seismic events, and corrective actions to resolve non-compliances related to the steel superstructure have been completed.

The key milestones for accomplishing removal of CPP-603 from service are provided below.

- Establishment of the Facility Safety Authorization Basis. Completed in December 1994 (Including re-rigging of storage equipment, SNAP fuel recanning, video inspection of all spent fuel and storage equipment, and seismic evaluation.)

- Movement of first 189 units from North and Middle Basins to CPP-666. .... Completed in July 1994
(Moved 10 additional units in September 1994.)

- Begin movement of South Basin Fuels .... Completed in May 1995

- Movement of second 189 units from North and Middle Basins to CPP-666 by December 1995 .... Completed in August 1995

- Removal of all fuel from the North and Middle Basins by December 1996 .... Completed in August 1996

- Removal of all fuel not requiring overpacking by December 2000.

- Dry Storage Overpacking Station construction and startup by December 1998. .... Completed in July 1997

- Fuel Removal from the CPP-603 South Basin by December 2000.

Of the eight milestones established in the Implementation Plan, six have been completed, all ahead of schedule.

An INEEL Spent Nuclear Fuel Management Plan was issued in September 1997 to direct the placement of spent fuel currently in existing INEEL facilities into interim storage. The plan addresses the coordination of intrasite fuel movements with new fuel receipts and intersite transfers that may be required in accordance with the upcoming DOE SNF Programmatic EIS ROD. The plan assumes that all spent fuel at INEEL will be placed into dry storage facilities or shipped offsite until it can be prepared for final disposition.

Causes and Impacts of Proposed Implementation Plan Change

The development of the DOE EM Accelerated Cleanup Plan in FY 1997 resulted in an INEEL goal of removal of spent fuel from all underwater storage facilities by FY 2006. The IFSF has become the planned dry interim storage facility for most of the INEEL spent fuel inventory until packaging and new NRC licensed interim storage facilities can be constructed. Movement of the EBR-II fuel from the CPP-603 underwater basin directly into the IFSF saves money and reduces personnel radiation exposure and the potential for spent fuel handling incidents by eliminating a significant amount of fuel handling. The change also improves the schedule for accomplishing the removal of the spent fuel inventory from the CPP-666 basin.

In FY 1994, a complete visual spent fuel inventory of the CPP-603 using underwater television cameras was performed. A few of the EBR-II canisters were noted to bubble when lifted to achieve a full inspection, and rust stains were noted on the bottoms of a few canisters. A subsequent ultrasonic examination of these canisters showed water has leaked into the canisters through the Swagelok lids. Transfer of these canisters back to the supplier

(Argonne National Laboratory - West) for an examination and assessment of the fuel was completed in January 1998. After the visual inspection, a transfer route for the fuel was selected. It was decided that the safest alternative would be to move the fuel directly into dry storage, rather than to move the problem fuel to the CPP-666 basin where continued deterioration might occur and affect that facilities operational safety. All of the EBR-II canisters will be individually ultrasonically examined and, if dry, moved to the IFSF.

The ultrasonic examinations and movement of the EBR-II fuel to the IFSF is now scheduled to begin by October 1998 and to be completed by June 2000. It will follow completion of most of the spent fuel canning and drying activities for the Implementation Plan milestone, "Remove all spent nuclear fuel from the CPP-603 Fuel Storage Facility," and receipts of two shipments of foreign research reactor spent fuel. An upgrade of the IFSF in-cell cranes and remotely operated fuel manipulator are also included in the facility schedule.

An assessment of the Implementation Plan milestone, "Complete removal of all spent nuclear fuel from CPP-603 not requiring overpacking," indicates that planning its completion by December 2000 vice the original scheduled December 1998 completion date will not countermand the Idaho supreme court order. Both of INEEL's remaining milestones are expected by be completed by September 2000. The overall vulnerability level of the CPP-603 underwater storage facility is not expected to increase because of the change. The EBR-II fuel is in sealed canisters so fission product leakage from and further deterioration over the next two years will not affect the operational safety of the facility. The bare aluminum fuel presents the highest hazard to the facility operation and, appropriately, has the highest priority for movement into the IFSF. Movement of the EBR-II fuel to the CPP-666 underwater facility effectively defers and corrective management of the potential for further water leakage and subsequent fuel degradation; therefore, movement into the IFSF improves the safety posture of the CPP-666 facility. The technology for moving South basin fuel into the IFSF is mature. The overpacking station has been installed, tested, and is currently in use for canning and drying the CPP-603 South basin aluminum clad fuel. The ultrasonic examination equipment to be used for the EBR-II canisters, proven in the previous inspections, was upgraded and determined to be ready for use as of January 1998.

The milestone "Remove all spent nuclear fuel from the CPP-603 Fuel storage Facility" is not affected by this change. All spent fuel will be moved by December 2000. The due date for milestone "Complete removal of all spent nuclear fuel not requiring overpacking from CPP-603" is adjusted to December 2000 vice December 1998 for the reasons stated above.

3.6.5 Key Milestones

Spent Nuclear Fuel

Phase III Plan of Action Issued	Completed October 1996
Strategic Plan Issued	Completed December 1994
Programmatic SNF EIS Record of Decision	Completed June 1995
Environmental Management Programmatic EIS Record of Decision	Completed June 1995
SNF Program Plan	Completed November 1995
Foreign Research Reactor EIS Record of Decision	Completed May 1996
Repository EIS Record of Decision	September 2000

Hanford

Notice of Intent for K-Basins EIS	Completed March 1995
Fuel Characterization Begin	Completed April 1995
Integrated Path Forward Schedule	Completed May 1995
Integrated Path Forward Schedule	Completed May 1995
K-Basins EIS Record of Decision	Completed March 1996
Fuel Removal Begin	December 1997
Fuel Removal Complete	December 1999

Savannah River

Interim Nuclear Materials Management EIS Record of Decision	Completed December 1995
Begin processing of Mk31 Targets in F-Canyon	Completed February 1996
Complete RBOF Fuel Consolidations	Completed August 1996
K- and L-Basin Upgrades	Completed May 1996
Complete processing of Mk31 Targets in F-Canyon	Completed January 1997
Begin dissolution of Mk16/Mk22 Spent Fuel	Completed July 1997
Complete dissolution of Mk16/Mk22 Spent Fuel	December 2000*
Disposition of resultant Mk16/Mk22 dissolution uranium solutions	To be determined*

* Original Implementation plan dates for completing dissolution and stabilization of Mk16/22 Spent Fuel were November 1999 and April 2000, respectively. The current milestone dates are in accordance with the Savannah River Phased Canyon Strategy which was accepted by the Board in their letter dated April 15, 1998.

Idaho

189 Fuel Units from North/Middle Basins Removed	Completed July 1994
Removal of next 189 Fuel Units from North/Middle Basins	Completed August 1995
Removal of All Fuel from North/Middle Basins	Completed August 1996
Removal of All Fuel Not Requiring Overpacking	December 1998
Startup of Dry Storage Overpacking Station	Completed July 1997
Removal of All Fuel from CPP-603	December 2000