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DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

The Secretary of Energy
Washington, DC 20585

January 19, 2001

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DNF SAFETY BOARD

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW
Washington, D.C. 20004

Dear Mr. Chairman:

Enclosed is Revision 1 of the Department's Implementation Plan for stabilization of the nuclear materials identified in Recommendation 2000-1. The primary purpose of this revision is to incorporate the plans and schedule for stabilizing nuclear materials at Los Alamos National Laboratory in order to complete the implementation plan which was provided to you in June 2000. This revision also updates the current status of, and changes to, several commitments from the June 2000 plan. Those changes were previously described to you in a letter dated November 22, 2000, from the Department's 2000-1 Responsible Manager.

We continue to closely track progress on all stabilization commitments and are pleased to be able to continue to show measurable progress at several sites. Of note is the initiation of spent nuclear fuel movement from the K-Basins at the Hanford site. We will keep you and your staff apprized of our progress in meeting the commitments in this plan. If you have any questions, please contact me or have your staff contact Mr. David Huizenga on (202) 586-5151.

Yours sincerely,

Bill Richardson

Bill Richardson

Enclosure

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An Implementation Plan for Stabilization and Storage of Nuclear Material

The Department of Energy Plan in Response to DNFSB Recommendation 2000-1
Revision 1

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January 2001

U. S. Department of Energy
Office of Environmental Management

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EXECUTIVE SUMMARY

The Defense Nuclear Facilities Safety Board ("DNFSB" or "Board") issued Recommendation 2000-1 on January 14, 2000, re-iterating the urgency of completing the nuclear material stabilization activities which had already been committed to under Recommendation 94-1. The Department continues to share the Board's concerns regarding nuclear materials stabilization. The urgent safety issues described in the original Recommendation 94-1 have either been corrected or had compensatory measures put in place to protect workers and the public until stabilization can be completed. Accordingly, in the original 2000-1 Implementation Plan, approved in June 2000, the Department requested that Recommendation 94-1 be closed and that the remaining stabilization activities be tracked under Recommendation 2000-1.

In Recommendation 94-1, issued May 26, 1994, the Board noted its concern that the halt in production of materials to be used in nuclear weapons froze the manufacturing pipeline in a state that, for safety reasons, should not be allowed to persist unremediated. Specifically, the Board expressed concern about certain liquids and solids containing fissile materials and other radioactive materials in spent fuel storage pools, reactor basins, reprocessing canyons, and various other facilities once used for processing and weapons manufacture. The Department of Energy ("DOE" or "the Department") accepted the Board's Recommendation on August 31, 1994, and submitted its initial implementation plan on February 28, 1995.

Two revisions of the 94-1 Implementation plan were issued in December 1998 and February 2000 prior to preparation of the initial 2000-1 Implementation Plan. At the time that the June 2000 plan was issued, the Office of Defense Programs outlined a process which they would follow to prepare an integrated plan with milestones for stabilization or discard of remaining 94-1 materials at Los Alamos National Laboratory. Incorporation of the plans for Los Alamos is the primary driver for this Revision 1 of the 2000-1 Implementation Plan.

The measures outlined in this plan to stabilize nuclear materials constitute an important part of an integrated management process to address these issues. In accordance with the first principle in Integrated Safety Management, DOE realigned its management organization for the nuclear materials stabilization effort in December 1998. The Assistant Secretary for Environmental Management (EM-1) is the lead Program Secretarial Official (PSO) for the Department for Recommendation 2000-1 since most of the nuclear materials stabilization activities are under the purview of that office. The Responsible Manager (RM) is the Deputy Assistant Secretary for Integration and Disposition, who has responsibility to perform all associated planning, response, and implementation activities. A member of the Office of Nuclear Materials and Spent Fuel (EM-21) is assigned as the Recommendation 2000-1 Implementation Plan Manager (IPM). The Responsible Manager and the Implementation Plan Manager will work with appropriate managers from the Offices of Defense Programs (DP) and Environmental Management (EM) to ensure that stabilization activities at DP and EM sites are completed in a safe and timely manner.

The Responsible Manager is supported by a 2000-1 Management Team, consisting of representatives from each of the Program Offices at Headquarters that have 2000-1 related stabilization activities at Field locations under their cognizance. The Offices of Fissile Materials Disposition (NN-60); Environment, Safety and Health (EH); Departmental Representative to the Board; and EM's Office of Science and Technology are also represented on the 2000-1 Management Team. It is important to note that, although the DP and NN-60 organizations have recently been reorganized as part of the new National Nuclear Security Administration, their representation and responsibilities with respect to DNFSB responses has not changed. The 2000-1 Management Team integrates activities across the sites and the material categories, managing interfaces among utilization, stabilization and disposition programs. The team is also working to make the most efficient use of the complex's facilities, examine methods and alternatives for improving practices and schedules as this effort continues, and evaluate the status of the Department's progress in meeting the Secretarial commitments contained in this Implementation Plan.

DOE has made progress in stabilizing nuclear materials for long term storage, ready for disposition. For example; 87% of all Pu solutions, 47% of residues and mixed oxides, 39% of special isotopes and 7% of spent nuclear fuel have been stabilized. The remaining material stabilization actions that must be completed are summarized below, along with an indication of any change from the commitments stated in the original 2000-1 Implementation Plan. A complete description of these activities for each site is found in the implementation plan body, and a crosswalk of the remaining commitments and their revised due dates is located in Appendix D. Integrated safety management systems are either in place or being implemented at these sites to ensure continued safe storage and stabilization of nuclear materials.

Remaining Actions Under Recommendation 2000-1

For the purposes of this Implementation Plan, the Department defines closure of the actions related to Recommendation 2000-1 as follows:

- All 94-1 plutonium metal and oxide is packaged according to the long-term storage standard.
- All 94-1 special isotope materials are in a form suitable for long-term storage.
- All 94-1 spent nuclear fuel is stabilized by dissolution or transferred to appropriate storage.
- All 94-1 uranium is in a form suitable for long-term storage.
- All 94-1 low assay materials are packaged in accordance with the Interim Safe Storage Criteria.

Chapter 4 of the Implementation Plan text describes those actions which were completed to eliminate the urgent risks discussed in Recommendation 94-1, and to put in place compensatory measures to ensure the safety of workers and the public until all stabilization activities are complete. Chapter 5 describes the remaining scope of materials and schedule (summarized below) for completing all of the stabilization activities discussed in Recommendation 2000-1.

Hanford

- All plutonium solutions will be stabilized by December 2001
- All plutonium metal will be packaged to conform to DOE-STD-3013 by August 2001 *(a five month delay from the March 2001 commitment in Rev. 0)*
- All plutonium oxide will be packaged to conform to DOE-STD-3013 or dispositioned offsite by May 2004
- Alloys will be packaged for disposition to WIPP or packaged to conform to DOE-STD-3013 by June 2001
- All residues <30% plutonium will be stabilized by April 2004
- All plutonium polycubes will be stabilized by August 2002
- All spent nuclear fuel and sludge will be removed from the K-Basins by August 2004

Savannah River

- All pre-existing plutonium solutions will be stabilized by December 2002
- All pre-existing metal and oxide >30% plutonium will be packaged to conform to DOE-STD-3013-2000 by June 2008
- All residues <30% plutonium will be stabilized by June 2008
- All americium/curium solutions will be stabilized by December 2005
- All neptunium solutions will be stabilized by December 2006
- All Mark 16 and Mark 22 spent nuclear fuel will be dissolved by March 2004
- All uranium solutions will be dispositioned by September 2005

Rocky Flats

- All piping systems will be drained and the plutonium solutions stabilized by March 2002
- All metal and oxide >30% plutonium will be packaged to conform to DOE-STD-3013-2000 by May 2002
- All plutonium residues will be packaged for off-site shipment by May 2002

Oak Ridge

- All plutonium will be packaged and shipped off-site by May 2002

Los Alamos National Laboratory

- All hydrides, nitrides, and cellulose rags will be stabilized by October 2001
- All solutions will be stabilized by October 2001
- All metal and oxide will be inspected and repackaged by October 2004
- All residues will be stabilized by October 2010

Lawrence Livermore National Laboratory

- Complete plutonium metal and oxide repackaging to conform to DOE-STD-3013-2000 by May 2002
- Stabilize and package LLNL's ash residues to conform to DOE-STD-3013-2000 by May 2002
- Stabilize and package all other LLNL residues to conform to DOE-STD-3013-2000 by May 2002

1.0 BACKGROUND

The Defense Nuclear Facilities Safety Board (DNFSB or Board) issued Recommendation 94-1 on May 26, 1994. The Department of Energy (DOE or the Department) accepted the Board's Recommendation on August 31, 1994, and submitted its implementation plan on February 28, 1995. The Board noted, in Recommendation 94-1, that it was concerned that the halt in production of materials to be used in nuclear weapons froze the manufacturing pipeline in a state that, for safety reasons, should not be allowed to persist unremediated. Specifically, the Board expressed concern about certain liquids and solids containing fissile materials and other radioactive materials in spent fuel storage pools, reactor basins, reprocessing canyons, and various other facilities once used for processing and weapons manufacture. On January 14, 2000, the Board issued its Recommendation 2000-1, which dealt with the same technical issues as 94-1. In Recommendation 2000-1, the Board expressed its concern that remediation activities were not being accomplished on the schedules originally agreed to, nor was there the same sense of urgency that had originally been their intent with 94-1. The Department acknowledges and continues to share the Board's concerns and has developed this revision of the 2000-1 Implementation Plan continue to address these urgent problems.

At about the same time as the Board's Recommendation 94-1, the Department of Energy (DOE) initiated activities to investigate the conditions of nuclear materials within the Department. Working groups were established to visit sites and assess the status of specific categories of nuclear material. The following reports provided a detailed description of the amount, location, condition and vulnerabilities associated with much of this material:

- *Spent Fuel Working Group Report on Inventory and Storage of the Department's Spent Nuclear Fuel and Other Reactor Irradiated Nuclear Materials and Their Environmental, Safety, and Health Vulnerabilities (November 1993)*
- *Plutonium Working Group Report on Environmental, Safety and Health Vulnerabilities Associated with the Department's Plutonium Storage (November 1994)*
- *Highly Enriched Uranium Working Group Report on Vulnerabilities (December 1996)*

The *Spent Fuel Working Group Report* identified significant vulnerabilities causing the Department to study alternative programmatic solutions. In addition, and as a result of a court order (Civil No. 91-0035-S-HLR, 6/28/93), the Department prepared the Programmatic Spent Nuclear Fuel Environmental Impact Statement. The final statement was issued in April 1995, with a Record of Decision on June 1, 1995.

The Departmental assessments identified above and the independent observations and concerns expressed by the Board made the following issues clear:

- There is an urgent requirement to address the growing technical problems associated with handling, stabilizing and storing excess nuclear material. These problems are especially noteworthy because the recent downsizing of the weapons complex has resulted in the loss, without replacement, of many of the skilled workers needed to correct the problems. This decreasing experience base, coupled with the increasing age of the facilities, makes the control of nuclear material and the prevention of inadvertent criticality events, uncontrolled exposure, and personnel contamination a continuing concern.

- The efforts to stabilize nuclear materials were heretofore limited to those undertaken by individual field organizations and constrained by each site's resources. Consequently, the stabilization of nuclear materials was pursued with different priorities, assets and treatment techniques. Several mutually exclusive and, in some cases, duplicative programs evolved. Without a Departmental perspective, some options for solving the problem were not adequately assessed (e.g., transporting all material of a certain type to one site for processing, versus processing material at multiple sites).

The Department initially broadened the scope of the response to Recommendation 94-1 to include additional bulk liquids and solids containing fissile materials and other radioactive substances in spent fuel storage pools, reactor basins, reprocessing canyons, processing lines and various facilities which require conversion to forms, or establishing conditions, suitable for safe interim storage. The scope was broadened to ensure that similar materials under similar conditions receive the same degree of management attention as those noted by the Board in its Recommendation.

Much progress has been made to address the concerns specified in the Department's vulnerability reports and the Board's Recommendation 94-1. This Implementation Plan revision provides an update on the completed actions from the Department's previous versions of its integrated plan for nuclear materials stabilization. Chapter 4 of the Implementation Plan text describes those actions which were completed to eliminate the urgent risks discussed in Recommendation 94-1, and to put in place compensatory measures to ensure the safety of workers and the public until all stabilization activities are complete. Chapter 5 describes the remaining scope of materials and schedule for completing all of the stabilization activities discussed in Recommendation 2000-1.

2.0 UNDERLYING CAUSES

Throughout the Cold War the Department of Energy was responsible for the development, manufacturing, maintenance and testing of the United States' arsenal of nuclear weapons. At the conclusion of the Cold War a majority of the Department's facilities that performed the various elements of work necessary to produce these nuclear weapons had been shutdown for various safety reasons with the expectation that they would be required to resume production within a relatively short time. Subsequently, world events have been such that the shutdown facilities have not resumed production and, as a consequence, the Department has shifted its emphasis from nuclear material production to environmental management to mitigate the risks caused by chemical and nuclear instability of the materials remaining in the facilities.

When nuclear weapons were being produced and the stockpile was growing, the vast majority of fissile material scrap and materials from retired weapons was recycled. It was less costly to recover fissile materials from high assay scrap and retired weapons than to produce new material. As a result, very little scrap containing fissile material was considered surplus. Consequently, these materials were designated, handled, and packaged for short-term storage; therefore, when the weapon production lines were halted in the late 1980s and early 1990s, many materials were left in conditions unsuitable for long-term storage.

In early 1994, the Board issued its Recommendation 94-1, which expressed the Board's dissatisfaction with the slow pace of actions being taken to correct the conditions brought to light during the plutonium and spent fuel assessments. In response, in February 1995 the Department issued its Recommendation 94-1 Implementation Plan. The Plan represented an integrated Department-wide program to provide timely mitigation of those conditions identified in the vulnerability assessments which presented the highest risks to worker, facility, and environment. For example:

- The by-products left from the processing of plutonium into weapons-grade components left a large legacy of deteriorating plutonium residues, metal and oxides in both solution and solid form at several facilities such as Hanford, Rocky Flats, and Savannah River. These materials require timely stabilization and repackaging to prevent further deterioration of conditions and a corresponding increase in the already unacceptable safety risks.

- The production and processing of plutonium and other nuclear materials at Hanford, the Idaho National Engineering and Environmental Laboratory, and Savannah River left a large legacy of spent nuclear fuel in storage pools. Both the fuel and the sludge emanating from the deteriorating fuel have become a significant environmental threat that mandates timely action to prevent further increase in the associated risks.

- To provide suitable fuel for reactors used to produce the plutonium that was turned into metal weapons components required processing natural uranium to produce enriched uranium. The by-products of this process continue to contaminate major facilities at both Oak Ridge and Savannah River. The risks associated with the highest risk solid deposits of uranium isotopes in an uranium enrichment facility at Oak Ridge have been mitigated. Savannah River has a large quantity of a uranium solution stored in its H-Canyon that is both a chemical and a radiological hazard that requires timely mitigation.

- The process of producing and purifying nuclear materials at Savannah River left a particularly hazardous inventory of special isotopes in both solution and solid forms that present significant safety risks.

A number of modifications to the 94-1 Implementation Plan became necessary in the years following its original preparation. These modifications were due to approval of major Departmental initiatives such as:

- *Accelerating Cleanup: Paths to Closure*, which described the Department's plans to accelerate closure of facilities and sites under the auspices of the Office of Environmental Management

- *The Rocky Flats Closure Project Management Plan*, which outlined specific actions the Department would take to accelerate the cleanup and closure of Rocky Flats

- The Record of Decision (ROD) for the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* regarding storage of surplus weapons-usable plutonium and highly-enriched uranium (HEU) pending disposition, and the strategy for disposition of plutonium

- The ROD for the Programmatic Environmental Impact Statement for *Stockpile Stewardship and Management* within the Office of Defense Programs which assigned new missions to some DP facilities

Modifications were also necessitated by technical improvements, previously unforeseen problems, and schedule changes that were encountered as stabilization and repackaging progressed at various sites. In December 1997 the Board called on the Department to prepare a comprehensive revision to the 94-1 Implementation Plan to capture all known and planned changes from the original Plan. Revision 1 of the Implementation Plan was approved by the Secretary of Energy in December 1998. The Board only conditionally accepted Revision 1 of the Implementation Plan, citing uncertainties about the Department's path forward for plutonium stabilization and storage in light of the hold that had been placed on construction of the Actinide Packaging and Storage Facility at Savannah River Site.

In addition, as Revision 1 was being prepared, an intensive rebaselining effort was underway for stabilization activities at the Hanford Plutonium Finishing Plant. The results of that rebaselining were reflected in Revision 2, approved on February 1, 2000, which also included updated plans for Rocky Flats, Oak Ridge, Lawrence Livermore National Laboratory, and Idaho.

Revision 3 of the Department's plan for "Remediation of Nuclear Materials in the Defense Nuclear Facilities Complex," which was also the original 2000-1 Implementation Plan, was approved on June 8, 2000, and updated the status of actions at all affected DOE facilities, described a path forward for SRS that did not include the Actinide Packaging and Storage Facility, and responded to the Board's Recommendation 2000-1 issued on January 14, 2000.

At the time that the June 2000 plan was issued, the Office of Defense Programs outlined a process which they would follow to prepare an integrated plan with milestones for stabilization or discard of remaining 94-1 materials at Los Alamos National Laboratory. While incorporation of the plans for Los Alamos is the primary driver for this Revision 1 of the 2000-1 Implementation Plan, this opportunity is being used to update the plans for stabilization activities at the Hanford Plutonium Finishing Plant, Rocky Flats Environmental Technology Site, and Oak Ridge National Laboratory.

3.0 BASELINE ASSUMPTIONS

Key Assumptions

In order to achieve the commitments outlined in this implementation plan, there are several key assumptions identified for each of the material categories presented in Section 5.2. These key assumptions include:

- Environmental and other studies will be used to develop alternatives; selection of alternatives will be made through Records of Decision or pursuant to appropriate NEPA review. For many of the materials described in Section 5.2, the NEPA process has been completed, while for some activities, some milestone dates may be contingent in part on decisions made pursuant to additional NEPA review. The NEPA process is a key element of DOE's planning process and one of the principal means of achieving stakeholder involvement.

- Implementation Plan execution is predicted upon target level funding being provided by the Congress in an atmosphere of stable mission requirements.

- The 94-1 Research and Development Program (described in Appendix G) has provided the needed technologies to support the stabilization needs for this plan, and will be maintained to support emergent R&D needs related to stabilization and storage of nuclear materials.

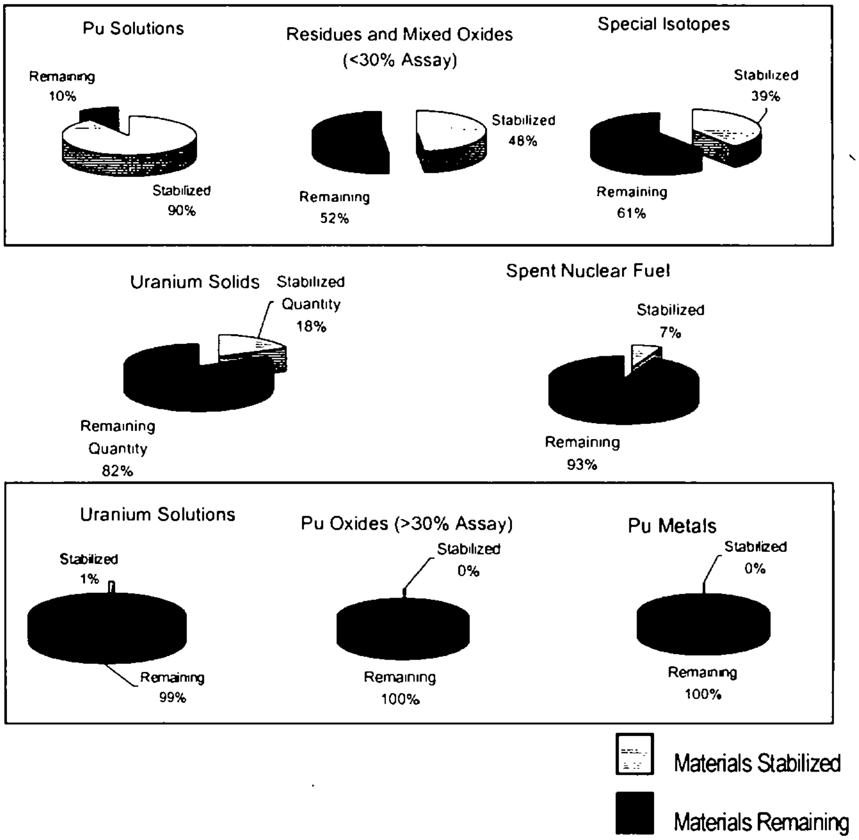
- Facilities will be restarted and operated within the context of each site's Integrated Safety Management System.

- Transportation issues (i.e., containers, logistics, environmental and stakeholder concerns) will be identified early and resolved.

4.0 SUMMARY OF COMPLETED ACTIONS

Figure 4.1 shows the progress that has been made in stabilizing the inventories of the various categories of nuclear materials included in the 94-1 Implementation Plan. In addition, by completing numerous risk reduction actions that were called for in the original 94-1 Implementation Plan, sites have significantly reduced the risk posed by those materials awaiting stabilization. A portion of those completed actions are described below, and a listing of all stabilization activities completed to date is included in Appendix F.

Figure 4.1: Completed Actions: Material Stabilization Progress



Hanford

- Commenced fuel removal at K-West Basin in December 2000
- High risk ash stabilized
- All bottles of Plutonium solution checked to ensure proper venting
- Thermal stabilization of Pu oxides was reinitiated in January 1999, with over 700 items thermally stabilized as of the end of FY 2000
- Magnesium hydroxide precipitation process started in September 2000
- Repackaging of Rocky Flats Ash for disposition to WIPP was initiated in September 2000
- Initiated stabilization of plutonium metals in September 2000

- Completed installation of Bagless Transfer System in September 2000, and began welding inner 3013 cans
- Cofferdams installed at K-Basins

Los Alamos National Laboratory
- Performed 100 percent visual inspection of vault inventory
- Stabilized all high-risk vault items

Lawrence Livermore National Laboratory
- Performed 100 percent verification of no plutonium metal in contact with plastic

Oak Ridge
- Uranium deposits with criticality potential removed at K-25 and K-29
- Interim actions taken to preclude criticality at MSRE
- Potentially explosive fluorinated charcoal denatured
- Over 50 percent of uranium inventory removed as gaseous Uranium Hexafluoride

Mound
- All plutonium metal in contact with plastic has been repackaged

Rocky Flats
- Vented all 2,662 residue drums
- Drained all tanks of high-level plutonium solutions (over 16 tanks) and stabilized solutions
- All plutonium metal in contact with plastic has been repackaged
- Started processing all major residue categories (non-specific, various dates)
- All highly-enriched uranium solutions (2,700 L) shipped off-site and stabilized

Savannah River
- Stabilized 303,000 liters of plutonium-239 solutions
- Stabilized 13,300 liters of plutonium-242 solutions
- Stabilized all 15,844 Mark-31 targets
- All plutonium metal in contact with plastic has been repackaged
- All available plutonium metal onsite has been packaged in a DOE-STD-3013 inner container
- Approximately 715 Mk-16/22 spent fuel assemblies have been dissolved
- Dissolved all 128 containers of legacy SS&C residues
- Dissolved all 202 containers of legacy Pu sweepings residues
- Dissolved all 1249 sintered depleted uranium/plutonium fuel rods
- Stabilized high-assay Pu-238 and shipped offsite for program use
- Dispositioned all 39 containers of legacy low-assay plutonium residues
- Stabilized 144 containers of TRR and EBR-II legacy spent nuclear fuel as an emergent risk reduction need
- Dissolved 57 containers of RFETS SS&C residues

Idaho National Engineering and Environmental Laboratory

- Completed removal of all spent nuclear fuel from the CPP-603 South Basin

4.1 Analysis of Safety Issues and Basis for Closure

The Department's review of the discussion contained in Recommendation 94-1 indicates that there were three safety issues which led to the nine sub-recommendations.

1. *Within two to three years, the interim configuration of some materials stored in the nuclear weapons manufacturing pipeline could pose imminent health and safety hazards to workers and to the public. Those items should be placed in improved storage as soon as possible.*

The Department has already taken action to resolve imminent safety hazards and to improve the characterization and management of all nuclear materials. Those completed and ongoing actions to maintain these materials safely until their stabilization is completed are described later in this chapter.

2. *Within a reasonable amount of time, remaining materials should be stabilized and safely stored before aging causes them to become an imminent health and safety hazard to workers and the public.*

Chapter 5 describes the remaining stabilization actions which remain from the 94-1 Implementation Plan, and which must be completed in response to Recommendation 2000-1.

3. *Research should be performed to fill any gaps in the information base needed to allow DOE to choose between alternate processes used to convert fissile materials into a form suitable for long-term storage and disposal.*

The Department of Energy chartered a Research Committee through the Nuclear Materials Stabilization Task Group in March 1995, which developed and issued the *94-1 Research and Development Plan* in November 1995. With all of the stabilization technology needs effectively addressed, the Department has transitioned the 94-1 R&D Program to the Nuclear Materials Focus Area. The Focus Area monitors ongoing implementation of technologies and is in place to assist with any emergent technology needs.

4.2 Site-specific Risk Issue Management Activities

4.2.1 Hanford

Hanford's 94-1 materials with the potential to become imminent safety hazards included plutonium solutions and certain sludges in PFP as well as degraded spent nuclear fuel in water-filled storage basins. As indicated in Section 4.0, actions to stabilize a portion of the solutions, vent solution containers, and stabilize certain sludge residues were completed.

Also, spent nuclear fuel removal was initiated at K-West Basin in December 2000.

Plutonium Finishing Plant Risk Reduction Strategy

The 94-1 Implementation Plan Revision 1 projected completion of the plutonium stabilization activities at PFP in December 2004. Stabilization actions at PFP were successfully restarted in January 1999. Further development of demonstrated acceleration opportunities have projected an earlier completion date. Based on restart experience and extensive re-planning, completion of stabilization and final packaging are now projected to be accomplished by May 2004.

As a result of continuing storage of the PFP nuclear materials, degradation of the materials and containers is expected to continue, resulting in an increased but manageable level of risk to workers over time. Approximately one to three storage containers per year require repackaging to prevent rupturing due to potential container failure as evidenced by bulging or paneling. Although a container has not ruptured in recent years, the probability that an item could potentially rupture due to storage container degradation and/or material chemistry will increase with time until stabilized and packaged to meet the long-term storage standard. This is expected to increase risk to the PFP workers, with little or no increase in risk to the public or nearby site workers. As material is stabilized, however, the overall risk to workers and the public will be reduced.

In parallel with the 1998 update, PFP was in the process of rebaselining the facility life-cycle missions of Pu materials stabilization and facility deactivation. Hanford established a "Tiger Team" to perform an extensive evaluation of all existing 94-1 plutonium stabilization processes, developed detailed resource-loaded actions necessary to accomplish the stabilization, and integrated these activities with the balance of plant activities to produce the PFP Integrated Project Management Plan (IPMP). Risk reduction associated with the various 94-1 Pu material stabilization activities and the overall 94-1 program at PFP was used as the basis for prioritization of materials stabilization. The IPMP provides credible funding profiles and supports the completion of stabilization and packaging in FY 2004 as committed to in the 1998 Implementation Plan update. The schedules for individual 94-1 materials have been modified based on risk reduction and more effective integration of activities throughout the PFP 2000-1 stabilization program.

Richland included the DEAR and Laws Clauses (48 CFR 970.5204-2 and 48 CFR 970.5204-78) in the contracts for the integrating contractor and subcontractors in order to develop the infrastructure and implement Integrated Safety Management (ISM) sitewide. This involves the development of procedures and personnel training according to the principles of ISM. A strong ISM system at PFP is improving the planning, conduct and review of all work and thus improves worker safety and reduces the number of occurrences. At the facility level, PFP developed the policies/procedures to implement ISMS (Phase I verification and Phase II implementation). DOE Phase II verification of ISMS implementation at PFP is scheduled was completed in July 2000.

The following is a summary of the risks associated with the plutonium material at PFP. This information is based on the Hanford *Update of the Department of Energy's 1994 Plutonium Vulnerability Assessment for the Plutonium Finishing Plant* (HNF-3541).

Plutonium Solutions

PFP currently stores approximately 430 items of plutonium bearing solutions. These solutions are stored in vented 10-liter containers. Approximately 100 of these items are polybottles stored in thin-walled stainless steel containers. The remaining items are Product Receiver (PR) containers in which the solutions are stored in thick-walled stainless steel vessels.

The primary concern with the storage of plutonium-bearing solutions is the radiolytic decay of the solution resulting in the formation of hydrogen. If improperly vented, the hydrogen could build up to within the explosive range and/or pressurize the container causing rupture. Venting of the solution containers assures pressure and hydrogen does not buildup to unacceptable levels. As an added precaution, non-sparking tools and grounding straps are used when opening the containers.

Another significant concern is degradation of the container (through corrosion or embrittlement) which could cause container failure and result in contamination spread. Not all solution storage containers were fabricated to the same criteria. Some PR cans were fabricated using pipe with plates welded to the ends. The design life for these containers is not known. Container corrosion rates are directly related to HCl concentration. However, recent data indicates that the chloride concentrations are low with the solution being primarily nitric acid with small amounts of chlorides. Therefore, corrosion due to chloride is not expected to be significant.

The integrity of the polybottles inside the thin walled storage containers is expected to be good since no deterioration was noted during the 1995 downloading and stabilization of approximately 25 polybottles of chloride and fluoride solutions. Although the stainless steel container surrounding a failed polybottle would contain any leaking solution for some period of time, an increased risk of worker contamination would exist during handling or spills.

All containers of solution are stored in a vented configuration and triple contingency exists to preclude criticality in event of container failure. Additionally, criticality analyses demonstrate that fissile material concentration as a result of evaporation is critically safe based on geometry controls for the inner and outer containers. A full inventory was conducted of all solution containers to identify those that did not have positive vents (vent clips and/or Nupro filters installed). Containers that do not have these vents are moved with a safety restraint until the outer lid is removed. All containers now have a monthly "bulge check" conducted to determine if pressurization of the outer can is taking place.

Checks were started in CY 1999 and to date there has been no detection of a bulging container.

Risk Associated with Continued Storage

Continued storage of the solutions at PFP will result in some increase in the contamination risk during handling or cleanup due to container failure. This failure could be induced by corrosion, embrittlement, or pressurization due to a restricted vent. In 1995, polybottles were visually inspected with no apparent degradation observed. However, given the lack of more recent data regarding the condition of these containers as well as the material within, these materials are considered higher risk relative to other materials.

Compensatory Measures

It is recognized that no monitoring program exists for solution containers and, therefore, no early warning mechanism for container failure and leakage exists. The compensatory actions being taken are as follows:

- Solutions at PFP are vented and stored in vault type rooms restricting unnecessary worker access.
- The air in the storage rooms is monitored for alpha emitters by fixed head and Continuous Air Monitor (CAM) samplers.
- Air in the rooms is exhausted through a filtered exhaust system.
- To guard against sparking, every container is electrically grounded and only non-sparking tools are used to open the containers.
- Procedures require the workers to wear protective clothing and respirators during any activity that involves opening containers.
- Monthly visual inspections are conducted to identify any action necessary to address unanticipated activities.

Unalloyed Plutonium Metal

PFP has been storing unalloyed plutonium metal items (350 items) in their current configuration for 15 to 30 years. This metal is typically fuels grade (16 to 18% Plutonium-240) and has a relatively high level of decay heat. The long-term storage criteria for plutonium requires plutonium metals and alloys to be visually free of non-adherent corrosion products, thus requiring them to be brushed if corrosion products are visible.

The material that is brushed off (primarily oxides with small amounts of hydrides and nitrides) will be thermally stabilized in muffle furnaces.

The PFP inventory included a few items of plutonium metal that radiographs indicated were stored in direct contact with plastic. This configuration is known to lead to the formation of pyrophoric plutonium nitrides and plutonium hydrides. Through 1992, PFP procedures also allowed plutonium metals to be wrapped in aluminum foil, bagged-out of the glovebox, and canned in food pack cans. This placed the plutonium in the same air space as the plastic, which also may lead to the formation of plutonium hydrides and nitrides. Plutonium nitrides can also be formed from atmospheric nitrogen in the cans. Formation of nitrides poses a concern since it causes the depletion of the atmosphere in the can, which may lead to the collapse of the cans. If the collapse of cans causes the seals to fail and if oxygen reaches the hydrided metal, the hydrides and nitrides in the can could react and cause expulsion of plutonium from the can contaminating the storage location and possibly workers.

PFP completed characterization of the metal inventory in April 2000. The weighing campaign was successfully completed on April 20. Radiography was completed on April 26. These efforts verified one item in contact with plastic, as well as 24 metal items and 4 plutonium alloy items exceeding 5 grams in weight gains. A total of five items were relocated to glovebox storage pending disposition due to their unstable container integrity. An evaluation was performed on these 35 items to determine appropriate disposition options including continued storage and subsequent surveillance. The evaluation identified 15 items as having higher risk of container degradation and the remaining 20 items acceptable for continued storage and monitoring on a weekly basis. In June 2000, vulnerabilities associated with the 15 items were successfully addressed by repacking 4 items, thermally stabilizing 4 items, and brushing/repackaging the remaining 7 items. The 20 less risk items are currently undergoing enhanced surveillance. Four (4) of the 20 items have been oxidized and three (3) items have been repackaged. These items are being addressed with the initiation of BTS in September 2000. Successful execution of the enhanced surveillance program and subsequent implementation of stabilization actions adequately mitigated any near term risk associated with these items.

Risk Associated with Continued Storage

Continued storage of unalloyed metals will result in a continuing buildup of americium-241 with an associated increase in decay heat. This will also lead to higher radiation levels for the material and, therefore, higher operator exposures. In addition, the increase in decay heat will elevate material temperatures, which may accelerate degradation of plutonium storage container seals and promote additional hydride/nitride formation.

Compensatory Measures

Actions taken by PFP to enhance the facility's ability to compensate for the risks associated with unalloyed metals in storage, include the following:

- PFP has a Vault Safety Inventory System (VSIS), which is used to continually monitor part of the food pack can inventory for bulging. The VSIS will not, however, detect container failures caused by the formation of plutonium nitride, which may cause cans to buckle inward. Therefore, an inspection program is currently used to ensure that the items on VSIS are visually inspected for inward buckling on an annual basis. The items not monitored by the VSIS system are visually inspected monthly.

- The unalloyed metals at PFP are stored in vault rooms thus minimizing unnecessary worker access. The air in the vault rooms is monitored for alpha emitters by fixed head and Continuous Air Monitor (CAM) samplers, and the air in the vault is exhausted through a filtered exhaust system.

- PFP utilizes a repackaging glovebox for the handling of suspect and failed containers. When identified, these containers are opened, the SNM inspected, and corrective actions taken. Typically the material would be repackaged and then returned to vault storage pending repackaging to long term storage requirements.

- PFP conducted a characterization program of weighing and radiography on the metal inventory to detect potential container failure as a result of excess oxidation.

Alloyed Plutonium Metals

PFP currently stores approximately 125 items containing plutonium alloys. Approximately one third of these are seven percent plutonium aluminum alloys, which are considered stable.

Approximately thirty of these items are plutonium-uranium alloys and the remaining are miscellaneous alloys. Some of these alloys, especially the plutonium-uranium alloys, may react as unalloyed plutonium metal. Although there is no direct evidence that hydrides and/or nitrides have formed on these alloys, conditions similar to those described in the discussion of unalloyed plutonium metal could be present and brushing of hydrides and nitrides may be necessary. Many of the items were packaged prior to the issuance of PFP's storage specification and their packaging configuration is unknown. For example, items are identified as simply stored in slip lid, lard cans, or shipping containers. Through at least 1992, PFP procedures allowed plutonium alloys to be wrapped in aluminum foil then bagged out of the glovebox and canned in food pack cans. This placed plutonium alloy in the same air space as plastic, which may lead to the formation of plutonium and uranium hydrides and nitrides.

Some of the alloys also have higher plutonium-240 content than PFP's plutonium metals (up to 25.8% plutonium-240) and present the same decay heat concerns noted for the high plutonium-240 unalloyed plutonium metal.

The constituents of the miscellaneous plutonium alloy "scrap" are not identified. Many items are of non-Hanford origin, are pre-1980 packages, and have not been characterized. Additional review of inventory records indicate that many of these miscellaneous alloy items may contain $<$ 30 wt% Pu + U and exhibit hazards similar to the plutonium-bearing residues. An effort is underway to further characterize and confirm the item contents. Those items verified to be $<$ 30 wt% Pu + U may be re-categorized as miscellaneous residues and discarded to WIPP.

Risk Associated with Continued Storage

For those alloys in which there is a potential for the formation of hydrides and nitrides, continued storage will result in a slight increased risk to workers during storage and throughout stabilization.

Compensatory Measures

Current compensatory measures include:

- As described for the unalloyed metals the VSIS is used to continually monitor most food pack cans for bulging.

- An annual visual inspection is used to detect food-pack cans exhibiting inward buckling due to nitride formation.

- The alloy metals at PFP will continue to be stored in vault rooms that restrict unnecessary worker access.

- As indicated previously, the air in the vault rooms is monitored for alpha emitters by fixed head and Continuous Air Monitor (CAM) samplers and the air in the vault is exhausted through a filtered exhaust system.

- PFP utilizes a repackaging glovebox for the handling of suspect and failed alloy containers. These containers can be opened, the contents inspected and corrective action taken, the material repackaged and returned to vault for storage.

- PFP conducted a characterization program of weighing and radiography on the metal inventory to detect container failure as a result of excess oxidation.

Plutonium Oxides and Mixed Oxides (> 30 wt% Pu + U)

PFP stores over 2500 items of plutonium oxides (> 30 wt%Pu + U) and over 2000 items of mixed plutonium-uranium oxides (MOX). The majority of the oxides and MOX are relatively stable. The primary hazard associated with these oxides is potential container pressurization caused by the radiolysis of impurities, such as organics or water. Container pressurization can result in breaching and contamination spread. Since these oxides have been stabilized to existing requirements in the past and are routinely monitored for signs of container pressurization, the risk of this accident occurring is considered low.

PFP also stores a large quantity of oxides that contain high percentages of chloride salt impurities which may cause corrosion of storage containers and off-gas line plugging during thermal stabilization. Other oxide-related issues include; less than adequate packaging (single contamination barriers), incomplete characterization, bulging of the inner containers, and the potential for generating flammable gasses due to deterioration of the plastic used in repackaging.

Many of the MOX items were received before current acceptance criteria were established. Based on limited radiography, some MOX items have only a single metal storage can barrier between the contaminated surface of the plutonium storage container and the vault atmosphere. These items are not packaged in accordance with current requirements and the radiographs suggest that the inner storage cans have deteriorated significantly. The corrosion mechanism is unclear, but it is likely to be result of some corrosive contaminant in the MOX scrap.

Risk Associated with Continued Storage

Continued Storage of the plutonium oxides and mixed oxides will result in an increase in risk to the workers due to potential container pressurization, continued deterioration of containers and a potential increase in hydride and nitride formation from un-stabilized metals.

Compensatory Measures

Current compensatory measures include:

- The oxide and MOX materials at PFP are stored in vault rooms restricting unnecessary worker access.

- As described for the unalloyed metals, the VSIS is used to continually monitor most food pack cans for bulging. Visual inspections are periodically performed to further identify potential problems.

- As indicated previously, the air in the vault rooms is monitored for alpha emitters by fixed head and Continuous Air Monitor (CAM) samplers and the air in the vault is exhausted through a filtered exhaust system.

- PFP will utilize a repackaging glovebox for the handling of suspect and failed alloy containers. These containers can be opened, the contents inspected, corrective action taken, the material repackaged and returned to the vault storage.

Sources and Standards (> 30 wt% Pu + U)

PFP stores approximately 200 items of sources and standards. The primary hazard associated with these sources and standards involves potential container pressurization caused by the radiolysis of impurities, such as organics or water, resulting in container breaching and contamination spread. These sources are relatively stable oxides and the risk of container breach is low.

Risk Associated with Continued Storage

Continued storage of the sources and standards will not result in an appreciable increase in risk because the materials consist of oxides that have been previously stabilized.

Polycubes

PFP's inventory of polycubes consists of approximately 250 vented food pack cans and polyjars. There are approximately 1,600 cubes stored in the food pack cans measuring up to 8 cubic inches each. In addition, there are approximately 20 items containing polycube scraps and miscellaneous residues resulting from the polycube fabrication process. Collectively, the polycubes contain plutonium and in some cases uranium bound in a polystyrene matrix and are over 20 years old. High radiation dose fields (over 1 R/hr on contact) have been measured. The polycubes also off-gas hydrogen and hydrocarbon gases as a result of the thermal and radiolytic decay of the polystyrene matrix. To accommodate the off-gas, the polycubes are stored in vented, filtered containers. Typically, polycubes are stored in single food pack cans that have a small hole in the top. A filter is attached to the top of the can over the hole. The polycube scraps and residues are stored in taped slip-lid containers. The taped containers provide for adequate venting to prevent build-up of hydrogen gas.

A contamination spread occurred in 1987 as a result of inverting a container of deteriorated polycubes and the filter failing. The glue that held the filter in place had apparently deteriorated due to the effects of radiation and age. Since the incident movement restrictions have been imposed.

Polycubes evaluated at PNNL and the PFP Laboratories demonstrated physical degradation of the cubes, and testing displayed a significant reduction in anticipated hydrogen off-gassing. Both conditions are the result of self-radiolysis occurring during storage. Polycubes with higher Pu or Pu+U loading displayed greater degradation of the cube geometry. Handling practices employed during FY 1999 supported numerous polycube handling activities without incident.

Risk Associated with Continued Storage

Continued storage of the polycubes will result in minor additional degradation of the structural integrity of the polycubes. The primary mechanism for the degradation of this material is through radiolysis. This degradation results in the formation of friable material which poses handling and storage risks. However, the increase in these risks will be minimal given the approximately thirty years these items have already been in storage, and evidence demonstrating significant reduction in generation of hydrogen gas. There is no evidence that delay will contribute to further degradation of the integrity of the filter adhesive.

Compensatory Measures

Filters were placed on the food pack cans, polyjars have been placed in a glovebox, and movement of the items has been restricted. The high radiation fields (> 1 R/hr) and the dose associated with handling these materials make additional characterization and other, more intrusive monitoring methods, very difficult.

Compensatory actions are as follows:

- The polycubes remain stored in vault rooms restricting unnecessary worker access.
- The air in the vault rooms is monitored for alpha emitters by fixed head and Continuous Air Monitor (CAM) samplers.
- Air in the vault is exhausted through a filtered exhaust system.
- Polycube cans/jars are vented through small holes covered by individual filters.
- ALARA considerations focused on the handling and contamination issues are observed in handling polycube cans/containers.

Residues (SS&C, Ash, Oxides <30 wt% Pu+U)

PFP stores approximately 1250 items of SS&C, ash and oxides < 30 wt% plutonium and uranium. Hazards associated with these materials are similar to those of plutonium oxides.

SS&C items with high plutonium assay are stored in 7-inch food pack cans. These 7-inch food pack items may also contain plutonium oxide and fluoride powders and/or plutonium metal. They may contain lab scraps and samples including fines and turnings. PFP characterized these materials using process knowledge. Additional characterization will be performed, as necessary, to support disposition.

The inventory of ash from Rocky Flats was thermally stabilized to at least 450°C, and less than one wt% LOI at PFP. This should provide sufficient stability to allow for continued storage until the material is dispositioned. The Hanford-origin ash is packaged per vault storage standards and stored in taped lard cans. No specific problems have been noted with this material in storage. As with the Rocky Flats ash, this ash should be acceptable for continued storage until disposition can be accomplished.

Increase in Risk Associated with the Delay in Stabilization

A delay in the stabilization of the residues will not result in an appreciable increase in risk because the materials have historically exhibited relatively stable characteristics.

Residues - (Miscellaneous Combustibles, Compounds, and Scrap)

PFP's inventory of miscellaneous items includes approximately 25 items of compounds (four basic types: fluorides, Pu-Zr scrap, Pu-Be scrap, and Pu-Th scrap), approximately 10 items of non-polycube combustibles, and approximately 30 items of miscellaneous scrap items. The primary hazard associated with these oxides is potential container pressurization caused by the radiolysis of impurities, such as organics or water. Container pressurization can result in breaching and contamination spread. A secondary concern exists due to the potential presence of plutonium metal and/or alloys. As described in previous sections the plutonium metal and alloys have the potential to form pyrophoric compounds (hydrides and nitrides).

Risk Associated with Continued Storage

Continued storage of this material will result in a minor increase in risk to the workers due to continuing container and material aging and the potential increase in pyrophoric hydride and nitride formation. The total plutonium content of these items is low, therefore, the increased dose associated with the additional in-growth of americium is low.

Compensatory Measures

Actions taken to enhance PFP's ability to compensate for the risks associated with the storage of these miscellaneous items include:

- The materials remain stored in vault rooms restricting unnecessary worker access.

- As described for the unalloyed metals, the VSIS is used to continually monitor most food-pack cans for bulging.

- The air in the vault rooms is monitored for alpha emitters by fixed head and Continuous Air Monitor (CAM) samplers.

- Air in the vault is exhausted through a filtered exhaust system.

- PFP utilizes a repackaging glovebox for the handling of suspect and failed packages. These packages can be opened, the SNM inspected and corrective actions can be taken, the material repackaged and returned to vault storage.

- Characterization via records research is ongoing. This characterization will assist PFP in identifying potential problematic items.

Fuel Pins

PFP stores approximately 140 items of un-irradiated fuel pins and assemblies. An additional 30 fuel assemblies are stored at FFTF. These fuel pins and assemblies are considered safe for interim storage pending disposition. No additional stabilization or packaging is required to meet the DNFSB Recommendation 94-1 Program requirements.

K-Basins Risk Reduction Strategy

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 1,200 ft from the banks of 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 metric tons of 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 (max) 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 (max) 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, however, and a seismic event could trigger considerable leakage.

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.

Richland has included the DEAR and Laws clauses in the Project Hanford Management Contract as stated in the PFP portion of this section. More specifically the K-Basins have developed facility specific policies/procedures that reflect the principles of ISM and this was validated through a Phase I verification team assessment. The Phase II (full implementation) validation occurred in November 1999. The SNF Project passed the Phase II validation.

Hanford's K-Basins store approximately 2,100 metric tons heavy metal of spent nuclear fuel (SNF). The basins are located about 1,200 feet from the Columbia River. Hanford is a seismically active area, while the basins are not seismically qualified and are well beyond the end of their designed life. The project to initiate and complete removal of all SNF, sludge, debris, and water from the K-Basins has been delayed from the original 94-1 commitment dates. Risk increase is directly proportional to the continued aging of the basins.

Although the basins are not currently leaking, they have been documented as leaking in the past. Their current status as non-leakers cannot be documented to the satisfaction of all parties. Their weakest architectural feature is a construction joint where the basins abut the K-Reactor building. Cofferdams have been installed to prevent drainage of the basins should those joints fail. The K-Basins safety basis postulates a seismically induced structural failure. In that event, operators would attempt to minimize any leakage with bags of Bentonite clay. Fire department assistance would also be requested to provide make-up water. The basins must be kept filled with water due to the potential pyrophoricity of the SNF as it dries and to maintain shielding from the fuel's high radioactivity.

The only other effective risk mitigation is to hasten fuel removal to dry interim storage in the 200 area plateau. To this end, DOE is focused on swift, safe completion of the Hanford Spent Nuclear Fuel Project.

4.2.2 Savannah River Site

Risk Reduction Strategy

Safety has been and continues to be the top priority in development and execution of the SRS Nuclear Materials Stabilization and Storage (NMSS) program. With respect to the SRS 2000-1 Program, this safety imperative manifests itself most directly as reduction and/or elimination of potential threat to worker/public health and safety or potential threat of environmental insult from ongoing stewardship of these materials. The SRS approach to reduction and/or elimination of potential risks associated with 2000-1 materials is aligned with the five functional areas of the Integrated Safety Management System (ISMS), namely: (1) define the scope of work; (2) analyze the hazards; (3) develop and implement controls; (4) perform the work safely; and (5) feedback and assess for continuous improvement.

Savannah River has included in the contractor's contract DEAR and Laws Clauses (48 CFR 970.5204-2 and 48 CFR 970.5204-78) for the integrating contractor and subcontractors to develop the infrastructure and implement Integrated Safety Management (ISM) sitewide. Implementation of ISM provides SRS with a robust safety program that can respond to urgent situations as well as identify adverse trends requiring management attention.

The remaining SRS 94-1 materials pending stabilization can be grouped according to active inventory management requirements as follows:

Solutions
HEU solution
Am/Cm solution
Np-237 solution
H-Area Pu-239 solution

SNF and Other Fuels and Targets in Water-filled Storage Basins
Mark-16/22 SNF
Miscellaneous fuels/targets

Materials in Vault Inventory
Plutonium Metal and Oxide
Plutonium Residues

The specific actions and controls for these materials within active inventory management at SRS are discussed below.

Solutions

Highly Enriched Uranium Solutions:

Prior to commencing dissolution of Mark-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 pre-1992 chemical processing and separation of spent nuclear fuel activities. 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 further processed for disposition.

Reviews have determined that effective controls are in place to prevent or mitigate accidents associated with the continued storage of uranium solutions in H-Canyon and Outside Facilities tanks. The most significant of these controls are the following:

- Uranium solutions (after fission products, plutonium, and neptunium have been removed) do not generate significant amounts of hydrogen, even in highly concentrated solutions. However, tanks within H-Canyon are connected to the Process Vessel Vent System and tanks outside the canyon are connected to the Recycle Vessel Vent System. Installed liquid level and specific gravity instruments provide an additional source of air to dilute evolved hydrogen.
- Solution in each tank is periodically sampled and analyzed for chemical and radioisotope composition.
- A report is issued semi-annually documenting the continued safety of storage of enriched uranium solution.
- Periodic chemical adjustments are made to maintain solution composition within approved limits.
- Liquid level in each tank is routinely monitored for unexpected changes. Action limits and required response are identified and controlled by procedure.
- Potential tank leaks are contained within sumps and would be detected by increase in sump level.
- Temperature of outside tanks is routinely monitored and controlled to prevent potential freezing of solution.

Expanded treatment, chemical adjustment, agitation, and solution movement options are available in case deficiencies occur in current storage conditions.

The H-Canyon facility will be processing additional Mark 16/22 fuel tubes for recovery of uranium and neptunium. The uranium solution will be stored for eventual transfer to TVA. The facility will also be "refreshing" existing HEU solution which will include recycle into the canyon for purification and consolidation. The solution will be consolidated in the double-wall HA-Line storage tank. The H-Canyon Authorization Basis addresses the controls necessary for protection during receipt and storage. In addition, the above listed controls will also be applied to any additional A-Line uranium storage tanks

Americium/Curium Solution:

Savannah River's inventory of special isotopes includes americium-243 and curium-244 (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 americium-241 to an oxide. However, the process equipment has not been maintained and requires extensive modification to restore it to use. A 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.

Reviews have determined that effective controls are in place to prevent or mitigate accidents associated with the continued storage of Am/Cm in tank 17.1. The most significant of these controls are the following:

- A corrosion assessment of tank 17.1 has been completed, and a program is in place to periodically sample the tank to analyze for corrosion products and monitor corrosion rates.
- An emergency transfer route from tank 17.1 to tank 16.2 has been established to ensure that the Am/Cm solution can be safely moved should anything happen to tank 17.1.
- Solution volume in tank 17.1 is closely controlled to ensure the maximum radionuclide concentration for accident analysis calculations is not exceeded and to ensure that the full volume of 17.1 can fit into tank 16.2 if the need arises. Liquid level in the tanks is routinely monitored for unexpected changes. Action limits and required response are identified and controlled by procedure.
- Tank 17.1 has been isolated by removing all but the essential piping to and from the vessel, including the cooling water jumpers.
- Hydrogen from radiolysis is purged from the tank through the safety-significant Process Vessel Vent System.
- A backup hydrogen purge system has been installed and is continuously operated at a flow rate sufficient to dilute hydrogen in the tank vapor space below 25% of the Lower Flammability Limit (LFL). A second backup hydrogen purge system is also installed and can be manually valved into service as an additional defense.
- Potential tank leaks are contained within the canyon cell and would be detected by increase in canyon cell sump level.

Several methods for stabilizing the americium-curium solutions were evaluated during development of the EIS for *Interim Management of Nuclear Materials at the Savannah River Site* (IMNM EIS). In the ROD, issued December 12, 1995, the vitrification alternative was selected. Basically, the vitrification alternative is to encapsulate the Am/Cm in a glass form.

Neptunium Solution:

SRS also has 6,000 liters 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 radioisotopic thermoelectric generators in spacecraft as well as terrestrial applications.

Reviews have determined that effective controls are in place to prevent or mitigate accidents associated with the continued storage of neptunium solution in H-Canyon tanks 9.6 and 9.8. The most significant of these controls are the following:

- Solution in each tank is periodically sampled and analyzed for chemical and radioisotope composition.
- A report is issued semi-annually documenting the continued safe storage of the neptunium solution.
- Periodic chemical adjustments are made to maintain solution composition within approved limits.
- Steam supply is not connected to neptunium storage tanks.
- All transfer lines into and out of each tank to other canyon vessels have been disconnected. Transfer lines may be reestablished for additional receipt of neptunium solutions during H-Canyon processing. See discussion below.
- Hydrogen from radiolysis is purged from each tank through the safety-significant Process Vessel Vent System. Installed liquid level and specific gravity instruments provide an additional source of air to dilute evolved hydrogen.
- Liquid level in each tank is routinely monitored for unexpected changes. Action limits and required response are identified and controlled by procedure.
- Potential tank leaks are contained within the canyon cell and would be detected by increase in canyon cell sump level.
- Safety systems are in place to continuously monitor cooling water effluent to detect potential radioactivity release to external systems and to divert contaminated water to prevent release to the environment.

Expanded treatment, chemical adjustment, agitation, and solution movement options are available in case deficiencies occur in current storage conditions.

The H-Canyon facility will be processing Mark 16/22 fuel tubes for recovery of uranium and neptunium and unirradiated Mk-53 targets for recovery of neptunium. The neptunium solution will be concentrated and stored in additional canyon tanks or combined with neptunium solution in Tanks 9.6 or 9.8. The H-Canyon Authorization Basis addresses the controls necessary for protection during receipt and storage. In addition, the above listed controls will also be applied to any neptunium storage tanks.

In the fourth Supplemental ROD to the IMNM EIS issued on October 31, 1997, DOE decided to process the solution in H-Canyon to remove decay products and other material that would interfere with subsequent conversion steps followed by transfer to HB-Line for conversion to an oxide.

Plutonium Solutions:

Savannah River completed conversion of F-Canyon plutonium solutions in April 1996. The plutonium metal produced by stabilizing solutions in the FB-Line has been packaged in containers that meet the criteria of DOE-STD-3013-2000 for inner containers, using a Bagless Transfer System (BTS). Savannah River completed installation of a BTS in the FB-Line facility in August 1997 as a demonstration of the new packaging technology.

The remaining solutions at SRS requiring stabilization are in the H-Canyon. 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 maintain acidity and 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. Safety of continued storage of the H-Canyon plutonium solutions until stabilization is complete has been enhanced through additional sampling and monitoring activities.

Reviews have determined that effective controls are in place to prevent or mitigate accidents associated with the continued static storage of Pu-239 solution in H-Canyon tanks 12.1, 16.3 and 18.3. The most significant of these controls are the following:

- Boric acid has been added to each tank as an additional defense against accidental criticality.
- Solution in each tank is periodically sampled and analyzed for chemical and radioisotope composition. Corrosion products are also monitored.
- A report is issued semi-annually documenting the continued safety of storage of plutonium solution.
- Periodic chemical adjustments are made to maintain solution composition within approved limits (e.g. acidity and concentration).
- Steam supply is not connected to plutonium storage tanks.
- All transfer lines into and out of each tank to other canyon vessels have been disconnected. Transfer lines may be reestablished for additional receipt of plutonium solutions from HB-Line. See discussion below.
- Hydrogen from radiolysis is purged from each tank through the safety-significant Process Vessel Vent System. Installed liquid level and specific gravity instruments provide an additional source of air to dilute evolved hydrogen.
- Liquid level in each tank is routinely monitored for unexpected changes. Action limits and required response are identified and controlled by procedure.
- Potential tank leaks are contained within the canyon cell and would be detected by increase in canyon cell sump level.

- Safety systems are in place to continuously monitor cooling water effluent to detect potential radioactivity release to external systems and to divert contaminated water to prevent release to the environment.

Expanded treatment, chemical adjustment, agitation, and solution movement options are available in case deficiencies occur in current storage conditions.

The H-Canyon facility will be receiving and storing additional plutonium-bearing scrap solution from HB-Line. This solution will be stored in additional canyon tanks or combined with plutonium solution in Tanks 12.1, 16.3 or 18.3. The H-Canyon Authorization Basis addresses the controls necessary for protection during receipt and storage. In addition, the above listed controls will also be applied to any plutonium storage tanks.

The fourth Supplemental ROD for the IMNM EIS calls for processing these solutions through HB-Line Phase II for conversion to an oxide. The plutonium oxide will be placed in temporary storage until a facility is available with the capability to meet the DOE storage standard.

Materials in Vault Inventory

Metal in Contact with Plastic:

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.

Plutonium Metal and Oxide:

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, over 1,100 containers of metal and oxide will be produced from the stabilization of solutions, targets, residues, and classified metal which will also require packaging and treatment to meet the metal and oxide storage standard. The objective is to ensure that all plutonium solids (metal and oxide) are in conformance with the DOE metal and oxide standard, DOE-STD-3013-2000.

Plastic packaging materials historically used in storage of these materials breakdown through radiolysis. In addition, pyrophoricity hazards can arise when hydriding of plutonium metal occurs, and personnel exposure and contamination hazards can arise through container degradation. The current SRS inventory of plutonium metal and all additional plutonium metal being produced from ongoing stabilization activities is being packaged in inner containers that meet the requirements of DOE-STD-3013-2000 using a bagless transfer system installed in FB-Line in August 1997. The bagless transfer system repackages these items into welded stainless steel containers with inert helium internal atmosphere, practically eliminating the potential risks associated with the previous historical packaging system.

As a result of the September 1, 1999 occurrence in which several workers were contaminated due to a faulty weld in a bagless can, several improvements in the bagless transfer system have been made `to reduce the potential for future weld failures. These include:

- Improved control and evaluation of welding parameters
- Improved inspection of completed welds
- Improved leak detection technique
- Increased frequency of surveillance of bagless cans

Several activities are underway to reduce risk until the remainder of the material can be repackaged. Effective controls are in place or being established to prevent or mitigate accidents associated with the continued storage of these materials in the FB-Line and 235-F Vaults. The most significant of these controls are the following:

- Design features of the vaults (e.g., monitors, ventilation, limited access, etc.) and radiological controls and procedures are in place to minimize worker risk in the event of container failure.
- Periodic weighing of items to detect unexpected weight gain.
- Periodic dimensional verification of containers to detect potential container deformation.
- Radiography of items to verify internal conditions.
- Radiological surveys of container surfaces to detect potential contamination release.
- Periodic Material Control and Accountability physical inspection of items.
- Periodic verification of filter functionality on containers so equipped.

Action criteria and required responses are identified and controlled by procedure. These include transfer to gloveboxes for physical sampling and interim repackaging if necessary. These actions and controls are described in detail in *A Surveillance Program to Assure Safe Storage of FB-Line and Building 235F Vault Materials, WSRC-TR-96-0413, December 30, 1996.* This program is responsive to the *DOE Criteria for Interim Safe Storage of Plutonium-Bearing Solid Materials, November 1995.* Since October 1998, a small number of storage containers have been repackaged as a result of anomalies identified through the vault surveillance program.

Plutonium Residues:

Savannah River identified residues in eight categories: 1) plutonium sweepings (202 containers); 2) plutonium turnings (37 containers); 3) Sand, Slag, and Crucibles (128 containers); 4) miscellaneous plutonium metal (10 containers); 5) miscellaneous plutonium alloy (18 containers); 6) mixed scrap (390 containers); 7) plutonium scrap (480 containers); and 8) DU/Pu (5 containers [1249 RODs, 2 MTU]).

The ES&H Plutonium Vulnerability Assessment identifies these materials as at-risk or possibly unstable. The degree of concern varies depending on the isotopic content, chemical impurities, and packaging. The IMNM EIS ROD, issued December 12, 1995, selected stabilization by dissolving material in F- or H-Area, purifying the plutonium in solution, and transferring the residual solution to FB- or HB-Line for conversion to a metal or oxide. The resulting metal and oxide will be handled similarly to the existing metal and oxide as discussed above. The IMNM EIS ROD also selected additional stabilization options, such as processing and storage for vitrification in the DWPF, for use where appropriate.

The stabilization pathway for these materials is to fully characterize them through analytical sampling to support aqueous processing. Where material and packaging properties are currently characterized incompletely, a program will be instituted to select the required stabilization process. Methods used will include NDA using digital radiography equipment and selected sampling of containers using existing gloveboxes with modification.

To date, more than 1,600 residue items previously stored in FB-Line and 235-F have been stabilized in F-Canyon and HB-Line. In addition, 110 other containers (100 FL-10s and 10 food pack cans) have been characterized for future stabilization and repackaged in more suitable containers for interim storage while awaiting stabilization.

Until the stabilization options can be exercised, the materials are being actively managed in vault inventory under the surveillance and monitoring program described above for plutonium metals and oxides.

SNF and Other Fuels and Targets in Water-filled Storage Basins

Mark-16/22 SNF and Miscellaneous Fuels and Targets:

The K- and L-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 Mark-31 targets having been stabilized, and approximately 715 Mk-22 spent fuel assemblies dissolved, the remaining inventory of SNF in the basins consists of approximately 1,170 Mark-16 and Mark-22 spent fuel elements. 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. However, 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.

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 de-ionizer 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.

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. The most significant of these upgrades are the following:

- Implementation of a corrosion surveillance program.
- Reorientation of fuel from vertical to horizontal storage to eliminate galvanic coupling corrosion.
- Use of high-capacity vendor water treatment to quickly lower water conductivity from over 120 μmho/cm to less than 10 μmho/cm.
- Addition of on-line de-ionization capability and a de-ionized make-up water system.
- Completion of a series of K- and L-Basin upgrade projects in May 1996.

The Secretary of Energy described these upgrades in a January 9, 1998, letter to the DNFSB, and the DNFSB indicated their concurrence that these actions had sufficiently improved basin water quality in an April 15, 1998, letter to the Secretary of Energy.

Based upon IMNM EIS RODs, Mark-31 target stabilization (December 12, 1995 ROD) was completed in March 1997, and dissolution of SRS Mark-16 and Mark-22 HEU SNF (February 8, 1996 ROD) 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. Miscellaneous aluminum-clad targets and fuels will also be dissolved, and the resultant solutions containing HEU may be blended down and be transferred to the TVA, similar to the existing HEU solution and solutions resulting from dissolution of the Mk-16/22 spent fuel. The remainder will be transferred to the Tank Waste Farm.

4.2.3 Rocky Flats

Rocky Flats' share of 94-1 materials with the potential to become imminent safety hazards included plutonium and uranium solutions; plutonium metal in contact with plastic; residues in unvented drums and some residue material categories (e.g., salts and graphite fines). As discussed in Section 4.0, all metal in contact with plastic has been repackaged, all drums containing plutonium residues have been vented and uranium-bearing solutions have been shipped to an off-site vendor and stabilized.

Risk Reduction Strategy

Rocky Flats has included in the contractor's contract DEAR and Laws Clauses (48 CFR 970.5204-2 and 48 CFR 970.5204-78) for the integrating contractor and subcontractors to develop the infrastructure and implement Integrated Safety Management (ISM) sitewide. More specifically, the ISM verification team has validated the ISM Phase I and II and P450.5 implementation for Buildings 771, 374, 707, 776, 559, and 774. The ISM system at Rocky Flats is proving its ability to continuously provide a sound safety program while responding to changes in strategy for site closure. In February 2000, the Department declared that the Rocky Flats Environmental Technology Site has implemented its Integrated Safety Management System.

Plutonium Solutions

Plutonium solutions originally existed in Buildings 371, 559, 771, 776/777, and 779, with the majority being in Buildings 371 and 771. These original solutions have been removed from Buildings 371, 776/777 and 779. Plutonium solutions have been drained and stabilized from the tanks in Buildings 771. The tanks that contained measurable volumes posed the most significant risk in both buildings. 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, solution stabilized, and tap and draining of process systems initiated. Tap and draining of Building 371 systems and processing of all Building 371 solutions were completed in June 1999. Access to areas where the potential for leakage from tanks or pipes exists 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.

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 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.

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 due to analytical analysis to support Site closure. 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 7200 liters 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 solutions that remain in process system pipes in Building 771 are corrosive and continue to generate hydrogen and deteriorate piping integrity resulting in leaks. These solutions present worker safety hazards from spills, and the potential for detonation and criticality. The removal and stabilization of solutions continues to be a high priority activity at Rocky Flats. System draining and piping removal activity prioritization is based on risk. In general, the actinide systems that are leaking and generating hydrogen are removed earlier. Leaking non-actinide systems are considered higher risk than non-leaking actinide systems. As of September 30, 2000, 31 of 42 systems have been drained and 25 of 42 systems have been removed.

Metals and Oxides

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. The remainder of the 1,858 items were brushed and repackaged by May 1997, including an additional 100 items which had been identified also to be suspect during the inspection process. All generated oxide, plus the existing backlog of unstabilized oxide, underwent thermal stabilization.

Residues

The Rocky Flats Environmental Technology Site has an inventory of approximately 106 metric tons of residues packaged in 3,930 55-gallon drums and 3,950 containers. The treatment of these residues was analyzed in the *Final Environmental Impact Statement on*

Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site (August 1998). These residues contain approximately 3 metric tons of plutonium and are stored in buildings 371, 707, 776, and 777. Most of these residues were originally classified as high risk. However the majority have been reclassified as low risk due to accomplishing actions that lowered their contained storage risk (i.e., venting of drums) and to extensive characterization of the residues during 1997 and 1998.

For most categories of residues, some form of stabilization or separation was thought to be needed in order to meet interim storage requirements, disposal requirements, or to terminate safeguards. Through characterization, innovations such as the pipe component, safeguards termination limit variances, and process refinements, acceleration of residue repackaging and removal is possible. Improvements in the IP milestone dates are proposed and the plan is now integrated to support Site closure. Table 4.2.3-1 summarizes the crosswalk between current path forward for residues and the original 94-1 Implementation Plan.

Characterization Insights: During 1997 and 1998, extensive characterization of the Rocky Flats residues was completed. With the exception of IDC 333, all characterization data at the 80 percent confidence level indicates that a hazard exists in no more than 15 percent of any IDC. To reclassify high risk residues as low risk, additional characterization samples were obtained to ensure that there is a 95 percent confidence level that a hazard exists in no more than 5 percent of the population ("95/5 confidence level"). The majority of residues have been re-characterized as low risk.

Packaging Residues into a Pipe Component: The pipe overpack component (POC) was developed by RFETS to increase the plutonium loading of the TRUPACT II in order to minimize the amount of drums and shipments to WIPP and to improve storage safety. The POC underwent and passed the Department of Transportation type B shipping container testing at the Sandia National Laboratory and was subsequently certified by the Nuclear Regulatory Commission for use.

Characterization analyses indicate that many of the residues can be classified as low risk even with small quantities of metallic species present. The amount of elemental metals that can be contained within a POC and undergo instantaneous oxidation without compromising the O-ring gasket has been evaluated. The POC has been structurally assessed and the POC's filter has been physically tested. All candidate IDCs for the POC can be safely contained without consequence.

The POC provides an additional margin of safety with regard to their storage, handling, transportation, and disposal. 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 POC. The tests conducted at the Sandia National Laboratory 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.

Table 4.2.3-1: Crosswalk between current RFETS residue path forward and original DNFSB 94-1 IP

Category	Residue/ Quantities/ IDCs	Path Forward	Crosswalk from original 94-1 IP
Salts	1. ***Direct Repack Salts* 15,907 kg** IDCs 363, 364, 365, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 418, 426, 427, 429, 433, 434, 435, 473, and 654	Blend, as required, repack into the pipe component and ship to WIPP (will pyro-oxidize the following IDCs: 365, 413, 414, 427, 434, and 654)	• IDCs 333, 655 and 044 moved to the Ash category • IDC 443, in figure 3.3-2 of the original 94-1 IP is a typo (should have been 433) and does not exist
Ash	2a. ***Ash and Graphite Fines* 24,509 kg** IDCs 044, 310, 333, 368, 372, 373, 374, 378, 419, 420, 421, 422, 423, 428, 601, and 655	Size reduce and blend, if necessary, and repack into the pipe component and ship to WIPP (IDC 333 will be stabilized)	• IDC 089 has been moved to Wet/Combustibles category • IDC 312 has been moved to Dry/Repacks category
	2b. ***Sand, Slag and Crucible residues* 3,359 kg** IDCs 387, 390, 391, 392, 393, 394, 395, 396, and 398	Repackage for disposal to WIPP	• SS&C will be shipped to WIPP (112 kg shipped to SRS as test samples)
Wet/Combustibles	3a. ***Wet/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, and 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 column resins, IDC 430 and 431 have been rinsed and will be cemented for WIPP)	• Combustible and Wet miscellaneous categories have been combined to a single Wet/Combustibles category • IDC 373 has been moved to Ash category • IDCs 301, 485, 486, 489 have been moved to the Dry/Repacks category
	3b. ***Fluoride residues 316 kg*** IDCs 090, 091,092, 093, and 097	Repackage for disposal to WIPP	• Fluorides will be shipped to WIPP
Dry/Repacks	7. ***Dry/Repack residues 39,328 kg*** IDCs 197, 300, 301, 303, 312, 320, 321, 334, 360, 370, 371, 377, 438, 440, 442, 479, 480, 484, 485, 486, and 489	Size reduce, declassify, and blend, if necessary, and repack for shipment to WIPP	• IDCs previously categorized as Inorganic
Others	• ***Other 78 kg*** IDCs 050 and 080	IDC 080 will be packaged in 3013s	• IDC 050 (skulls) have been dispositioned and no longer exist

Safeguard Termination Limit Variances: 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 requested and received authority to terminate safeguards on all residues below ten weight percent plutonium that are planned to be disposed of at WIPP. 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 for these residues during the transport to and above ground storage at WIPP prior to disposal.

Salts

All high risk salts were stabilized by July 1999. Stabilization consisted of pyro-oxidation/blending to below 10 weight percent plutonium concentration, and packaging in a pipe overpack component to meet ISSC and WIPP standards. Repackaging of all remaining salts was completed in November 2000.

Sand, Slag and Crucible

Sand, Slag and Crucible (SS&C) residues were initially planned to be shipped to SRS. However, with the opening of WIPP in March 1999 and resolution of technical issues which had made disposal of these residues at WIPP uncertain, there is no longer any advantage in shipping SS&C to SRS for processing. The SS&C will be repackaged and shipped to WIPP for disposal. This will result in final disposition several years earlier than the previous approach and will be more cost effective. The first ROD was subsequently amended (August 25, 1999) to allow SS&C residues to be repackaged and disposed of to WIPP.

The majority of SS&C is currently repackaged in a configuration (non-vented) that supported shipment to SRS. A surveillance program has been implemented to ensure the SS&C is stored safely until the material is repackaged for WIPP disposal. SS&C residues have been characterized to a 95% confidence level and have been reclassified as low risk.

Wet/Combustibles

All leaded gloves have been stabilized. Repackaging wet/combustible residues to meet the ISSC and the WIPP acceptance criteria started on October 6, 1998. Ion exchange resins were classified as high risk due to the fuel and oxidizer in intimate contact concern. Cementation of the ion exchange resins was completed in February 1999.

Approximately 11,000 kg of wet/combustible residues were classified as high risk. Characterization of the high risk combustibles at the 95 percent level was completed in February 1999. All high risk wet/combustible residues have been reclassified as low risk.

Fluorides

The decision to ship the fluoride residues to SRS was in the first ROD for the *Residues and Scrub Alloy EIS* (issued November 25, 1998). The fluoride residues were originally classified as a low risk and also have been confirmed to be a low risk through the characterization program. With the opening of WIPP in March 1999 and other circumstances, including delays in securing shipping container certification required prior to transporting the plutonium fluoride residues to SRS, there are no longer cost, waste management, or schedule advantages in shipping the fluoride residues to SRS for separation. The Department has decided to prepare the fluoride residues for direct disposal at WIPP. The first ROD was subsequently amended (January 11, 2001) to allow fluoride residues to be packaged and disposed of at WIPP.

Ash

Most of the ash residues initially classified as high risk have been re-characterized as low risk. The primary exception is IDC 333 (calcium metal), which was stabilized by April 1999.

4.2.4 Oak Ridge

Deposit Removal Project at the East Tennessee Technology Park (ETTP): All of Oak Ridge's Deposit Removal Project commitments at the ETTP have been completed . The original materials at the ETTP were 65 deposits of HEU in the systems in the K-25 Building which were greater than 500 grams each and may have presented an unacceptable criticality risk. Knowledge gained during completion of mechanical removal of four of the deposits in March 1996 and additional criticality safety analyses caused the scope of the project to be reassessed. All but nine of the 61 deposits remaining were determined to be in stable configurations that satisfied the double contingency principle for criticality safety and, therefore, did not require near-term removal. Additionally, three deposits in the K-29 Building were judged to be of sufficient concern that they were added to the project.

As a result of the reassessment of the K-25 deposits and the addition of the K-29 deposits, Oak Ridge submitted a proposed change to the Recommendation 94-1 Implementation Plan in July 1997. The change, which was approved by the Secretary in October 1997 and subsequently accepted by the DNFSB, revised the site's 94-1 Deposit Removal commitments into two categories. Category 1 deposits, defined as deposits having one control on a single nuclear parameter, were removed by early December 1997 completing that commitment on time. The Category 2 deposits (those having multiple controls on a single nuclear parameter) were physically removed by January 29, 1998, thus completing the commitment two months early.

4.2.5 Los Alamos National Laboratory

The LANL 94-1 residue processing efforts have been underway for several years now. In 1995, a risk-based prioritization scheme was developed that focused on the risks as identified in the DNFSB recommendation 94-1. Since LANL had not observed total package failure (loss of containment) for items stored in the vault, the focus was on inner-package failure as a metric. The definition used to determine if a package "failed" is detectable contamination on the inside of the outer container. Since that time, a large number of items (>2700) have been inspected for loss of inner-package integrity. These visual examinations suggest the following correlations: 1) the likelihood of inner-package failure is only loosely coupled to the corrosiveness or reactivity of the stored material; 2) inner-package failure is a function of package age and/or packaging technique but exact cause of failure is difficult to determine; and, 3) the likelihood of total package failure is very small and can be properly managed by a surveillance program as part of vault operations.

A total of 3943 items are included in the Los Alamos National Laboratory's 00-1 inventory. These items are excess to programmatic needs, and include HEU and Pu-238 items. Figure 1 traces the evolution of the current excess inventory from the original 94-1 inventory through the current items. The shaded boxes indicate the end state for each of the paths. In addition to the 4924 items that have been stabilized, another 1051 items have been determined to be of programmatic use and therefore removed from the 94-1 contribution to the excess inventory. A total of 1307 items have been generated since 1994 that contain plutonium-239 that is in excess to programmatic requirements. These have been included in the overall 00-1 inventory.

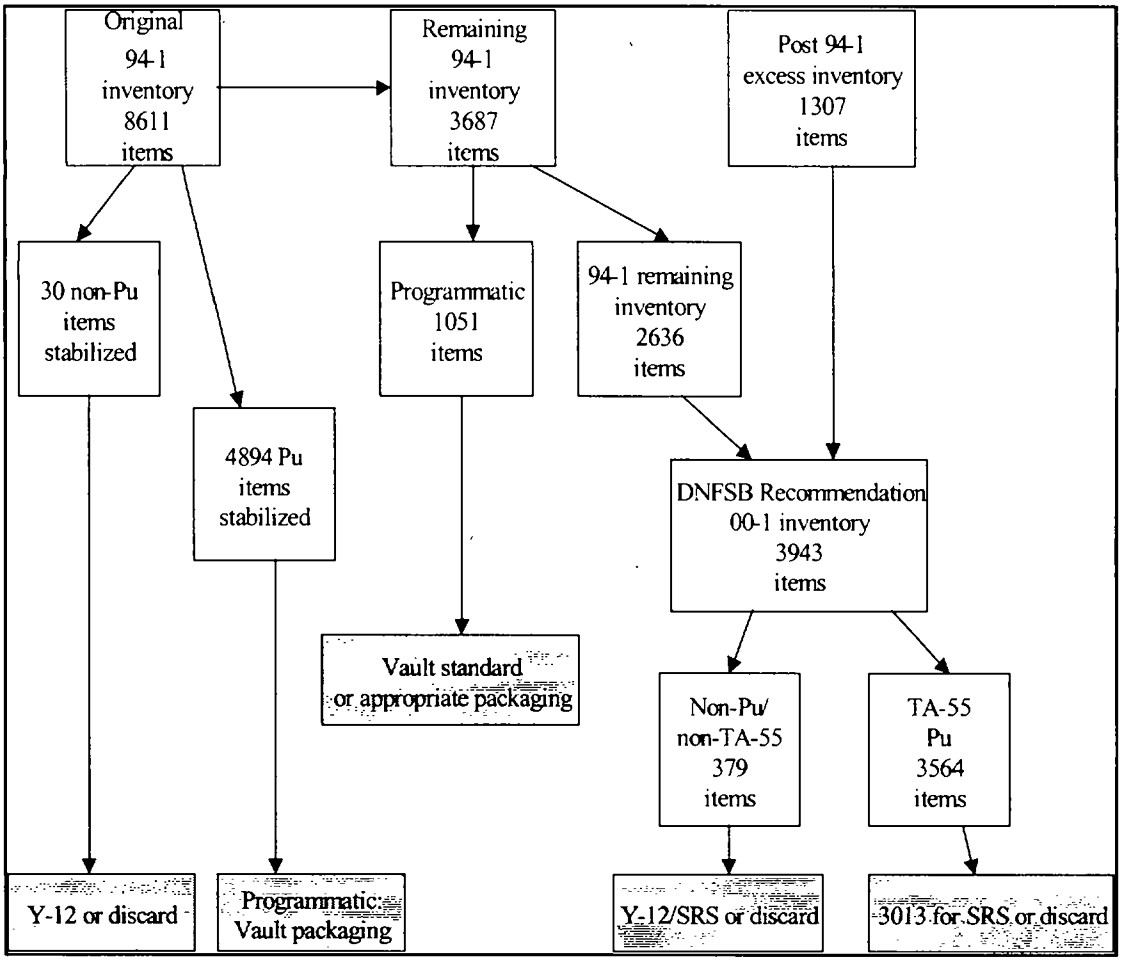


Figure 1: Evolution of the original Los Alamos 94-1 inventory into excess inventory and programmatic inventory

Los Alamos National Laboratory Risk Reduction Strategy

Items that are stored in the PF-4 vault have multiple layers of both administrative and engineered protection for personnel. The vault is divided up into individual rooms, each of which has continuous air monitors, fixed head air samplers, and posted radiation background readings. Each room in the vault is swiped quarterly to detect any contamination, the filter on each fixed head air sampler is changed weekly, and personnel monitor themselves upon exiting the vault. There are procedural requirements for a visual check of all items on a shelf when a new item is stored or when an item is removed from the vault. LANL is also using the MC&A-driven inventory verification requirements to further expand their knowledge of the condition of packaging. Approximately 300 measurements are performed annually on randomly selected items. If an item must be removed from the existing outer container, it is visually examined to determine the condition of the inner barriers and then it is repackaged to meet the new vault requirements.

The following is a summary of the risks associated with the plutonium material stored at TA-55 and at other locations at LANL. The inventory is broken up into general categories of material and the planned actions for those categories.

Metal and Oxides

LANL currently has an excess inventory of 814 items including alloyed metal, unalloyed metal, and plutonium oxide. These items do not meet the current packaging configuration and are scheduled for repackaging to meet the DOE-STD-3013 criteria beginning in FY01.

Risks Associated with Continued Storage

The risk associated with continued storage of these materials is very small. Any residual risk is associated with the dispersible nature of these matrices. The risk of continued storage is that most of these items do not meet the current packaging standards for the vault. However, these items can be thermally stabilized and placed in welded containers. This will eliminate any residual risk based on the current packaging configuration for these items.

Compensatory Measures

There are currently no compensatory measures associated with these items. The overall risk management of the storage vault is adequate for managing these items until they can be placed in welded containers.

Salts and MgO Crucibles

LANL has 1464 items that are chloride-based process residues. This segment of the inventory consists of electrorefining salts, molten salt extraction salts, direct oxide reduction salts, miscellaneous salts and magnesia crucibles. Approximately 67% of the items exceed 10% Pu by weight criteria for discard. These items cannot be processed through the nitrate aqueous equipment due to corrosion concerns.

Risks Associated with Continued Storage

There is minimal risk associated with continued storage of these items. The risk of continued storage is that some of these items do not meet the current packaging standards for the vault. No pressurization of containers, or other packaging issues that have been observed at other contractor sites have been observed at LANL.

Compensatory Measures

There are currently no compensatory measures associated with these items. The overall risk management of the storage vault is adequate for managing these items until they can be placed in welded containers.

Solutions

There are a total of 49 solution items; 48 plutonium solutions and 1 uranium solution. All of these items are in gloveboxes and none are stored in vaults. There is one subset, 6 organic solutions, that have been identified as part of a treatability study for dealing with radioactive liquids contaminated with RCRA listed organic materials.

Risks Associated with Continued Storage

There are potentially significant risks if plutonium contaminated liquids are stored in the vault areas of LANL facilities. However, none of these items are stored in vaults and the current operating procedures for receipt of material in LANL vaults prohibit the acceptance of liquids for storage.

Compensatory Measures

- All of the solutions are stored in gloveboxes.
- No plutonium contaminated liquids are routinely stored in PF-4 or the CMR vaults.

Residues

There are a total of 592 items that may require processing through the nitrate process lines. There are wide variety of matrices included in this category, including items to be leached such as glass, and a number of low item count categories such as contaminated firebrick. Concurrent paths will be evaluated for these residues. Criteria are being developed to evaluate the residue items for direct discard. LANL will develop and implement the criteria and procedures for this discard. This approach will be pursued in place of the Plutonium Discard Methodology. While differing slightly from the Rocky Flats approach, the basic goal is similar. All items that meet the attractiveness level D criteria will be candidates for discard and evaluated further. Items that may have more than one handling path will be evaluated to determine the safest, cheapest and fastest method of disposition.

For the 00-1 inventory, there are a large number of items that may fall into the attractiveness level D category. LANL is exploring the feasibility of requesting, and being granted, an exception for discarding plutonium residues that are of attractiveness level D and up to 10% assay. Such an exception would allow for the direct discard of approximately 850 items. However, each item will need to be evaluated individually to assure that all of the level D criteria are met. Level D items can roll-up to Cat I quantities of plutonium. This fact will require evaluations to determine the requirements for either terminating safeguards, or what safeguards may be required to assure the secure handling and disposition of these materials. The safeguards termination requirements are only a part of the overall evaluation that must be performed. A complete evaluation of all applicable Federal, State, and DOE requirements with respect to waste handling, storage, packaging and transport will be completed and all requirements will be met, or where possible, negotiated with the appropriate entity. This will apply to on-site at Los Alamos, transport to WIPP and all WIPP requirements.

While the complete evaluation of the requirements for direct discard is being performed, requests will be formulated and submitted to DOE for approval of categories to be included in the final direct discard inventory. Several requests to discard materials such as specific graphite items and items that meet attractiveness level E criteria have been submitted and approved by DOE. A number of other items, such as HEPA filters, non-specific combustibles and non-combustibles, and other items, will be evaluated for immediate direct discard using DOE approval. While some these matrices exceed the current safeguards termination limits (STL), they represent difficult to process items.

Risks Associated with Continued Storage

There are some items that may pose a relatively greater risk than others in this segment of the inventory. The risk of continued storage is that some of these items do not meet the current packaging standards for the vault. All of these items have been stored for many years without any apparent packaging problems. However, those that have been identified as having a higher relative risk will be stabilized earlier in the campaign.

Compensatory Measures

There are currently no compensatory measures associated with these items. The overall risk management of the storage vault is adequate for managing these items until they can be placed in welded containers.

Unsheltered Containers

There are a total of 9 unsheltered containers. Because of their size and bulk, there are significant logistical requirements for processing these items. The most probable path for these items will be to introduce an item into PF-4, remove the contents, package these consistent with the upgraded vault storage requirements, and evaluate which of these "newly" produced items can be directly discarded and which require additional processing. These newly produced items cannot be stored in CMR building because LANL is in the process of deinventorying CMR to a security Cat III level. These items would exceed the Cat III threshold.

Risks of Continued Storage

These items pose a higher relative risk because they are stored in an unsheltered configuration.

Compensatory Measures

- Each of these items is extensively surveyed for any indication of containment degradation.
- The area immediately surrounding each container is surveyed regularly.
- The storage area is cordoned off and is posted as requiring special access for entry.
- Additional protection, such as a shelter with continuous air monitoring, or fitted covers for the flange lids, is being evaluated.

Miscellaneous Items

There are a total of 379 items that are a mixture of actinides. Included in these items are matrices containing primarily HEU, matrices with neptunium, americium, curium, or mixtures of all of these, and items containing Pu238. Many of these items will be directly discarded as soon as possible. Non-destructive assay methods for many of the mixed actinide matrices do not presently exist, which precludes the direct discard under current requirements. For those that cannot be directly discarded, specialized handling will be required to avoid contaminating process lines with these highly undesirable isotopes.

Risk of Continued Storage

There is no higher relative risk associated with the continued storage of these items. Virtually all of these items are either non plutonium-239, or are mixed actinide items. The risk of continued storage is that some of these items do not meet the current packaging standards for the vault. The biggest single issue is the need for advanced measurement techniques to allow for the discard of many of these items. Most are in shielded containers such that personnel exposure is minimized for vault workers.

Compensatory Measures

There are currently no compensatory measures associated with these items. The overall risk management of the storage vault is adequate for managing these items until they can be placed in welded containers.

Programmatic Material

In addition to the legacy items, LANL has a very active programmatic inventory of 1051 items that were originally a part of the 94-1 inventory. Items packaged after 1998 are in robust containers. However, the packaging configuration would need to be confirmed for those items packaged prior to 1998, about 700 items. There are also numerous new items generated as a result of ongoing programmatic work. Products and residues are stabilized and packaged in robust containers for storage in the vault concurrent with generation. This approach will avoid a repeat of 94-1/00-1 concerns for the condition of items stored in vaults at LANL.

4.2.6 Lawrence Livermore National Laboratory

The 2000-1 inventory at LLNL includes 114 cans of ash residues, 91 containers of metal that are either double canned or that use aluminum foil as the inner barrier, and 92 containers of other plutonium oxides greater than 50 wt% plutonium. This inventory is located in Building 332, which is a functional plutonium processing and handling facility that meets Federal, state, and local environmental regulations as outlined in the LLNL site-wide Environmental Impact Statement. The ongoing packaging characterization and non-destructive assay program at LLNL which was begun under 94-1 has not identified any urgent risk items.

5.0 REMAINING STABILIZATION ACTIVITIES

This chapter describes the stabilization actions which remain from the 94-1 Implementation Plan, and which must be completed in response to Recommendation 2000-1.

5.1 Inventory Summaries

The original 94-1 Implementation Plan (Rev. 0, February 1995) identified the inventories of nuclear materials requiring stabilization. The following sections summarize the remaining material inventories in the context of the original inventories.

5.1.1 Plutonium Solutions

Approximately 412,000 liters 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. About 90% of those solutions have been stabilized, and approximately 40,000 liters still require stabilization.

Table 5.1.1 compares the plutonium solutions inventories at the three major sites. The tabulated information includes quantities existing at the time the original Recommendation 94-1 Implementation Plan was promulgated and changes in the inventories that have occurred since then. Note that changes in total quantities to be stabilized at Rocky Flats and Hanford reflect improved inventory estimates.

Solidification is used to stabilize plutonium solutions. Once solidified, the plutonium metal/oxide would be safely stored until final material disposition is determined. Since intersite transport of plutonium solutions is prohibited, integration of stabilization capabilities between the sites is not an option under consideration. Stabilization at each site ranges from the use of existing facilities, such as a Savannah River canyon, to the development of additional processes such as Magnesium Hydroxide precipitation at Hanford's Plutonium Finishing Plant.

Table 5.1.1: 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 (L) as of 3/00	Plutonium Stabilized (Kg)	Current Location
Rocky Flats	143	30,000	Bldgs 371, 559, 771, 776/777, 779	30,000	143 Kg	2,000+ ‡	100	Bldgs 371, 559, 771
Savannah River	Classified	320,000	F-Canyon	--*	--	0	Classified	–
Savannah River	Classified	34,000	H-Canyon	34,000	Classified	34,000	0	H-Canyon
Hanford	358	4,800	Plutonium Finishing Plant	4,690**	341	4,270	30	PFP
Hanford	9	22,700	PUREX	--	--	0	None***	Tank Farm

* 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 actual plutonium solutions drained from piping systems are expected to be an order of magnitude less than estimated.

5.1.2 Plutonium Metals and Oxides

The DOE currently manages large quantities of plutonium metal and oxide. In general, the metal and oxide exists in several grades and forms, and is 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 5.1.2-1 and 5.1.2-2 respectively compare the metal and oxide (>50% Pu) inventories at the affected sites. The tabulated information includes the quantities described in the original Recommendation 94-1 Implementation Plan and changes in the inventories that have occurred since then.

DOE's commitment is to place all plutonium metal and oxide which is excess to programmatic needs into a form which is suitable for storage until disposition of the material can be accomplished. For metal, stabilization is accomplished by brushing to remove any oxide which has formed on the item's surface then packaging in a welded container in an inert atmosphere using a "bagless transfer" technology (or, in the case of LANL, an electrolytic decontamination technology) which does not require the use of plastic bags or gaskets. Oxide is packaged similarly, however before packaging it is heated to a high temperature to drive off any moisture or organics that may have been absorbed in the material. Additional metal or oxide materials which are generated at processing sites from the stabilization of other material forms will be packaged to the same standard.

An exception to the above description is scrub alloy, a plutonium-rich alloy material which is the byproduct of a process used to purify plutonium. Scrub alloy contains high quantities of americium which poses a radiation exposure hazard. Current plans are for scrub alloy to undergo a separation process to remove constituents from the alloy which would otherwise make it unacceptable to the Materials Disposition program. In accordance with the first ROD for the *Residues and Scrub Alloy* EIS (issued November 25, 1998), all RFETS scrub alloy has been shipped to the Savannah River Site for processing in the canyon facilities.

Table 5.1.2-1: Plutonium Metals

Site	Original SNM Inventory (kg)	Original Number of Items	Original Locations	Adjusted Number of Items (See Notes)	Remaining to be Stabilized as of 3/00	Remaining Items' Location(s)
Rocky Flats	6,600	3,403	371, 559, 707, 771, 776/ 777, 779,991	3,403	3,403	371, 707 (Note 1)
Hanford	700	350	PFP, PNNL*	352 (Note 2)	339	PFP
Los Alamos	1133	2000	TA-55, CMR, TA-18	210 (Note 3)	210	n/a
Savannah River	490	450	FB-Line, 235F, SRTC	174	29	FB-Line
Argonne-West	**	**	ZPPR, FMF, 752	**	**	ZPPR, FMF, 752
Argonne-East	0.45	210	205, 212, 315	210	210	205, 212, 315
Lawrence Livermore	20	250	B 332	91*** (Note 4)	91	B 332
Mound	0.855	20	T, SW\R	20	0	n/a
Oak Ridge	0.3013	30	3027, 3038, 5505	30	30	3027
Sandia	6.7	5	NMSF	5	5	NMSF

* PNNL 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 consolidated to listed locations.
2. 350 in original Implementation Plan was a rounded number.
3. See Section 5.2.5.
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 5.1.2-2: Plutonium Oxides (> 50 % Assay)

Site	Original SNM Inventory (kg)	Original Number of Items	Original Locations	Adjusted Number of Items (See Notes)	Remaining to be Stabilized as of 3/00	Remaining Items' Location(s)
Rocky Flats	3,200	3,296	371, 559, 707, 771, 776/ 777, 779,991	3,296	3,296	371, 707[1]
Hanford	1,500	2,500	PFP, PUREX, PNNL*	2,611[2]	2,611	PFP
Los Alamos	721	2,000	TA-55, CMR, TA-18	451[3]	451	n/a
Savannah River	650	550	FB-Line, HB-Line, 235F, SRTC	800[4]	800	FB-Line, 235F
Argonne-West	**	**	ZPPR, FMF, 752	**	**	ZPPR, FMF, 752
Argonne-East	0.48	695	200, 306, 315	695	695	205, 212, 315
Lawrence Livermore	102	154	B 332	92[5]	92	B 332
Mound	28.132	107	T, SW\R	107	0	n/a
Oak Ridge	1.706	83	3027, 3038, 5505, 7920, 7930, 9204-3	83	83	3027, 3038, 5505
Lawrence Berkeley	0.014	354	70, 70A, 70-147A	354	354	70, 70A, 70-147A
Sandia	1.4	10	HCF, ACRR, NMSF	10	10	NMSF

* 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 listed locations.
2. Better split between oxides >50% and residues.
3. See Section 5.2.5.
4. More accurate inventory and characterization of material.
5. 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.

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

Solid process residues are bulk materials contaminated with significant quantities of plutonium. Residues remaining to be stabilized include feedstock and materials-in-process to nuclear weapon fabrication and nuclear material production until fabrication ceased in 1989. The residues include materials such as impure oxides and metals, halide salts, combustibles, ash, dissolver heels, sludge, contaminated glass and metal, and other items. Table 5.1.3 describes the residue inventories at the various DOE sites.

The remaining items awaiting stabilization are not currently in a configuration suitable for long-term storage. The form of some materials, such as ash, poses a dispersibility hazard. Other materials, such as salts, may contain small particles of pyrophoric materials which create a worker safety hazard. Processing, treatment, stabilization, and/or repackaging of residues has already commenced at several sites. Capabilities to deal with the various types of residues exist at multiple facilities. Trade studies have been used extensively to examine and compare options for stabilization of various residue categories. Efforts are being made to integrate the stabilization plans throughout the complex to take advantage of the unique capabilities some sites offer.

Table 5.1.3: Summary of Plutonium Residue and Mixed Oxides (<50% Assay)

Site	Original SNM Inventory (Kg)	Original Number of Items	Original Locations	Adjusted Number of Items or Amount (See Notes)	Number of Items or Amount Remaining to be Stabilized as of 3/00	Remaining Items' Location
Rocky Flats	3,000	20,532	371, 559, 707, 771, 776/777, 779,991	20,532	9,958	371, 707
Hanford	1,500	5,000	PFP, PUREX, PNNL	4,034[1]	3,977	PFP
Los Alamos	1,400	6,300	TA-55, CMR	5,900[2]	1,891	TA-55, CMR
Savannah River	Classified	1,306	235-F, FB-Line, SRTC	1,270[3]	925	235-F, FB-Line
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 <50% 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.
5. Items reported in kilograms

5.1.4 Special Isotopes

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. Special isotope inventories covered by the original 94-1 Implementation Plan are shown in Table 5.1.4 together with their current status. DOE production processes created quantities of plutonium-242, neptunium, americium, and curium solutions which were retained as feedstocks for the future production of heavy isotopes. As in the case of the plutonium solutions described earlier, continued storage of these materials in solution form poses an unacceptable risk, primarily due to potential for leakage and release to the environment. Stabilization of these materials to a solid form suitable for long-term storage has been completed in the case of plutonium-242 and is planned for neptunium and americium/curium solutions. Stabilization can be accomplished via conversion to a solid oxide form or via vitrification in a glass matrix. The Nuclear Materials Stewardship Program is utilizing a systems approach to examine the life-cycle management of these materials.

Table 5.1.4: 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 Stewardship 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 Stewardship Program.

5.1.5 Highly-enriched Uranium Stabilization Requirements

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. Much of the highly-enriched uranium (HEU) inventory included in the original implementation plan has been stabilized, as shown in Table 5.1.5 and described in chapter 4. For the remaining HEU to be stabilized, Savannah River plans to blend the HEU solutions at that site into a low enriched uranium configuration suitable for use as commercial reactor fuel. Details of this project can be found in the *Off-Specification Fuel Project Plan*. HEU solids remaining in the Oak Ridge Molten Salt Reactor Experiment will be removed and turned over to be managed under the uranium-233 Safe Storage Program Execution Plan.

Table 5.1.5: Highly-enriched Uranium Inventory Summary

Site	Type of Material	Original Quantity	Original Location	Quantity Stabilized as of 3/00	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 and Outside Facilities	0	Bldg 221-H and Outside Facilities
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

* 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.

5.1.6 Spent Nuclear Fuel

Spent Nuclear Fuel (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 awaiting evaluation of their waste classification. In Recommendation 94-1, the Board highlighted concerns involving SNF located in the K-East Basin at the Hanford Site, the CPP-603

Basin at the Idaho National Engineering and Environmental Laboratory, and the processing canyons and reactor basins at the Savannah River Site. This material, described in Table 5.1.6, represents a subset of the total inventory of spent nuclear fuel managed under the DOE SNF Program. At Hanford, the only SNF material covered by 2000-1 is SNF and sludge in the K-East and K-West Basins. At Idaho, SNF in the CPP-603 Basin comprised the 94-1 inventory and has all been removed. At Savannah River Site, Mark-31 targets (now stabilized) and Mark-16 and -22 SNF made up the 94-1 inventory.

Table 5.1.6: 2000-1 Spent Nuclear Fuel Inventory Summary

Site	Original MTHM	Original Volume (m^3)	MTHM Requiring Stabilization as of 4/00	Volume Requiring Stabilization (m^3) as of 4/00
Hanford	2,132	256	2,132	256
Idaho	2.9*	64.4*	0	0
Savannah River	154**	83.5**	5	43

* 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.

** The February 1995 94-1 Implementation Plan showed the values of 206 MT and 164 m^3 for the total SNF inventory at SRS. The above values represent the 94-1 portion of that inventory.

The 2000-1 SNF materials pose a risk to workers and the environment due to their prolonged storage in facilities and conditions that were originally intended to provide temporary storage. The structural integrity of these facilities in the case of a seismic event and the potential for release of radioactivity to the environment are of primary concern. Stabilization is being accomplished by dissolving damaged and at-risk SNF where facilities exist to carry out that operation, transferring SNF to a modern underwater storage facility, and by designing and constructing dry storage facilities at other locations. Dissolution of the Mark-16 and -22 SNF at Savannah River Site will produce a projected 1,400,000 liters of additional HEU solution, which will be stabilized along with the site's pre-existing HEU solution inventory.

5.2 Site Safety Issue Resolution Approaches

5.2.1 Hanford

The commitments for stabilizing plutonium-bearing materials described in this section represent specific disposition pathways for the various material types and their associated completion dates. In 1999, PFP completed evaluation of all alternatives for the remaining 2000-1 materials and included the path-forward for each in an Integrated Project Management Plan (IPMP). This IPMP utilized a resource-loaded, systems engineering approach to develop a 2000-1 materials stabilization schedule that provides a higher level of confidence in PFP's ability to meet its stabilization commitments. This Implementation Plan incorporates the schedule developed during that effort, including the incorporation of vault upgrades to support fully DOE-STD-3013-2000 packaging compliance (Addendum 1 to the IPMP). As processing experience is gained, and schedule opportunities or recovery work arounds are identified, resequencing of planned material stabilization logic will be considered. Resequencing of materials may be implemented if shown to maximize utilization of resources to meet or accelerate completion of established milestones.

Resolution Approach

Plutonium Solutions:

PFP currently stores approximately 430 items of plutonium-bearing solutions. These solutions are stored in vented 10-liter containers. Approximately 100 of these items are polybottles stored in thin-walled stainless steel containers. The remainder are in Product Receiver (PR) containers in which the solutions are stored in thick-walled stainless steel vessels.

PFP has four general types of solutions. The largest group (~400 items) are nitric acid solutions. These solutions range from product grade to very lean, impure solutions. The majority of these solutions will be processed in the magnesium hydroxide precipitation process.

The second group of solutions is the approximately 15 chloride or chloride contaminated solution items. It is anticipated that these solutions will be able to be processed in the same manner as the nitric acid solutions.

The third group includes approximately 15 caustic solution items. These solutions may not be compatible with the current solution stabilization process. It is likely that some fraction of the plutonium has already precipitated out of these solutions. PFP will characterize these solutions to determine how to disposition them.

The last group is the one item of organic solution. This item will be effectively stabilized during laboratory testing at Hanford.

Solutions stabilization process development activities using the prototype vertical denitration calciner were restarted in September 1999. A limited volume of Pu solution was effectively stabilized during this testing which will continue to support the use of the production calciner as a potential backup to magnesium hydroxide precipitation. Additionally, Pacific Northwest National Laboratory and the PFP laboratory initiated testing of the magnesium hydroxide precipitation process for PFP Pu solutions to develop the optimum process necessary to achieve the most efficient stabilization of these materials.

A magnesium hydroxide precipitation process was installed at PFP to convert plutonium solutions to a precipitate that is processed through PFP's muffle furnaces for final stabilization and packaging to meet the long-term storage standard. The precipitation process began operation in September 2000. The precipitated plutonium hydroxide is recovered via filtration and converted to the stable oxide form by calcining in a muffle furnace and packaged to meet DOE-STD-3013. PFP is pursuing an increase to the plutonium concentration in the feed solution to increase the precipitation process throughput and shorten the stabilization period.

Upon startup of the precipitation operation it was found that each precipitation batch was yielding over three times as much precipitate as was expected. The higher than expected volume is due to corrosion products in the precipitate. A study was completed that determined the volume of precipitate associated with each of the five solution subcategories associated with "nitric acid solutions." The study showed that high precipitate volumes would be a significant problem for four of the five subcategories. The plant is currently investigating strategies for reducing the precipitate volume by preferentially precipitating the plutonium (leaving the transition metal corrosion products in solution).

A previously considered stabilization technology, a production scale vertical denitration calciner, will be retained though not fully installed, as a potential backup option. Consideration will also be given to transfer of solutions with low plutonium concentration to the tank farms for disposition if this is determined to be a safe, cost effective alternative.

Spent Nuclear Fuel:

To address the urgent K-Basin issues, DOE and its regulators have developed a K-Basin recommended path forward to remove the fuel from the basins (a removal action under CERCLA), to stabilize it, and to place it in a safe, secure interim storage. The Department's decision concerning this action is consistent with the ROD from the EIS for *Management of SNF from the K-Basins* at the Hanford Site, Richland, Washington, which was issued in March 1996. 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 (MCO) 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 and transferred to interim storage at the T-Plant Canyon located at the 200 west area, prior to processing and ultimate disposition. The sludge material will be managed as SNF while at K-Basins, and will be declared as waste, specifically remote-handled TRU, as soon as it leaves K-Basins.

- The CSB spent fuel storage configuration will provide 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 achieve nuclear safety equivalency comparable to Nuclear Regulatory Commission licensed fuel storage facilities.

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 if the water is not replaced promptly.

- An Unreviewed Safety Question (USQ) was declared concerning the existence of three 12-inch and five 4-inch drain valves in each basin. Corrective action plans, including engineered solutions have been implemented to resolve this USQ.

- 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.

- A path forward for basin sludge that considers the probable differences between sludge in the fuel canisters and sludge lying on the basin floor has been developed. 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 known 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 Environmental Restoration Disposal Facility or 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.

Fuel Removal began December 7, 2000 from K-West Basin as the first MCO was lifted from the basin and moved to the Cold Vacuum Drying Facility for processing. The Contractor has also proposed a new out-year strategy called the Alternate Fuel Transfer Strategy (AFTS). This proposed strategy would move fuel from the K-East Basin to the K-West Basin for in-basin processing (washing, inspecting, and loading into baskets) in lieu of processing in the K-East Basin. This change could potentially reduce worker exposure by minimizing modifications, upgrades and equipment installation in the K-East Basin.

The proposed plan will require DOE-HQ and DNFSB review along with TPA renegotiation with the State and EPA. The proposed schedule would also require changes to several of the commitments contained in this Implementation Plan. However, all changes being proposed reflect either no change or an acceleration of completion dates (i.e. KE/KW combined fuel removal completion remains July 30, 2004 and KE/KW combined sludge removal completion would be accelerated from August 31, 2004 to July 31, 2004). It would also require combining, replacing or deleting several interim TPA and DNFSB milestones to reflect this alternate strategy. DOE will review the proposed strategy and make a decision in January 2001 regarding the contractor proposal. DOE would then enter negotiations with the TPA stakeholders and offer alternative commitments and milestone dates to replace existing TPA and DNFSB milestones.

Unalloyed Plutonium Metals:

In November 1998, a complex-supported workshop on PFP metals (350 items) was held in

Denver to evaluate potential hazards associated with opening of the containers at PFP. Based on information gained from this workshop, it was determined that it would be acceptable to open the containers in the PFP oxide processing gloveboxes. Additionally, it was determined that storage of the metal after brushing in welded cans would be acceptable to support long-term storage. As a result, a decision was made in February 1999 to brush the PFP metals to remove the corrosion products and repackage to meet the storage criteria. The removed corrosion products will be thermally stabilized in PFP muffle furnaces and packaged to meet the long-term storage standard.

In April 2000, PFP completed a characterization of the metal inventory as part of the enhanced surveillance program consisting of weighing and radiography. The weighing campaign was successfully completed on April 20. Radiography was completed on April 26. These efforts verified one item in contact with plastic, as well as 24 metal items and 4 Pu alloy items exceeding 5 grams in weight gains. A total of five items were relocated to glovebox storage pending disposition due to their unstable container integrity. An evaluation was performed on these 35 items to determine appropriate disposition options including continued storage and subsequent surveillance. The evaluation identified 15 items as having higher risk of container degradation and the remaining 20 items acceptable for continued storage and monitoring on a weekly basis. In June 2000, vulnerabilities associated with the 15 items were successfully addressed by repacking 4 items, thermally stabilizing 4 items, and brushing/repackaging the remaining 7 items. The 20 less risk items are currently undergoing enhanced surveillance. Four (4) of the 20 items have been oxidized and three (3) items have been repackaged. Successful execution of the enhanced surveillance program and subsequent implementation of stabilization actions adequately mitigated any near term risk associated with these items.

Use of a Bagless Transfer System (BTS) at PFP to package items in welded inner containers that meet the specifications of the long-term storage standard began in September 2000. In the original 2000-1 Implementation Plan (June 2000), the Department committed to complete outer packaging of unalloyed metal items by March 2001. At the time that document was prepared, Hanford was working with SRS to put together a test plan for developing a first of a kind outer container welding system. The delivery date for the system is February 2001. With this delivery date, the March 2001 commitment to complete brushing and packaging the metal inventory can not be met. The Department now estimates that this material will be placed in inner containers by March 2001 and in outer containers by August 2001.

Alloyed Plutonium Metals:

PFP also stores approximately 125 plutonium alloys. Approximately one third of the alloys in storage are plutonium aluminum alloys. These are considered stable, however they are not acceptable to the Materials Disposition Program. DOE is considering an option to discard these alloys to WIPP. Related programmatic and NEPA considerations are being evaluated.

PFP also has plutonium uranium alloys in storage and other miscellaneous alloys. Hydrides and/or nitrides may have formed on these alloys as discussed above resulting in similar storage conditions. PFP plans to disposition these alloys in the same manner as the unalloyed plutonium metals. Further review of inventory records indicate that many of these miscellaneous alloys may contain less than 30 wt% Pu + U. These items verified to be less than 30 wt% Pu + U may be recategorized as "miscellaneous residues" and dispositioned to WIPP in accordance with the residues schedule.

Plutonium Oxides and Mixed Oxides (> 30 wt% Pu+U):

PFP stores approximately 2,800 plutonium oxide items and 2,300 mixed plutonium-uranium oxide items (MOX). These oxides are being thermally stabilized in muffle furnaces and will be packaged to meet long-term storage criteria. Hanford successfully restarted thermal stabilization of oxides in two muffle furnaces in January 1999. Three additional furnaces were installed, and activated in March 2000. Additional high capacity furnaces are planned to be installed at PFP in fiscal year 2001. These and other initiatives, such as implementation of increased charge size, have the potential to accelerate schedules, but must be developed and integrated with the balance of plant activities.

Sources and Standards:

PFP stores approximately 200 items of sources and standards. The hazards are similar to those of oxides described above. Plutonium-beryllium sources will be shipped to LANL for dispositioning. All other sources and standards not required to support Hanford needs will be stabilized and packaged to DOE-STD-3013-2000 using the same process as described for oxides above.

Polycubes:

The path forward for stabilization of polycubes is a one-step thermal stabilization cycle in the muffle furnaces. DOE-RL consulted with the Office of Fissile Materials Disposition to ensure acceptability of this process with regard to planned disposition actions. This processing option will allow more cost-effective stabilization of the polycubes and an opportunity for acceleration of polycube stabilization completion. The resultant oxides will be packaged to DOE-STD-3013-2000.

The muffle furnace stabilization option will provide significant benefits to PFP including: reduced dose to the operators, less complex equipment operations, utilization of existing equipment, and require only minor changes to the existing thermal stabilization processes. Start-up of polycube stabilization could be achieved as a feed shift in the muffle furnaces. Testing performed at PNNL and PFP on both simulated and actual polycubes have demonstrated that polycube stabilization in a one-step furnace operation can be performed safely and efficiently. Laboratory tests were completed to optimize the effective throughput.

The items containing polycube scraps and residues are planned to be stabilized using the same process as polycubes. As an alternative stabilization path forward, the scraps may be disposed of as TRU of TRU-Mixed similar to the other plutonium bearing residues.

Residues (SS&C, Ash, Oxides < 30 wt% Pu+U):

PFP stores approximately 1250 items of SS&C, Ash and Oxides < 30 wt% plutonium and uranium. The SS&C and Oxides < 30 wt% plutonium and uranium are planned to be cemented at PFP and disposed of as TRU or TRU-Mixed waste per WIPP/WAC consistent with application of Section 308 of Public Law 105-245, 1998. The ash residues will be packaged in a pipe-and-go configuration for shipment to WIPP. PFP plans to conduct an evaluation of the use of pipe-and-go for all residue types. The pipe-and-go containers are being evaluated for shipping (some or all) this material, with or without cementation in order to accelerate schedule and reduce cost. If determined to be required, the calcium metal in the SS&C will be reacted with water in a controlled fashion prior to being cemented or packaged in the pipe-and-go containers.

Residues - Compounds:

PFP has four types of compounds in storage. This includes approximately 10 PuF_3 and PuF_4 items as well as one PuF_3-UF_6 item. Cementation and/or pipe-and-go disposition methods are being evaluated for these items.
PFP also has approximately 15 items of plutonium-zirconium scrap, plutonium-thorium scrap, or plutonium-beryllium scrap. These items are less than 30 wt% plutonium and will, therefore, be candidate items for cementation and discard.

Residues - Non-polycube Combustibles:

PFP has approximately 10 items of miscellaneous non-polycube combustibles. The path forward is to discard these items to WIPP per WIPP/WAC via cementation. If this proves impracticable, these items could be thermally stabilized using the same process as for polycubes. The resultant product could be either disposed of as TRU waste to WIPP or if the assay is > 30 wt% plutonium and uranium, the material could be packaged to DOE-STD-3013-2000.

Residues - Miscellaneous Plutonium-bearing Materials:

PFP has approximately 30 items of miscellaneous plutonium-bearing materials. The concern with these materials is the same as for plutonium oxides. Also, miscellaneous plutonium alloys less than 30 wt% Pu + U may be recategorized as "Residues - Miscellaneous Plutonium-bearing Materials." Better characterization is required before definitive stabilization plans can be made. Two options are being considered. The plan is to discard these items to WIPP via cementation or Pipe-and-go. If the assay is greater than 30 wt% plutonium and uranium, the material could be packaged to meet the revised long-term storage standard.

DELIVERABLES/MILESTONES

Plutonium Metals

Commitment Statement: The metal will be brushed and repackaged per the long-term storage standard. The resulting corrosion products will be thermally stabilized and packaged to meet the DOE long-term storage standard.
Responsibility: L. D. Romine, DOE-RL, Project Manager
Applicable Facilities: Plutonium Finishing Plant
Commitment Deliverable: Complete brushing and repackaging of metal inventory.
Due Date: August 2001

(Note: Due date has been delayed from original 2000-1 Implementation Plan commitment of March 2001.)

Plutonium Oxide and Mixed Oxide (> 30% Plutonium and Uranium)

Commitment Statement: Oxides will be stabilized, in muffle furnaces and packaged to meet the DOE long-term storage standard.
Responsibility: L. D. Romine, DOE-RL, Project Manager
Applicable Facilities: Plutonium Finishing Plant
Commitment Deliverable: Complete stabilization and packaging of oxides (>30 wt% Pu/U).
Due Date: May 2004

Plutonium Solutions

- Commitment Statement: Stabilization of solutions has been initiated through the utilization of the prototype denitrator calciner. This equipment is being utilized to develop design/process criteria for a production calciner which is currently being maintained as a backup to the primary solutions stabilization. The $MgOH_2$ precipitation process is being utilized for processing the majority of PFP solutions and precipitate will be oxidized in muffle furnaces and packaged to meet the DOE long-term storage standard.

Responsibility: L. D. Romine, DOE-RL, Project Manager
Applicable Facilities: Plutonium Finishing Plant
Commitment Deliverable: Complete stabilization and packaging of plutonium solutions.
Due Date: December 2001

Polycubes

- Commitment Statement: Polycubes will be stabilized through existing muffle furnaces. The stabilized material will be packaged to meet the DOE long-term storage standard.
  Responsibility: L. D. Romine, DOE-RL, Project Manager
  Applicable Facilities: Plutonium Finishing Plant
  Commitment Deliverable: Complete stabilization and packaging of polycubes.
  Due Date: August 2002

Plutonium Alloys

- Commitment Statement: Alloys will be packaged for disposition to WIPP or stabilized and packaged at PFP to meet the DOE long term storage standard.
  Responsibility: L. D. Romine, DOE-RL, Project Manager
  Applicable Facilities: Plutonium Finishing Plant
  Commitment Deliverable: Package alloys for disposition to WIPP or stabilize and package per DOE-STD-3013 criteria.
  Due Date: June 2001

Residues

- Commitment Statement: PFP residues will be cemented and/or packaged in a pipe over-pack to be disposed of as TRU or TRU-mixed waste per WIPP/WAC criteria.
  Responsibility: L. D. Romine, DOE-RL, Project Manager
  Applicable Facilities: Plutonium Finishing Plant
  Commitment Deliverable: Complete stabilization and packaging of residues.
  Due Date: April 2004

Spent Nuclear Fuel

- Commitment Statement: Richland will complete fuel removal from the K-West Basin. This

interim milestone will be complete when all spent nuclear fuel has been removed from K-West Basin. It is understood that additional fuel fragments may be discovered during removal of the sludge.
Responsibility: P. G. Loscoe, DOE-RL, Project Manager
Applicable Facilities: K-West Basin Facility including the fuel retrieval, integrated water treatment and cask loadout systems; Cask Transportation System; Cold Vacuum Drying Facility; and Canister Storage Building.
Commitment Deliverable: Complete fuel removal from the K-West Basin.
Due Date: December 2002

- Commitment Statement: Richland will begin fuel removal from K-East Basin. The KE Basin spent nuclear fuel retrieval system shall begin retrieving, cleaning, and packaging spent nuclear fuel, and the First Multi-Canister Overpack of spent nuclear fuel from K-East Basin will be loaded and transported to the Cold Vacuum Drying facility for processing.
  Responsibility: P. G. Loscoe, DOE-RL, Project Manager
  Applicable Facilities: KE-Basin Facility including the fuel retrieval, integrated water treatment and cask loadout systems; Cask Transportation System; Cold Vacuum Drying Facility; and Canister Storage Building.
  Commitment Deliverable: Begin fuel removal from the K-East Basins.
  Due Date: December 2002

- Commitment Statement: Richland will begin sludge removal from K-Basins. DOE shall complete and approve K-East sludge removal definitive design documents, all associated construction, and readiness assessments, and initiate removal of sludge from the Basin.
  Responsibility: P. G. Loscoe, DOE-RL, Project Manager
  Applicable Facilities: K-East Basin Facility including sludge removal system; Sludge Transport System; and Unloading System at the T-Plant Facility.
  Commitment Deliverable: Begin sludge removal from the K-Basins.
  Due Date: December 2002

- Commitment Statement: Richland will complete fuel removal from K-East Basin. This interim milestone will be complete when all spent nuclear fuel has been removed from the K-East Basin. It is understood that additional fuel fragments may be discovered during removal of the sludge.
  Responsibility: P. G. Loscoe, DOE-RL, Project Manager
  Applicable Facilities: K-East Basin Facility including the fuel retrieval, integrated water treatment and cask loadout systems; Cask Transportation System;

Cold Vacuum Drying Facility; and Canister Storage Building.
Commitment Deliverable: Complete fuel removal from the K-East Basin.
Due Date: July 2004

- Commitment Statement: Richland will complete sludge removal from the K-Basins.
  Responsibility: P. G. Loscoe, DOE-RL, Project Manager
  Applicable Facilities: K-East Basin Facility including sludge removal system; Sludge Transport System; and Unloading System at the T-Plant Facility.
  Commitment Deliverable: Complete sludge removal from K-Basins.
  Due Date: August 2004

5.2.2 Savannah River Site

In March 2000, the Savannah River Site (SRS) completed a sitewide reprioritization and rebaselining with the intent of establishing an achievable schedule for completing all stabilization activities. The results of that effort are discussed below.

Uranium Solutions:

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 (and Mk-16/22 spent nuclear fuel) 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.

DOE is continuing with its primary path forward to blend down HEU materials for delivery to TVA. DOE expects an agreement with TVA to be finalized in the next few weeks.

SRS continues to evaluate the backup contingency for stabilization of HEU solutions (i.e., blending to less than one percent uranium-235 and conversion to a solid) in the event that the anticipated TVA arrangement cannot be negotiated successfully. This evaluation includes identification of preliminary activities for blending the pre-existing (and Mk-16/22) uranium solution down to less than 1% enrichment, for restart of FA-Line, and for determining if there is a less expensive commercial alternative for conversion to oxide.

Americium/Curium Solution:

Several methods for stabilizing the americium-curium solutions were evaluated during the development of the IMNM EIS. The vitrification alternative was selected in the IMNM EIS

ROD (December 12, 1995). Basically, the vitrification alternative is to encapsulate the Am/Cm in a glass form.

An Americium/Curium Demonstration Project for vitrifying the Am/Cm solution began in 1995 and the Americium/Curium Vitrification Project was initiated in FY 1996, but development of a suitable melter proved to be a more formidable problem than originally estimated. As a result, the project had to be reassessed. Design and construction activities related to vitrification were curtailed 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, Semi-continuous Pour method has subsequently been replaced with an Induction-Heated Cylindrical Melter: Batch Feed-Batch Pour method. This R&D was completed, and design basis data/information has been used to revise the Design Basis Documents and rebaseline the project. Detail design restarted in the Spring of 1999, and the new cost and schedule baseline was approved in February 2000.

Neptunium Solutions:

In the fourth Supplemental ROD to the IMNM EIS, issued on October 31, 1997, DOE selected processing the neptunium solution in H-Canyon to remove decay products and other material that would interfere with subsequent conversion steps followed by transfer to HB-Line for conversion to a low-fired oxide. The Office of Nuclear Energy, Science and Technology has completed and DOE has issued the *Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* (December 2000) that includes analyses concerning domestic production of Pu-238. If the subsequent Record of Decision (currently expected to be issued in January 2001) selects a site for domestic production of Pu-238 or a site for storage of Np-237 oxide, the Np oxide product from HB-Line will be packaged to meet or exceed shipping requirements and be shipped to the selected site. Alternatively, the oxide will be stored on-site pending disposition.

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.

Plutonium Solutions:

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 fourth Supplemental Record of Decision is to process the solutions to oxide in the H-Canyon and HB-Line facilities. The solution will undergo processing in the H-Canyon as necessary to remove impurities that would interfere with the conversion-to-oxide process in HB-Line. The plutonium oxide will be placed in temporary storage until the capability is available to high fire the oxide and package it in accordance with the DOE storage standard.

Based on progress to date on facility restarts, and incorporation of lessons learned from six successful Operational Readiness Reviews and eight readiness assessments, H-Canyon plutonium solution stabilization is expected to begin in December 2001 and be completed in December 2002.

Plutonium Metal and Oxide:

A capability at SRS to repackage plutonium to meet the metal and oxide storage standard will be established. Equipment capable of high firing plutonium oxide and packaging plutonium metal and oxide in accordance with DOE-STD-3013 will be installed in existing building 235-F. Pre-conceptual design evaluations for the modifications to building 235-F have been completed with the conclusion that the plutonium stabilization and packaging capability can be provided in building 235-F. Because of the preliminary nature of the pre-conceptual efforts, it is not possible to provide a definitive project and operational schedule at this time. Conceptual design and 35% detail design for the building 235-F project must be completed before the final project and operational baseline dates are established. It is expected that the final project baselines will be established in FY 2002. We expect that as further design continues the current uncertainties will be resolved with a goal of accelerating project completion.

While the SRS has established the capability to package plutonium metal into the inner 3013 container (the FB-Line Bagless Transfer System), the greatest risk reduction for SRS plutonium storage will be achieved when plutonium oxides are packaged in accordance with the long-term storage criteria (DOE-STD-3013-2000). Nonetheless, in developing the Building 235-F stabilization and packaging project design, DOE will evaluate the option of establishing the outer-3013 container packaging capability in advance of completing the entire project. DOE will establish the outer 3013 capability early, and establish appropriate milestones for the project and completion of the 3013 packaging of plutonium metals, if it can be established without impacting the earliest final completion of the 235-F project. The SRS will continue to monitor the progress of both the Hanford and Rocky Flats stabilization and packaging projects. Lessons learned during completion, startup and operation of those projects will be factored into the design activities at the SRS and alternatives will be evaluated that might accelerate establishing the DOE-STD-3013-2000 capabilities at the SRS.

Rocky Flats Classified Plutonium Metal:

DOE decided in the ROD for the *Storage and Disposition of Weapons-Useable Fissile Materials Final Programmatic EIS* (January 1997) to relocate all RFETS non-pit weapons-usable plutonium, to include approximately 200 containers of classified plutonium metal, to SRS pending selection of SRS as the immobilization site. DOE selected the SRS in the ROD for the *Surplus Plutonium Disposition EIS* (January 2000) as the site for immobilization disposition. The classified plutonium metal at RFETS is being shipped to SRS where it will be recast in FB-Line and packaged in accordance with DOE-STD-3013.

Residues:

For residues, the first IMNM EIS ROD, issued December 12, 1995, selected stabilization by dissolving material in F- or H-Area, purifying the plutonium in solution, and transferring the residual solution to FB- or HB-Line for conversion to a metal or oxide. The first IMNM EIS ROD also included the additional stabilization options of improving storage and vitrifying the materials in F-Canyon. The fourth Supplemental ROD issued October 31, 1997, added processing and storage for vitrification in the DWPF as another stabilization method.

The sand, slag and crucible and DU/Pu have been dissolved in F-Canyon, and the plutonium sweepings have been dissolved using both F-Canyon and HB-Line Phase I. The resultant solutions in F-Canyon will be converted to metal in FB-Line and packaged in BTS containers. The resultant solution in HB-Line will be converted to oxide using HB-Line Phase II. The miscellaneous plutonium metal has been recast in FB-Line and packaged in BTS containers.

Where material and packaging properties are characterized incompletely, a program has been instituted to select the required stabilization process. Methods used include NDA using digital radiography equipment installed in March 1997, and selected sampling of containers using existing gloveboxes with modification. Full material characterization capability began in April 1999.

Current plans call for the repackaging of all existing high-grade, mixed plutonium solids (> 100 g/can) to meet the metal and oxide storage standard. Other possibly unstable residues which are slated for processing include the mixed, low-grade solids. The material processed in HB-Line will be transformed to oxide, while the residues processed in F-Area will be converted to metal. Ultimately, the plutonium oxides will be high fired and the plutonium metals and oxides will be packaged in accordance with DOE-STD-3013.

Rocky Flats Scrub Alloy:

In accordance with the first RFETS Residue EIS ROD (issued November 25, 1999), the existing scrub alloy at RFETS has been shipped to SRS where it will be dissolved in F-Canyon. The plutonium recovered will be processed through F-Canyon and transferred to FB-Line for conversion to metal and packaging for storage.

Spent Nuclear Fuel:

Based upon the IMNM EIS ROD (February 8, 1996), dissolution of SRS Mark-16 and Mark-22 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.

Miscellaneous aluminum-clad targets and fuels will also be dissolved, and the resultant solutions containing HEU may be blended down and transferred to TVA, similar to the existing HEU solution and solutions resulting from dissolution of the Mk-16/22 spent fuel. The remainder will be transferred to the Waste Tank Farm.

DELIVERABLES/MILESTONES

Plutonium Solutions

- Commitment Statement: Begin converting pre-existing H-Canyon Pu-239 solution to oxide
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: H-Canyon and HB-Line
  Commitment Deliverable: Begin operating HB-Line Phase II and conversion of the Pu-239 solution to oxide
  Due Date: December 2001

- Commitment Statement: Complete conversion of pre-existing H-Canyon Pu-239 solution to oxide
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: H-Canyon and HB-Line
  Commitment Deliverable: 34,000 liters of H-Canyon Pu-239 solutions converted to oxide.
  Due Date: December 2002

Metal and Oxide >30% Plutonium

- Commitment Statement: Complete conceptual design for 235-F Stabilization subproject
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: N/A
  Commitment Deliverable: Complete conceptual design for the subproject
  Due Date: January 2001 - April 2001

- Commitment Statement: Begin detail design for 235-F Stabilization subproject
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: N/A
  Commitment Deliverable: Begin detail design for the subproject
  Due Date: March 2001 - August 2001

- Commitment Statement: Begin construction for 235-F Stabilization subproject
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: 235-F
  Commitment Deliverable: Begin construction activities for the subproject
  Due Date: July 2002 - April 2003

- Commitment Statement: Begin operation of equipment for high firing and packaging plutonium in accordance with DOE-STD-3013
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: 235-F
  Commitment Deliverable: Begin stabilizing and packaging plutonium for long-term storage
  Due Date: January 2005 - January 2007

Residues <30% Plutonium

- Commitment Statement: Begin converting SRS residue solution to oxide
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: HB-Line
  Commitment Deliverable: Begin operation of HB-Line Phase II to convert solution from dissolution of pre-existing SRS plutonium residues to oxide
  Due Date: January 2003

- Commitment Statement: Complete dissolution of SRS pre-existing plutonium residues
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: HB-Line, FB-Line and H-Canyon
  Commitment Deliverable: All SRS plutonium residues from May 1994 inventory dissolved
  Due Date: September 2005

- Commitment Statement: Complete stabilization and packaging of all plutonium at SRS to DOE-STD-3013
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: 235-F
  Commitment Deliverable: All pre-existing SRS plutonium metal and oxide, and plutonium metal and oxide resulting from stabilization of all material within the April 2000 scope of the SRS stabilization program, stabilized and packaged in accordance with DOE-STD-3013

Due Date: June 2006 - June 2008

Special Isotopes

- Commitment Statement: Complete Am/Cm Vitrification Project Design
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: N/A
  Commitment Deliverable: Complete design for the Project
  Due Date: November 2001

- Commitment Statement: Delivery of in-cell vitrification equipment
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: N/A
  Commitment Deliverable: Receive in-cell Am/Cm vitrification equipment from vendor
  Due Date: May 2002

- Commitment Statement: Complete construction for Am/Cm Vitrification Project
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: F-Canyon/Multi-Purpose Processing Facility
  Commitment Deliverable: Complete MPPF construction activities
  Due Date: October 2003

- Commitment Statement: Begin stabilization of Am/Cm solution
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: F-Canyon/Multi-Purpose Processing Facility
  Commitment Deliverable: Begin pre-treatment of the May 1994 inventory of Am/Cm solution stored in F-Canyon
  Due Date: October 2004

- Commitment Statement: Begin vitrifying Am/Cm solution
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: F-Canyon/Multi-Purpose Processing Facility
  Commitment Deliverable: Begin vitrifying May 1994 inventory of Am/Cm solution stored in F-Canyon
  Due Date: January 2005

- Commitment Statement: Complete vitrifying Am/Cm solution

Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
Applicable Facilities: F-Canyon/Multi-Purpose Processing Facility
Commitment Deliverable: Vitrify May 1994 inventory of Am/Cm solution stored in F-Canyon
Due Date: December 2005

- Commitment Statement: Begin stabilization of Np-237 solution
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: H-Canyon and HB-Line
  Commitment Deliverable: Begin converting May 1994 inventory of Np-237 solution to oxide
  Due Date: April 2005

- Commitment Statement: Complete stabilization of Np-237 solution
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: HB-Line and H-Canyon
  Commitment Deliverable: Np solution converted to stable oxide
  Due Date: December 2006

Uranium

- Commitment Statement: Complete DOE/TVA interagency agreement for Off-Specification Fuel Program
  Responsibility: Laura S. H. Holgate, DOE-HQ, NN-60
  Applicable Facilities: N/A
  Commitment Deliverable: Agreement signed by both DOE and TVA for transfer of uranium from DOE to TVA
  Due Date: February 2001 *(Note: This is a change from the August 2000 commitment date in the original 2000-1 Implementation Plan. This change is due to continuing negotiations with TVA.)*

- Commitment Statement: Complete transfer of HEU solution to double-walled tank
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: H-Canyon and HA-Line
  Commitment Deliverable: Chemically refresh HEU solution stored outside H-Canyon and transfer to double-walled tank
  Due Date: September 2001

- Commitment Statement: Begin disposition of pre-existing enriched uranium solution and

enriched uranium solution resulting from Mk-16/22 SNF dissolution
Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
Applicable Facilities: H-Canyon, HA-Line
Commitment Deliverable: Begin isotopic blend down of HEU solution and transfer of low enriched uranium solution to TVA
Due Date: March 2003

- Commitment Statement: Complete disposition of pre-existing enriched uranium solution and enriched uranium solution resulting from Mark-16/22 SNF dissolution
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: H-Canyon, HA-Line
  Commitment Deliverable: All enriched uranium solutions transferred to TVA
  Due Date: September 2005

Spent Nuclear Fuel

- Commitment Statement: Complete Mark-16/22 SNF dissolution
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: H-Canyon
  Commitment Deliverable: Mark-16/22 SNF dissolved
  Due Date: March 2004

RFETS Metal and Scrub Alloy

- Commitment Statement: Begin dissolution of RFETS scrub alloy
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: F-Canyon
  Commitment Deliverable: Begin dissolving RFETS scrub alloy
  Due Date: April 2001

- Commitment Statement: Complete dissolution of RFETS scrub alloy
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: F-Canyon
  Commitment Deliverable: Complete dissolving RFETS scrub alloy
  Due Date: September 2001

- Commitment Statement: Complete direct casting RFETS classified plutonium metal
  Responsibility: Roy J. Schepens, DOE-SR, Assistant Manager
  Applicable Facilities: FB-Line
  Commitment Deliverable: Complete recasting RFETS classified metal
  Due Date: March 2006

5.2.3 Rocky Flats

Plutonium Solutions:

Solutions remain in Building 559 and Building 771. Building 559 continues to generate small quantities of low-level waste solutions due to analytical analysis to support Site closure. Building 771 continues to generate liquids from the tap and drain operations. 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. Solutions from Building 771 and Building 559 activities that are compatible with the Caustic Waste Treatment System process will be stabilized in Building 371. 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 impact of delays in Building 771 tap and draining will result in processing liquids in Building 371 through March 2002.

Experience gained during preparation and draining the first system in Building 771 indicated that flammable concentrations of hydrogen gas should be expected in all of the process system piping/components and appropriate safety controls should be implemented. This required expanding the hydrogen safety controls which were already applied to tanks to process piping systems. Activities in the process and laboratory areas are controlled to prevent ignition sources. Tools, vacuum pumps, drain-taps and other equipment used on systems that are to be drained are 'non-spark' by design. Also, draining preparations include venting and purging operations that assure hydrogen in the piping is below the lower explosive limit.

Building 771 continues to drain and remove piping systems. The two methods used to remove piping systems in Building 771 are a system-by-system (removal immediately after system has been drained) approach, and a recently added room-by-room approach. This new room-by-room approach (1) significantly increases worker industrial safety, (2) implements process efficiency lessons-learned from Building 779, and (3) reduces risk by accelerating draining of piping systems ahead of milestone schedules. The method that provides the greatest efficiency for risk reduction will be implemented. To minimize risk, each piping system is sampled to determine the system hydrogen generation rate. If the hydrogen concentration exceeds 25% of the lower explosive limit prior to pipe removal, the piping system will be removed immediately after draining (i.e., by implementing the system-by-system approach). The known leaking low points and joints are identified, contained, and controlled.

If hydrogen monitoring indicates that the piping system does not need to be removed immediately, the room-by-room approach is implemented. This method provides for partial removal of the process system to logical hold points or removal of the entire system. The piping may remain in place for up to 18 months after draining is completed, however, pipe removal is scheduled to be completed by December 2001. Prior to piping removal, the system is vacuum purged to ensure that any potential hydrogen is removed. The room-by-room approach minimizes the hazards associated with interference from other piping systems and improves industrial worker safety. Many piping systems are located several layers deep in the overheads that are located above gloveboxes and tanks. These piping systems are difficult to access; require intricate scaffolding to reach; and expose the workers to work in potentially unsafe conditions. The room-by-room approach allows piping to be removed from the bottom up, where piping is easily accessible without intricate scaffolding thereby substantially reducing fall, strain, and chemical exposure risk to the worker.

Both methods use characterization data gathered at the time of process system draining. If the room-by-room method is used, characterization data is saved and the piping left is tagged tying it back to the draining characterization data. This revised strategy supports site acceleration of process system draining and completion of work by December 2001. As of September 30, 2000, 31 of 42 systems have been drained and 25 of 42 systems have been removed.

The liquid stabilization program will be integrated with current efforts to meet the appropriate safe storage criteria (i.e., DOE-STD-3013-2000 or Interim Safe Storage Criteria) for the plutonium solids generated as a result of the stabilization process. The solids generated will be initially packaged to meet site storage requirements until packaged to meet longer-term storage criteria. Figure 5.2.3-1 shows a simplified flow diagram.

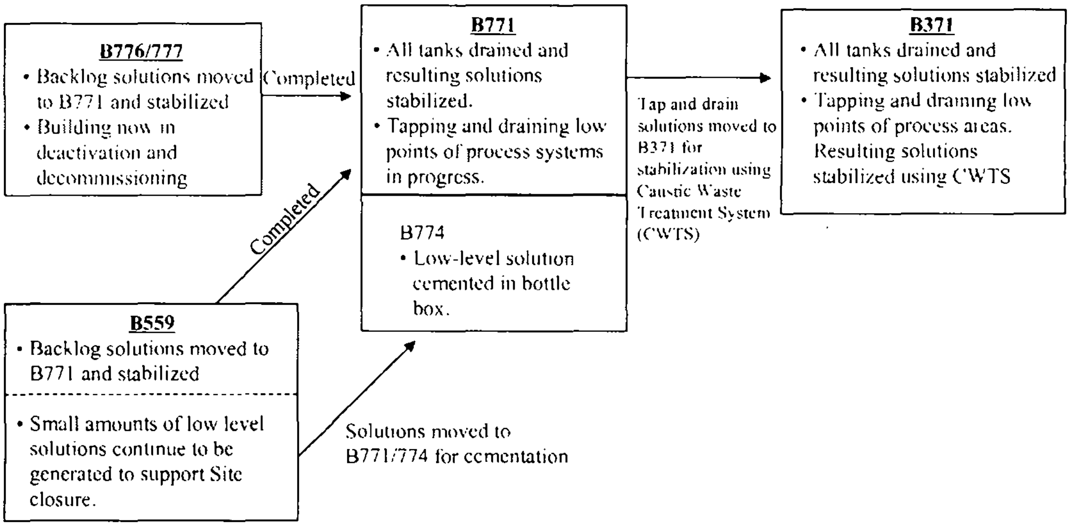


Figure 5.2.3-1: Plutonium Solution Stabilization Process Flow Diagram

Metals and Oxides: In order to meet DOE-STD-3013-2000, the long term storage standard, a packaging system with manual furnaces is being installed in Building 371. The system will feature the capability to brush loose oxide from metal, stabilize the oxide to meet the 0.5 weight percent moisture requirement, and package both metal and oxide in a welded stainless steel container, which is sealed within a second welded stainless steel container.

In the original 2000-1 Implementation Plan (June 2000) it was projected that this system would be available to start packaging metal or oxide into 3013 containers by October 2000. That commitment date was missed and startup is now expected in March 2001. This startup delay is primarily driven by delays in the completion of construction of the plutonium oxide stabilization gloveboxes and furnaces. Longer than expected procurement of critical parts and longer than expected fabrication and final installation in Building 371 caused this construction delay. This delay in construction has caused a corresponding delay in the overall packaging and stabilization system testing, issuing the operating and maintenance procedures, and completing engineer and operator qualifications. Additionally, it has taken longer than expected to train and qualify operators to safely operate the automated packaging and welding portion of the system.

The Department plans to accelerate the shipment of plutonium metal and oxides at Rocky Flats to the Savannah River Site (SRS) in order to support the goal of accelerating closure at Rocky Flats from 2010 to 2006. The K-Area at SRS has been modified to allow storage of Rocky Flats' plutonium pending disposition. Classified plutonium will not be packaged in a 3013 container before shipment to SRS. This material will be declassified by recasting in FB-Line at the SRS then ultimately put into a 3013 container.

Scrub alloy, an alloyed button of plutonium and americium from the scrubbing of salts from the molten salt extraction process, has been shipped to SRS for processing in F-Canyon. Processing of the scrub alloy at SRS allows the americium (a high worker exposure source) to be extracted to the high-level waste processing system and the by-product plutonium metal to be packaged to the long-term storage standard. Shipments of RFETS scrub alloy were completed in March 2000. See Section 5.2.2 for when this material will be stabilized.

Residues:

Plans for remaining residues requiring stabilization are as follows:

Salts: Salt repackaging in a pipe component to meet ISSC and WIPP standards was completed in November 2000.

Wet Combustibles: Approximately 11,000 kg of wet/combustible residues were originally classified as high risk. With the recharacterization of wet combustible residues from high hazard to low hazard, the need to perform any stabilization has been eliminated. Most of these low hazard wet combustible residues need only undergo a combination of sorting, blending, drying, repackaging, headspace gas sampling, and gas generation testing. A portion of these low hazard residues need only undergo real-time radiography, headspace gas sampling and gas generation testing. Operations that implement this simplified repackaging strategy commenced on October 6, 1998. All of these residues will meet the WIPP standards. The majority of these residues will not meet the ISSC (i.e., double metal containment boundaries), but will be made ISSC compliant or shipped to WIPP by May 2002. A high priority will be placed on shipping combustibles to WIPP, especially those that are non-ISSC compliant. In the interim, surveillance monitoring will be performed to ensure safe interim storage.

Ash: Remaining low risk ash (including graphite fines) will be blended as necessary to be below the 10 percent plutonium concentration limit, then repackaged into containers and placed in pipe component to meet ISSC and WIPP standards. Ash repackaging will be complete by May 2002.

Sand, Slag, and Crucible Residues: SS&C residues are currently being stored in a non-vented configuration. Surveillance will be performed until repackaging to WIPP standards commence. As required, any corrective actions to assure safe storage will be taken. SS&C residues will be blended, as required, to below the 10 weight percent plutonium concentration limit and placed in a pipe component to meet ISSC and WIPP standards. Repackaging operations will be complete by May 2002.

Implementation Plan revisions have been made to reduce overall site risk and support Site closure while meeting original commitments of making all low risk residues ISSC compliant by May 2002. Pending shipment to WIPP, a post-stabilization monitoring program for all residues will be implemented to assure safe interim storage.

DELIVERABLES/MILESTONES

Solutions

- Commitment Statement: Complete removal of all liquids in B771 (including all non-actinide systems).
  Responsibility: Henry F. Dalton, DOE-RFFO, Assistant Manager
  Applicable Facilities: Building 771
  Commitment Deliverable: Remove all liquids from B771.
  Due Date: December 2001

- Commitment Statement: Complete processing all of the B771 liquids.
  Responsibility: Henry F. Dalton, DOE-RFFO, Assistant Manager
  Applicable Facilities: Building 371
  Commitment Deliverable: All B771 liquids processed.
  Due Date: March 2002

Metal and Oxide

- Commitment Statement: Start packaging metal or oxide into 3013 containers.
  Responsibility: Henry F. Dalton, DOE-RFFO, Assistant Manager
  Applicable Facilities: Building 371
  Commitment Deliverable: Start packaging metal or oxide into 3013 containers.
  Due Date: March 2001 *(Note: This is a delay from the original 2000-1 Implementation Plan commitment of October 2000.)*

- Commitment Statement: Repackage all metal and oxides (except classified metal) into 3013 containers.
  Responsibility: Henry F. Dalton, DOE-RFFO, Assistant Manager
  Applicable Facilities: Building 371
  Commitment Deliverable: Repackage all metal and oxides (except classified metal) into 3013 containers.
  Due Date: May 2002

Residues

- Commitment Statement: Complete repackaging all remaining low risk residues to meet ISSC
  Responsibility: Henry F. Dalton, DOE-RFFO, Assistant Manager
  Applicable Facilities: Buildings 707 and 371
  Commitment Deliverable: Complete repackaging all remaining low risk residues to meet ISSC.
  Due Date: May 2002

5.2.4 Oak Ridge

The remaining material at Oak Ridge in the 2000-1 scope is plutonium stored at ORNL in Building 3027. Stabilization and removal of uranium materials at the Molten Salt Reactor Experiment at Oak Ridge National Laboratory, originally part of 94-1, is no longer being monitored by the DNFSB. Completion of this removal action will no longer be considered part of the 2000-1 program, but it is being tracked as an action under the Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA).

Plutonium: The quantities of plutonium metals and oxides (>50% assay) and plutonium residues and mixed oxides (<50% assay) shown in Tables 3.2-1, 3.2-2, and 3.3-1 of the original Recommendation 94-1 Implementation Plan (March 1995) erroneously include both materials that continue to have a programmatic use and materials that are excess to programmatic needs.

Only the excess materials, approximately 609 grams of Pu-238/Np-237 designated for transfer to the Department's Pu-238 Heat Source Program and approximately 708 grams of "other" plutonium identified as unneeded and packaged awaiting shipment to LLNL, are specifically 2000-1 materials.

It is Oak Ridge's intention that it will meet its one 2000-1 plutonium commitment to, "Repackage all plutonium metals and oxides to meet the metal and oxides storage standard," by May 2002, by transferring the Pu-238/Np-237 to the Department's Pu-238 Heat Source Program when facilities are available to secure the material, and by shipping its other 2000-1 material to LLNL where it will be integrated into and processed with that site's 2000-1 Plutonium inventory. An agreement for shipping the material is currently being negotiated with LLNL.

DELIVERABLES/MILESTONES

Metal and Oxide >30% Plutonium

- Commitment Statement: Repackage all plutonium metals and oxides to meet the metal and oxide storage standard.
  Responsibility: H. Clark
  Applicable Facilities: ORNL, Building 3027
  Commitment Deliverable: Dispose of unneeded plutonium at ORNL.
  Due Date: May 2002

5.2.5 Los Alamos National Laboratory

Materials in the original 94-1 inventory at Los Alamos National Laboratory (LANL) included several high-risk residue material categories (sand, slag and crucible, hydroxide precipitates, silica filter residues, and potentially nitrated cellulose clean-up rags). Los Alamos completed stabilization of the majority of these vault items in 1998. The remaining items of these types contain mixtures of actinides in small quantities. The preferred path for most of these items is discard.

All items, regardless of programmatic designation, sent to the vault since the institution of new requirements are packaged in new vault outer containers. New vault packaging requirements, instituted in 1998, include an outer container that has a positive, O-ring seal, is helium leak checked, and filtered. Earlier packaging only required a taped, outer container that could be any size. There was no positive seal or filter arrangement. The new vault outer containers have consistent sizes and slip-on shielding that is designed to attenuate the 60 KeV gamma from americium but still allows the higher energy gamma to pass through so that NDA measurements can be performed.

Table1 shows the inventory workoff schedule for the 3943 items in the 00-1 inventory. LANL's annual stabilization and/or discard progress will be measured against this table.

Table 1: LANL Rec. 00-1 Inventory Workoff Schedule

Description	Total Items	Item Count per Year									
		2001	2002	2003	2004	2005	2006	2007	2008	2009	201 0
Metal/Oxide-like Materials	1451	252	353	377	350	0	0	0	0	0	0
Salts and MgO	1464	10	65	181	205	225	255	241	152	103	17
Solutions	48	48	0	0	0	0	0	0	0	0	0
Residues	592	55	98	127	130	71	56	49	46	41	48
Unsheltered Containers	9	0	1	1	1	1	0	2	1	1	1
Misc. Items	379	3	0	0	0	0	28	81	60	113	94
TOTAL	3943	368	517	686	686	297	339	373	259	258	160

The inventory has been divided into 6 general categories. The first represents a minimal processing category that has significant potential for dispersion should there be a complete failure of a container. These are oxides and other materials that can be thermally treated and placed in welded containers. The second major category is materials that will require chloride operations.

The third is solutions. The fourth, residues that can be handled through the existing nitrate processing lines. The fifth is the unsheltered containers, and the final category consists of items that are primarily non-Pu239 matrices.

The schedule indicates that the entire inventory will be stabilized by FY2010. Items that can be thermally processed and put directly into welded containers have been front-end loaded on the schedule. There is a gap in FY06 for handling the unsheltered containers. It is anticipated that in this general timeframe, there may be a programmatic need for the handling and processing capability unique to these types of items. All solutions will be stabilized in FY01.

<u>*Programmatic Metal*</u>:

The programmatic use metal will be stored in reusable flanged containers (ConFlat containers), or welded containers that are not intended for shipment offsite. The programmatic metal stored in ConFlat containers shows that the metal does not oxidize. This reusable container has proven to be equivalent to welded containers and can be deployed without having to maintain expensive welding equipment. Also, as compared to welded containers, the only waste from these containers is the copper gasket that must be thrown away after each use. In case of a welded container, the entire container must be thrown away. There are also metal items that are in welded inner and outer containers. These containers do not meet the configuration of the latest 3013 standard, but are doubly welded containers. Currently, LANL has about 100 packages of non-excess metal in DOE-STD-3013-94 packages. Because these items will not be shipped to Savannah River for ultimate disposition, there is no need to repackage these into a different geometric configuration. Periodic visual inspections of these welded containers have not found any indications of container degradation. Also, opening similarly packaged programmatic metal has demonstrated that the cans have been sealed and no metal degradation has occurred.

LANL has a total of 1051 items in the programmatic inventory. Items packaged after 1998 are in robust containers. However, the packaging configuration would need to be confirmed for those items packaged prior to 1998, about 700 items. Examination of the packaging will be coordinated by the programmatic "owners", and schedules are being developed for accomplishing this activity.

<u>*Programmatic Sealed Sources:*</u>

There are also a large number of other sealed items such as NDA standards, Pu/Be sources and material sealed in other configurations for programmatic purposes. These items will not be repackaged, either inner or outer packaging.

<u>*Excess Plutonium Metal, Oxides and Oxide-like materials:*</u>

There are several categories that may be candidates for stabilization, blending and canning into 3013 containers to meet long-term storage requirements. These items will be considered together in the prioritization of the overall inventory and are listed in the following table.

Item Description	No. of Items
Plutonium Oxide	614
Sweepings and Screenings	252
Filter Residues	266
Unalloyed Metal	135
Incinerator Ash	119
Alloyed Metal	65
TOTAL	**1451**

These items should all form oxides after stabilization. Some of the metal items will be oxidized to meet the DOE-STD-3013 and shipping requirements which set a lower limit on the size of a metal item. Items that weigh less than the specified amount, or have a geometry that could be construed as potentially pyrophoric (i.e thin pieces and high surface area pieces) will be oxidized. Items that can be directly packaged will be welded into 3013 cans. After blending and stabilization, these items will be packaged according to the plutonium storage standard and stored in the TA-55 vault. The inner can packaging and welding will be performed by personnel and equipment used for the ARIES project on a non-interference basis. The blending and sampling will establish the acceptability for storage in 3013 containers awaiting final disposition. These items represent approximately 37% of the entire excess inventory.

Residues - Salts and MgO Crucibles:

LANL has 1464 items that are chloride-based process residues. These are ER, MSE, DOR, miscellaneous salts and magnesia crucibles. These items cannot be processed through the nitrate aqueous equipment due to corrosion concerns. Approximately 67% of the 1464 items exceed 10% Pu by weight criteria for discard. As a result, these items will be processed to an oxide through equipment specifically designed for high chloride content feed streams. This equipment and personnel are also the primary reprocessing capability for the ongoing programmatic work in support of the weapons program and as a result will be stabilized by FY2010. Items requiring chloride operations have been staged such that all other programmatic needs for residue processing have been met. These items represent approximately 37% of the total excess inventory.

Residues - Solutions:

There are a total of 49 solution items: 48 plutonium solutions and 1 uranium solution. All of these items are in gloveboxes and none are stored in vaults. There is one subset, 6 organic solutions, that have been identified as part of a treatability study for dealing with radioactive liquids contaminated with RCRA listed organic materials. This may extend the processing schedule for these specific 6 items. The remainder items will be stabilized in FY2001.

Residues:

There are a total of 592 items that may require processing through the nitrate process lines. There are a wide variety of matrices included in this category, including items to be leached such as glass, and a number of low item count categories such as contaminated firebrick. Concurrent paths will be evaluated for these residues. Criteria are being developed to evaluate the residue items for direct discard. LANL will develop and implement the criteria and procedures for this discard. This approach will be pursued in place of the Plutonium Discard Methodology. While differing slightly from the Rocky Flats approach, the basic goal is similar. All items that meet the attractiveness level D criteria will be candidates for discard and evaluated further. Items that may have more than one handling path will be evaluated to determine the safest, cheapest, and fastest method of disposition.

Residues - Miscellaneous Items:

There are a total of 379 items that are a mixture of actinides. Included in these items are matrices containing primarily HEU, matrices with neptunium, americium, curium, or mixtures of all of these, and items containing Pu-238. With the sole exception of a single solution item, all of these materials will be stabilized later in the 00-1 campaign. Many of these items will be directly discarded. Non-destructive assay methods for many of the mixed actinide matrices do not presently exist, which precludes the direct discard under current requirements. For those that cannot be directly discarded, specialized handling will be required to avoid contaminating process lines with these highly undesirable isotopes.

Unsheltered Containers:

There are a total of 9 unsheltered containers. The unsheltered containers will be processed at a rate of one per year beginning in FY02. The schedule for treating these shelters is provided in Table 1. The most probable path for these items will be to introduce an item into PF-4, remove the contents, package these consistent with the upgraded vault storage requirements, and evaluate which of these "newly" produced items can be directly discarded and which require additional processing. With the current configuration of equipment in the process area, it is not possible to deal with more than one of these containers at a time. Further, based on past experience, it is assumed that each container will generate approximately 100 "new" items, roughly half of which can be directly discarded. The remaining items will be packaged to meet the vault storage standards and processed as concurrent with generation as possible. As shown in Table 1, a container is not scheduled to be handled until the discard criterion has been fully evaluated and the requirements established. This approach will allow the material that can be directly discarded to be dispositioned and will provide definition for the processing requirements for the remaining items.

DELIVERABLES/MILESTONES

Solutions

- Commitment Statement: Complete stabilization of all solutions
  Responsible Manager: Sujita Pierpoint, DP-253
  Applicable Facilities: TA-55
  Commitment Deliverable: Stabilize all legacy solutions
  Due Date: October 2001

Metal and Oxide

- Commitment Statement: Complete stabilization and packaging to DOE-STD-3013
  Responsible Manager: Sujita Pierpoint, DP-253
  Applicable Facilities: TA-55
  Commitment Deliverable: Stabilize and package all excess metal, oxide and oxide-like material to meet DOE-STD-3013 criteria
  Due Date: October 2004

Residues

- Commitment Statement: Complete stabilization of hydrides, nitrides, cellulose rags
  Responsible Manager: Sujita Pierpoint, DP-253
  Applicable Facilities: TA-55
  Commitment Deliverable: Stabilize all relatively unstable items
  Due Date: October 2001

- Commitment Statement: Stabilize salt residues and other residues
  Responsible Manager: Sujita Pierpoint, DP-253
  Applicable Facilities: TA-55
  Commitment Deliverable: Process, stabilize and/or discard residues
  Due Date: October 2010

Unsheltered Containers

- Commitment Statement: Resume processing containers in FY'01
  Responsible Manager: Sujita Pierpoint, DP-253

Applicable Facilities: TA-55
Commitment Deliverable: Empty the contents of each container, characterize and stabilize or discard these contents.
Due Date: October 2010

5.2.6 Lawrence Livermore National Laboratory

The 2000-1 inventory at LLNL includes 114 cans of ash residues, 91 containers of metal that are either double canned or that use aluminum foil as the inner barrier, and 92 containers of other plutonium oxides greater than 50 wt% plutonium. This inventory is located in Building 332, which is a functional plutonium processing and handling facility that meets federal, state, and local environmental regulations as outlined in the LLNL Environmental Impact Statement.

Resolution Approach

LLNL has procured the BNFL packaging system with which it will package its excess 2000-1 plutonium inventory to meet the requirements of the plutonium packaging and storage standard (DOE-STD-3013-2000). LLNL will use an existing glove box and furnaces to meet stabilization requirements; however, the glove box is not currently authorized for plutonium operations. Therefore, the Plutonium Facility work control process will be implemented to obtain authorization for plutonium operations. The PuSAP Installation was scheduled to be completed and be operational in the spring of 2000. Due to funding prioritization, the non-availability of BNFL engineers, design issues, and uncertainties in the welding certification requirements, the start-up has been delayed into FY 2001. Processing and repackaging of the 2000-1 inventory will begin directly thereafter.

> Metal and Oxide Materials: LLNL has approximately 91 containers of metal and 92 containers of oxide that are excess inventory not required to support active Defense Programs missions. This material will be thermally stabilized and packaged in accordance with DOE-STD-3013-2000 by May 2002. It will be retained in storage on site until further disposition is directed.

Additionally, LLNL is negotiating an agreement with Oak Ridge for that site's small inventory of plutonium metal and oxide, approximately 708 grams, to be shipped to LLNL. The plan is for the material to be integrated into LLNL's excess metal and oxide inventory and then stabilized and packaged as part of the site's 2000-1 commitment.

> Ash residues: In 1994, eight of the cans containing ash residues were found to be pressurized. All 114 cans were vented to mitigate the pressurization problem and a study to determine a plan for the stabilization and packaging of the contents for long-term storage was completed. The ash will be washed with water or a weak acid solution and then thermally stabilized by calcination prior to packaging. This process is limited to small batch sizes making it necessary to extend the milestone date to May 2002. Resultant material that meets with DOE-STD-3013-

2000 will be packaged accordingly. The resultant material that meets the disposal criteria will be shipped to WIPP. The remainder will be retained on site until a decision for further disposition is made.

Residue materials: The stabilization and packaging of residues will be completed by May 2002. The "other than ash" residues that meet the acceptance criteria will be shipped to WIPP. The remainder will remain on site awaiting a decision for further disposition.

DELIVERABLES/MILESTONES

Metal and Oxide >30% Plutonium

- Commitment Statement: Complete plutonium metal and oxide repackaging.
  Responsibility: Karen Dodson, LLNL
  Applicable Facilities: LLNL Building 332
  Commitment Deliverable: Complete plutonium metal and oxide repackaging.
  Due Date: May 2002

Residue <30% Plutonium

- Commitment Statement: Stabilize and package LLNL's ash residues.
  Responsibility: Karen Dodson, LLNL
  Applicable Facilities: LLNL Building 332
  Commitment Deliverable: Complete ash stabilization and packaging.
  Due Date: May 2002

- Commitment Statement: Stabilize and package all other LLNL residues.
  Responsibility: Karen Dodson, LLNL
  Applicable Facilities: LLNL Building 332
  Commitment Deliverable: Complete all residue stabilization and repackaging.
  Due Date: May 2002

6.0 ORGANIZATION AND MANAGEMENT

Completing the commitments identified in this Implementation Plan (IP) is one of the highest priorities of the Department. The Assistant Secretary for Environmental Management (EM-1) is the lead Program Secretarial Official (PSO) for the Department since most of the nuclear materials stabilization activities are under her purview. The Responsible Manager (RM) is the Deputy Assistant Secretary for Integration and Disposition, who has responsibility to perform all associated planning, response, and implementation activities, consistent with guidance provided in the *Interface with the Defense Nuclear Facilities Safety Board* (DOE M 140.1-1A), Section I.3.f, "Responsibilities of the Responsible Manager." He is also responsible for working directly with program offices and providing recommendations for integration of implementation activities across programs and sites. In fulfilling these duties, he has the authority to escalate plan revision and implementation matters to the appropriate level of management for resolution. The Office of Nuclear Materials and Spent Fuel (EM-21) is the Recommendation 2000-1 Implementation Plan Manager (IPM). The Responsible Manager and the Implementation Plan Manager will work with appropriate managers from the Offices of Defense Programs (DP) and Environmental Management (EM) to ensure that stabilization activities at DP and EM sites are completed in a safe and timely manner.

Program direction shall pass from appropriate Program Offices in EM and DP to Field Offices under their cognizance. Consistent with the Department's Integrated Safety Management policy, the Program and Field Offices have the authority to direct, and are accountable to perform, the nuclear materials stabilization activities safely and in accordance with the Secretarial commitments contained in this IP. They are also responsible to provide timely information so that the Responsible Manager and Implementation Plan Manager can have a realistic assessment of progress toward meeting these commitments.

The Implementation Plan Manager is the day-to-day manager for the 2000-1 IP, and shall report directly to the Responsible Manager on 2000-1 issues. The Responsible Manager is supported by a 2000-1 Management Team, consisting of representatives from each of the Program Offices at Headquarters that have 2000-1 related stabilization activities at Field locations under their cognizance. The Offices of Fissile Materials Disposition (NN-60); Environment, Safety and Health (EH); Departmental Representative to the Board; and EM''s Office of Science and Technology will also be represented on the 2000-1 Management Team. Their participation will ensure proper management of the interfaces between the materials stabilization and disposition programs, adequate resolution of environmental, safety and health vulnerabilities, and timely consideration of technology needs. It is important to note that, although the DP and NN-60 organizations have recently been reorganized as part of the new National Nuclear Security Administration, their representation and responsibilities with respect to DNFSB responses has not changed.

Field Office Managers are responsible for developing and executing fully resource-loaded 2000-1 management plans for their sites. These plans shall include appropriate narrative and schedules sufficient to indicate how their respective sites will meet their 2000-1 commitments. Recommendation 2000-1 Site Management Plans (2000-1 SMPs) may be developed as independent documents, or they may be identifiable components of each site's current EM Project Baseline Summaries (PBS) as long as the site's program for meeting their Recommendation 2000-1 Implementation Plan commitments are readily recognizable and extractible for review.

Reporting

The commitments in this IP will be supported by resource-loaded schedules. Overall progress toward meeting Recommendation 2000-1 Implementation Plan commitments will be reported monthly by each site via direct data inputs into either the EM Integrated Planning, Accountability and Budgeting System (IPABS), or the Department's Safety Issues Management System (SIMS) which is administered by the Office of the Departmental Representative to the Defense Nuclear Facilities Safety Board (S-3.1). For those sites reporting via IPABS, the 2000-1 Implementation Plan Manager will update the SIMS database to be consistent with the most recent information reported by the sites. The 2000-1 Management Team will analyze the 2000-1 SIMS information each month and review the status of implementation with the Responsible Manager. The commitment status will be reviewed with the lead Program Secretarial Official (EM-1), Responsible Manager (EM-20), EM Deputy Assistant Secretaries, and Field Managers on a quarterly basis through a process being institutionalized as a part of the EM Integrated Planning, Accountability and Budgeting System (IPABS). The 2000-1 Management Team will work with the appropriate Field Office managers to prepare an annual 2000-1 Implementation Plan Status Report using information from SIMS and IPABS. This status report will be an integral part of the Secretary's Annual Report to Congress.

Change Control

Complex, long-range plans require sufficient flexibility to accommodate changes in commitments, actions, or completion dates that may be necessary due to additional information, improvements, or changes in baseline assumptions. The Department's policy is to (1) have the Secretary approve all revisions to the scope and schedule of plan commitments; (2) provide prior, written notification to the Board on the status of any implementation plan commitment that will not be completed by the planned milestone date; and (3) clearly identify and describe the revisions and bases for the revisions. Fundamental changes to the plan's strategy, scope, or schedule will be provided to the Board through formal reissuance of the implementation plan. Other changes to the scope or schedule of planned commitments will be formally submitted in appropriate correspondence approved by the Secretary, along with the basis for the changes and appropriate corrective actions.

APPENDIX A
GLOSSARY

Actinide—Any of a series of chemically similar, mostly synthetic, radioactive elements with atomic numbers ranging from actinium (89) through lawrencium (103).

Alpha emitter—A radioactive substance that decays by releasing an alpha particle.

Alpha particle—A particle consisting of two protons and two neutrons, given off by the decay of many elements, including uranium, plutonium, and radon. Alpha particles cannot penetrate a sheet of paper. However, alpha emitting isotopes in the body can be very damaging.

Americium—A manmade element. Americium is a metal that is slightly heavier than lead. Americium-241 is produced by the radioactive decay of plutonium-241; in addition to being an alpha-emitter, it is an emitter of gamma rays. Americium-241 has a half-life of 433 years.

As low as reasonably achievable (ALARA)—The approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit, but a process that has the objective of attaining doses as far below the applicable limits as is reasonably achievable.

Ash residues—This category of residues includes incinerator ash; inorganics; sand, slag, and crucible; graphite fines; and firebrick. These residues are grouped together because of the similar methods in which the residues will be treated and/or repackaged.

Atomic Energy Act (AEA)—A law originally enacted in 1946 and amended in 1954 that placed nuclear production and control of nuclear materials within a civilian agency, originally the Atomic Energy Commission. The Atomic Energy Commission was replaced by the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

Beta emitter—A radioactive substance that decays by releasing a beta particle.

Beta particle—A particle emitted in the radioactive decay of many radionuclides. A beta particle is identical to an electron. It has a short range in air and a small ability to penetrate other materials.

Blend down—A process in which an appropriate material is added to a plutonium-bearing material to reduce the concentration of plutonium in the material. The quantity of plutonium in the material remains the same while the total quantity of material increases.

Bounded—Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

Button—Plutonium metal in a hemispherical shape, weighing approximately 2 kilograms.

Calcination—A process in which a material is heated to a high temperature to drive off volatile matter (to remove organic material) or to effect changes (as oxidation or pulverization or to convert it to nodular form). Calciners and nodulizing kilns are considered to be similar units. The temperature is kept below the fusion point.

Canister—A stainless-steel container in which nuclear material is sealed.

Canyon—A heavily shielded building at the Savannah River Site used in the chemical processing of radioactive materials to recover special isotopes. Operation and maintenance are performed by remote control.

Cask—A heavily shielded massive container for holding nuclear materials during shipment.

Cementation—A process in which cement and water are added to a plutonium-bearing material to create a concrete or grout material form.

Ceramification—A process in which an inorganic oxide is heated at high temperatures to the point at which oxide particles begin to fuse together. This forms a ceramic material.

Characterization—The determination of waste or residue composition and/or properties, whether by review of process knowledge, nondestructive examination or assay, or sampling and analysis, generally done to determine appropriate storage, treatment, handling, transportation, and disposal requirements.

Cold Ceramification—A process that stabilizes materials (e.g., residues) by converting them into chemically bonded phosphate ceramics.

Contact-handled waste—Packaged waste whose external surface dose rate does not exceed 200 mrem per hour.

Contamination—The deposition of undesirable radioactive material on the surfaces of structures, areas, objects, or personnel.

Criticality—The conditions in which a system is capable of sustaining a nuclear chain reaction.

Curie—The basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of the isotope radium-226. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second.

Decay (radioactive)—Spontaneous disintegration of the nucleus of an unstable atom, resulting in the emission of particles and energy.

Decontamination—Removal of unwanted radioactive or hazardous contamination by a chemical or mechanical process.

Depleted uranium—Uranium that, through the process of enrichment, has been stripped of most of the uranium-235 it once contained, so that it has more uranium-238 than natural uranium. It is used as shielding, in some parts of nuclear weapons, and as a raw material for plutonium production.

Dissolution—A process in which a material is dissolved.

DOE Orders—Requirements internal to the U.S. Department of Energy that establish DOE policy and procedures, including those for compliance with applicable laws.

Dose (or radiation dose)—A generic term that means absorbed dose, effective dose equivalent, committed effective dose equivalent, or total effective dose equivalent as defined elsewhere in this glossary.

Dose rate—The radiation dose delivered per unit time (e.g., rem per year).

Dry/Repacks—This category includes all inorganic residues resulting from production operations. (Formerly called *Inorganics*.)

Effluent—A gas or liquid discharged into the environment.

Enriched uranium—Uranium that has greater amounts of the isotope uranium-235 than occur naturally. Naturally occurring uranium is nominally 0.720 percent uranium-235.

Environmental Assessment (EA)—A concise public document that a Federal agency prepares under the National Environmental Policy Act (NEPA) to provide sufficient evidence and analysis to determine whether a proposed agency action would require preparation of an environmental impact statement (EIS) or a finding of no significant impact. A Federal agency may also prepare an EA to aid its compliance with NEPA when no EIS is necessary or to facilitate preparation of an EIS when one is necessary.

Environmental Impact Statement (EIS)—A document required of Federal agencies by NEPA for major Federal actions or legislation with potential for significantly affecting the environment. A tool for decisonmaking, it describes the potential impacts of the proposed and all reasonable alternative actions.

Fissile material—Any material fissionable by thermal (slow) neutrons; the two primary fissile isotopes are uranium-235 and plutonium-239.

Fission—The splitting or breaking of a nucleus into at least two other nuclei and the release of a relatively large amount of energy. Two or three neutrons are usually released during this type of transformation.

Fission products—The nuclei produced by fission of heavy elements, and their radioactive decay products.

Fissionable material—Commonly used as a synonym for fissile material, the meaning of this term has been extended to include material that can be fissioned by fast neutrons, such as uranium-238.

Frit—Finely ground glass used as feedstock input for vitrification.

Ful Flo filter—A filter used to remove particulates that are 1 to 5 microns and larger, from liquid streams. The filter is packed with activated charcoal/graphite or fiberglass.

Gamma ray—Very penetrating electromagnetic radiation of nuclear origin. Except for origin and energy level, identical to x-rays. Electromagnetic radiation frequently accompanying alpha and beta emissions as radioactive materials decay.

Geologic repository—A place to dispose of radioactive waste deep beneath the earth's surface.

Glovebox—Large enclosure that separates workers from equipment used to process hazardous material while allowing the workers to be in physical contact with the equipment; normally constructed of stainless steel with large acrylic/lead glass windows. Workers have access to equipment through the use of heavy-duty, lead-impregnated rubber gloves, the cuffs of which are sealed in portholes in the glovebox windows.

Half-life—The time in which one-half of the atoms of a particular radioactive substance disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

Hazardous material—A substance or material in a quantity and form that may pose an unreasonable risk to health and safety or property when transported in commerce.

Hazardous substance—Any substance subject to the reporting and possible response provisions of the Clean Water Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.

Hazardous waste—Under the Resource Conservation and Recovery Act, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Source, special nuclear material, and by-product material, as defined by the Atomic Energy Act, are specifically excluded from the definition of solid waste.

High-efficiency particulate air (HEPA) filter—A filter with an efficiency of at least 99.95 percent used to remove particles from air exhaust streams prior to releasing to the atmosphere.

High-level waste—The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly from reprocessing and any solid waste derived from the liquid that contains a combination of transuranic and fission product nuclides in quantities that require permanent isolation. High-level waste may include the highly radioactive material that the NRC, consistent with existing law, determines by rule requires permanent isolation.

Immobilization—A process that converts plutonium-bearing material to a stable form for disposal.

Isotopes—Different forms of the same chemical element that differ only by the number of neutrons in their nucleus. Most elements have more than one naturally occurring isotope. Many isotopes that do not exist in nature have been produced in reactors and particle accelerators.

Item Description Code (IDC)—At Rocky Flats, solid residues are categorized by type of material and identified by these IDCs.

Lag Storage—Short-term storage for logistical reasons.

Low enriched uranium (LEU)—Uranium enriched until it consists of up to 20 percent uranium-235. Used as nuclear reactor fuel.

Low-level waste —Any radioactive waste that is not spent fuel, high-level, or transuranic waste, and does not contain hazardous waste constituents.

Management Approach—Refer to strategic management approach.

Millirem (mrem)—One-thousandth of a rem.

Mitigate—To take practicable means to avoid or minimize the potentially harmful effects of an action (e.g., environmental harm from a selected alternative).

Mixed Oxide (MOX)—A physical blend of uranium oxide and plutonium oxide which can be used as fuel in a nuclear reactor.

Mixed waste—Waste that contains both "hazardous waste" and "radioactive waste" (as defined in this glossary).

Muffle furnaces—Small (approximately 1 cubic foot) oven-like electrically-heated units, lined with refractory material, which can be used to heat material placed onto trays inserted into the unit.

National Environmental Policy Act (NEPA)—A Federal law, enacted in 1970, that requires the Federal Government to consider the environmental impacts of, and alternatives to, major proposed actions in its decisionmaking processes. Commonly referred to by its acronym, NEPA.

Neutron—An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1.

Nonproliferation—Efforts to prevent or slow the spread of nuclear weapons and the materials and technologies used to produce them.

Normal operation—All normal conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

Nuclear weapon—Any weapon in which the explosion results from the energy released by reactions involving atomic nuclei.

Nuclide—A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Package—For radioactive materials, the packaging together with its radioactive contents as presented for transport (the packaging plus the radioactive contents is the package).

Packaging—For radioactive materials, it may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shock to ensure compliance with U.S. Department of Transportation regulations.

Plutonium—A manmade fissile element. Pure plutonium is a silvery metal that is heavier (for a given volume) than lead. Material rich in the plutonium-239 isotope is preferred for manufacturing nuclear weapons. Plutonium-239 has a half-life of 24,000 years.

Plutonium residues—Material containing plutonium that was generated during the separation and purification of plutonium or during the manufacture of plutonium-bearing components for nuclear weapons.

Process—Any method or technique designed to change the physical or chemical character of the residue or scrub alloy to render them less hazardous, safer to transport, store or dispose of, and/or less attractive for theft.

Purex—An acronym for Plutonium-Uranium Extraction, the name of the chemical process usually used to remove plutonium and uranium from spent nuclear fuel, irradiated targets, and other nuclear materials. As used in this EIS, the PUREX process is used to separate out plutonium from residues or scrub alloy.

Pyro-oxidation—A process in which sodium carbonate is heated with a plutonium-bearing salt matrix to a high temperature to convert any reactive metals in the matrix to nonreactive oxides.

Pyrophoric—Pyrophoric liquids are any liquids that ignite spontaneously in dry or moist air at or below 54.4 degrees Centigrade (130 degrees Fahrenheit). A pyrophoric solid is any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

Radiation (ionizing)—Energy transferred through space or other media in the form of particles or waves. In this document, we refer to ionizing radiation that is capable of breaking up atoms or molecules. The splitting, or decay, of unstable atoms emits ionizing radiation.

Radioactive waste—Waste that is managed for its radioactive content; solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended and of negligible economic value considering costs of recovery.

Radioactivity—The spontaneous emission of radiation from the nucleus of an atom. Radionuclides lose particles and energy through this process of radioactive decay.

Radioisotopes—Radioactive nuclides of the same element (same number of protons in their nuclei) that differ in the number of neutrons.

Radionuclide—A radioactive element characterized according to its atomic mass and atomic number that can be manmade or naturally occurring.

Raschig (glass) rings—These residues originated from Process Vent Scrubber Systems and in plutonium solutions processing production tanks. The rings are small, hollow, borosilicate glass cylinders that are used to absorb neutrons and thus prevent criticality in the aforementioned production tanks. These rings are coated with insoluble plutonium compounds.

Record of Decision (ROD)—A document prepared in accordance with the requirements of 40 CFR 1505.2 and 10 CFR 1021.315 that provides a concise public record of DOE's decision on a proposed action for which an EIS was prepared. A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternative, factors balanced by DOE in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, why they were not.

rem (Roentgen Equivalent Man)—A unit of radiation dose. Dose in rem is numerically equal to the absorbed dose in rad multiplied by a quality factor, distribution factor and any other necessary modifying factors (1 rem = 0.01 sievert).

Repackage—A process in which some residue materials may be removed from their current packaging containers and placed in new containers for improved safe secure storage or to meet packaging requirements for shipment.

Resource Conservation and Recovery Act (RCRA) as Amended—The statute or law that establishes, among other things, a system for managing hazardous waste from its generation until its ultimate disposal.

Risk—Expression of an impact that considers both the probability of that impact occurring and the consequences of the impact if it does occur.

Risk assessment (chemical or radiological)—The qualitative and/or quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological pollutants.

Safe, secure trailer (SST)—A specially designed semitrailer, pulled by a specially designed tractor, that is used for the safe, secure transportation of cargo containing nuclear weapons or special nuclear material.

Safeguards termination limit (STL)—Concentrations of plutonium in materials (by weight percent), above which the material would be attractive as a source of plutonium.

Salt distillation—A process that separates transuranic materials from a salt matrix by distilling the
salt away from any metal oxides present in the salt.

Salt scrub—A process used to recover plutonium from salt residues. The salt is heated with a mixture of aluminum and magnesium. The magnesium reacts with plutonium chloride in the salt to form plutonium metal, which forms an alloy with the aluminum called scrub alloy.

Scrub alloy—A magnesium/aluminum/americium/plutonium metal mixture that was created as an interim step in plutonium recovery.

Shredding—A process in which materials are cut into small pieces, which have a combined surface area larger than the original materials.

Special nuclear material (SNM)—Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the Nuclear Regulatory Commission, pursuant to the provisions of the Atomic Energy Act of 1954, Section 51, determines to be special nuclear material.

Spent fuel standard—A term, coined by the National Academy of Sciences and modified by DOE, meaning that alternatives for the disposition of surplus weapons-usable plutonium should seek to make this plutonium roughly as inaccessible and unattractive for weapons use as the much larger and growing stock of plutonium in civilian spent nuclear fuel.

Stabilized residues—Plutonium residues that have been processed to make them chemically stable.

Transuranic—Any element whose atomic number is higher than that of uranium (that is, atomic number 92). All transuranic elements are produced artificially and are radioactive.

Transuranic waste—Waste contaminated with alpha-emitting radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries/gram at time of assay.

Uranium—The basic material for nuclear technology. It is a slightly radioactive naturally occurring heavy metal that is more dense than lead. Uranium is 40 times more common than silver.

Variance (from safeguards termination limits)—Removal of requirements for strict material control and accountability as special nuclear material when evaluations demonstrate that the proposed processing method for the material, the controls in place for normal handling of transuranic waste from the processing, and the limited quantity of special nuclear material present at any particular place and time preclude the need to take additional measures to address threats of diversion and theft.

Vitrification—A process that uses glass to encapsulate or agglomerate the plutonium contained in residues or scrub alloy in order to immobilize it.

Vulnerabilities—Conditions or weaknesses that may lead to radiation exposure to the public, unnecessary or increased exposure to the workers, or release of radioactive materials to the environment.

Waste Acceptance Criteria (WAC)—The requirements specifying the characteristics of waste and waste packaging acceptable to a disposal facility and the documents and processes the generator needs to certify that waste meets applicable requirements.

Waste classification—Wastes are classified according to DOE Order 5820.2A, "Radioactive Waste Management," and include high-level waste, transuranic waste, and low-level waste.

Waste Isolation Pilot Plant (WIPP)—A facility in southeastern New Mexico being developed as the disposal site for transuranic and transuranic mixed waste, not yet in operation.

Waste management—The planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities.

Waste minimization—An action that avoids or reduces the generation of waste by source or toxicity reduction, improves energy usage, or recycles.

WIPP WAC—Performance based waste acceptance criteria that must be met to allow disposal at the Waste Isolation Pilot Plant (refer to "Waste Acceptance Criteria" and Waste Isolation Pilot Plant," given above).

APPENDIX B
ACRONYMS AND ABBREVIATIONS

ACB	Auxiliary Charcoal Bed
ALARA	As-Low-As-Reasonably-Achievable
APSF	Actinide Packaging and Storage Facility
CERCLA	Comprehensive Environmental Response Compensation and Liabilities Act
CFR	Code of Federal Regulations
CMR	Chemistry and Metallurgy Research Building (LANL)
CPP-603	Fuel Storage Building at INEEL
CSB	Canister Storage Building
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DWPF	Defense Waste Processing Facility
EBR	Experimental Breeder Reactor
EIS	Environmental Impact Statement
EM	Environmental Management
ES&H	Environment, Safety and Health
ETTP	East Tennessee Technology Park
FFTF	Fast Flux Test Facility
FMF	(Argonne West)
HEU	Highly-enriched Uranium
HSP	Health and Safety Procedure

IDC	Item Description Code
IFSF	Irradiated Fuel Storage Facility
IMNM EIS	Interim Management of Nuclear Materials Environmental Impact Statement
INEEL	Idaho Engineering and Environmental Laboratory
IPABS	Integrated Planning, Accountability and Budgeting System
IPM	Implementation Plan Manager
IPMP	Integrated Project Management Plan
ISSC	Interim Safe Storage Criteria
LANL	Los Alamos National Laboratory
LEU	Low-enriched Uranium
LFL	Lower Flammability Limit
LLNL	Lawrence Livermore National Laboratory
LOI	Loss On Ignition
m^3	Cubic Meters
MCO	Multi-canister Overpacks
MOX	Mixed Oxide
MSRE	Molten Salt Reactor Experiment
MTHM	Metric Tons Heavy Metal
MTU	Metric Tons Uranium
NDA	Non-detectable Activity
NEPA	National Environmental Policy Act
NMSF	Nuclear Material Storage Facility (Sandia)

NMSS	Nuclear Material Stabilization and Storage Program
ORNL	Oak Ridge National Laboratory
PDM	Plutonium Disposition Methodology
PFP	Plutonium Finishing Plant
PFP EIS	Plutonium Finishing Plant Stabilization Final Environment Impact Statement
PNL	Pacific Northwest Laboratory
POC	Pipe Overpack Component
PUREX	Plutonium Uranium Extraction
PuSAP	Plutonium Stabilization and Packaging Project
R&D	Research and Development
RBOF	Receiving Basin for Off-Site Fuels
RFETS	Rocky Flats Environmental Technology Site
RFP	Request For Proposals
RL	Richland
ROD	Record of Decision
SIMS	Safety Issues Management System
SNF	Spent Nuclear Fuel
SNM	Special Nuclear Material
SMP	Site Management Plan
SPS	Stabilization Packaging System
SRS	Savannah River Site
SRTC	Savannah River Technology Center

SS&C	Sand, Slag, and Crucible
STD	Standard
STL	Safeguards Termination Limits
TRU	Transuranic
TRUPACT	Transuranic Package Transporter
TVA	Tennessee Valley Authority
TWRS	Tank Waste Remediation System
μmho	Micro-mho (a unit of conductance)
WAC	Waste Acceptance Criteria
WIPP	Waste Isolation Pilot Plant
WSRC	Westinghouse Savannah River Company
ZPPR	Zero Power Physics Reactor (ANL-West)

APPENDIX C
REFERENCES

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APPENDIX D
SUMMARY OF COMMITMENTS

HANFORD PLUTONIUM FINISHING PLANT

Plutonium Solutions

- *Commitment Statement:* Complete stabilizing and packaging plutonium solutions.
  IP Commitment Number: 106
  Due Date: December 2001

Plutonium Metals

- *Commitment Statement:* Complete brushing and repackaging of metal inventory.
  IP Commitment Number: 110
  Due Date: August 2001

Plutonium Oxide and Mixed Oxides >30 wt % Pu + U

- *Commitment Statement:* Complete stabilizing and packaging of oxides > 30 wt%.
  IP Commitment Number: 111
  Due Date: May 2004

Plutonium Alloys

- *Commitment Statement:* Package aluminum alloys for disposition to WIPP. Brush and package remaining alloys at PFP.
  IP Commitment Number: 114
  Due Date: June 2001

Polycubes

- *Commitment Statement:* Complete stabilization and packaging of polycubes.
  IP Commitment Number: 115
  Due Date: August 2002

Residues

- *Commitment Statement:* Complete stabilization and packaging of residues.
  IP Commitment Number: 116
  Due Date: April 2004

HANFORD K-BASINS

Spent Nuclear Fuel

- *Commitment Statement:* Complete fuel removal from the K-West Basin to the Cold Vacuum Drying Facility.
  IP Commitment Number: 118W
  Due Date: December 2002

- *Commitment Statement:* Begin fuel removal from the K-East Basin to the Cold Vacuum Drying Facility.
  IP Commitment Number: 117E
  Due Date: December 2002

- *Commitment Statement:* Complete fuel removal from the K-East Basin to the Cold Vacuum Drying Facility.
  IP Commitment Number: 118E
  Due Date: July 2004

- *Commitment Statement:* Begin K-Basin sludge removal.
  IP Commitment Number: 119
  Due Date: December 2002

- *Commitment Statement:* Complete K-Basin sludge removal.
  IP Commitment Number: 120
  Due Date: August 2004

SAVANNAH RIVER

Plutonium Solutions

- *Commitment Statement:* Begin converting pre-existing H-Canon Pu-239 solution to oxide.
  IP Commitment Number: 201
  Due Date: December 2001

- *Commitment Statement:* Complete converting pre-existing H-Canyon Pu-239 solution to oxide.
  IP Commitment Number: 202
  Due Date: December 2002

Metal and Oxide >30% Pu

- *Commitment Statement:* Complete conceptual design for 235-F Stabilization subproject.
  IP Commitment Number: 205
  Due Date: January 2001 - April 2001

- *Commitment Statement:* Begin detail design for 235-F Stabilization subproject.
  IP Commitment Number: 206
  Due Date: March 2001 - August 2001

- *Commitment Statement:* Begin construction for 235-F Stabilization subproject.
  IP Commitment Number: 207
  Due Date: July 2002 - April 2003

- *Commitment Statement:* Begin operation of equipment for high firing and packaging plutonium in accordance with DOE-STD-3013-99.
  IP Commitment Number: 208
  Due Date: January 2005 - January 2007

<u>Residues <30% Pu</u>

- *Commitment Statement:* Begin converting SRS residue solution to oxide.
- *IP Commitment Number:* 210
  Due Date: January 2003

- *Commitment Statement:* Complete dissolution of SRS pre-existing plutonium residues.
  IP Commitment Number: 211
  Due Date: September 2005

- *Commitment Statement:* Complete stabilization and packaging of all plutonium at SRS to DOE-STD-3013-99.
  IP Commitment Number: 212
  Due Date: June 2006 - June 2008

<u>Special Isotopes</u>

- *Commitment Statement:* Complete Am/Cm Vitrification Project design.
  IP Commitment Number: 213
  Due Date: November 2001

- *Commitment Statement:* Delivery of in-cell vitrification equipment.
  IP Commitment Number: 214
  Due Date: May 2002

- *Commitment Statement:* Complete construction for Am/Cm Vitrification Project.
  IP Commitment Number: 215
  Due Date: October 2003

- *Commitment Statement:* Begin stabilization of Am/Cm solution.
  IP Commitment Number: 216
  Due Date: October 2004

- *Commitment Statement:* Begin vitrifying Am/Cm solution.
  IP Commitment Number: 217
  Due Date: January 2005

- *Commitment Statement:* Complete vitrifying Am/Cm solution.
  IP Commitment Number: 218
  Due Date: December 2005

- *Commitment Statement:* Begin stabilization of pre-existing Np-237 solution.
  IP Commitment Number: 219
  Due Date: April 2005

- *Commitment Statement:* Complete stabilization of pre-existing Np-237 solution.
  IP Commitment Number: 220
  Due Date: December 2006

Uranium

- *Commitment Statement:* Complete DOE/TVA interagency agreement for Off-Specification Fuel program.
  IP Commitment Number: 221
  Due Date: February 2001

- *Commitment Statement:* Complete transfer of HEU solution to double-walled tank.
  IP Commitment Number: 223
  Due Date: September 2001

- *Commitment Statement:* Begin disposition of pre-existing enriched uranium solution and enriched uranium solution resulting from Mk-16/22 SNF dissolution.
  IP Commitment Number: 224
  Due Date: March 2003

- *Commitment Statement:* Complete disposition of pre-existing enriched uranium solution and enriched uranium solution resulting from Mk-16/22 SNF dissolution.
  IP Commitment Number: 225
  Due Date: September 2005

Spent Nuclear Fuel

- *Commitment Statement:* Complete Mark-16/22 SNF dissolution.
  IP Commitment Number: 227
  Due Date: March 2004

RFETS Metal and Scrub Alloy

- *Commitment Statement:* Begin dissolution of RFETS scrub alloy.
  IP Commitment Number: 228
  Due Date: April 2001

- *Commitment Statement:* Complete dissolution of RFETS scrub alloy.
  IP Commitment Number: 229
  Due Date: September 2001

- *Commitment Statement:* Complete direct casting RFETS classified plutonium metal.
  IP Commitment Number: 230
  Due Date: March 2006

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Solutions

- *Commitment Statement:* Complete removal of all liquids in B771 (including all non-actinide systems) by December 2001.
  IP Commitment Number: 302
  Due Date: December 2001

- *Commitment Statement:* Complete processing all of the B771 liquids by March 2002.
  IP Commitment Number: 303
  Due Date: March 2002

Metal and Oxide >30% Pu

- *Commitment Statement:* Start packaging metal or oxide into 3013 containers.

IP Commitment Number: 304
Due Date: March 2001

- *Commitment Statement:* Repackage all metal and oxides (except classified metal) into 3013 containers by May 2002.
  IP Commitment Number: 305
  Due Date: May 2002

Residues <30% Pu

- *Commitment Statement:* Complete repackaging all remaining low-risk residues to meet the ISSC by May 2002.
  IP Commitment Number: 308
  Due Date: May 2002

OAK RIDGE

Metal and Oxide >30% Pu

- *Commitment Statement:* Repackage all plutonium metals and oxides to meet the metal and oxide storage standard.
  IP Commitment Number: 401
  Due Date: May 2002

LOS ALAMOS NATIONAL LABORATORY

Solutions

- *Commitment Statement:* Complete stabilization of all solutions
  IP Commitment Number: 501
  Due Date: October 2001

Metal and Oxide

- *Commitment Statement:* Complete stabilization and packaging to DOE-STD-3013
  IP Commitment Number: 502
  Due Date: October 2004

Residues

- *Commitment Statement:* Complete stabilization of hydrides, nitrides, cellulose rags

IP Commitment Number: 503
Due Date: October 2001

- *Commitment Statement:* Stabilize salt residues
  IP Commitment Number: 504
  Due Date: October 2010

Unsheltered Containers

- *Commitment Statement:* Complete processing containers.
  IP Commitment Number: 505
  Due Date: October 2010

LAWRENCE LIVERMORE NATIONAL LABORATORY

Metal and Oxide >30% Pu

- *Commitment Statement:* Complete plutonium metal and oxide repackaging by May 2002.
  IP Commitment Number: 601
  Due Date: May 2002

Residue <30% Pu

- *Commitment Statement:* Stabilize and package LLNL ash residues by May 2002.
  IP Commitment Number: 602
  Due Date: May 2002

- *Commitment Statement:* Stabilize and package all other LLNL residues by February 2001.
  IP Commitment Number: 603
  Due Date: May 2002

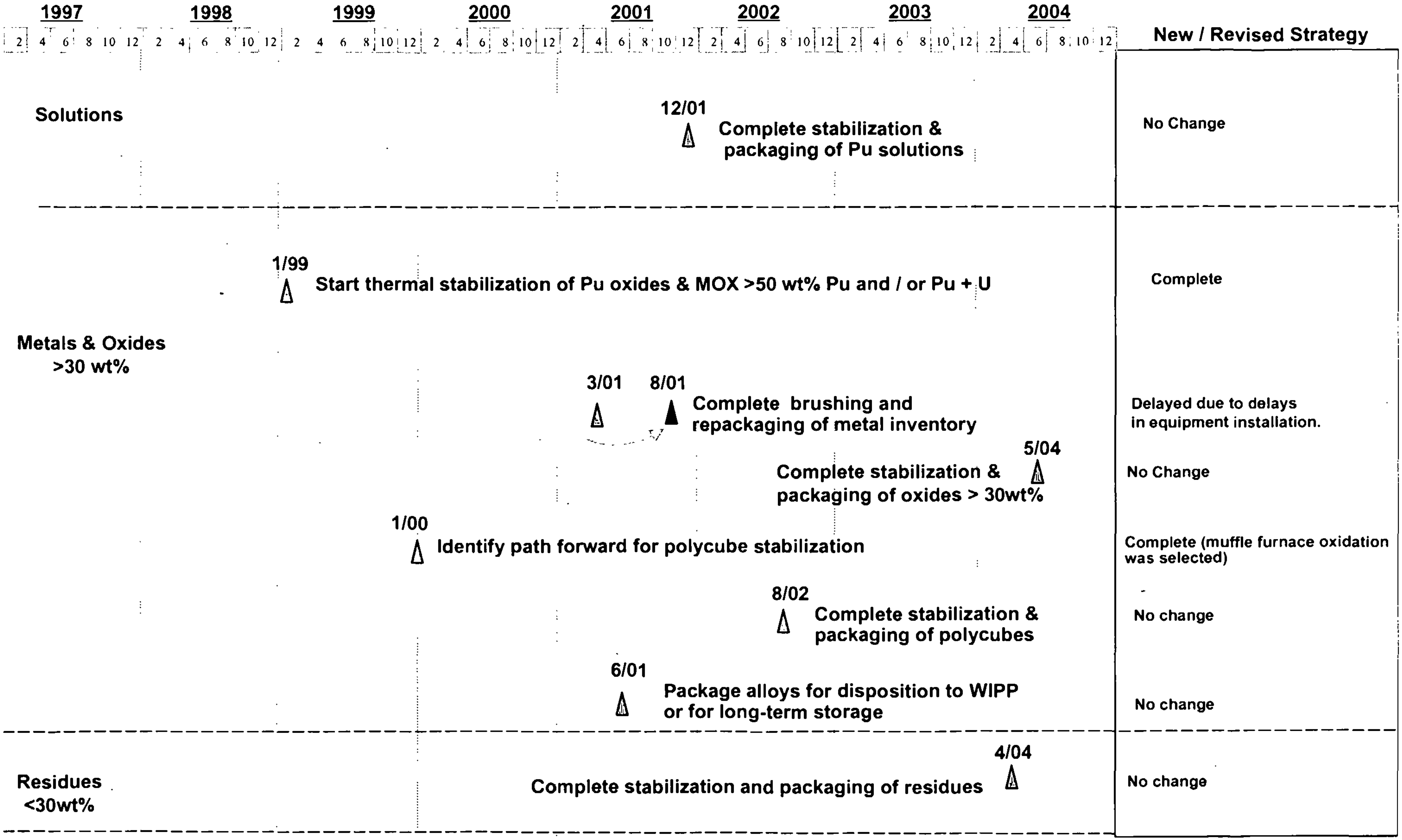
APPENDIX E
IP COMMITMENT SUMMARY SCHEDULE

This attachment provides a top-level summary time line that shows the start and end dates of resolution activities for each safety issue.

The following pages in this attachment are an illustration of the scheduled completion dates for the top-level commitments made in the Recommendation 2000-1 Implementation Plan.

Appendix E

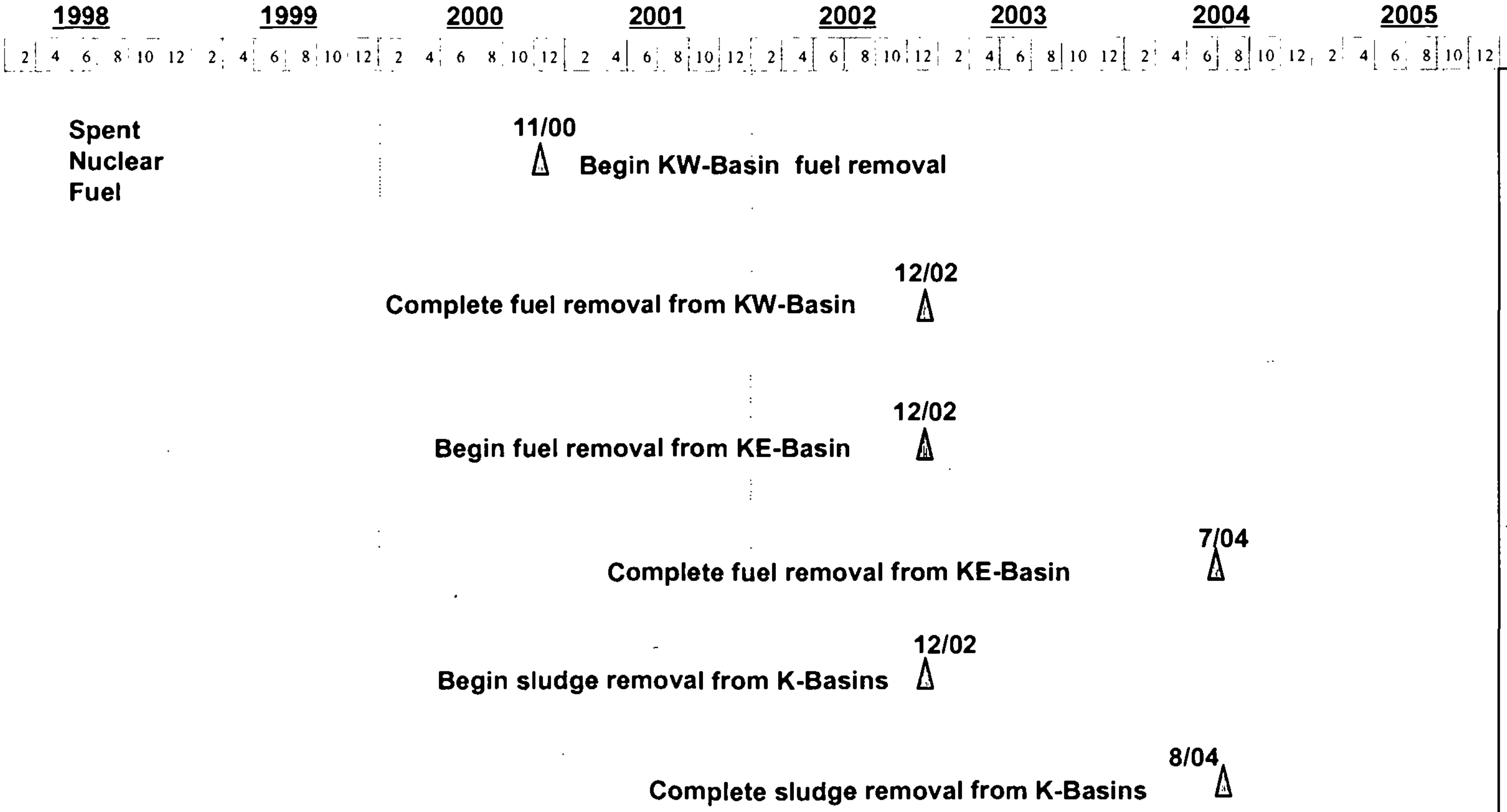
Richland 2000-1 IP Commitments



			New / Revised Strategy
Solutions	12/01	Complete stabilization & packaging of Pu solutions	No Change
Metals & Oxides >30 wt%	1/99	Start thermal stabilization of Pu oxides & MOX >50 wt% Pu and / or Pu + U	Complete
	3/01 8/01	Complete brushing and repackaging of metal inventory	Delayed due to delays in equipment installation.
	5/04	Complete stabilization & packaging of oxides > 30wt%	No Change
	1/00	Identify path forward for polycube stabilization	Complete (muffle furnace oxidation was selected)
	8/02	Complete stabilization & packaging of polycubes	No change
	6/01	Package alloys for disposition to WIPP or for long-term storage	No change
Residues <30wt%	4/04	Complete stabilization and packaging of residues	No change

January 16, 2001

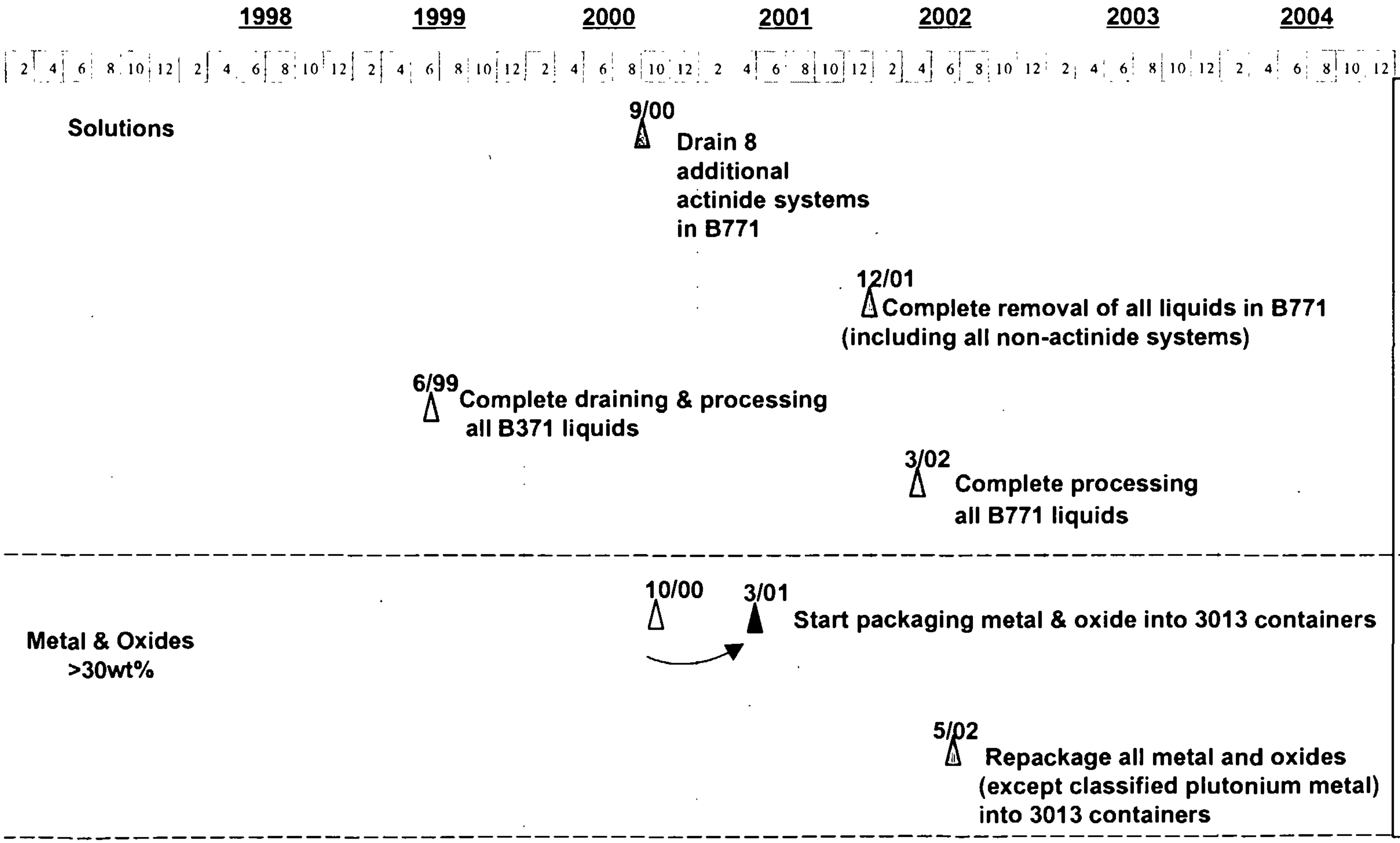
Richland 2000-1 IP Commitments (Cont)



			New/Revised Strategy
Spent Nuclear Fuel	Begin KW-Basin fuel removal	11/00	Completed late in 12/00
	Complete fuel removal from KW-Basin	12/02	No change
	Begin fuel removal from KE-Basin	12/02	No change
	Complete fuel removal from KE-Basin	7/04	No change
	Begin sludge removal from K-Basins	12/02	No change
	Complete sludge removal from K-Basins	8/04	No change

Appendix E

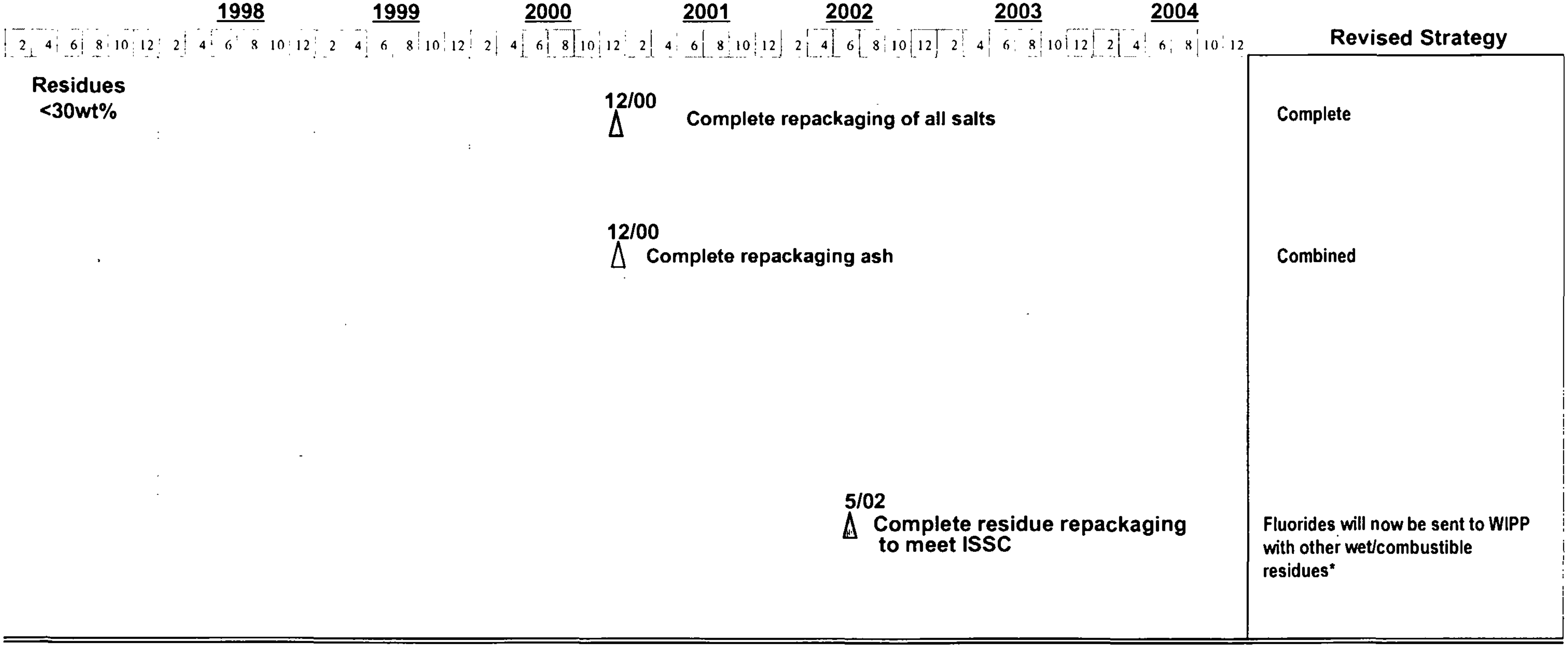
Rocky Flats 2000-1 IP Commitments



			Revised Strategy
Solutions	9/00	Drain 8 additional actinide systems in B771	Complete
	12/01	Complete removal of all liquids in B771 (including all non-actinide systems)	No Change
	6/99	Complete draining & processing all B371 liquids	Complete
	3/02	Complete processing all B771 liquids	No change
Metal & Oxides >30wt%	10/00 3/01	Start packaging metal & oxide into 3013 containers	Delays due to weld qualification, B371 shutdown, and installation of contamination control equipment.
	5/02	Repackage all metal and oxides (except classified plutonium metal) into 3013 containers	No Change

January 16, 2001

Rocky Flats 2000-1 IP Commitments (Cont)



Revised Strategy

Residues <30wt%

12/00 Δ Complete repackaging of all salts

Complete

12/00 Δ Complete repackaging ash

Combined

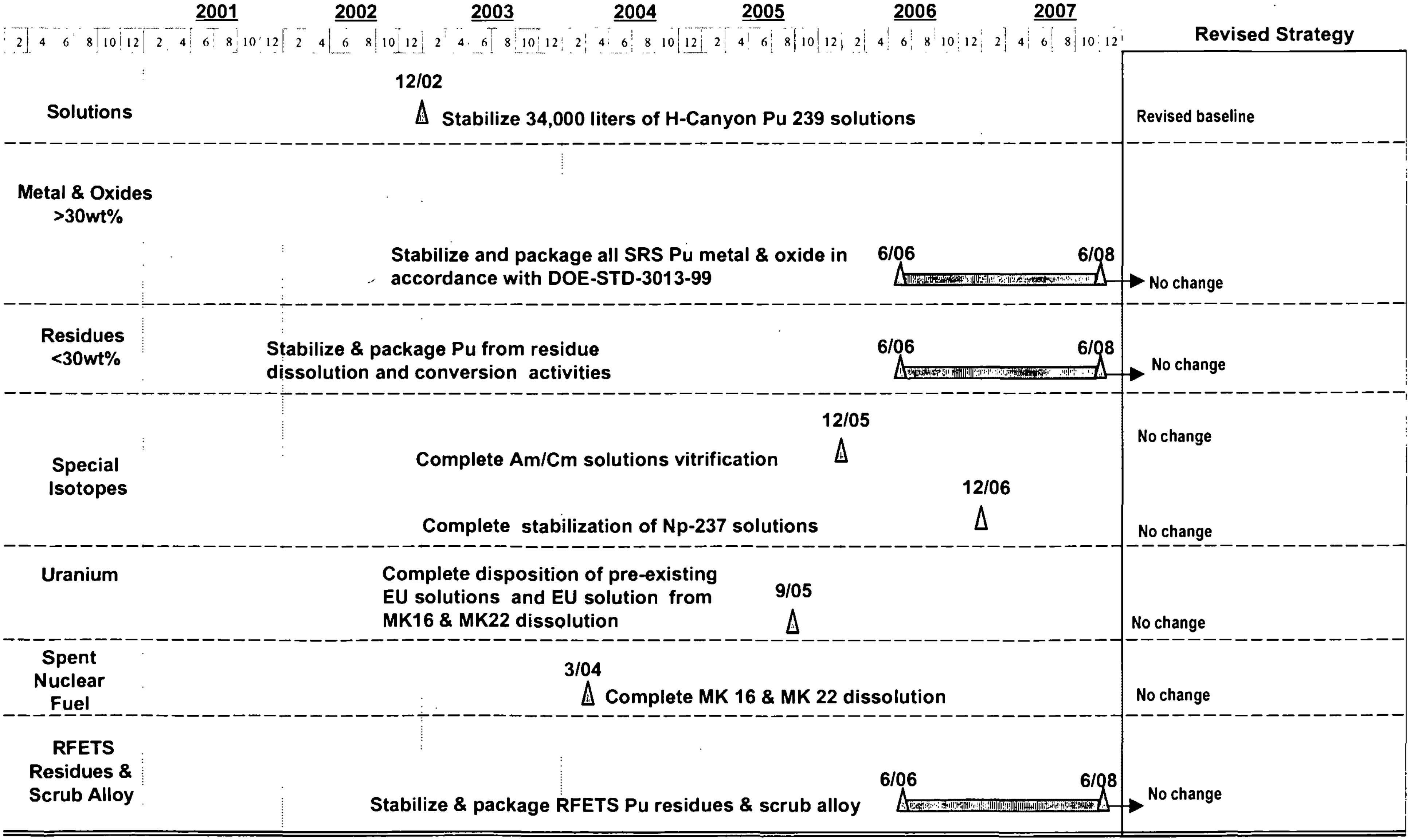
5/02 Δ Complete residue repackaging to meet ISSC

Fluorides will now be sent to WIPP with other wet/combustible residues*

*** All remaining residue milestones now combined; same end date**

Appendix E

Savannah River 2000-1 IP Commitments



			Revised Strategy
Solutions	Stabilize 34,000 liters of H-Canyon Pu 239 solutions	12/02	Revised baseline
Metal & Oxides >30wt%	Stabilize and package all SRS Pu metal & oxide in accordance with DOE-STD-3013-99	6/06 – 6/08	No change
Residues <30wt%	Stabilize & package Pu from residue dissolution and conversion activities	6/06 – 6/08	No change
Special Isotopes	Complete Am/Cm solutions vitrification	12/05	No change
	Complete stabilization of Np-237 solutions	12/06	No change
Uranium	Complete disposition of pre-existing EU solutions and EU solution from MK16 & MK22 dissolution	9/05	No change
Spent Nuclear Fuel	Complete MK 16 & MK 22 dissolution	3/04	No change
RFETS Residues & Scrub Alloy	Stabilize & package RFETS Pu residues & scrub alloy	6/06 – 6/08	No change

January 17, 2001

Appendix E
2000-1 IP Commitments for Los Alamos, Livermore, Oak Ridge and INEEL

1998 1999 2000 2001 2002 2003 2004

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				Revised Strategy
LANL Metal & Oxide >30wt%	Inspect and repackage all legacy Pu metal & oxide (materials before 05/94) for long term storage criteria	9/03 △	10/04 ▲	Revised stabilization strategy
LANL Residues <30wt%	Stabilize legacy residues (materials before 05/94) recover plutonium as oxide & package for long term storage	9/05 △		10/10 ▲ Revised stabilization strategy
LLNL Metal & Oxide >30wt%	Repackage Pu metal & oxide	5/02 △		No change
LLNL Residues <30wt%	Stabilize ash residues	5/02 △		No change
	Stabilize all other residues	5/02 △		No change
OR Metal & Oxide >30wt%	Repackage Pu metal & oxides to M&O standard	5/02 △		No change
INEEL Spent Nuclear Fuel	Complete fuel removal from the CPP-603.	4/00 △		Completed ahead of schedule on 4/28/2000

January 16, 2001

APPENDIX F
LISTING OF COMPLETED ACTIONS

This attachment lists all commitments completed to date.

Hanford PFP

Ensured all bottles containing Pu solutions are properly vented, 5/95
Stabilized 220 liters of chloride solutions, 9/95
Issued clean-out and stabilization EIS ROD, 6/96
Completed solution technology development, 4/96
Completed transfer of 22,700 liters of PUREX solutions to tank farms, 4/95
Began engineering studies for a new repackaging line, 9/95
Stabilized existing inventory of low organic residues in muffle furnaces, 6/95
Stabilized 46 cans of selected RFETS ash in muffle furnaces, 1/96
Initiated thermal stabilization of Pu oxides and MOX, 1/99.
Documented approach for ash disposition, 1/99.
Completed a characterization of plutonium solutions, 2/99.
Decision on shipping and/or processing approach for select 94-1 materials at alternative sites, 2/99.
Decision on process selection for solutions that could not be processed untreated through the production vertical denitration calciner, 2/99.
Documented analysis and decision for processing of the inventory of unalloyed plutonium metal to meet DOE-STD-3013, 2/99.
Initiate operation of the prototype vertical denitration calciner, 9/99.
Documented decision for polycubes stabilization path forward, 2/00.
Magnesium hydroxide precipitation process started, 9/00
Initiated repackaging of Rocky Flats Ash for disposition to WIPP, 9/00
Initiated stabilization of plutonium metals, 9/00
Installed Bagless Transfer System, 9/00

Hanford SNF

Performed K-basin sludge removal demonstration along with cofferdam installation, 12/94
Completed K-West Basin cofferdam installation, 2/95
Developed K-Basins potential funding options and acquisition strategy, 3/95
Issued K-Basin EIS NOI, 3/95
Completed K-East Basin cofferdam installation, 4/95
Began fuel characterization in K-Basin hot cells, 4/95
Issued K-Basin Integrated Path Forward Schedule providing details of major system acquisitions and materials movements, 4/95

Issued Management of SNF from K-Basins EIS ROD, 3/96
Initiated SNF movement from K-West Basin to Cold Vacuum Drying Facility, 12/00

Savannah River

Isolated Am/Cm solution storage tank from cooling water systems, 2/95
Issued the ROD for the F-Canyon Plutonium Solutions EIS, 2/95
Restarted F-Canyon Second Pu Cycle Solvent Extraction (Operational Readiness Reviews), 2/95
Re-examined the L-Basin corrosion coupons, 2/95
Increased surveillance of the Am/Cm solution storage tank, 3/95
Repackaged all 14 containers of Pu-238 solids, 3/95
Completed L-Basin sludge consolidation, 3/95
Issued the Interim Management of Nuclear Materials (IMNM) Final EIS, 10/95
Restarted FB-Line (Operational Readiness Reviews), 11/95
Issued a Conceptual Design Report for the Am/Cm Vitrification Project, 11/95
Repackaged all plutonium metal in contact with plastic, 11/95
Completed re-orientation of L-Basin fuel, 11/95
Issued the first ROD for the IMNM Final EIS, 12/95
Restarted full F-Canyon operations (Operational Readiness Reviews), 2/96
Stabilized 303,000 liters of Pu solutions, 4/96
Completed SNF storage basin upgrades, 5/96
Stabilized all 46 containers of Pu-238 residues (concurrent with 94-1 scope), 6/96
Demonstrated direct casting for stabilization of miscellaneous Pu metal, 6/96
Completed RBOF fuel consolidation, 8/96
Restarted H-Canyon Frames Waste Recovery and HB-Line Phase III Pu-242 Operations (Readiness Reviews), 8/96
Stabilized all 3,500 gallons of Pu-242 solution, 12/96
Stabilized all 15,884 Mark-31 targets, 3/97
Installed digital radiography capability, 3/97
Stabilized all 83 containers of failed TRR and EBR-II SNF (concurrent with 94-1 scope), 6/97
Restarted H-Canyon dissolving of Mark-22 SNF (Operational Readiness Reviews), 7/97
Completed re-orientation of K-Basin fuel, 7/97
Started bagless transfer repackaging of Pu metal (Readiness Assessments), 8/97
Shipped all remaining high-assay Pu-238 offsite for program use (concurrent with 94-1 scope), 9/97
Started HB-Line dissolving of Pu-239 residues (Operational Readiness Reviews), 3/98
Restarted H-Canyon First Cycle Solvent Extraction (Readiness Assessments), 5/98
Dissolved all 128 containers of legacy Sand, Slag and Crucible residues, 7/98
Began HEU Solution Wash and Concentration in H-Canyon (Line Management Reviews), 8/98
Restarted F-Canyon 6.1D dissolver operations (Line Management Reviews), 8/98
Stabilized remaining 62 containers of TRR SNF (concurrent with 94-1 scope), 10/98

Implemented H-Canyon First Cycle Additional Criticality Controls (Readiness Assessment), 11/98
Completed dissolution of all 202 containers of legacy Pu-239 sweeping residues, 3/99
Began residue characterization in FB-Line (Line Management Reviews), 4/99
Dissolved 57 containers of RFETS SS&C residues transferred to the SRS, 4/99
Transferred SNM into the modified Building 235-F vault, 6/99
Completed bagless repackaging of all available plutonium metal, 7/99
Started HB-Line Low-Assay Plutonium dissolution (Readiness Assessment), 8/99
Started F-Canyon DU/Pu dissolution (Readiness Assessment), 8/99
Completed dissolution of 1,249 DU/Pu sintered oxide fuel rods, 10/99
Started Low-Assay Plutonium transfers from HB-Line to H-Canyon Tank 8.2 (Readiness Assessment), 1/00
Declared K-Area Material Storage operationally ready (Operational Readiness Reviews), 1/00
Completed dissolution of all 39 containers of Low-Assay Plutonium (concurrent with 94-1 scope), 1/00
Resumed BTS operations, 6/00
Completed Phase 3 H-Canyon Restart, 6/00
Began Building 235-F project conceptual design, 7/00
Resumed HB-Line dissolution of residues, 9/00
Began preliminary design of HEU Blend-down project, 11/00
Completed dissolution of approximately 715 Mark-22 spent fuel assemblies, 11/00

Rocky Flats

Completed NEPA analysis (an Environmental Assessment) for solution stabilization, 4/95
Started draining B771 hydroxide tanks and begin processing, 11/96
Completed draining four (4) B771 hydroxide tanks, 8/96
Completed B771 hydroxide precipitation process, 3/97
Started draining four (4) B771 high-level tanks and begin processing, 9/97
Started draining B371 tanks and begin processing, 12/96
Completed draining six (6) B371 Cat B tanks, 2/97
Completed draining one (1) B371 criticality tank, 5/97
Completed processing liquids from seven (7) B371 tanks, 6/97
Started tap and drain of B771 room/systems, 1/98
Completed processing liquids from the B771 high-level tanks and B371 bottles, 7/98
Completed draining four (4) B771 high-level tanks, 12/97
Completed draining of remaining B371 criticality line tanks, 2/98
Started tap and drain of B371 room/systems, 6/98
Completed draining and processing all B371 liquids, 6/99
Thermally stabilized the existing backlog of all known RFETS reactive Pu oxide (63 kgs), 1/97
Repackaged a total of 256 items in B707 where Pu is in direct contact with plastic, 11/95

Repackaged 1,602 Pu metal items not in direct contact, but in proximity to, plastic, 12/96
Repackaged all Pu metal in direct contact with plastic, 5/97
Conducted sampling and inspection to determine relative risk and for repackaging Pu metals and oxides in close proximity to plastic and other synthetic materials, 9/95
Vented 700 unvented residue drums, 12/95
Vented 2,045 residue drums with a potential for hydrogen gas generation, 9/95
Began stabilization by pyrochemical oxidation 6,000 kg of higher-risk salts, 1/98
Vented all inorganic residues, 12/95
Vented all wet/miscellaneous residues, 12/95
Began bottling and shipping 2,700 liters of HEU solutions offsite for stabilization, 8/96
Removed all HEU uranyl nitrate solutions (2,700 liters) from B886 and completed all shipments offsite, 11/96
Completed characterization of specified salt, combustibles, and IDC 368 to a 95/5 confidence level, 2/99
Completed stabilizing ion exchange resins, 3/99
Completed stabilizing ash residue IDC 333, 4/99
Completed stabilizing high risk salts, 7/99

Oak Ridge

Placed K-25/K-29 Category I deposits in a safe configuration, 12/97
Placed K-25/K-29 Category II deposits in a safe configuration, 1/98
Completed MSRE interim corrective measures; drain water from the ACB cell, partition the off-gas system, eliminate the water sources, 11/95

Los Alamos

Stabilized high-risk vault items to meet the long-term storage standards, 7/98
Completed peer review of packaging operations for long-term storage, 4/95
Integrated and demonstrated repackaging operations at the TA-55 Pu facility, 4/95
Began repackaging of Pu metal and oxide at the TA-55 Pu facility, 5/95
Stabilized 220 kgs of residues, 10/95
Developed risk-based, complex-wide categorization and prioritization criteria that all stored residues will be required to meet, 3/96
Performed a 100% inspection of vault inventory, 4/95
Recovered 100 neutron sources, 4/95
Processed 90% of analytical solutions, 8/95
Processed 100 kgs of sand, slag and crucible materials, 4/95
Processed 70 kgs of hydroxide solids, 4/95

Lawrence Livermore National Laboratory

Began inspection of Pu metal items, 4/95
Completed trade-off study to develop plans for the stabilization and packaging of ash/residues for long-term storage, 11/96

Idaho National Engineering and Environmental Laboratory

Moved an additional 189 SNF units from CPP-603 North and Middle Fuel Storage Facility to CPP-666, 9/95
Moved all SNF (6.84 metric tons) from CPP-603 North/Middle Basins to CPP-603, 8/96
Began movement of CPP-603 South Basin SNF, 5/95
Constructed and started CPP-603 dry storage overpacking from CPP-603, 7/97
Completed removal of all spent nuclear fuel from the CPP-603 South Basin, 4/00

Mound

Repackaged all Pu metal in direct contact with plastic, 9/96
Repackaged all Pu metals and oxides to meet the DOE metal and oxide storage standard, 3/97

Appendix G
Summary of 94-1 Research and Development Program

Background

Recommendation 94-1, Sub-recommendation (2), states:

> *"...a research program [should] be established to fill any gaps in the information base needed for choosing among the alternate processes to be used in safe interim conversion of various types of fissile materials to optimal forms for safe interim storage and the longer term disposition. Development of this research program should be addressed in the program plan called for by [the Board]."*

The Department of Energy chartered a Research Committee through the Nuclear Materials Stabilization Task Group in March 1995, which developed and issued the *94-1 Research and Development Plan* in November 1995.

To ensure the technology needs for stabilization continue to be addressed and that the R&D Plan reflects the current needs and status of the complex, the Plutonium Focus Area (PFA) was established by DOE in October 1995 under the DOE Idaho Operations Office (DOE-ID), with support from Lockheed Martin Idaho Technologies Company (LMITCO) and Argonne National Laboratory (ANL). As part of its responsibility, the PFA organized a Technical Advisory Panel (TAP) to update and revise the R&D Plan annually. The first update was issued in November 1996 and the most recent update, Revision 3 dated September 1998, has been issued. Since that time, the Plutonium Focus Area merged with the Nuclear Material Stewardship Project Office Technology Program and has become the Nuclear Materials Focus Area.

The R&D Plan provides a thorough evaluation of progress and R&D needs to meet 94-1 materials stabilization and storage commitments. The Plan also identifies R&D needs caused by interfacing DOE programs (i.e., DOE programs wherein information or requirements are communicated or agreed upon in support of nuclear materials stabilization and disposition), anticipates possible disposition paths for nuclear materials, and documents resulting research requirements. These requirements may change as disposition paths become more certain. Thus, this plan represents snapshots of progress at the time of Plan preparation.

Revision 0 of this Plan (November 1995) catalogued R&D needs to address nuclear material stabilization issues. Revision 1 (November 1996) narrowed the focus of those needs to more effectively target specific problem areas. Revision 2 (November 1997) indicated many medium risk and two high risk technologies in the complex wide stabilization baseline that placed the 94-1 milestone commitments at risk. Many of these risks have been currently mitigated, e.g., the pipe overpack component (POC) at RFETS for disposing residues, or by committing to more realistic milestone dates at Hanford and SRS. The current revision (September 1998) incorporates results from anticipated complex wide 94-1 IP changes that will be finalized in December 1998. In addition, it identifies areas that require more oversight by the Nuclear Materials Stewardship Program Office and DOE field offices, and areas that require further interface negotiation and policy evaluation by DOE.

The R&D Plan is circulated in the R&D community to generate comments and solutions to identified problems (promising technology solutions are submitted as white papers) in response to R&D gaps and programmatic risks identified in the Plan. Additionally, Los Alamos National Laboratory (LANL), as the Lead Laboratory for 94-1 R&D, prepares a Program Plan in response to the recommendations from the R&D Plan. During FY 1998,
the PFA TAP reviewed submitted white papers and provided peer reviews of LANL applied and core technologies. In 1999, the TAP was replaced by a Technical Advisory Group (TAG) which will peer review technical needs identified by the field offices and sponsored by NMFA.

The R&D Plan is closely coordinated with the 94-1 Implementation Plan (IP). Changes in baseline technology selection and in operational R&D need dates for technologies are extracted from the IP updates for inclusion in this R&D Plan. The original TAP assessed technical maturity of the sites' baselines from the IP and, in instances where the TAP believed there were gaps or high programmatic risks in the new technology baseline, recommended backup technologies for inclusion in the R&D Plan.

Interfacing DOE programs are also integrated into the R&D Plan. Updates of various policy and technical documentation that have an impact on the stabilization of 94-1 materials are closely reviewed. In particular for this R&D Plan, materials stewardship, disposition, and safeguards termination requirements all impacted on the R&D requirements to ensure that technical issues are addressed and are consistent with U.S. policy.

This Appendix summarizes the current Research and Development Plan (September 1998, Revision 3) and provides further update to reflect ongoing program development efforts to prepare this IP revision.

1998 R&D Plan

As with previous revisions, the 1998 R&D Plan addresses five of the six material categories contained in the 94-1 IP, namely: plutonium solutions, plutonium metals and oxides, plutonium residues, highly enriched uranium, and special isotopes. R&D efforts related to spent nuclear fuel (SNF) stabilization are specifically excluded from the plan as these efforts are coordinated through the Technology Integration Technical Working Group, established by the Office of Spent Fuel Management.

Materials stabilization and other related research activities discussed in the FY 1998 Plan were categorized into 13 functional areas driven by requirements to stabilize and store materials. The areas are:

- Safe Storage Requirements
- Disposition Requirements
- Safeguards and Security Requirements
- Safety Requirements
- Plutonium Oxides Stabilization
- Plutonium Solutions Stabilization
- Plutonium Residues Stabilization
- Special Isotopes Stabilization
- Highly-Enriched Uranium Stabilization
- Packaging
- Surveillance and monitoring
- Core Technology
- Russian Technology Collaboration

Each category was linked to appropriate 94-1 IP milestones that are schedule requirement needs for R&D. Schedule needs for a specific category of R&D at a specific site were determined by evaluating the programs defined in IP changes provided by each site.

Down-selected Technologies

During 1998, seven technologies were identified as "down-selected" within the R&D Plan. The PuSPS stabilization technology (Milestone IP-3.2.022) was down-selected because RFETS will use muffle furnaces for the operation and the PuSPS front-end stabilization unit would not be installed (see 1998 R&D Plan, paragraph 4.1.4).

Four technologies applicable to RFETS pyrochemical salts were down-selected as the pipe overpack component (POC) option was chosen for the disposition of salts to WIPP. If stabilizing pyrochemical salts were the only objective, then salt oxidation would be the only required R&D activity. However, pyrochemical salt oxidation is currently operational at RFETS and meets the needs for stabilization. RFETS is continuing to characterize pyrochemical salts to determine their risk and therefore do not require pyro-oxidation for stabilization. (see 1998 R&D Plan, paragraph 4.3.2.4).

Two Packaging Technologies (Milestones IP-3.2-045 and IP-3.2-014) became baseline. LANL has demonstrated electrolytic decontamination on welded stainless steel storage containers. LLNL has developed and demonstrated a system to transfer plutonium oxide powder within a glovebox without generating dust. (see 1998 R&D Plan, paragraph 7.1.4).

Accomplishments and Path Forward

Safe Storage, Disposition and Safeguard Requirements

The 1998 R&D Plan developed seven recommendations in this area. Los Alamos developed the technical bases for extending the scope of the DOE-STD-3013-96 from 30wt% to 100wt% Pu/U and up to a storage temperature of 250°C. The revised DOE-STD-3013-99 was issued in December 1999.

On a parallel path, Los Alamos developed alternative moisture measurement methods to Loss on Ignition (LOI). The Supercritical Fluid Extraction (SFE) and Neutron Moderation methods were selected for implementation.

Ongoing work is directed at the impact of chloride ions in stored stabilized oxides on stress corrosion cracking of stainless steel 3013 containers.

EM is actively engaged with OFMD (NN-60) in the evaluation process for impure (Pu+U) materials with regard to OFMD's acceptance criteria, and the stabilization program is monitoring waste disposal sites acceptance criteria to ensure the WAC and RCRA requirements are met.

Plutonium Stabilization

Eleven recommendations were developed for plutonium stabilization. Classified plutonium forms should be shipped to SRS from RFETS for declassification and storage.

LLNL ash residues must be monitored closely and a review of technical and programmatic progress of stabilization must be conducted. Cold-bonded phosphate ceramification should be maintained as a backup for direct disposal of RFETS ash to WIPP.

DOE has initiated actions to develop a material management organization which will address plutonium, uranium, heavy isotopes, and small quantities of materials not addressed in the 94-1 Implementation Plan.

Highly-enriched Uranium

No recommendations were developed in this section. See the 1998 R&D Plan, Section 6 for more details.

Packaging and Storage Technologies

Two recommendations were developed for packaging and storage technologies. Close tracking of the packaging portion of the PuSPS at RFETS is necessary to ensure the need date is met.

Core Technologies

No recommendations were developed for the Core Technology. However, the Core Technology mission will continue by providing scientific and technical support in resolving stabilization, storage, and transportation issues associated with plutonium materials management.

Summary

In conclusion, with the technical strategy developed for most of the 94-1 materials stabilization pathways, the future R&D effort will continue its focus on the following:

- PFP solutions (precipitation/other)
- Continued development of surveillance and monitoring techniques for long-term vault storage of SNM. Included are materials identification and surveillance activities as well as development of novel surveillance and monitoring technologies to support a long-term integrated surveillance program at storage sites.
- Core technology (maintain technical expertise for SNM). Current areas in which technical expertise is being maintained include materials science, gas-solid chemistry, separation science, surface science, smart materials, and chemical thermodynamics.
- Continued development of corrosion mechanisms for the safe storage of 3013 containers.