A Strategic Approach to Integrating the Long-Term Management of Nuclear Materials

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The Department of Energy's Integrated Nuclear Materials Management Plan

A Report to Congress

June 2000

The Secretary of Energy
Washington, DC 20585

June 30, 2000

I am pleased to transmit the Integrated Nuclear Materials Management Plan which addresses how the Department of Energy can more effectively integrate its management of nuclear materials and achieve efficiencies to minimize its costs.

The Department launched a Nuclear Materials Stewardship Initiative in January 2000 to support and strengthen our strategic approach to the integrated life-cycle management of nuclear materials. The Department's core missions entail use of nuclear materials that are vital to national security, and the proper management of these materials is essential to the protection of the public and the environment. As a key component of the Stewardship Initiative, the development of this Plan has accelerated coordination and integrated planning among the various programs that manage nuclear materials.

The Nation's need to maintain a robust nuclear materials management capability for the foreseeable future is clear. The Stewardship Initiative and this Integrated Nuclear Materials Management Plan therefore have long-term significance. This Plan presents the following:

- the first consolidated account to Congress and the public of the Department's unclassified inventory of nuclear materials and a description of how and where we manage these materials;
- a description of how we are coordinating and integrating activities of the various programs and field offices that are responsible for these materials;
- an examination of opportunities for achieving greater integration, coordination, and efficiency in the management of our nuclear materials; and
- a 25-point, multi-year agenda for realizing these opportunities.

In short, this Integrated Nuclear Materials Management Plan charts a path toward a more robust, efficient, cost-effective nuclear materials complex that can carry our nation securely into the future.

Bill Richardson

Bill Richardson

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Foreword

The Under Secretary of Energy
Washington, DC 20585

June 30, 2000

The Department of Energy's responsibilities for nuclear materials management have evolved in response to changing national priorities. At the end of the Cold War, the Department's obligations shifted from making nuclear materials to stabilizing, storing, and dispositioning them. Before 1989, the majority of the Department's nuclear materials management responsibilities were performed by the Office of Defense Programs. Since then, responsibility for these materials has been broadened to include the Offices of Environmental Management, Fissile Materials Disposition, and Defense Nuclear Nonproliferation. In addition, the Offices of Nuclear Energy, Science, and Technology; Naval Reactors; Science; and Civilian Radioactive Waste Management have important nuclear materials management roles. While each program has effectively addressed its specific responsibilities, corporate integration will offer additional opportunities for increased effectiveness.

The Department launched a Nuclear Materials Stewardship Initiative in January 2000 as an element of the Secretary's efforts to improve the Department's operations management. Building on work started by the Office of Environmental Management in 1998, the Stewardship Initiative signals increased corporate focus through the Nuclear Materials Council that includes all secretarial officers and operations office managers with responsibility for nuclear materials.

By integrating crosscutting responsibilities, the Council elevates decision making to the corporate level for the life-cycle management of nuclear materials in a manner that is safe, environmentally sound, efficient, cost-effective, transparent, and in accord with nonproliferation requirements. This Integrated Nuclear Materials Management Plan is the Council's first major work product. The Plan presents the strategic approach and common framework necessary to achieve these results. The Plan is not a decision document. It does not establish new policies or supersede existing ones. Rather, the Plan is a vehicle for describing existing conditions as well as setting forth commitments to pursue opportunities for improvements. The task force that supports the Nuclear Materials Council, composed of senior managers from each program office with responsibility for nuclear materials, has the authority to see that commitments in this Plan are met.

The intense collaboration that has produced this Plan adds additional momentum to the Stewardship Initiative and promotes its success. The expected outcome of this effort is clear: reduced costs, enhanced efficiencies, and a strengthened long-term management of vital nuclear material-driven missions.

Ernest J. Moniz

Executive Summary

The Purpose and Scope of this Plan

This Integrated Nuclear Materials Management Plan is the product of a management initiative at the highest levels of the Department and responds to a congressional directive. The Department launched the Nuclear Materials Stewardship Initiative (NMSI) in January 2000 to accelerate the work of achieving integration and cutting long-term costs associated with the management of nuclear materials, with the principal focus on excess materials.

The effective management of nuclear materials is important to the Administration and Congress for a set of reasons: (1) some materials are vital to our national defense; (2) the materials pose physical and security risks; (3) managing them is costly; and (4) costs are likely to extend well into the future.

The Congress directed the development of an integrated fissile materials management plan and established reporting requirements in Section 3172 of the Fiscal Year (FY) 2000 National Defense Authorization Act. In particular, the Act directed the following:

(a) PLAN. The Secretary of Energy shall develop a long-term plan for the integrated management of fissile materials by the Department of Energy. The plan shall:

(1) identify means of coordinating or integrating the responsibilities of the Office of Environmental Management, the Office of Fissile Materials Disposition, the Office of Nuclear Energy, and the Office of Defense Programs for the treatment, storage and disposition of fissile materials, and for the waste streams containing fissile materials, in order to achieve budgetary and other efficiencies in the discharge of those responsibilities; and

(2) identify any expenditures necessary at the sites that are anticipated to have an enduring mission for plutonium management in order to achieve the integrated management of fissile materials by the Department.

(b) SUBMITTAL TO CONGRESS. The Secretary shall submit the plan required by subsection (a) to the Committee on Armed Services of the Senate and the Committee on Armed Services of the House of Representatives not later than March 31, 2000.

Planning for results

In response to these requirements, the Department has developed a plan containing unclassified inventory information that charts a path toward integrated and effective life-cycle management of nuclear materials. As the integration process continues, there will be a need to address national security issues resulting from classified matters and information not provided as part of this report.

The Department currently manages its nuclear materials under 8 programs that have offices in 36 different locations. Therefore, gathering and developing information for this Plan engaged many Departmental Headquarters, field, contractor, and laboratory personnel across the complex, a task that has itself given momentum to integration efforts. The Plan identifies past and present activities to achieve better coordination and integration of nuclear materials management responsibilities; and the Plan presents future opportunities for the Department to further coordinate and integrate cross-program responsibilities for the treatment, storage, and disposition of excess nuclear materials.

The Plan presents the following information:

- the Department's first consolidated account to Congress and the public of its unclassified inventory of nuclear materials and a description of how and where they are managed,
- an examination of opportunities for greater integration, and
- a description of next steps toward realizing those opportunities.

The Plan was developed and will be implemented under the direction of the Nuclear Materials Council, which carries out the NMSI. Chaired by the Under Secretary of Energy, Science and Environment, the membership of the Council includes all secretarial officers responsible for nuclear materials. The task force that supports the Council is composed of senior managers from each program office and field office with responsibility for nuclear materials management. A number of the Council's member programs have been incorporated into the new National Nuclear Security Administration (NNSA). The Department will ensure that NNSA is fully integrated into NMSI and the work of the Council.

This Plan is not a decision document and does not establish new policies or supersede existing ones. Actions taken pursuant to it will be subject to the decision-making processes established by Departmental requirements and procedures.

As a Report to Congress, the Plan is not being issued for public comment, but the Department welcomes the participation of the public as it pursues the Plan's implementation. The Department's well-established mechanisms for involving the public in its decision making, including the National Environmental Policy Act (NEPA) process, will facilitate this involvement.

Nuclear materials management as covered by this Plan

As discussed within this Plan, nuclear materials management is comprehensive and includes all missions and functions performed as reflected in Figure S-1. This Plan addresses the full life cycle for nuclear materials. In addition to the missions served and functions performed under nuclear materials management, a number of cross-program actions must also be accomplished. These include:

- providing safeguards and security protection,
- placing materials under transparency regimes consistent with international agreements,
- forecasting nuclear materials requirements,
- completing analytical studies,
- planning material disposition strategies,
- transporting materials, and
- conducting research into improved management practices.

Nuclear materials addressed in this Plan

Nuclear materials addressed in this plan are categorized as:

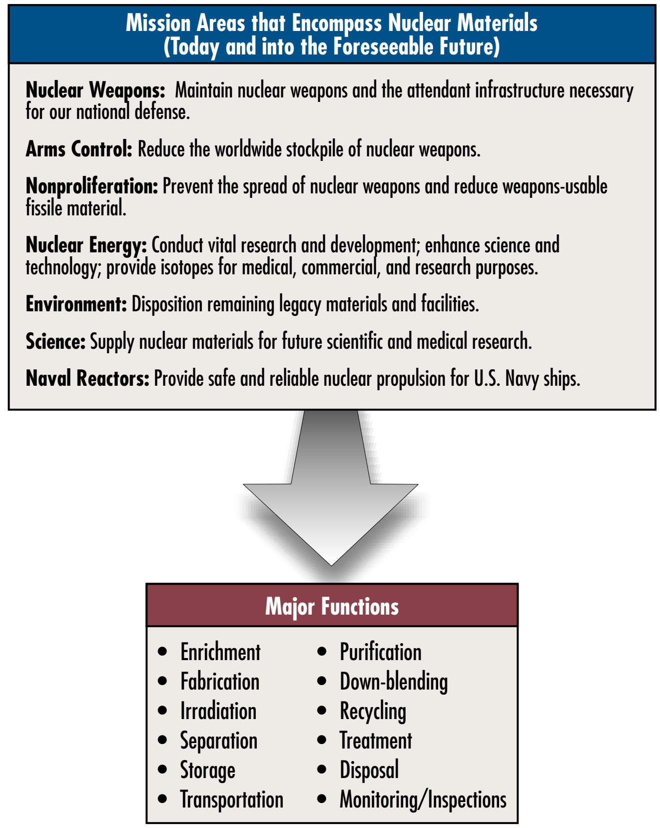
- meeting national security missions,
- serving non-national security programmatic use,
- excess, or
- surplus.

National security missions include nuclear deterrence and non-proliferation. Non-defense programmatic use includes research and development and support of nuclear power generation. Once materials become excess, the Department will either declare them a national resource to be stored for a yet undefined future use, transfer them for beneficial use, such as for medical treatments, identify a new programmatic use, or declare the material to be surplus and disposition it. The category into which a given material fits significantly impacts the baseline plan for the material and the required infrastructure, budget, and capabilities. When materials are moved from one category to the next, the change affects facility requirements and life-cycle cost estimates.

Of the materials managed by the Department, this Plan covers fissile materials [such as plutonium-239 (Pu-239), uranium-233 (U-233), and uranium-235 (U-235)] and non-fissile materials for national security or other programmatic uses or those that require management as surplus materials. In order to consider the Department's entire inventory as an integrated whole, the scope of this report is broader than requested by Congress.

Existing inventories of low-level (LLW), mixed, transuranic (TRU), and high-level wastes (HLW) are not covered in this Plan, even though these wastes contain quantities of fissile and non-fissile nuclear materials. The Department generally distinguishes wastes from nuclear materials according to legal definitions that address relative proportions of radioactive and non-radioactive constituents.

Figure S-1 The Nuclear Materials Missions and Major Functions Discussed in this Plan



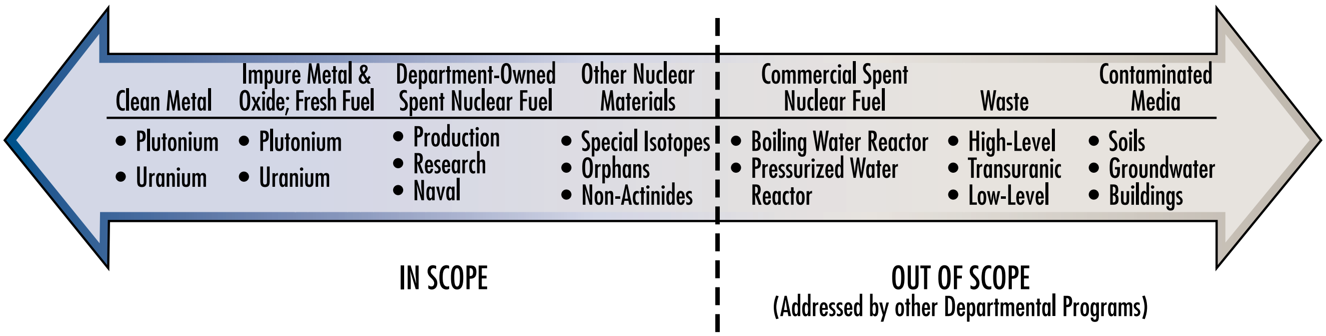
Waste is managed predominantly by the Office of Environmental Management (EM) on a site-by-site basis. There are, however, several efforts underway within EM to improve integration of waste management practices. For example, in working with the state regulatory agencies pursuant to the Federal Facility Compliance Act, EM identified several opportunities to consolidate treatment and thus avoid building new facilities to treat small quantities of similar wastes at multiple sites. EM has also promoted regional waste management and disposal. These efforts are described in EM's program plans and environmental impact analyses. The Office of Civilian Radioactive Waste Management also has a significant role in the disposal of high-level nuclear waste and spent nuclear fuel.

The spectrum of nuclear materials for this Plan, including those that are in scope and out of scope, is depicted in Figure S-2.

Estimated cost information

The Plan presents a crosscut of estimated costs of managing nuclear materials by showing the relative distribution of FY 2001 projected costs by selected programs, by function, and by material type. The Department prepares its budget on a

Figure S-2 Spectrum of Nuclear Materials



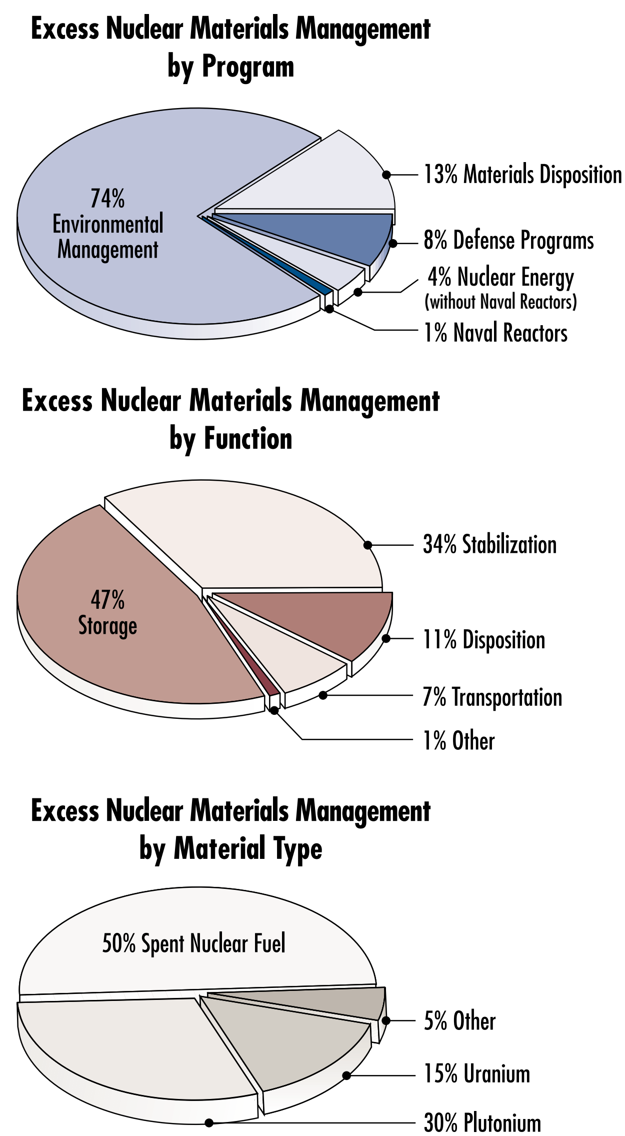
program basis in support of its major missions as defined in the Strategic Plan. Programs with material management responsibilities may budget differently from each other and the costs of managing nuclear materials may be embedded in facility, site landlord, and other activities.

These crosscut estimates for nuclear materials management were developed using reasonable assumptions and informed judgment. They convey only a "rough order-of-magnitude" (ROM) estimate of a portion of the Department's budget that supports the actual handling of nuclear materials. Other costs, such as for repository development, are not included. The benefit of this approach is that it has helped target our integration efforts. We have identified, for example, that: (1) the majority of near-term efforts in nuclear materials management are anticipated to be executed by EM; (2) storing materials will cost more than most of the other materials management functions combined; and (3) the management of spent nuclear fuel will require as many resources as all the other nuclear materials combined.

This ROM estimate of the costs of managing excess nuclear materials is a significant portion of the Department's total annual budget. Figure S-3 depicts the relative distribution of estimated costs in three ways:

- *By program:* Programs responsible for carrying out missions have their own budgets. As has been noted, EM has by far the largest share of costs associated with managing nuclear materials.
- *By management function:* These are general program costs associated with nuclear materials management that can be identified with a particular management function such as stabilization, storage, transportation, and disposition, but not with a specific nuclear material category. Storage costs dominate this category.
- *By nuclear material:* These costs are identified with the four nuclear material categories covered in this Plan: plutonium (Pu), uranium (U), spent nuclear fuel, and other nuclear materials. Costs for plutonium are

Figure S-3 FY 2001 Estimated Cost Breakouts



estimated at roughly 30 percent of this category, spent nuclear fuel roughly 50 percent of this category, uranium roughly 15 percent of this category, and other nuclear materials roughly 5 percent of this category.

A more detailed and comprehensive review will be conducted before the Department can confidently provide more complete costs of managing its nuclear materials.

Stewardship of Nuclear Materials: An Enduring and Evolving Mission

Transitioning from Cold War to peacetime missions

The Department's substantial inventory of nuclear materials has accumulated over many years. The Department and its predecessor agencies operated facilities to conduct research on, design, test, and manufacture nuclear weapons; to conduct basic science, nuclear engineering research and development, and special isotope programs; and to support naval nuclear propulsion. These facilities and laboratories acquired and produced enormous amounts of materials in various forms.

The weapons complex grew to comprise over 2 million acres of land, 120 million square feet of buildings at 17 major sites, and, during half a century of operations, manufactured tens of thousands of nuclear warheads and employed hundreds of thousands of workers. Approximately $300 billion had been spent through 1995 (in 1995 dollars). Managing nuclear materials is inherently costly. It requires expensive infrastructure for functions from processing through storage and disposal. The risks posed require health and safety precautions in nuclear material handling and shipping. In addition, weapons-usable materials require highly sophisticated safeguards and security measures.

With the end of the Cold War, the weapons complex was scaled back and production was sharply curtailed. Compliance with the technical and administrative terms of international arms control treaties and nonproliferation agreements became an important new responsibility. New missions and programs reflected this shift in operations and emphasis, highlighted the need to adjust the organizational structure, and provided the opportunity to pursue efficiencies.

In the late 1980's and early 1990's, growing concerns about environmental and safety issues related to weapons production caused the Department to suspend, temporarily, various operations throughout the weapons complex.

Many temporary shutdowns eventually became permanent. However, because these shutdowns were viewed as temporary when the decision was made, the Department did not make long-term plans for storage or disposition of materials before suspending operations. Thus, large quantities of materials were left "in the pipeline." How best to manage these legacy materials and other materials currently in use is an important challenge the Department faces today. Table S-1 provides a listing of these legacy materials.

Table S-1 Legacy of Nuclear Materials Left Over from the Cold War

- Approximately 100 metric tons (MT) of Pu-239. Greater than 50 MT is surplus and is stored at 7 sites in a wide variety of forms and storage configurations (the majority in clean metal form and others as metals, oxides, alloys, residues, and reactor fuel).
- Excess highly enriched uranium (HEU) in the amount of 174 MT was withdrawn from national security programs, half of which is in the form of metal and the other half in a variety of forms (oxide, reactor fuel, compounds, irradiated fuel and targets, and others).
- Over 4,700 MT of surplus low enriched uranium (LEU) at 28 sites. The largest blocks are in the forms of alloyed and unalloyed metals and oxides, residing primarily at the Hanford and Fernald sites, and uranium hexafluoride (UF_6), residing at Paducah. An additional 5,300 MT of excess LEU designated as programmatic is also in the U.S. inventory.
- Over 760,000 MT of depleted uranium (DU) at 34 sites. Most of this is in the form of depleted UF_6 (DUF_6) and is stored at the three gaseous diffusion plants – the former K-25 at Oak Ridge, Paducah, and Portsmouth.
- Over 1,900 kilograms of U-233 at 5 sites, with the bulk at Idaho National Engineering and Environmental Laboratory (INEEL) (irradiated and unirradiated fuels) and Oak Ridge National Laboratory (ORNL) (recovered uranium oxide).
- About 2,500 MT of Department-owned spent nuclear fuel stored at 4 sites.
- An "other materials" group that includes over 50,000 items with over 100 million curies of radioactivity. This group includes a wide variety of isotopes with varying chemical and physical forms that are legacies of various national security, nuclear energy, and research and development activities.

Constraints to integration

The scale and complexity of the challenges that confront nuclear materials management, as well as its history, have influenced the pace of integration. These challenges include the following:

- **National security requires interagency decision making.** The Department often cannot unilaterally make management decisions on matters relating to non-proliferation and national security. Departmental plans need to reflect interagency coordination with respect to national security and international treaties and obligations.

- **The Department's nuclear materials management infrastructure is both diffuse and interconnected.** Nuclear materials are the focus of missions ranging from national security to disposition of legacy materials. The materials are located at many sites around the country. The facilities in the nuclear materials complex are maintained, modified, or closed based on either site or program drivers. Decisions made at one site or within one program may have significant management and cost impacts at other sites or programs.
- **The inventory requires complex handling and disposition**. Nuclear materials have unique physical characteristics that require specific kinds of security, handling, storage, and packaging. Each material has previously had defined uses, and specific processes governed its management. Now, large quantities are either surplus or available for other uses.
- **Precise costs are difficult to establish**. The Department's budget is structured around program missions that have evolved over time. While nuclear materials management activities are an integral part of various Departmental programs, these costs are not necessarily identified separately in the program's budget.
- **The information base is diverse and maintained at multiple locations.** Information about the nuclear materials inventory has been compiled over many years and captured in many different systems.
- **Facility and infrastructure improvements compete with other program priorities for annual funding.** More than half of Departmental facilities are greater than 40 years old and will need extensive repairs or will need to be replaced in the coming decades. Each program with nuclear materials management responsibilities is responsible for planning the upgrade and replacement of facilities needed to perform its mission. These costs must be budgeted year-to-year, can only be distributed across the time required for construction, and compete with other program priorities.

Institutionalizing integration and pursuing an action agenda

Stewardship of nuclear materials demands integration and coordination, leadership, vigilance, and best management practices. This Plan describes the current state of the Department's approach to institutionalizing the integration of nuclear materials and fulfilling its stewardship obligations. This strategic approach encompasses cross-program issues related to infrastructure, transportation, and information management. It will ultimately have to encompass personnel core competencies, currently the subject of a separate planning process.

The Department began its pursuit of an integrated stewardship strategy with the initiation of the Nuclear Materials Integration Project (NMI). NMI was chartered in early 1998 by EM to improve inventory information, determine disposition paths for surplus nuclear materials, and identify opportunities for program improvements, risk reduction, and cost savings. Through these and other efforts, the Department has accomplished the following:

- acquired a comprehensive understanding of materials in inventory;
- developed better structured planning efforts focused on the total life cycle of nuclear materials;
- applied systems engineering tools to identify and evaluate alternative disposition paths and identify areas needing cross-program and field coordination; and
- taken actions that will help achieve the safe disposition of nuclear materials at Mound, Fernald, and Rocky Flats.

The successful experience with NMI within one program, provided the impetus for the Department to expand integration across multiple programs and undertake the NMSI described earlier.

The Nuclear Materials Council, which carries out the NMSI, oversees the responsible management of nuclear materials throughout their entire life-cycles: production, use, recycle and recovery, storage, transportation, and disposition. It works to better meet mission requirements, reduce vulnerabilities posed by existing materials and aging facilities, and develop solutions for ultimate disposal of material for which the nation has no current or future use. The NMSI commits the Department to:

- make near-term decisions and take actions that will have a long-term impact on nuclear materials stewardship;
- make decisions to achieve operational improvements; and
- conduct long-term planning that supports its corporate strategy and long-term mission for the future of the nuclear materials complex.

The Council's Action Agenda

The Council's multi-year action agenda is summarized in Table S-2 on the next page and will be regularly reviewed and adjusted as needed to accommodate changing circumstances. As the Nuclear Materials Council continues to implement this important agenda over the next few years, the Department will report on its progress in the Strategic Plan and through its annual budget requests.

The Council's action agenda is the product of an extensive analysis of baseline activities to identify opportunities for greater integration, consulting widely with personnel in Headquarters and the field. Opportunities have been grouped under two categories: (1) policy and organizational change, and (2) improving operations.

Policy and organizational changes

As the decision-making forum for actions taken pursuant to the NMSI, the Nuclear Materials Council advances the following tasks:

- **Consolidate nuclear materials management expertise.** As Departmental sites and facilities are being downsized and closed, staff is being reduced, and budgets are shrinking, significant capability in both technical expertise and processing facilities is being lost. In 1996, to maintain needed core expertise and capability for managing Department-owned spent nuclear fuel, the Department established a National Spent Nuclear Fuel Program at INEEL. To expand this concept and to facilitate program integration, the Department is evaluating the option of establishing additional nuclear materials management groups for plutonium, uranium, non-actinide isotopes/sealed sources, and heavy isotopes.

  These groups would be empowered to propose and plan optimum management solutions across programs for a given set of materials. Before the Department implements this integration, roles and responsibilities, operating protocols, and resources must be addressed.
- **Establish a policy for designating excess nuclear materials that do not have a disposition path either as a national resource or a waste.** On one hand, storing excess nuclear materials is very expensive and they should only be maintained in the nation's inventory if they have the potential for being used in the future. On the other hand, many unique radioisotopes will not be produced again without extraordinary costs and, therefore, should be disposed of only after careful evaluation.
- **Tackle crosscutting issues and make planning decisions on high-priority cross-program issues that prevent individual programs from successfully meeting their mission obligations.** Examples of such issues are listed in Table S-3.
- **Upgrade and integrate the Departmental nuclear materials information management and inventory accountability system.** An updated system would streamline data acquisition, standardize data fields, eliminate redundancy, promote public confidence, and facilitate management of the data needed to make informed decisions by programs and the Department as a whole.
- **Develop and revise Departmental orders, policies, and planning documents concerning nuclear materials management to reflect improvements to the current state of materials management.**

Improving operations

The operational improvements called for in this Plan could benefit the Department over the coming decades. The underlying task is to critically examine current missions and baseline plans to determine if there are better ways of accomplishing them.

A team of multi-program, field, and laboratory subject matter experts familiar with current and past nuclear materials management issues performed this critical analysis. They built on recent work, including NEPA analyses, Defense Nuclear Facilities Safety Board (DNFSB) Recommendation Implementation Plans, technical studies of potential disposition options, and other Departmental initiatives. Operational improvement opportunities will be further investigated under the auspices of the Nuclear Materials Council. Based on analyses performed to date, four opportunities have emerged as having significant potential for improving the Department's management of nuclear materials:

- **Complete an integrated assessment of surplus plutonium stabilization, storage, and disposition.** The Department operates plutonium handling facilities at Rocky Flats, Hanford, Argonne-West (ANL-W), Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), and Savannah River Site (SRS). Other sites handle smaller quantities. Surplus plutonium inventories from Rocky Flats are being transferred to SRS. An analysis of options to cost effectively stabilize and store surplus plutonium has been undertaken.

  The Department's conclusion is to modify existing facilities at SRS rather than construct a new facility. This conclusion takes into consideration the Department's January 2000 decision to construct surplus plutonium disposition facilities at SRS. With the planned plutonium

Table S-2 Multi-year Agenda for the Nuclear Materials Council

Policy and Organizational Changes

- Policy
  1. Revise the Department's Strategic Plan to ensure that Nuclear Materials Stewardship is integrated into the Department's major missions.
  2. Update DOE Order 5660.1B - Management of Nuclear Materials - to include nuclear materials stewardship missions, including the responsibilities of the Nuclear Materials Council and the Nuclear Materials Stewardship Task Force.
  3. Establish a "National Resource Policy" that identifies the criteria to be applied when determining whether excess legacy nuclear materials that do not currently have a disposition path specified should be maintained for a future use or disposed of.
- Organization and Budget
  4. Review the costs for managing nuclear materials within the Department.
  5. Develop options and select an approach for institutionalizing a Nuclear Materials Stewardship staff coordination function.
  6. Evaluate the costs and benefits of establishing nuclear material management groups and formally charter those that will serve corporate nuclear materials management needs.
  7. Complete, in time for the FY 2003 budget process, a strategy document to establish the acceptance criteria, programmatic requirements, and budget requirements needed to guide any future transfer of certain "national resource" materials to the Office of Nuclear Energy, Science and Technology.
  8. Investigate opportunities to apply proceeds from surplus materials sales to help offset their disposition costs.
- Planning, Analysis, and Decision Making
  9. Make planning decisions, subject to NEPA review, concerning high-priority, cross-program issues, including the disposition of legacy nuclear materials, americium, curium, neptunium, uranium-233, strontium and cesium, among others.
  10. Complete a cost/benefit, business-case analysis of alternatives for improving the Department's nuclear materials information management and inventory accountability system and upgrade and integrate to the degree appropriate.
  11. Convene a cross-program team to integrate planning for the disposal of defense high-level nuclear waste and Department-owned spent nuclear fuel in a repository and to address safeguards and security licensing requirements.
  12. Establish an integrated planning and decision-making process for facilities and infrastructure required to meet the needs of a modernized nuclear materials management complex.
  13. Perform a qualitative and quantitative projection of the long-term capabilities needed to perform the Department's nuclear materials management missions.
  14. Develop policy-level decision support tools to support long-term planning and decision making.
  15. Assess opportunities to integrate and enhance nuclear materials research and development.
  16. Develop Web-based tools for sharing information and facilitating coordination among Departmental programs and between Headquarters and the field on topics directly related to the Council's evolving agenda.
- Stakeholder and Public Involvement
  17. Establish appropriate mechanisms and opportunities for involving the public on issues that could affect them.

Improving Operations

- Plutonium
  18. Implement decisions from integrated assessment of plutonium storage consolidation.
  19. Implement decisions from integrated assessment of plutonium stabilization.
  20. Configure the three plutonium disposition facilities to take advantage of existing and planned infrastructure to achieve improved schedules, cost savings, and other programmatic synergies.
- Uranium
  21. Complete integrated assessment of uranium missions and facilities, including a method for consolidating uranium storage.
  22. Complete analysis of non-HEU opportunities and recommend improvements.
- Transportation and Containers
  23. Evaluate the protocols and practices used by shippers of radioactive materials and wastes.
  24. Design a financial charge-back approach for non-national security shipments of nuclear materials.
  25. Evaluate consolidation and streamlining of nuclear materials package management.

disposition activities and the ability to accommodate interim plutonium storage needs within existing and modified facilities, the long-term plutonium storage capability that would be provided by a new facility would not be cost effective.

With issuance of the Record of Decision designating SRS as the sole management site for surplus plutonium disposition, the Department will configure the three planned plutonium disposition facilities to take advantage of existing and planned infrastructure to achieve improved schedules, cost savings, and other programmatic synergies.

- **Optimize uranium missions and facilities.** The current strategy is to maintain uranium materials in safe storage, with stabilization and blend-down as needed, until reuse in national defense or other programmatic applications or disposition as surplus uranium. With respect to disposition, the Department intends to maximize reuse of surplus uranium materials to the extent that they meet or can be processed to meet specifications for commercial use. Some options that will require additional analyses have been identified for DU in the form of DUF_6. Planning and evaluations for determining potential reuse or other disposition of U-233, LEU, and natural uranium are in the early stages. Upon completion, the Department will be able to assess the full spectrum of uranium missions and facilities. This could result in cost savings or avoidance and improvements in overall program execution.
- **Optimize transportation and packaging strategies for nuclear materials management.** A major function of materials management is safe and timely transportation of nuclear materials and waste. The Department has been packaging and shipping waste and material for years and has an excellent safety record. Packaging and shipping requirements are expected to increase significantly in the future, and the Department believes shipping campaigns can be better integrated and coordinated among programs and field sites.

Table S-3 Near-Term Cross-Program Issues

- Disposition of Americium and Curium
- Disposition of U-233 and Neptunium-237 (Np-237)
- Disposition of Cesium and Strontium
- Disposition of Plutonium-Contaminated HEU
- Uranium Chemical Processing Infrastructure
- Availability of Storage and Shipping Containers
- Cost Recovery for Use of Services, Facilities, or Processes
- Access for International Monitoring

- **Optimize technology investments.** Technology development within the weapons complex has traditionally involved the laboratories funded by program offices. In general terms, the needs of each program were unique, and research and development was assigned either to a laboratory or to an informally recognized center of excellence. In addition, the production sites had "process development" organizations that fine-tuned the production, recovery, and manufacturing processes designed by the major laboratories.

  The complexity and diversity of Departmental programs and technology initiatives make them a good candidate for further integration. For example, the Department has invested in nuclear instrumentation technology development. In this area, the Office of Defense Nuclear Nonproliferation is developing improved, and more automated, safeguards and security systems that the Offices of Defense Programs, EM, and Fissile Materials Disposition can use in storage facilities.

Planning for the Future

Near-term decisions about the nuclear materials complex should be informed by long-term planning. The Department needs to define and analyze a set of working assumptions about the long-term requirements of the complex that extends beyond the current planning horizon. Therefore, the Department will undertake a qualitative and quantitative analysis of long-term requirements. This analysis will include an evaluation of future missions and potential functions that will need to be performed.

As the work of furthering the integration of the nuclear materials complex proceeds, the Department will enlarge the information resources it draws on for analyses, refine analytic techniques by using quantitative analyses, and employ decision support tools, including public involvement, to ensure a sound foundation for decision making. This analysis will become integral to the Department's long-term strategic planning.

Conclusion

Among the many conclusions that can be drawn from the work done to prepare this Plan, the Department believes the following are particularly valuable:

- Management of nuclear materials must be well integrated at the corporate level. The Nuclear Materials Council, chaired by the Under Secretary of Energy, Science and Environment will foster better decision making on issues that crosscut programs.
- The Department's strategic vision must extend beyond the current decade to effectively guide near-term decisions

about facility decommissioning and new facility investments in the nuclear materials complex.

- Integrated management of nuclear materials must be fully in concert with, and provide the leadership for, our nation's international commitments and treaty obligations.
- There exist many opportunities for achieving better integration and cost avoidance.
- The Nuclear Materials Council will continue to play a vital role in the accomplishment of effective integration.

Given the scale, complexity, and sensitivity of nuclear materials management, the task of integration has been a significant Departmental challenge. Implementing this Plan, however, has accelerated coordination and integrated planning and will produce cost savings or cost avoidance. Chartering the NMSI and this Plan represent near-term steps in elevating crosscutting decisions to a corporate level with a long-term perspective.

Introduction and Background

Chapter 1

Management of nuclear materials is a fundamental and enduring responsibility that is essential to meeting the Department's national security, nonproliferation, energy, science, and environmental missions into the distant future. To meet this responsibility, the Department is committed to maintaining a coherent and forward-thinking approach to management of these materials through their entire life cycle, from production to use or disposal.

This Plan is the product of ongoing management initiatives and responds to Section 3172 of the FY 2000 National Defense Authorization Act. Both the Department and Congress share the view that significant additional costs can be saved or avoided by better integrating activities related to the management of nuclear materials. This is particularly important given the substantial cost of these management functions and the need to modernize the nuclear materials management complex.

This Integrated Nuclear Materials Management Plan presents the following information:

- a consolidated account to Congress and the public of the Department's unclassified inventory of nuclear materials,
- a description of how these materials are currently managed,
- an examination of opportunities for achieving greater integration, and
- next steps toward realizing those opportunities.

The Plan both offers a valuable information resource and charts a path toward the Department's goal — the integrated, effective, cradle-to-grave management of nuclear materials. The Department believes that, over time, implementation of the Plan can deliver substantial benefits in cost-savings and efficiencies and that those efficiencies will further reduce radiological and other physical risks and contribute to a more robust nuclear materials complex.

This Plan is not itself a decision document. It does not establish new policies or supersede existing ones. Actions taken pursuant to it will be subject to the decision-making processes established by Departmental requirements and procedures.

As a Report to Congress, the Plan is not being issued for public comment, but the Department welcomes the participation of the public as it implements the Plan's principles. The Department's well-established mechanisms for involving the public in its decision making, including the NEPA process, will facilitate this.

Nuclear Materials Covered by this Plan

The materials covered by this Plan include:

- plutonium,
- uranium,
- spent nuclear fuel (Department-owned), and
- other nuclear materials.

These materials are currently stored in a variety of forms and packagings and range from the purer forms of clean plutonium metal to a variety of impure forms such as scrap, residues, and solutions. They also include a variety of isotopes, sources, and so-called "orphan" materials.

The scope of this Plan has been broadened beyond fissile materials, which the congressional request addressed. The Department believes that its entire nuclear materials inventory must be considered as an integrated whole. Low-level, transuranic, and high-level waste streams, although large in volume, are not covered in this Plan, but they are addressed in the Department's EM program plans.

How this Plan is Organized

The remainder of Chapter l provides a brief background on the history of the Department's nuclear materials management, addresses key considerations that guide its efforts, and describes nuclear materials management responsibilities across Departmental programs. Chapter 2 discusses the current approach to managing nuclear materials (the baseline program). Chapter 3 describes the opportunities for organizational and policy improvements and operational improvements that will promote integration, cost savings, or cost avoidances. Chapter 4 recaps the current state of the Department's nuclear materials management program and looks ahead to the Department's agenda for organizational and policy change and improving operations.

Background

Decades of weapons production – the legacy

From 1943 to 1989, the nuclear weapons complex produced and processed tons of unique materials. The complex grew to comprise over 2 million acres of land (an area approximately the size of the States of Rhode Island and Delaware combined) and 120 million square feet of buildings located at 17 major sites, dwarfing the size of most Fortune 500 corporations. Some idea of the scale of this enterprise can be understood from the cost.

From the Manhattan Project through 1995, the United States has spent approximately $300 billion (escalated to FY 1995 constant dollars) on nuclear weapons research, production, and testing. During half a century of operations, the complex manufactured tens of thousands of nuclear warheads and employed hundreds of thousands of workers.

The knowledge and resources gained from weapons production activities also benefited peaceful uses of atomic energy, such as civilian nuclear power and isotope production for medical, agricultural, and industrial applications.

Nuclear materials production started with mined and milled uranium. Uranium was enriched into U-235 either for direct use in nuclear weapons or to produce plutonium for the same purpose. Plutonium was produced by using U-235 as a fuel to produce neutrons to irradiate uranium-238 (U-238) in reactors. In some cases, the U-238 was contained in separate targets. These materials were then chemically processed to recover recyclable uranium and to extract plutonium. Tritium gas, used to boost the explosive power of most modern nuclear weapons, was produced by irradiating lithium targets and then extracting the tritium.

In the late 1980's and early 1990's, growing concerns about environmental and safety issues caused the Department to temporarily suspend various operations throughout the weapons complex. Many of these temporary shutdowns became permanent with the end of the Cold War and the collapse of the Soviet Union. However, the Department had not made long-term storage or disposition plans for the "in-process" nuclear materials prior to suspending operations. Safely managing these materials is an important national challenge.

Appendix I provides a more detailed history of U.S. nuclear materials production.

Planning for legacy cleanup and waste disposition

The Department has given high priority over the past several years to the accelerated cleanup and closure of sites and the disposition of nuclear materials and waste. Key planning efforts, which are documented in the Department's Baseline Environmental Management Report (DOE, 1996g) and "Accelerating Cleanup: Paths to Closure" (DOE, 1998c), significantly furthered Departmental progress in defining the scope, schedules, and life-cycle costs to meet cleanup objectives. The Department's vision, as stated in the Paths to Closure document, is to complete cleanup at most of its 113 sites by 2006.

As part of continuing planning efforts to accomplish this vision, the Department has developed critical closure paths and timetables for closure activities and progress has been made in identifying waste and nuclear materials inventories, determining disposition paths, and evaluating opportunities for program improvements and cost avoidances. Several major NEPA analyses and Records of Decision have been completed that determine the disposition path for surplus plutonium and surplus HEU. Other decisions have been made under NEPA regarding stabilization efforts for materials such as DU and at-risk spent nuclear fuel and target materials to resolve near-term storage vulnerabilities and prepare the materials for disposition. These decisions, and other current activities and plans, are discussed further in Chapter 2.

Changing Departmental missions

With the end of the Cold War and after nearly 50 years of large-scale nuclear materials production and research focused primarily on nuclear weapons, the Department's mission has changed in nature and scope. The nuclear weapons complex has ceased weapons-capable material production, since national security and strategic reserve materials in the stockpile are sufficient at this time to meet defense needs. However, the Department has production requirements to replenish its tritium stockpile and to generate specialized isotopes for research and development and medical and commercial applications.

The Department must meet its future national security, non-proliferation, nuclear energy, and science requirements, even as it simultaneously: (1) "right sizes" the nuclear weapons complex; (2) plans the disposition of a large and diverse inventory of surplus materials; and (3) continues to mitigate environmental safety and health issues that result from the legacy of 50 years of materials production.

Following are the seven Departmental mission areas that are most affected by nuclear materials management decisions and the major functional capabilities required for the complex. The Department expects these missions to remain important for the foreseeable future and to drive decisions on the use or disposition of nuclear materials.

Mission Areas that Encompass Nuclear Materials (Today and into the Foreseeable Future)

Nuclear Weapons: Maintain nuclear weapons and the attendant infrastructure necessary for our national defense.

Arms Control: Reduce the worldwide stockpile of nuclear weapons.

Nonproliferation: Prevent the spread of nuclear weapons and reduce weapons-usable fissile material.

Nuclear Energy: Conduct vital research and development; enhance science and technology; provide isotopes for medical, commercial, and research purposes.

Environment: Disposition remaining legacy materials and facilities.

Science: Supply nuclear materials for future scientific and medical research.

Naval Reactors: Provide safe and reliable nuclear propulsion for U.S. Navy ships.

Major Functions

- Enrichment
- Fabrication
- Irradiation
- Separation
- Storage
- Transportation
- Purification
- Down-blending
- Recycling
- Treatment
- Disposal
- Monitoring/Inspections

Key drivers for the management of nuclear materials

A number of key drivers have helped shape the transition from yesterday's Cold War missions to today's management and disposition missions: (1) science-based stockpile stewardship; (2) nonproliferation and national security; (3) surplus materials disposition; and (4) safety issues associated with storage. These are discussed in more detail below.

Science-Based Stockpile Stewardship. Maintaining nuclear weapons without nuclear testing is a technically challenging and unprecedented task. In part, this is because the unique materials in nuclear weapons are aging beyond experience. Through the Science-Based Stockpile Stewardship program, the United States is meeting this challenge. Scientists at the national laboratories are improving their understanding of the fundamental physics and chemistry that govern weapons performance. By careful measurement of the materials that make up a nuclear weapon and by understanding how those materials interact and age, scientists expect to predict changes in safety, reliability, and performance.

Nonproliferation and National Security. There are many treaties and agreements, international commitments, Executive Orders, and legislative actions that drive the nonproliferation and national security program needs with respect to nuclear materials management. U.S. nuclear nonproliferation policy is anchored in certain bedrock principles and actions, which are described and reviewed in annual Administration Reports to Congress pursuant to Section 601 of the Nuclear Nonproliferation Act of 1978, as amended by the Nuclear Proliferation Prevention Act of 1994. These principles include the following:

- Preventing the spread of nuclear explosives to additional countries is a fundamental objective of U.S. national security and foreign policy.
- The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) is an indispensable instrument for promoting and maintaining peace among nations.
- Consistent with Article VI of the NPT, the United States is committed to achieving further reductions in U.S. and Russian nuclear arsenals.
- By Administration policy, the provisions of the Comprehensive Test Ban Treaty remain an important constraint on the proliferation of nuclear weapons and development of advanced new types of nuclear weapons.
- The International Atomic Energy Agency (IAEA), with its system of international safeguards on nuclear material, makes a vital contribution to global security.
- Agreements for peaceful nuclear cooperation among the United States and its partners provide an essential framework of conditions and controls for mutually beneficial cooperation in the peaceful uses of nuclear energy.
- Effective nuclear export controls make a major contribution to ensuring that nuclear technology involved in cooperation with other nations is used for peaceful purposes only.
- All countries should maintain: (1) adequate systems of materials accounting and control; and (2) physical protection of nuclear materials.

Some of the key nonproliferation programs, and the nuclear management considerations that arise as a result of these programs, are summarized as follows. Appendix II provides a more extensive discussion of the U.S. nonproliferation commitments.

- **Strategic Arms Reduction Treaty (START) III —** Beginning in FY 2000, the Department leads an interagency task force on warhead and fissile materials to implement a START III concept for warhead elimination. The interagency task force decisions will drive domestic needs for facilities to dispose of pits and transparency measures to confirm that weapons are being dismantled and that excess fissile materials removed from dismantled nuclear weapons are not reused in the production of new nuclear weapons. The Department maintains a technical dialogue with Russian scientific and technical organizations through the Lab-to-Lab Weapons Dismantlement Transparency efforts. Through this dialogue, U.S. and Russian scientists will jointly develop and evaluate proposed transparency measures.

- **U.S. - Russia Plutonium Disposition Agreement —** The United States is currently negotiating an agreement with Russia on plutonium disposition under which the two countries would proceed to implement parallel programs with comparable rates of plutonium disposition. Substantial progress on this agreement will commit the United States to disposition weapons-capable plutonium using either mixed oxide (MOX) fuel or immobilization as a means to increase proliferation resistance. This agreement is needed before the United States will begin construction of plutonium disposition facilities at SRS.
- **International Plutonium Management Guidelines (INFCIRC-549) —** The United States and eight other plutonium-using countries submitted to the IAEA their acceptance of this unified package of accepted rules for the storage, handling, and transportation of civil plutonium, as well as military plutonium that has been declared as no longer required for defense purposes. Reporting requirements include a formal declaration of national plutonium strategies and an annual declaration of stockpiles of non-military plutonium (with an estimate of plutonium content in spent nuclear fuel).
- **HEU Transparency Implementation Program —** The Department is responsible for ensuring that the nonproliferation aspects of the February 1993 HEU Purchase Agreement between the United States and the Russian Federation are met. Under the Agreement, conversion of the HEU components into LEU is performed in Russian facilities. The program permits the United States to have confidence that the Russian side is abiding by the Agreement and requires the United States to support comparable monitoring activities by Russian Federation representatives at U.S. facilities subject to the Agreement. Key features of transparency measures currently include regular visits to all facilities that process uranium subject to the Agreement, plus permanent monitoring presence at the Ural Electrochemical Integrated Enterprise in Russia and at the Portsmouth Gaseous Diffusion Plant in the United States. DOE coordinates its HEU Transparency Implementation operations with the Department of State.
- **The U.S.-Russia-IAEA Trilateral Initiative —** The Initiative is aimed at increasing international verification of weapons-usable materials in the two states, to confirm that fissile materials no longer needed for defense purposes are not reused to produce nuclear weapons. A trilateral working group has been negotiating the legal and technical aspects of the initiative, which will drive requirements for transparency, monitoring needs, and managed access at both U.S. and Russian facilities.
- **Fissile Material Cut-Off Treaty (FMCT) —** The Department continues to support the U.S. Government-led negotiations on the FMCT and will provide implementation-related analytical and technical support. The Department will conduct domestic and international exercises and/or multilateral verification workshops and site visits to assess monitoring impacts and requirements. The Department also will conduct multi-agency cooperative assessments, on-site inspection simulations, and complex data surveys to support the compilation of treaty and agreement-mandated declaration submissions. Further, these activities may be conducted to support bilateral agreements that may be negotiated with individual countries to monitor the production of weapons-usable nuclear material.
- **IAEA Strengthened Safeguards Program —** The United States is committed to supporting the IAEA Strengthened Safeguards Program. This program allows for international inspectors on all sites associated with nuclear programs, including those involved in national security programs, and environmental sampling at those sites. There will be a need for new approaches to managed access at sensitive Departmental facilities under this program, as well as an opportunity to lead the international community in technical implementation.

Surplus Materials Disposition. The driving force for disposition of surplus nuclear weapons-capable fissile materials is to reduce the threat of nuclear weapons proliferation worldwide. Comprehensive disposition actions are needed to ensure that surplus materials are converted to proliferation resistant forms. In September 1993, President Clinton issued the Non-Proliferation and Export Control Policy in response to the growing threat of nuclear proliferation. Further, in January 1994, President Clinton and Russia's President Yeltsin issued a joint statement between the United States and Russia on non-proliferation of weapons of mass destruction and the means of their delivery. In accordance with these policies, the focus of the U.S. nonproliferation efforts includes ensuring the safe, secure, long-term storage and disposition of surplus weapons-capable fissile materials inventories. Disposition activities undertaken by the United States will enhance its credibility and flexibility in negotiations on bilateral and multilateral reductions of these inventories.

Safety Issues Associated with Storage. A top priority is safely managing at-risk nuclear materials and facilities. This is being accomplished through stabilization and repackaging of materials and improving storage facilities. The DNFSB has played a significant role in identifying safety issues associated with existing storage of materials. Various Departmental environmental, safety, and health vulnerability assessments have also resulted in priority attention to stabilizing and repackaging materials and upgrading or replacing key facilities. Examples include:

- DNFSB Recommendation 94-1 (DNFSB, 1994) identified the need to stabilize and safely store large amounts of fissionable and other nuclear materials. The Board was especially concerned about specific liquids and solids in spent fuel storage pools, reactor basins, reprocessing canyons, processing lines, and various other defense facilities remaining in the manufacturing pipeline when pit production at Rocky Flats was terminated in 1989. The Department has moved to remediate these safety vulnerabilities, as documented in its Implementation Plan (DOE, 1995f and revisions 1998b and 2000b).
- In January 2000, the DNFSB issued Recommendation 2000-1 (DNFSB, 2000) as a followup to its 94-1 Recommendation. While a great deal has been accomplished in meeting the safety objectives set forth in Recommendation 94-1, particularly with regard to those materials that constituted the most imminent hazards, the Board is concerned that problems continue to exist and that the implementation of Recommendation 94-1 has taken longer than expected. The Board encouraged the Department to address stabilization of the remaining materials with more urgency. Remaining problems cited by Recommendation 2000-1 are highlighted in the text box to the left.
- Other DNFSB safety recommendations have dealt with conditions of U-233, plutonium pit storage, safety management at the Pantex Plant, and criticality safety (DNFSB, 1997a, 1997b, 1998, 1999a, and 1999b). The Department has been actively addressing these issues, as well as safety issues identified independently in safety and health vulnerability assessments (DOE, 1993, 1994, and 1996e). The current baseline activities and plans described in Chapter 2 include actions to address these various safety recommendations.

DNFSB Recommendation 2000-1

- Stabilize uranium solutions outside SRS's H Canyon to remove criticality concerns.
- Remediate the americium and curium solutions at SRS's F Canyon and neptunium solutions at H Canyon.
- Convert remaining plutonium solutions to stable oxides or metals and package into welded containers with inert atmospheres.
- Treat plutonium-bearing polycubes at Hanford's Plutonium Finishing Plant to remove and stabilize the plutonium.
- Continue stabilization of spent nuclear fuel at SRS.
- Stabilize and seal within welded containers with an inert atmosphere the plutonium oxides produced at various defense facilities and those which do not conform to the Department's standard for long-term storage (DOE, 1999k).
- Enclose legacy plutonium metal in sealed containers with an inert atmosphere.
- Remediate and/or safely store various residues at the three production sites and two of the national laboratories.

Organizational Responsibilities

Departmental program offices implement the various missions and other responsibilities described above. Through the program offices, the Department also undertakes nuclear materials stabilization, waste management, science research, technology development, and other functions associated with its missions.

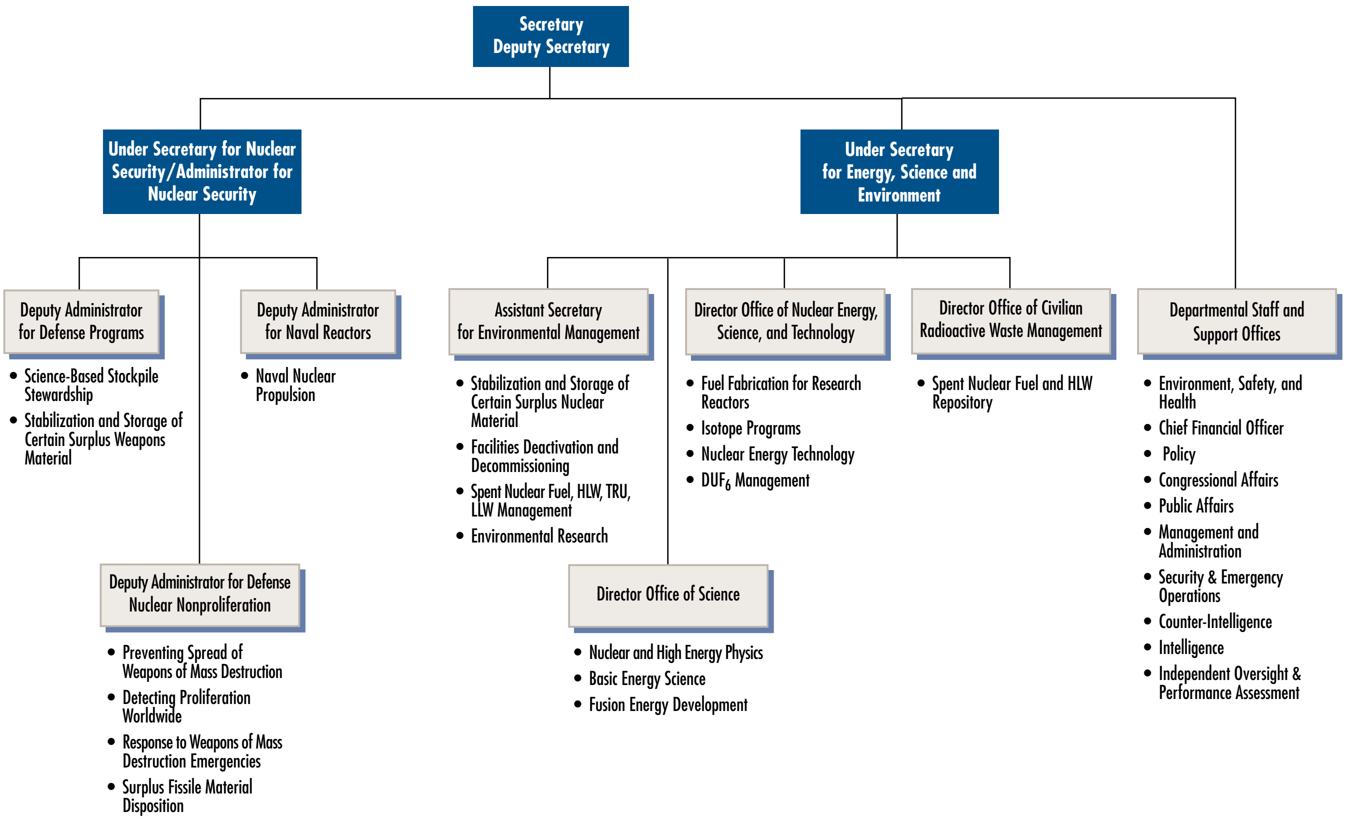
Figure 1-1 displays the Department's organizational structure for implementing its nuclear material management missions. The complete Departmental organization chart is provided in Appendix III. Programs with line responsibility for managing nuclear materials are as follows:

National Nuclear Security Administration (NNSA) — The new NNSA brings together those organizations having direct responsibility for maintaining the nation's nuclear weapons arsenal, as well as planning for and completing the disposition of surplus fissile materials. The NNSA also provides policy and technical assistance to curb global proliferation of weapons of mass destruction, emphasizing U.S. nuclear nonproliferation, arms control, and nuclear safety objectives.

Office of Defense Programs (DP) — DP provides an infrastructure and the intellectual capability to maintain the nuclear weapons stockpile, including replacing limited life components and ensuring an adequate supply of tritium. Since 1989, when the production of new warheads was stopped at Rocky Flats, the primary focus of DP has shifted from weapons production to stockpile life extension and surveillance. DP is now responsible for:

- continuing to maintain the nuclear stockpile, including the strategic inventory of weapons-usable nuclear materials;
- restructuring and modernizing the weapons complex; and

Figure 1-1 Current DOE Functional Structure for Nuclear Materials Management



- retaining the capability to resume nuclear testing and meet production requirements appropriate to future national security needs.

In fulfilling its national security responsibility, DP is required to maintain the vitality of the key nuclear weapons national laboratories: LANL, LLNL, and Sandia National Laboratories (SNL).

Office of Environmental Management (EM) — EM is responsible for the stabilization and storage of certain surplus weapons-capable nuclear materials; treatment and storage of high-level waste and spent nuclear fuel; deactivation, decontamination, and decommissioning of excess facilities; disposal of TRU, LLW and mixed low-level waste; waste minimization; and material recovery/reuse. Over the years, EM has accepted custody of substantial quantities of non-waste, surplus nuclear materials. If programmatic uses are identified, they are reassigned to user organizations. EM will otherwise dispose of all remaining nonweapons-capable materials in an efficient manner.

Office of Nuclear Energy, Science and Technology (NE) — This office conducts vital research and development, enhances science and technology, and manages nuclear facilities and materials. NE's responsibilities include:

- utilization, management and disposition of nuclear materials such as natural uranium and DUF_6;
- nuclear fuel element fabrication for research reactors;
- conversion of U.S. university research reactors from HEU to LEU reactor fuel;
- production of Pu-238 for National Aeronautics and Space Administration (NASA) missions (currently under NEPA review); and
- medical, industrial, and research isotope production and distribution.

Office of Defense Nuclear Nonproliferation (NN) — NN is the lead office for activities and programs that support U.S. arms control and nonproliferation policies, goals, and objectives, as well as statutorily mandated activities. The office provides leadership and representation for the Department in the international arms control and nonproliferation community and the U.S. Government's interagency process, as well as for the U.S. Government in national and international arms control and nonproliferation negotiations, agreements, and interactions. NN is also responsible within the Department for technology development and program implementation to prevent the proliferation of nuclear weapons, detect nuclear proliferation, and monitor nonproliferation and arms control treaties and agreements.

Office of Fissile Materials Disposition (NN-60) - The Office of Fissile Materials Disposition reports to the Office of Defense Nuclear Nonproliferation as of March 1, 2000, as part of the NNSA reorganization. For purposes of this report, the Office of Fissile Materials Disposition will be designated as MD. The principal objective of the Office of Fissile Materials Disposition is the disposition of substantial inventories of surplus U.S. weapons-usable plutonium and HEU and providing technical support for reciprocal actions by Russia for the disposition of its surplus weapons plutonium. MD is working with Russia to conduct joint tests and demonstrations of plutonium disposition technologies.

Office of Naval Reactors (NR) — Executive Order 12344, as set forth in Public Law 106-65, stipulates responsibilities and authority of the Naval Nuclear Propulsion Program, of which the Deputy Administrator for Naval Reactors is a part. NR's responsibilities include:

- performing research, development, design, acquisition, construction, inspection, installation, certification, testing, overhaul, refueling, operating practices and procedures, maintenance, supply support, and ultimate disposition of naval nuclear propulsion plants;
- ensuring the safety of reactors and associated naval nuclear propulsion plants and controlling radiation and radioactivity associated with naval nuclear propulsion activities; and
- administering the naval nuclear propulsion program.

Office of Civilian Radioactive Waste Management (RW) — RW is responsible for implementing the Nuclear Waste Policy Act, as amended, for developing a permanent, safe, monitored geologic repository for disposal of spent nuclear fuel from commercial nuclear power plants and for Department-owned spent fuel and HLW.

Office of Science (SC) — SC is responsible for funding the operation of facilities that use non-national security nuclear materials for basic and applied research (e.g., specified non-Department university research and development). SC manages many smaller nuclear materials facilities at research laboratories, and provides non-national security nuclear materials as needed for Department and non-Department programs. SC also evaluates the necessity to acquire, produce, or recover nuclear materials not available from the existing inventory.

The way in which these programs manage nuclear materials within their specific areas of responsibility is reflected in the Department's baseline programs as described in Chapter 2.

Baseline Programs

Chapter 2

This chapter presents the Department's consolidated, baseline program for the management of nuclear materials. For ease in presentation, the baseline program is organized into four major material categories: plutonium, uranium, spent nuclear fuel, and other nuclear materials. These material groupings have unique characteristics, technical considerations, and disposition plans.

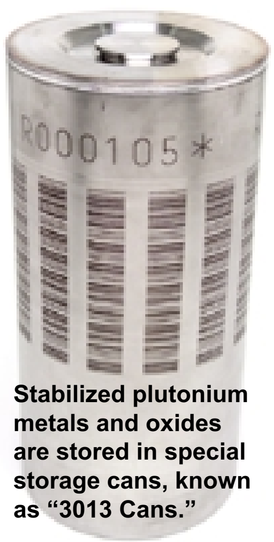
An overview of each material category's inventory, disposition strategy, and key associated facilities is provided in this chapter. Table 2-1 depicts decisions made under NEPA and ongoing NEPA reviews, DNFSB Recommendations and Implementation Plans, and other analyses that drive the way the Department manages these materials. Also discussed in this chapter are areas that cut across all material types such as facilities, transportation, and technology. The chapter closes with a presentation on the distribution of Departmental funding by program, materials management function, and material type.

Table 2-1 Nuclear Materials Management Implementation Drivers

	Plutonium	Uranium	Spent Nuclear Fuel	Other Nuclear Materials
Decisions Under NEPA				
Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement (DOE, 2000a)	✔			
Record of Decision for Long-Term Management and Use of Depleted Uranium Hexafluoride (DOE, 1999g)		✔		
Records of Decision on the Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site (DOE, 1998a, 1999a, 1999e)	✔			
Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials (DOE, 1997a)	✔			
Records of Decision for the Final Environmental Impact Statement for a Dry Storage Container System for the Management of Naval Spent Nuclear Fuel (DOE, 1997f, 1997g)			✔	
Record of Decision for the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (DOE, 1996i)	✔	✔		
Record of Decision for the Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement (DOE, 1996c)		✔		
Record of Decision for the Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel (DOE, 1996b)			✔	
Records of Decision on Interim Management of Nuclear Materials at the Savannah River Site (DOE, 1995d, 1996d, 1996h, 1997e)	✔	✔	✔	✔
Records of Decision on Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs (DOE, 1995b, 1996a)			✔	
Ongoing NEPA Reviews				
Management of Spent Nuclear Fuel at the Savannah River Site (Final Environmental Impact Statement - DOE, 2000d)			✔	
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 [Notice of Intent (NOI)-DOE, 1999i]	✔			✔
Treatment and Management of Sodium Bonded Spent Nuclear Fuel (Draft Environmental Impact Statement - DOE, 1999d)			✔	
Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain (Draft Environmental Impact Statement – DOE, 1999h)	✔	✔	✔	✔
Site-Wide Environmental Impact Statement, Oak Ridge Y-12 Plant (NOI - DOE, 1999c)		✔		
DNFSB Recommendations and Associated DOE Implementation Plans				
Recommendation 2000-1, Follow-on to Recommendation 94-1, Improved Schedule for Remediation in the Defense Nuclear Complex (DNFSB, 2000); Implementation Plan (DOE, 2000b)	✔	✔	✔	✔
Recommendation 99-1, Safe Storage of Pits at Pantex (DNFSB, 1999b); Implementation Plan (DOE, 2000c)	✔			
Recommendation 98-2, Safety Management at the Pantex Plant (DNFSB, 1998); Implementation Plan (DOE, 1999l)	✔			
Recommendation 97-2, Continuation of Criticality Safety at Defense Nuclear Facilities (DNFSB, 1997b); Implementation Plan (DOE, 1998d)		✔		
Recommendation 97-1, Safe Storage of Uranium-233 (DNFSB, 1997a); Implementation Plan (DOE, 1997c)		✔		
Recommendation 94-1, Improved Schedule for Remediation in the Defense Nuclear Complex (DNFSB, 1994); Implementation Plan (DOE, 1995f, 1998b, and 2000b)	✔	✔	✔	✔
Other				
DOE Standard 3013, Stabilization, Packaging, and Storage of Plutonium-Bearing Materials (DOE, 1999k)	✔			
FY 2000 Stockpile Stewardship Plan (Executive Overview) (DOE, 1999b)	✔	✔		
SRS Chemical Separation Facilities Multi-Year Plan (DOE, 1997b)	✔	✔	✔	✔
HEU Working Group Report on Environmental, Safety, and Health Vulnerabilities Associated with Storage of HEU (DOE, 1996e)		✔		
Y-12 Environmental Assessment/Finding of No Significant Impact (DOE, 1995g)		✔		
Settlement Agreement between DOE, U.S. Navy, and the State of Idaho (Public Service Company of Colorado vs Batt) (PSC, 1995)			✔	
Plutonium Working Group Report on Environmental, Safety, and Health Vulnerabilities Associated with the Department's Plutonium Storage (DOE, 1994)	✔			✔
Spent Nuclear 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 (DOE, 1993)			✔	

Plutonium

Overview and Inventories



Stabilized plutonium metals and oxides are stored in special storage cans, known as "3013 Cans."

Plutonium is a manmade fissile element. Pure plutonium is a silvery metal, heavier than lead. Material rich in the Pu-239 isotope is preferred for manufacturing nuclear weapons. The half-life of Pu-239 is 24,000 years. From the early 1940's to the late 1980's, the U.S. Government produced plutonium for its nuclear weapons stockpile and research and development programs. The process involved neutron bombardment of uranium in production reactors at the Hanford and Savannah River sites and chemical processing in facilities at these same sites to produce purified plutonium products, generally metal. Metal for weapons was then sent to Rocky Flats to be made into weapons parts (including pits). These weapons parts were then shipped to Pantex for assembly into nuclear weapons. Rocky Flats was also required to conduct a large amount of processing for purification and recovery of the weapons parts that came back from weapons dismantlement/retirement activities at Pantex.

These production and processing activities, geared to high output, produced a large quantity of leftover materials: metal scrap, oxides, solutions, and waste forms still containing significant amounts of plutonium. With the cessation of weapons production, many plutonium forms were left in in-process conditions without defined recovery or stabilization paths. Additionally, many of these former production facilities still exist and are in use today for stabilization and disposition activities. These facilities are, in many cases, old and possess inadequate storage capacities for surplus plutonium materials.

Currently, the Department manages approximately 99.5 MT of plutonium, consisting of several different isotopes, the predominant isotope of which is Pu-239 (see Figure 2-1). A large portion of this weapons-capable plutonium is used by national security programs managed by DOE and the Department of Defense (DoD). National security plutonium material is used in the nuclear weapons stockpile and material held for reserves at Pantex, or used for process development and research and development at the two weapons design laboratories, LANL and LLNL. It also includes material that is part of mutual defense activities to support U.S. Government agreements to hold, exchange, or otherwise manage nuclear material in cooperation with our allies to provide for enhanced national security of the United States and its allies.

Of the total plutonium managed by the Department, 52.5 MT are excess to national security needs (see Figure 2-2). Most of this material is in the form of excess pits (for weapons) and fuel. A small portion of the 52.5 MT supports programmatic uses such as basic scientific research, criticality research, and production of medical isotopes. Most of this is in the form of fuel for the Zero Power Physics Reactor (ZPPR) and Fast Flux Test Facility (FFTF). The majority of the excess, approximately 48 MT, has no programmatic need. This material is located at seven major sites and is in a variety of physical forms and purity levels. These materials are packaged in cans, pins, plates, drums, or combinations thereof. Table 2-2 provides a summary of the Department's approach for plutonium management.

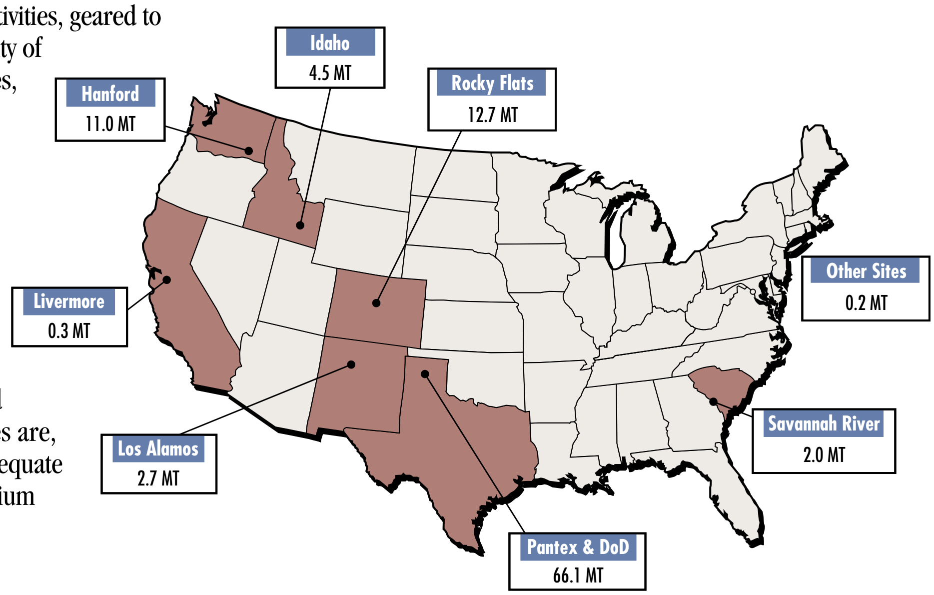
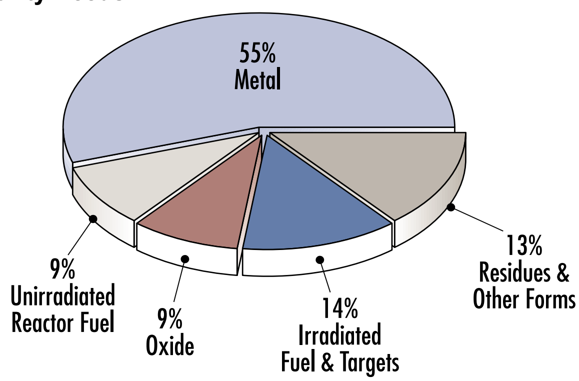


Figure 2-1 Plutonium Inventories by Site **(Based upon the Secretary of Energy's *Openness Initiative* Announcement of February 6, 1996.)**

Figure 2-2 Forms of Plutonium Excess to National Security Needs



Baseline Program

Continued National Security and Non-National Security Programmatic Uses. The major portion of national security plutonium will remain in the weapons stockpile and associated strategic reserve. Smaller quantities are required by various elements of the Stockpile Stewardship Program to support continued maintenance of the U.S. weapons stockpile. The Stockpile Stewardship Program is documented in the annual updates to the classified Stockpile Stewardship Plan prepared by the Office of Defense Programs in the National Nuclear Security Administration (DOE, 1999b). The Department's policy is to eliminate, where possible, the stockpiles of plutonium and ensure the highest standards of safety and accountability. The United States prohibits production of plutonium for nuclear explosives purposes, or outside of international safeguards. The United States also makes available fissile material no longer needed for our national security purposes to safeguarding by the IAEA, consistent with plans for treatment, storage, and disposition.

Non-national security programmatic reserve material is used to support programmatic uses other than national security, such as basic science research, criticality, or manufacturing heat sources. The Department's strategy for non-national security programmatic Pu-239 is to store the plutonium-based fuels safely pending potential future uses (i.e., fuel for the FFTF and ZPPR). If a decision were made to restart the FFTF, the inventory of unirradiated FFTF mixed uranium-plutonium oxide fuel currently being stored at Hanford would be used to fuel and operate the FFTF. If the reactor were deactivated, the unirradiated MOX fuel would be appropriately dispositioned. The Department is now considering retaining the ZPPR fuel as a national resource at ANL–W. The Department is currently preparing a Programmatic Environmental Impact Statement (PEIS) (DOE, 1999i) to consider the potential impacts of expanded nuclear facilities to accommodate new civilian nuclear energy research and development efforts and isotope production missions, including the role of the FFTF. The balance of the programmatic plutonium is in small research quantities and sealed sources, and those uses are discussed together with other nuclear materials later in the chapter.

Surplus Plutonium Stabilization and Storage – Surplus plutonium material includes inventories that have no identified programmatic needs. These materials exist in a range of forms and purities (primarily as metals, oxides, and residues). While the plutonium materials discussed are generally in stable forms and do not require processing, much of the surplus plutonium materials are not in safe forms for long-term storage. Improperly stored Pu-239 poses a variety of hazards. When containers or packagings fail to fully protect plutonium metal from exposure to air, oxidation can occur and cause packaging failures and personnel contamination. Contamination can also occur when plutonium solutions leak from tanks or piping. Plutonium in the form of scrap materials or residues generated by weapons production is often very

Table 2-2 Plutonium Management Approach

Pu Material	Storage and Stabilization	Disposition
Weapons Stockpile	• Maintain in weapons stockpile and associated reserve – Surveillance – Assessment and certification – Design and manufacturing (refurbish and certify)	• Use for national security
Programmatic (Non-National Security)	• Store pending future use	• FFTF fuel use is contingent upon decisions in PEIS/Record of Decision
Excess or Surplus	• Repackage pits for safe storage (address DNFSB Recommendation 99-1) • Stabilize and repackage metals and oxides for safe storage (address DNFSB Recommendations 94-1 and 2000-1); process at-risk fuel and targets at SRS • Consolidate plutonium storage • Improve SRS storage capacity (K-Area Material Storage and Building 235-F)	• Repackage (stabilize and blend as needed) plutonium residues for disposal at the Waste Isolation Pilot Plant (WIPP) • Dispose of spent nuclear fuel (containing plutonium) in a monitored geologic repository • Pursue hybrid approach for surplus plutonium: – Immobilize plutonium in ceramic material with high-level waste for geologic disposal – Irradiate as MOX fuel in domestic, commercial reactors (with spent fuel prepared for a monitored geologic repository)

corrosive, chemically reactive, and difficult to contain. Buildings and equipment that are aging, poorly maintained, or of obsolete design contribute to the overall problem.

The DNFSB has urged the Department to expedite stabilization of its surplus plutonium materials (Recommendations 94-1 and 2000-1) (DNFSB, 1994 and 2000). The Department is in the process of repackaging pits and is actively repackaging metals and oxides to place them in safe conditions — either in special packaging that meets standards for long-term storage or in packages suitable for disposal at WIPP.

In accordance with its Record of Decision on the Storage and Disposition of Weapons-Usable Fissile Materials (DOE, 1997a), the Department will consolidate surplus non-pit plutonium at SRS from Rocky Flats to facilitate closure of facilities. Previous plans had anticipated construction of a new Actinide Packaging and Storage Facility (APSF) at SRS to provide the needed storage capacity. Recent analyses have determined that a preferred approach would be to use existing storage capabilities at SRS [K-Area Material Storage (KAMS) and Building 235-F]. These facilities will require upgrade or expansion. Detailed discussion of this topic is found in Chapter 3.

Surplus Plutonium Disposition – The fundamental purpose of the program is to maintain a high standard of security and accounting for these materials while in storage, and to ensure that plutonium declared excess to national security needs (now, or in the future) is not used for nuclear weapons. On January 11, 2000, the Department issued its Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement (EIS) (DOE, 2000a), affirming an earlier decision to pursue a hybrid approach for disposition of surplus plutonium and selecting SRS as the location for the facilities. The hybrid approach uses both immobilization and MOX fuel technologies and will require construction of three facilities at SRS:

- A pit disassembly and conversion facility (PDCF) will be used to disassemble nuclear weapons pits and to convert the metal (along with other non-pit pure metal) to a declassified oxide form suitable for international inspection. The resultant oxide would either be used as feedstock for MOX fuel or be immobilized for direct disposal with HLW in a geologic repository.
- A facility to fabricate MOX fuel for irradiation in existing, domestic commercial reactors. Following irradiation, the spent nuclear fuel will be shipped to a geologic repository for disposal.
- An immobilization facility to convert plutonium stocks not suitable for reactor fuel to a ceramic form that would then be sealed in cans and placed in empty HLW canisters using the "can-in canister" concept. The canisters will be transported to the existing Defense Waste Processing Facility (DWPF) to be filled with borosilicate glass containing HLW. The canisters will eventually be shipped to a geologic repository for disposal, along with Departmental and commercial spent nuclear fuel.

Approximately 3 MT of plutonium in residues, primarily at Rocky Flats, will be repackaged (with stabilization and blending down, as needed) and shipped to WIPP for disposal as TRU waste. The remainder of the Rocky Flats residues and scrub alloy will be sent to SRS for processing and storage until final disposition. These residues were addressed in the Records of Decision concerning the management of Rocky Flats plutonium residues and scrub alloy (DOE, 1998a, 1999a, 1999e). About 7.5 MT of plutonium, in the form of spent nuclear fuel, is expected to be disposed of intact in a geologic repository. The only exception is a very small quantity of plutonium present in damaged targets and fuels scheduled for processing at SRS. Depending on the fuel type, this small quantity of plutonium will either be processed into plutonium metal for disposition or dispositioned as an HLW stream.

In sum, the end state for all surplus plutonium is geologic disposal (either WIPP or an HLW geologic repository). See Table 2-3 for an overview of key plutonium facilities. Figure 2-3 shows the amounts of Pu-239 that are to be dispositioned as discussed earlier, and Figure 2-4 presents the current status of the complex as it pertains to sites storing plutonium awaiting disposition.

"Can-in Canister" concept for immobilized plutonium

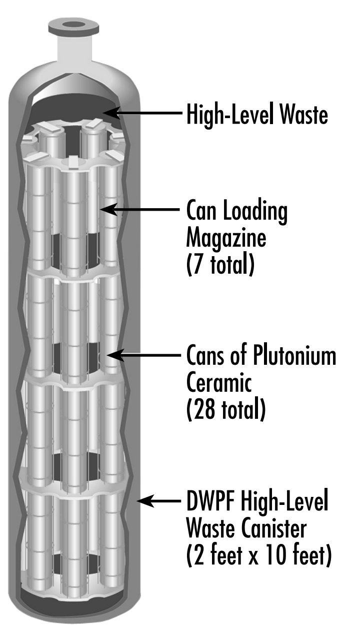


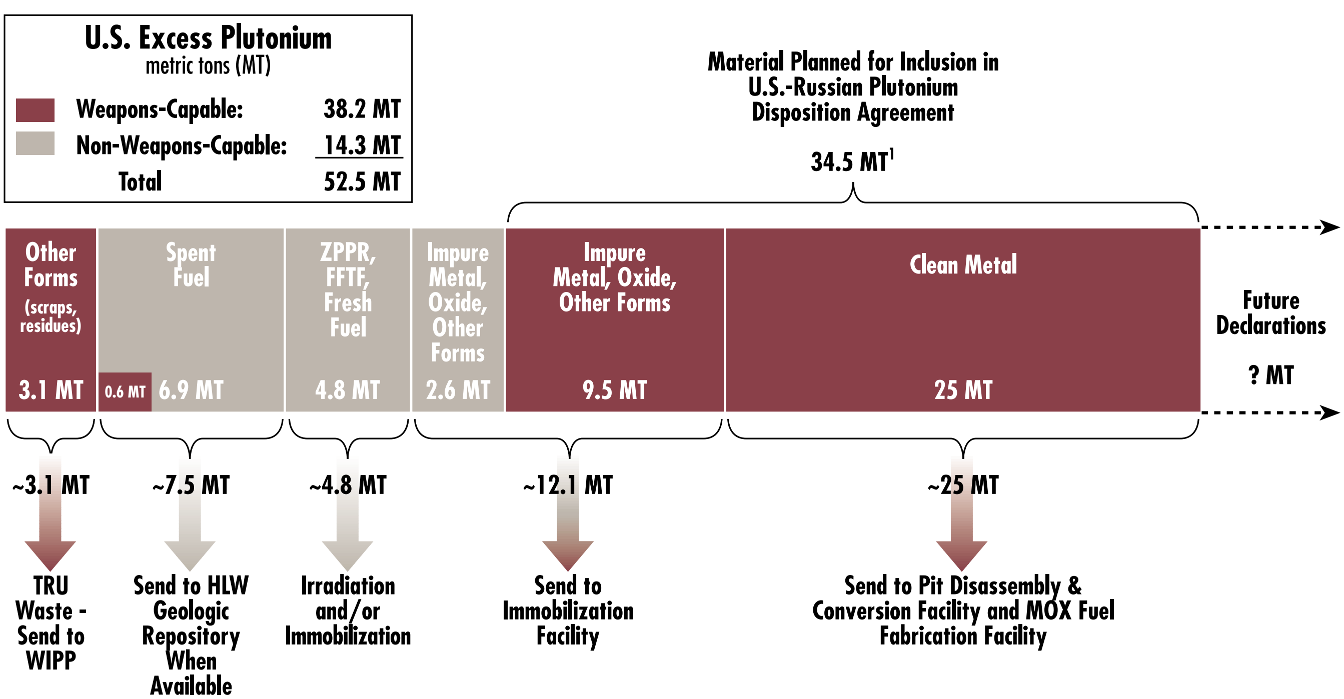
Table 2-3 Key DOE Plutonium Facilities

Facilities	Site	Function	Status
TA-55/PF-4, Plutonium	LANL	• Research and development (R&D) supporting stockpile stewardship (incl. pit rebuild) • Stabilization, packaging and storage of surplus residues, metal, and oxide • Development and testing supporting disposition of surplus plutonium	• Stewardship activities ongoing (e.g., plutonium aging, pit rebuild) • Stabilization of residues underway • PDCF Advanced Recovery and Isotope Extraction System (ARIES) work continues supporting facility design
New Chemistry and Metallurgy Research Facility	LANL	• R&D - Analytical Chemistry • R&D - Engineering and Design Support • R&D - Metallurgy • Remote Operations	• Proposed facility to begin Operation in 2010, subject to NEPA review
Facility (B332)	LLNL	• R&D supporting science-based stockpile stewardship • Development and testing supporting disposition of surplus plutonium • Development of methods to survey and monitor Pu for international inspection	• Stabilization of metals and oxides beginning at LLNL • Pu immobilization disposition development work continues • Pit Disassembly and Conversion testing continues • Advanced Pu monitoring technique development ongoing
Zone 4	Pantex	• Current storage of surplus and national security pits • Pit surveillance in support of science-based stockpile stewardship • Future storage of surplus pits	• Pit storage and surveillance activities ongoing
Zone 12	Pantex	• Current storage of surplus and national security pits • Repackaging of pits • Disassembly of weapons components • Future storage of national security pits	• Disassembly ongoing in concert with pit rebuild and other stockpile stewardship activities • Repackaging of pits underway
Fuel Manufacturing Facility, Zero Power Physics Reactor	ANL-W	• Storage of Pu ZPPR fuel	• Fuel in storage pending future use
F- and H-Canyons/FB-Line, HB-Line	SRS	• Processing of at-risk fuel and targets; stabilization of Pu-239 residues	• Pu-239 stabilization ongoing in canyon facilities and HB/FB lines
Existing storage facilities (K-Area Materials Storage and 235-F)	SRS	• Storage	• Pu-239 material in storage in 235-F vault • K-Area was recently modified to store surplus metal and oxide pending disposition; scheduled to start receiving material from Rocky Flats in Fall 2000
New Pit Disassembly and Conversion Facility	SRS	• Disassembly of pits and convert to unclassified oxide product	• January 2000 Record of Decision selected SRS as site • Design work has been initiated
New Plutonium Immobilization Facility	SRS	• Conversion of non-pit Pu into oxide and encapsulation into ceramic matrix for disposal	• January 2000 Record of Decision selected SRS as site • Design work scheduled to begin 2001
New MOX Fabrication Facility	SRS	• Fabrication of MOX fuel from oxide	• January 2000 Record of Decision selected SRS as site • Design work has been initiated
Plutonium Finishing Plant Complex	Richland (RL)	• Stabilization, packaging, and storage of plutonium metal, oxide, and residues • Storage of miscellaneous fuel materials	• Planning for remaining stabilization and packaging work essentially complete • Stabilization work on oxides has been initiated
400 Area (in/near Fast Flux Test Facility)	RL	• Storage of FFTF fuel	• Ongoing storage pending decision under NEPA on use/disposition of FFTF fuel
Building 707	Rocky Flats Environmental Technology Site (RFETS)	• Stabilization, packaging, and storage of plutonium residues	• Stabilization for interim storage continues • Completion targeted for May 2002 • Other facilities continue packaging of waste for disposal
Building 371	RFETS	• Stabilization, packaging, and storage of plutonium metals, oxides, and residues	• Pu stabilization and packaging system is scheduled to package metals and oxides to long-term storage standards in Fall 2000

Figure 2-5 provides a summary representation of the major paths in the Department's current baseline program to accomplish its plutonium missions. The following discussion presents some of the key issues faced in implementing the baseline program.

- When certain operations ceased at the end of the Cold War, plutonium materials were temporarily left in unstable conditions.
  - Residues stabilization schedules are slipping, risks need to be more fully understood, and uncertainty reduces the accuracy of estimated costs.
  - Each site/facility is planning, somewhat independently, for storage capacity necessary to meet near-term programmatic needs. More comprehensive and integrated evaluations are needed to identify storage needs.
- National security and nonproliferation work at the national laboratories may be impeded by space constraints. For example, increased space is needed for materials used to design, develop, and verify instrument performance.
- There is a significant need to establish functions in support of Science-Based Stockpile Stewardship and to replace the fabrication functions previously performed at Rocky Flats. Approximately 50 percent of the nation's plutonium will be managed in this path. Historical capabilities, capacities, and technologies are essentially obsolete and are in need of replacement. Component fabrication technology must be upgraded and new certification capability must be established.
- Nonproliferation programs require materials for access, monitoring, instrument development, and advanced monitoring research, some of which are dependent on plutonium.
- The Department will dispose of approximately 50 percent of the plutonium and simultaneously use these quantities to negotiate a reduction in the inventory of Russian-held plutonium. New facilities are needed to accomplish this mission.
- Increased integration is needed for the design, certification, procurement, and management of shipping containers, Department-wide.
- Finally, improved planning and management integration is needed among sites and Departmental offices to meet mission requirements (e.g., transportation, safety, storage, waste criteria). A more corporate level, comprehensive vision and plan for management of the Department's inventory of plutonium is needed to meet all Department objectives.

Figure 2-3 U.S. Excess Plutonium by Material Type and Disposition Pathway



[1]Assumes 0.6 MT of plutonium results from the processing of residues and scrap

Figure 2-4 The Department's Plutonium Complex in the Year 2000

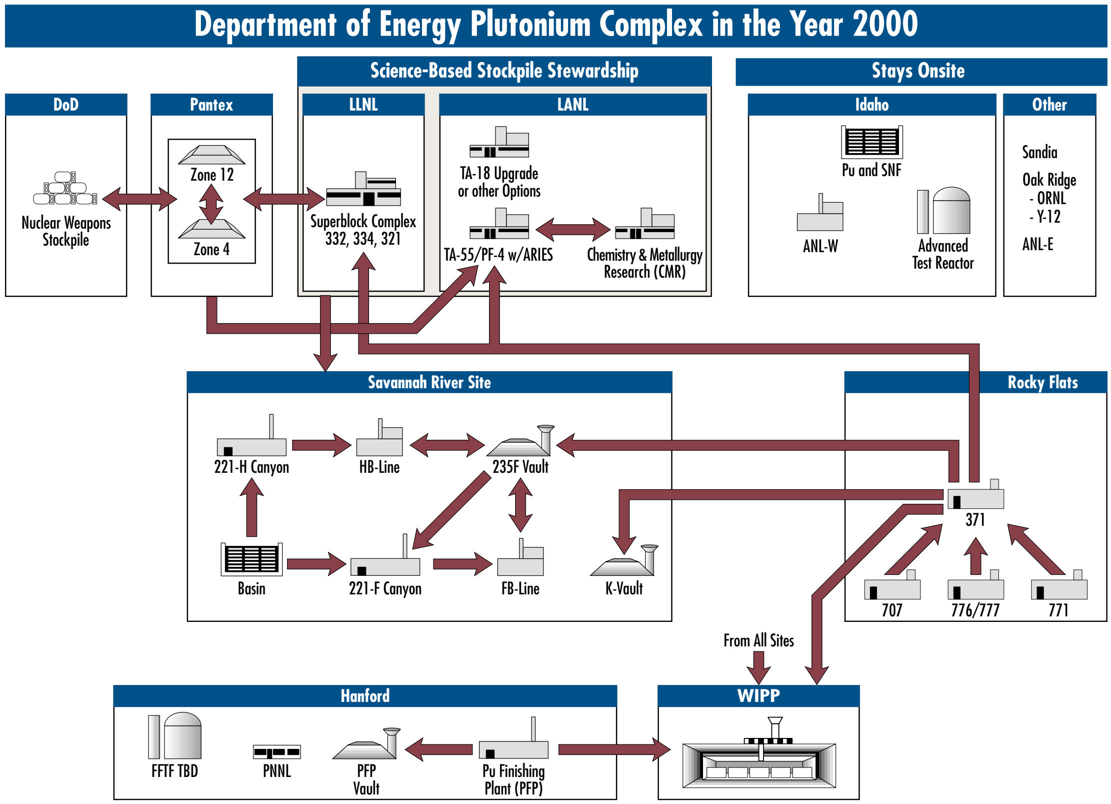
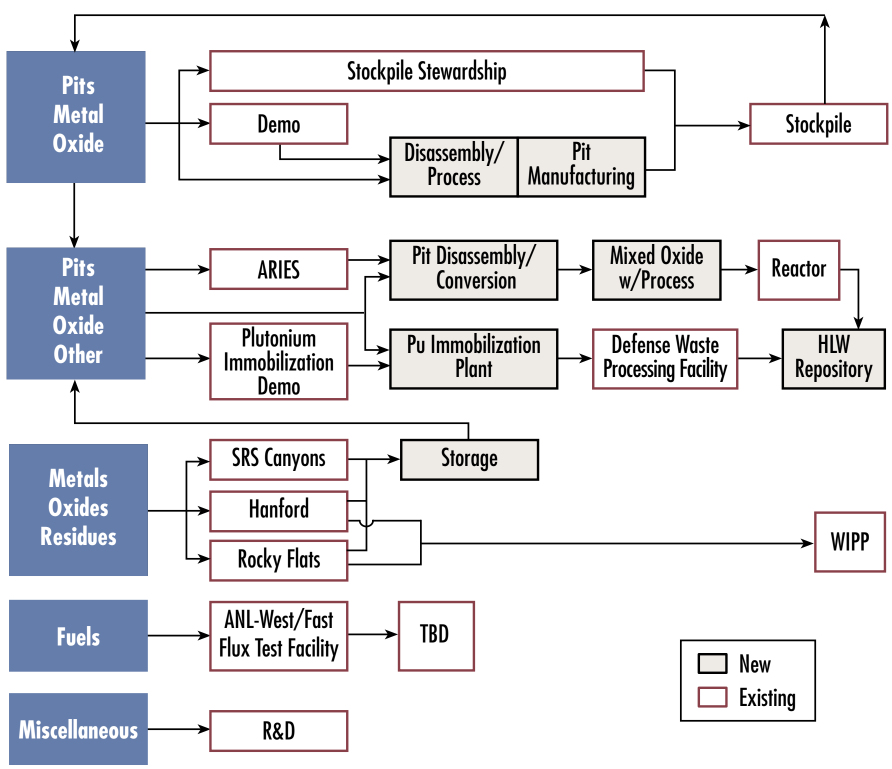


Figure 2-5
Representative Plutonium Baseline Disposition Pathways



Uranium

Overview and Inventories

Uranium is a slightly radioactive, naturally occurring element that is denser than lead. In its natural form, about 99 percent of the atoms in uranium have an atomic weight of 238, while less than 1 percent of the atoms have an atomic weight of 235. From the 1940's through today, the Department and its predecessor agencies used a process called gaseous diffusion to increase the proportion of U-235 in uranium, thereby enriching this material to an isotopic composition suitable for nuclear applications. Gaseous diffusion divides a stream of UF_6 gas, in its naturally occurring isotopic composition, into one stream enriched in U-235 and one depleted. Five to 10 kilograms of DU are produced for each kilogram of LEU and up to 200 kilograms of DU are produced for every kilogram of HEU.

Depleted Uranium Slugs

- *Highly-enriched uranium* (HEU) (equal to or more than 20 percent U-235) is used in weapons components and reactor fuels. Due to decreasing need, HEU production for the nuclear weapons program was discontinued in 1964 and it was discontinued for the Naval reactor fuel program in 1992. Of the Department's total current HEU inventory, 174 MT has been withdrawn from weapons programs and declared excess to national security. A small amount of the excess has programmatic use as blended-down fuel for research reactors. Half of this excess is stored at the Y-12 Plant at Oak Ridge.
- *Low-enriched uranium* (LEU) (less than 20 percent U-235) was used for production reactors and is now used as a replacement for HEU in domestic and foreign research reactors. At one time, the Department produced LEU for use in commercial nuclear power plants. However, in 1993, the United States Enrichment Corporation (USEC) assumed this responsibility. Most LEU is stored at Hanford, Paducah, and Fernald.
- *Depleted uranium* (DU) (depleted in the U-235 isotope) has been used for weapons parts, radiation shielding materials, as armor and penetrators by the military, and in a variety of commercial applications. Most surplus DU is in the form of DUF_6, stored in cylinders at the three gaseous diffusion plants.
- *Natural uranium* (NU) was obtained and stockpiled in substantial quantities to serve as a feed for enrichment processes. Most of the NU is stored at Paducah and Portsmouth.
- *Uranium-233* (U-233) is a manmade isotope resulting from the neutron capture of thorium-232 and has been used in weapons research and in reactor fuel programs. Most of the unirradiated U-233 is stored at ORNL as an oxide and at Idaho as fabricated Light-Water Breeder Reactor fuel (LWBR).

Baseline Program

The Department's policy is to eliminate where possible the stockpiles of HEU and ensure the highest standards of safety and accountability. The Department's uranium materials baseline program includes maintaining materials in safe interim storage (with stabilization and blend-down as needed) pending use/reuse in national defense or other programmatic applications or disposition as surplus uranium. The United States prohibits the production of HEU for nuclear explosives purposes or outside of international safeguards. The United States also makes fissile material no longer needed for our national security purposes available for safeguarding by the IAEA, consistent with plans for treatment, storage, and disposition. With respect to disposition of surplus uranium, the Department prefers to maximize the reuse of surplus uranium materials to the extent they meet (or can be processed to meet) specifications for use in the commercial nuclear fuel market. Plans for commercial use or disposal have been developed for surplus HEU in keeping with nonproliferation policies to minimize the civil use of HEU. Figure 2-6 depicts the excess HEU inventories by site. Evaluations are still in the early stages for determining potential disposition of U-233, LEU, NU, and other DU. The quantities of these materials are classified.

The overall management of the Department's excess uranium is accomplished through multiple Department programs, with the

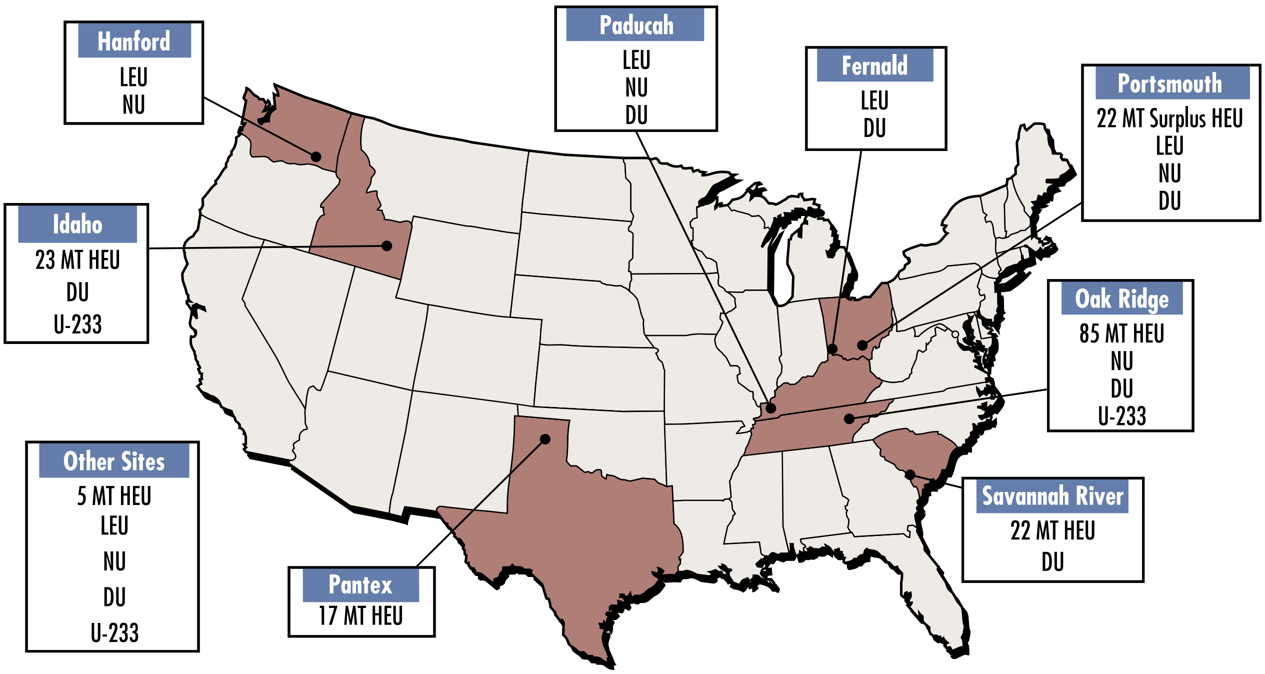


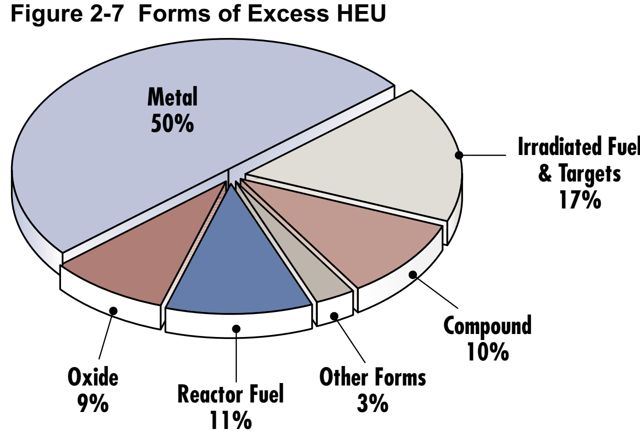
Figure 2-6 Excess HEU Inventories by Site (Based upon the Secretary of Energy's *Openness Initiative* Announcement of February 6, 1996.)

programmatic responsibility of HEU disposition residing with MD. Management of LEU/NU/DU is primarily the proposed responsibility of EM and NE, assisted by the Oak Ridge Uranium Management group. The management of U-233 is shared by DP, EM, MD, and NE. The management approach for each material type is discussed below.

Management Approach for HEU – The Y-12 Plant at Oak Ridge is the primary facility in the complex for storing and processing HEU, although significant quantities of surplus HEU are being processed at SRS and at two commercial facilities. Most of the national security, programmatic-use, and surplus HEU inventories are being consolidated at the Y-12 Plant. HEU is stored in secured and heavily protected vaults (a significant portion of the budget for HEU management and storage). Much will require processing before it can be reused. To support the consolidation, a new HEU Materials Facility is being planned. The facility would hold high quality HEU. Other forms, such as scrap, residue and fuel elements, would be stored elsewhere pending recovery of the HEU (Figure 2-7). A new Enriched Uranium Manufacturing Facility, not yet authorized, is in the feasibility study stage. This facility would be used for weapons program needs and would not have the capability and/or capacity to blend, process, or recover surplus materials. Upgrades to existing facilities to ensure safe operations have been identified.

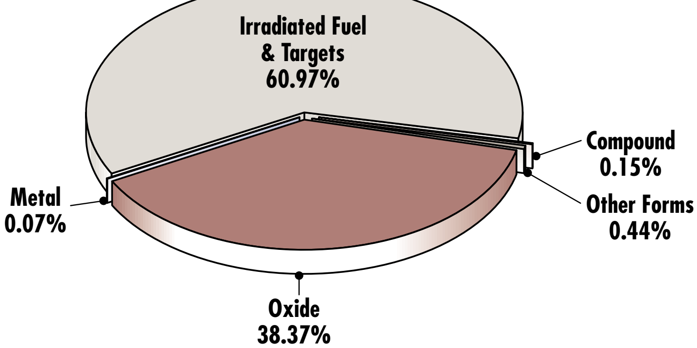
Under the 1996 Department Record of Decision on the disposition of surplus HEU (DOE, 1996c), the disposition strategy for HEU is to make it non-weapons-usable by blending it down to LEU for reuse as commercial reactor fuel (85 percent) or disposal (15 percent). Of the 174 MT of excess HEU, ownership of 62 MT of surplus material has already been transferred to USEC, including 48 MT that will be transferred over the next 6 years pursuant to the USEC Privatization Act (USEC, 1998) and the Memorandum of Agreement between USEC and the Department. An additional 30 to 40 MT of "off-specification" surplus HEU is planned to be transferred to the Tennessee Valley Authority (TVA) for use in its reactors. Of this material, approximately half would be down-blended at SRS and the remaining half at a licensed commercial vendor to be selected by TVA. The remaining quantity is undergoing additional evaluation to identify an appropriate disposition alternative.

Figure 2-7 Forms of Excess HEU



Management Approach for U-233 – The Department's inventory of separated U-233 is small relative to that of plutonium and HEU. However, the U-233 is weapons-usable and has stringent radiation protection requirements. Approximately half of the U-233 is stored at Oak Ridge. Most of this material is purified and of high isotopic quality, but is stored in a facility at Oak Ridge that requires upgrades to ensure continued safe storage. A similar quantity exists as a compound (with thorium) in fabricated LWBR irradiated/non-irradiated fuel elements. This material is stored at INEEL (Figure 2-8).

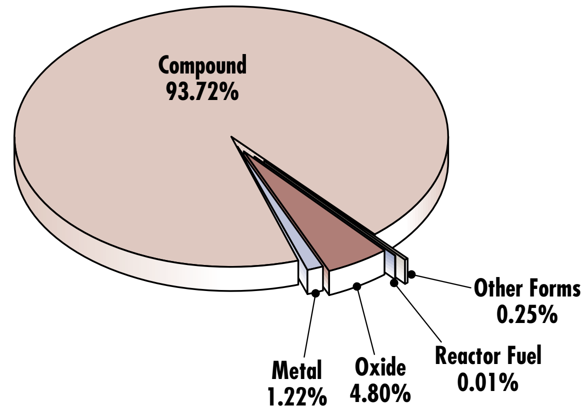
Figure 2-8 Forms of Uranium-233



In 1997, the DNFSB recommended that the Department clarify line responsibility for U-233 by establishing a single line item project to develop and implement a comprehensive plan for U-233, including the establishment of standards for U-233 packaging, transportation, and storage (DNFSB, 1997a, DOE, 1997c). A program is in place to remediate the near-term vulnerabilities and to evaluate the advantages and disadvantages of future management options. The Department is currently assessing what programmatic options will be evaluated in a future EIS. Options currently under consideration include preserving the high-quality U-233 as a national resource material for future use (e.g., decay to beneficial medical isotopes and R&D on proliferation resistant fuel cycles) and treating and disposing of the remaining material, depending on the results of economic studies for storage versus disposal.

Management Approach for DU – The Department maintains an active cylinder management program to improve existing storage conditions for the large inventories of DUF_6 at the gaseous diffusion plants. Under the Record of Decision for Long-Term Management and Use of Depleted Uranium Hexafluoride (DOE, 1999g), the Department will convert the DUF_6 inventory to uranium oxide, uranium metal, or a combination of both. The depleted uranium oxide form will be stored for potential future use. At this time, the Department does not believe that long-term storage or disposal as DU metal is reasonable, however, it is open to exploring these options

Figure 2-9 Forms of Depleted Uranium



further. The Department plans to issue a Request for Proposal (RFP) in FY 2000 for conversion services and to prepare an EIS on the construction and operation of conversion facilities.

Smaller quantities of other forms of DU (Figure 2-9) currently have no formal, defined disposition path. Options for these materials will be evaluated as part of a future EIS on the management of potentially reusable uranium materials.

Management Approach for LEU and NU – LEU and NU are currently stored in a variety of forms and containers at multiple sites. LEU is used as fuel for domestic and foreign research reactors and NU is used as enrichment feed or for blending. While some quantities of LEU and NU have identified programmatic uses, other quantities are surplus and do not have defined disposition paths. Planning has been hampered due to insufficient characterization of these materials. Disposal of LEU is problematic in that compliance with enrichment limits at disposal sites could require extensive down-blending and packaging to meet transportation and disposal criteria. The infrastructure for such treatment is not in place, and a final path for disposition of this LEU has yet to be determined. For any end state, LEU may have to be stored temporarily until processing capacity is available. Restrictions on commercial sales and a depressed uranium market also present issues to the disposition of LEU and NU. A future EIS will evaluate the storage and disposition options for LEU and NU, including consolidation of usable inventories (Figures 2-10 and 2-11). Key uranium facilities are highlighted in Table 2-4.

Figure 2-10 Forms of Low Enriched Uranium

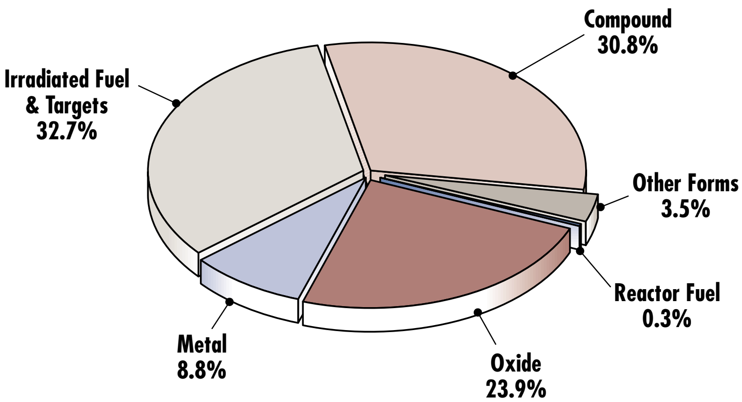


Figure 2-11 Forms of Natural Uranium

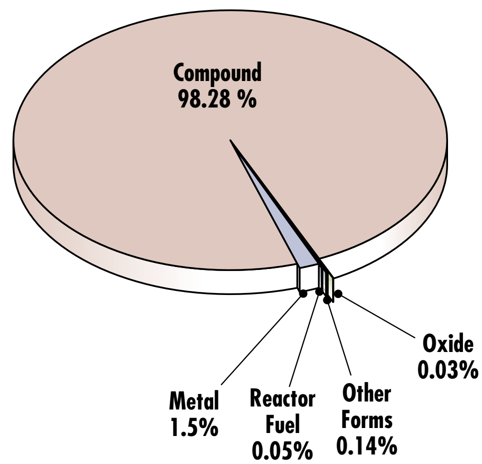


Table 2-4 Key Uranium Facilities

Facilities	Site	Functions	Status
New Highly Enriched Uranium Materials Facility	Y-12	Storage	– Propose to begin final design as FY 2001 budget line item – Construction planned FY 2001-2005 – On-line in FY 2005 – To be addressed in Y-12 Site-Wide EIS
Proposed Enriched Uranium Manufacturing Facility	Y-12	Chemical recovery, metal processing, down-blending	– Feasibility study underway – Projected construction beyond 2010 – Some funding provided under Y-12 Modernization Project
New DUF_6 Conversion Facility	Paducah/ Portsmouth	Conversion of DUF_6 to metal or oxide	– RFP for conversion services to be issued FY 2000 – Begin final design as FY 2001 budget line item – Proposed construction planned to begin FY 2002 – On-line in FY 2004 – To be addressed in DUF_6 Facilities EIS
Existing buildings: 9212, 9204-2E, 9215, 9720-5, and 9206	Y-12	Storage, packaging, processing	– 9000 series buildings recently out of stand-down status (stand-down has resulted in backlog of materials to be processed)
Radiochemical Development Facility (3019) Irradiated Materials Testing Facility (3025) Radiochemical Laboratory (4501)	ORNL	Storage	– Continue to store and treat Molten Salt Reactor Experiment primarily U-233 and store, inspect and repackage U-233 in accordance with DNFSB 97-1 Program Execution Plan (complete 2002)
F and H Canyons	SRS	Storage and processing of HEU solutions and irradiated targets and fuel elements	– F and H Canyons are being utilized to stabilize materials in accordance with DNFSB Recommendations 94-1 and 2000-1 Implementation Plans

Spent Nuclear Fuel

Overview and Inventories

Spent nuclear fuel is nuclear fuel that has been permanently withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. Some irradiated targets are also managed as spent nuclear fuel due to their close similarity to reactor fuels and to their planned disposition in a geologic repository. The United States stopped reprocessing the Department's spent nuclear fuel for production purposes in 1992. The United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in spent fuel reprocessing for either nuclear power or nuclear explosive purposes. Today, the Department's spent fuel is being stabilized, packaged for interim storage, and prepared for anticipated disposal in a geologic repository.

The Department currently manages about 2,500 metric tons of heavy metal (MTHM) of spent nuclear fuel (owned by the Department) at four sites: Hanford, Idaho, SRS, and Oak Ridge (Figure 2-12). Some small quantities of spent fuel are in storage at West Valley in New York and at the Fort St. Vrain site in Colorado. An additional 100 MTHM is expected to be received into inventory over the next 35 years, primarily from domestic and foreign research reactors and the Naval Reactors Program.

The Department's current inventory comes from: (1) its test and materials production reactors, (2) non-Department U.S. Government reactors, (3) U.S. university research reactors, (4) foreign research reactors, (5) U.S. Navy propulsion reactors, and (6) Department-owned commercial spent nuclear fuel. There are over 250 different fuel types that have different enrichment, fissile materials, cladding, and geometry. The major types and quantities are depicted in Table 2-5.

Table 2-5 Major Fuel Types and Surplus Quantity

Material	Surplus Quantity (MTHM)	Program
Spent Nuclear Fuel	2,494	
- Aluminum-based	10	EM
- Non-aluminum-based	21	EM
- Production Fuel/FFTF	2,115	EM/NE
- Department-owned Commercial	217	EM
- Sodium-bonded	61	EM/NE
- All Other	70	EM/NR

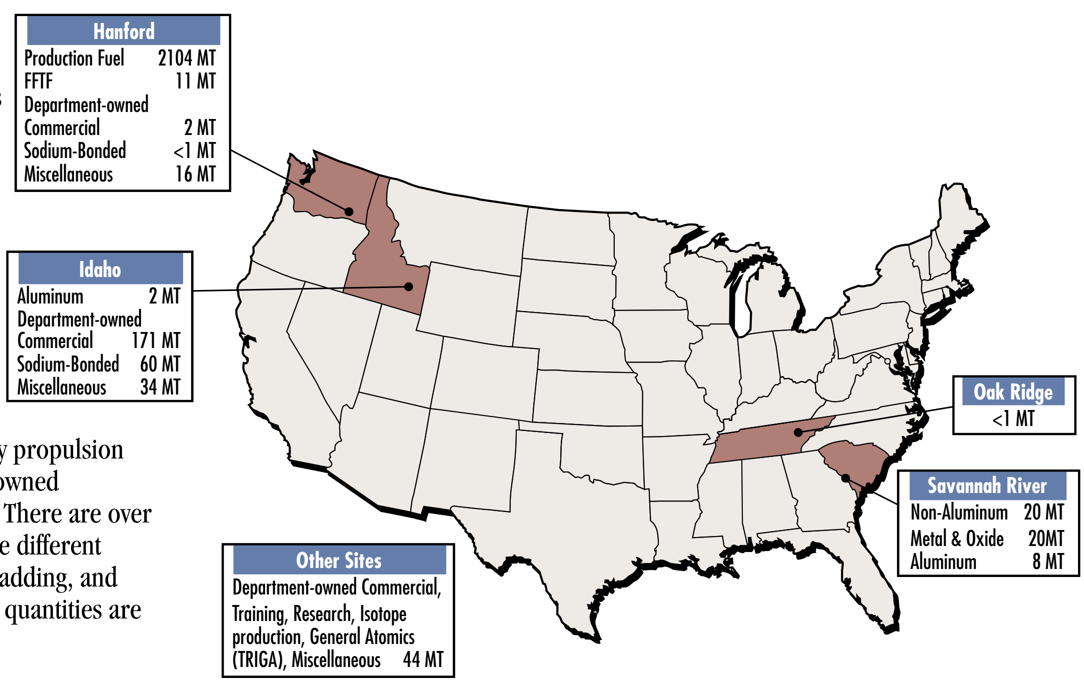


Figure 2-12 Spent Fuel Inventories by Site

Baseline Program

Much of the Department's spent fuel is stored in underwater basins (wet storage). Many of these basins are outdated; some spent fuel is corroded and could pose a risk in its current storage condition; and some fuel is not suitable in its current form for disposal in a repository (Table 2-6). Therefore, current programs and plans are focused on:

- correcting existing vulnerabilities,
- moving spent fuel from wet basins to dry storage,
- processing at-risk spent fuel, and
- preparing spent fuel in "road-ready" condition for anticipated future disposal in a high-level waste geologic repository.

Being "road-ready" means packaged inside a sealed canister that would be acceptable at a repository without having to be reopened at the time of shipment.

Pursuant to the Nuclear Waste Policy Act (NWPA) of 1982, as amended, the Department's RW is currently evaluating a site at Yucca Mountain, Nevada, as a possible location for a geologic repository. The Department is required by law to use a repository developed under the NWPA for disposal of HLW and spent fuel from national defense and civilian nuclear activities, unless the President finds that a separate repository for defense wastes is required. In 1985, President Reagan determined that a separate repository was not needed, and since then the Department has planned for disposal of its HLW from defense nuclear activities in a repository developed by RW. The role of a repository is central to Administration policy because the completion of a permanent geological repository is essential not only for commercial spent fuel disposal, but also for the cleanup of the Department of Energy's nuclear weapons complex and disposal of its weapons-capable materials. A repository also furthers U.S. international nuclear nonproliferation objectives.

Table 2-6 Current Approach for Storage and Preparation for Disposal of Spent Nuclear Fuel

Site	Approach
Hanford	• Move all spent fuel to new dry storage. • Place production fuel in Multi-Canister Overpacks pending shipment to a geologic repository. • Place FFTF fuel and other miscellaneous fuel in canisters for interim storage. Repackage for final disposition when repository acceptance criteria are finalized. [Note: The future use of FFTF is being evaluated under a range of potential options in an ongoing NEPA evaluation (DOE, 1999i). One option includes use of the facility as a candidate for isotope production and R&D missions. Another option is closure of the facility.] • Department-owned commercial fuel is already in road-ready form for shipment to a repository. • Store sodium-bonded fuel at FFTF until shipment to ANL-W for dispositioning with the balance of the sodium-bonded spent fuel.
INEEL	• Transfer aluminum-based fuel to SRS for interim storage. • Receive non-aluminum-based spent fuel from SRS and from domestic and foreign research reactors. • Close older wet storage facilities and transfer fuel to new dry storage. • Per agreement with State of Idaho, have all fuel in dry storage by 2023. • Dry and package all fuels in road-ready dry storage. No treatment beyond drying and characterization is anticipated. • Maintain sodium-bonded fuel in both wet and dry storage pending a Record of Decision on treatment and management of this material.
SRS	• Transfer non-aluminum-based spent fuel to INEEL for interim storage. • Receive aluminum-based fuel from INEEL and from domestic and foreign research reactors. • Maintain spent fuel in wet storage until treatment and storage facilities are brought online (pending NEPA review). • Aluminum-based spent fuel that poses health and safety concerns is processed using existing facilities; a small quantity of special fuels is proposed to be processed to prepare for disposition. • Pursue alternative technology development. Pending a Record of Decision, the planning basis is to melt and dilute all remaining aluminum fuel. (This would result in a homogeneous well-characterized waste form that would meet repository acceptance criteria.)

Decisions made in 1995 and 1996 (DOE, 1995a, 1995c, and 1996a) resulted in regionalized management of Department-owned spent nuclear fuel by fuel type. This regionalized approach to interim management of the Department's spent fuel (Table 2-7) consists of the following:

- Hanford production reactor spent fuel and selected commercial test and research reactor spent nuclear fuel will remain at Hanford.
- Non-aluminum-based spent fuel will be consolidated and stored at INEEL.
- Aluminum-based spent fuel will be consolidated and stored at SRS. Spent fuel posing health and safety risks is being processed.
- Naval spent nuclear fuel will be shipped to INEEL for examination and storage.

This approach is being implemented with foreign and domestic shipments being made to both Idaho and SRS. A major benefit of the regionalized strategy is that the interim storage sites are able to concentrate their resources on packaging and planning for disposition of spent fuel types for which they have unique management expertise.

The National Spent Nuclear Fuel Program, located at INEEL, provides centralized planning, inventory tracking, and quality assurance functions for the Department's baseline program. The Program is tasked with coordinating repository disposition efforts for Department-owned spent nuclear fuel and is working closely with RW to integrate Department-owned spent fuel into the preliminary repository design basis. A draft EIS has been prepared to consider the potential environmental impacts of developing, operating, and eventually closing a repository (DOE, 1999h).

In the meantime, the Department is working to resolve existing vulnerabilities and to package spent fuel in road-ready canisters for dry interim storage. With the exception of the small amount of spent nuclear fuel that is being processed at SRS, most Department-managed spent nuclear fuel would be directly disposed of in a geologic repository. Some may undergo treatment (melt and dilute), but the resultant waste forms would ultimately be disposed of in a repository (Figure 2-13).

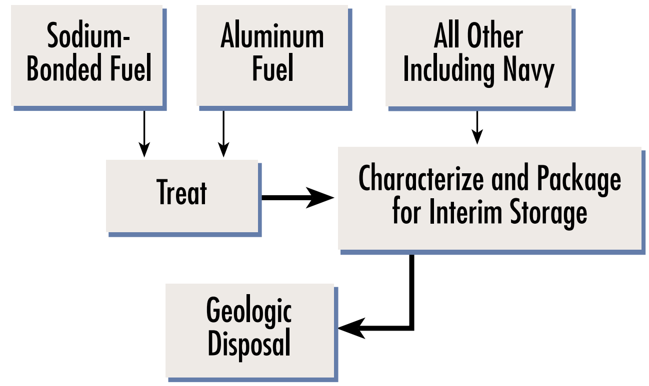


Figure 2-13 Spent Nuclear Fuel Disposition Paths

Fuels that do not meet repository acceptance criteria would need to be treated. The Department is working with the U.S. Nuclear Regulatory Commission (NRC) to receive its feedback on Department plans to prepare its spent nuclear fuel for disposal. This effort should minimize the risk associated with packaging of spent fuel for disposal prior to repository licensing. For planning purposes, it is assumed that shipments from the Department's three spent fuel management sites to a repository would take place during the 2010-2039 timeframe.

New storage/packaging/treatment facilities will be proposed to address spent nuclear fuel needs (see Table 2-7). These facilities will also be considered for other missions to maximize the Department's return on investment. One approach to maximizing the utility of any new facilities is by storing other HLW (e.g., vitrified HLW glass) in the same facilities. The Hanford Canister Storage Building, for example, has flexible capacity to store HLW glass logs in addition to the Multi-Canister Overpacks for which the facility was initially considered. The new facilities may be dry systems and either built to standards comparable to NRC regulations or as privatized facilities managed as NRC licensed facilities.

Table 2-7 Key Spent Nuclear Fuel Facilities

Facilities	Site	Function
Canister Storage Building	Hanford	Construction of the Canister Storage Building for dry storage of N-reactor spent fuel from the 105-K East and West basins is complete. Currently developing detailed plans for packaging other fuels for shipment to the repository.
Dry Transfer/Storage Facility	INEEL	Two facilities under procurement, one at the Naval Reactor Facility (Naval spent nuclear fuel), and a second facility at the Idaho Nuclear Technology and Engineering Center (non-Naval spent nuclear fuel).
CPP-603, CPP-666	INEEL	Existing wet storage pools; spent fuels are being transferred from the older, unlined CPP-603 facility to the newer, lined CPP-666 facility for interim storage pending eventual transfer to dry storage in the privatized Dry Transfer/Storage Facility.
Three Mile Island (TMI) Dry Storage Facility	INEEL	Thirty horizontal storage modules (HSM) have been completed; drying of canisterized TMI spent fuel is underway at the Test Area North facilities, with packages then transferred to the HSM for storage.
Fuel Conditioning Facility, Hot Fuel Examination Facility	ANL-W	Existing hot cell facilities; used in the demonstration program for the electrometallurgical treatment of sodium-bonded spent fuel; being evaluated under NEPA for the treatment of the remaining 60 MTHM of sodium-bonded spent fuels.
Irradiated Fuels Storage Facility	INEEL	Dry storage facility for storage of graphite spent fuel; expanded use for dry storage of spent fuels removed from vulnerable wet storage.
105-K/L Basins, Receiving Basin for Offsite Fuels	SRS	Current wet storage of production and research reactor spent fuels; some aluminum-based spent fuels are being processed.
Treatment and Storage Facility		Planning is ongoing (Record of Decision expected Spring 2000) that could result in modifying an existing reactor building to treat (melt/dilute) all remaining aluminum-based spent fuel.

Other Nuclear Materials

Overview and Inventories

The Department manages a variety of nuclear materials that are categorized for purposes of this document as "other nuclear materials." They include a variety of isotopes with applications including national security, nuclear energy, research and development, commercial use, and medical applications. Almost all Department sites, many universities, and private industry contributed to the development, production, and use of these materials.

For purposes of this Plan, the other nuclear materials are grouped into seven categories according to similarity in physical forms, radiation characteristics, safety and environmental risk, and interim and long-term management issues.

- *Special Isotopes* — This category includes isotopes produced in bulk and managed either as "strategic" isotopes or as useful byproducts from national security missions. Pu-238 and californium-252 are in continuing demand for use in radioactive heat and power sources and as medical and neutron sources, respectively. Neptunium-237, americium-243, and curium are feed materials for isotope production. The Department has more of these isotopes than it needs to support new isotope production in the foreseeable future. Small-quantity isotopes (berkelium-249, Pu-242, and other isotopes of californium, curium, and heavier elements) have continuing uses inside and outside of the Department in research and medicine. Naturally occurring isotopes (thorium-232 and radium-226) can be obtained commercially for future supply needs.
- *Large Beta-Gamma Materials* — This group is dominated by about 2,000 cesium/strontium sources (double-encapsulated), currently stored in wet basins at Hanford. Also included are sealed cobalt-60 irradiation sources and slugs, compounds of cesium and strontium, floor sweepings and scrap from source fabrication operations, and (at ORNL) a single strontium source containing nearly one million curies.
- *Actinide and Neutron Sources* — Approximately 1,400 actinide sources, with a total curie content of about 22,000 curies, are distributed across the complex. A considerable inventory of unsealed standards, samples, and small items are associated with research functions. About 1,000 sealed neutron sources also exist across the complex.
- *Other Sealed Sources, Standards, and Research Materials* — Small technical materials (sealed and unsealed sources, standards, research materials, etc.) make up this category. However, in terms of numbers of items in the "Other Materials Inventory," these materials represent approximately 25,000 of the 33,000 items inventoried. The majority are at the laboratories and former weapons production sites.
- *Thorium Materials* — A significant quantity (>100 MT) of surplus thorium metal and thorium oxide exists at 19 Department sites and a group of foreign and NRC licensees. The majority of the inventory exists at 3 sites and exceeds 10 MT each – Y-12, Sandia, and Idaho. Smaller quantities exist at EM sites that have near-term closure goals, such as Mound and Rocky Flats.
- *Light Nuclear Materials* — This group includes heavy water, tritium, and lithium. These are sensitive materials that are needed to support nuclear materials production. Heavy water was formerly used as a moderator/coolant in the Department's nuclear material production reactors. These reactors, and consequently, the heavy water production facilities, have been deactivated, as they are no longer needed to meet mission requirements. Much of the Department's remaining supply of heavy water is located at SRS. A small quantity of very pure stock is held at ORNL for research purposes.

  Although not a fissile material, tritium is a key component of all nuclear weapons presently in the nation's arsenal. Because of the relatively short half-life of tritium, long-term tritium supply and recycling capability will be required to maintain the weapons determined to be needed for national defense under the prevailing Nuclear Weapons Stockpile Plan. Production in one or more commercial light water reactors (LWR) will be the primary tritium supply source. An accelerator option is being developed, but not constructed, as a backup to commercial LWR tritium production as specified in the May 1999 Record of Decision (DOE, 1999f). Lithium is used as a target material for the production of tritium in the LWR approach.
- *Orphans* — This group includes materials, usually with unique physical or chemical characteristics, that fall outside the scope of established nuclear material management programs. Most are associated with Department reactors and include lightly irradiated or unirradiated fuels, subcritical assemblies, and reactor structural materials. The beryllium reflectors used by the Advanced Test Reactor at Idaho and the High Flux Isotope Reactor at Oak Ridge are a good example of orphan materials. Contaminated with tritium, these reflectors have an undefined disposition pathway.

Baseline Program

At present, there is no comprehensive assessment of these "other" materials. The Department has initiated the development of a Department-wide inventory and documented baseline plans for a number of the materials. For example, over 1,100 categories of materials have been identified. Baseline disposition paths have been established for about 60 percent of these. The remaining paths are "to be determined" and require additional analysis to establish disposition pathways. This effort will require continued momentum to produce a comprehensive inventory and to develop plans for all of the materials.

The approach for managing these materials varies depending on the material. As depicted in Table 2-8, disposition encompasses direct reuse, processing and refabrication, and storage while awaiting reuse or preservation as a national resource, disposal, or consumption (i.e., isotopes that are irretrievable or have short half-lives).

Continued Isotope Missions. To assess the Department's isotope needs, NE is preparing a PEIS to examine how the Department's nuclear facility infrastructure might be able to accommodate expanded civilian nuclear missions in the area of isotope production (medical and Pu-238, and research and development) (DOE, 1999i). The PEIS will include an evaluation of the possible restart of the FFTF at the Hanford site. The Draft PEIS is scheduled to be issued in mid-2000.

The potential demand for Pu-238 and its potential supply sources are major factors in NE's evaluation. Pu-238 is used in advanced radioisotope power systems for NASA space missions, and options are under consideration for establishing a Pu-238 production capability within the Department complex. This evaluation also includes options for storage facilities for the Np-237 inventory currently stored at SRS, since Np-237 is the source material required for Pu-238 production.

The Department lacks long-term storage capacity that can be reserved solely for other materials. For example, the bulk of SRS neptunium may be retained for future programmatic use. Storage, however, may span several decades before the actual use occurs. Interim storage of stabilized isotopes has the potential to impact missions to store excess weapons-capable fissile material. Capability needs are relatively straightforward, but the timing of the need for peak storage will interact with storage schedules and budget requests for enhanced capacity.

Table 2-8 Summary of Current Approach for Special Isotopes

Material Type	Strategy
Plutonium-238	• Continue national security support with self-contained DP capability. • Develop long-term production and infrastructure plan for future NASA needs (PEIS).
Neptunium-237	• Develop long-term program for storage and use, based on results of PEIS. Options include storage and fabrication of targets for Pu-238 production, storage as national resource, or disposal. • Stabilize SRS solutions and scrap as oxide for storage or later disposal.
Californium-252 and Other Heavy Isotopes	• Continue Oak Ridge heavy isotope production program. • Continue neutron source fabrication, reuse, and recovery program. • Consolidate surplus from discontinued operations in Oak Ridge.
Americium-243/Curium-244	• Stabilize SRS solutions as glass for storage or later disposal. • Continued storage of Mark18 targets at SRS pending future use/disposition decision.
Plutonium-242	• Continue national security support with self-contained DP capability. • Consolidate surplus from discontinued operations at Los Alamos.
Americium-241	• Continue to manage separated supplies under Isotope Production and Distribution office for sale or Department use. • Rely on commercial sector to provide supply and fabrication services to future customers. • Consolidate surplus from discontinued operations at Los Alamos.
Thorium-232	• Maintain low-level inventories to support Department energy programs. • Rely on commercial sector to provide supply and fabrication services to future customers. • Transfer surplus supplies to LLW programs for disposal.
Small-Quantity Isotopes	• Continue to provide irradiation services in Department research reactors and accelerators, relying on commercial sector for fabrication and disposal services. • Continue production and distribution of Certified Reference Materials to research institutions and industry. • Manage surplus from discontinued operations through Non-Actinide Isotope and Sealed Sources Management group.

Facility needs for isotope programs will depend heavily on future decisions (Table 2-9). The major functions that will be required include:

- production sources, including research and test reactors and accelerators;
- processing facilities to support small-scale recovery of produced isotopes, including Pu-238;
- isotope separation, chemical treatment, and fabrication facilities for Pu-238 power and heat sources, californium sources, Certified Standards, and some research materials;
- storage and transportation facilities; and
- waste treatment and disposal facilities.

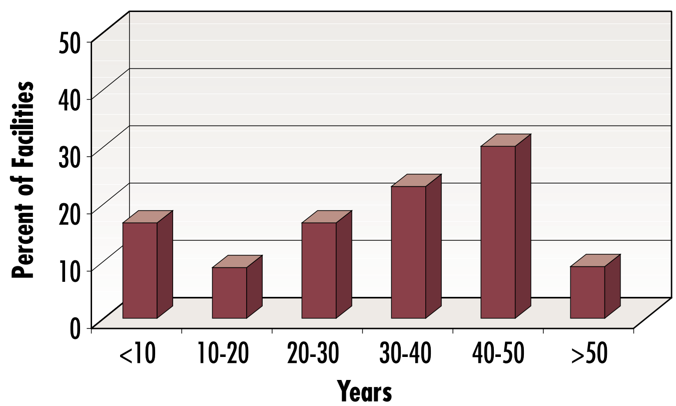
DP retains the capability for fabrication of parts needed for defense support and R&D. New capability for the fabrication of Pu-238 for radioisotope power and heat sources (replacing processes formerly performed at SRS) may be needed. The siting of this capability will be chosen under the PEIS (DOE, 1999i).

Table 2-9 Key Facilities for Other Materials

Key Facility	Site	Purpose	Status
Waste Encapsulation and Storage Facility	Hanford	Cesium and stronium storage	Operational
Tank Waste Remediation System	Hanford	Cesium and stronium vitrification	HLW vitrification scheduled to begin in 2009
F and H Canyons	SRS	Stabilization and packaging of bulk solutions	Operational
High Flux Isotope Reactor	ORNL	Isotope production	Operational
Radiochemical Engineering Development Center	ORNL	Research, storage, chemical processing of heavy isotopes	Operational
Resource Recovery	To be determined	Separate neutron sources	Pending site selection
Other Material Storage	To be determined - multiple sites	Store Department and commercial sources pending reuse, recovery, or disposition	Pending site selection
Hot Cells	Various	Support characterization and packaging operations	Existing at most sites where needed
Advanced Test Reactor	INEEL	Research, isotope production	Operational
Fast Flux Test Facility	Hanford	Research, isotope production	Reactor is on standby; future use is being evaluated in PEIS on isotope production missions

Crosscutting Considerations

Figure 2-14 Age Distribution of 90 Key Facilities



The infrastructure needed to manage nuclear materials is extensive and includes facilities utilization, technology development and deployment, and integrated transportation planning and execution. The following subsections describe the status of efforts in each of these crosscutting areas.

Facilities

The United States has a substantial investment in the facilities needed to manage its large inventory of nuclear materials. During the era of nuclear weapons production, the Department and its predecessor agencies built and used more than 20,000 facilities. Currently used or planned facilities are distributed at sites throughout the country (see Figure 2-15) and among many of the Department's program offices. Existing facilities are continually maintained, modified, or closed based on site or programmatic drivers. Site-specific decisions made for a particular facility or within a particular program may cause management and cost impacts for other sites or programs.

As shown in Table 2-10, the Department's material management needs have changed over the past decade from production of weapons material to treatment, storage, and disposition (i.e., programmatic use or disposal).

Table 2-10 Primary Processing Functions Over Time

Pre-1990	1990 to 2000	Post-2000
Production Reprocessing HLW storage LLW disposal Programmatic use	Storage Stabilization Remediation Characterization Repackaging HLW treatment Mixed/LLW treatment Programmatic use	Storage/Consolidation HLW disposal Spent Nuclear Fuel disposal Mixed/LLW disposal Processing/blending for commercial Light-Water Reactor fuel Programmatic use Nonproliferation activities

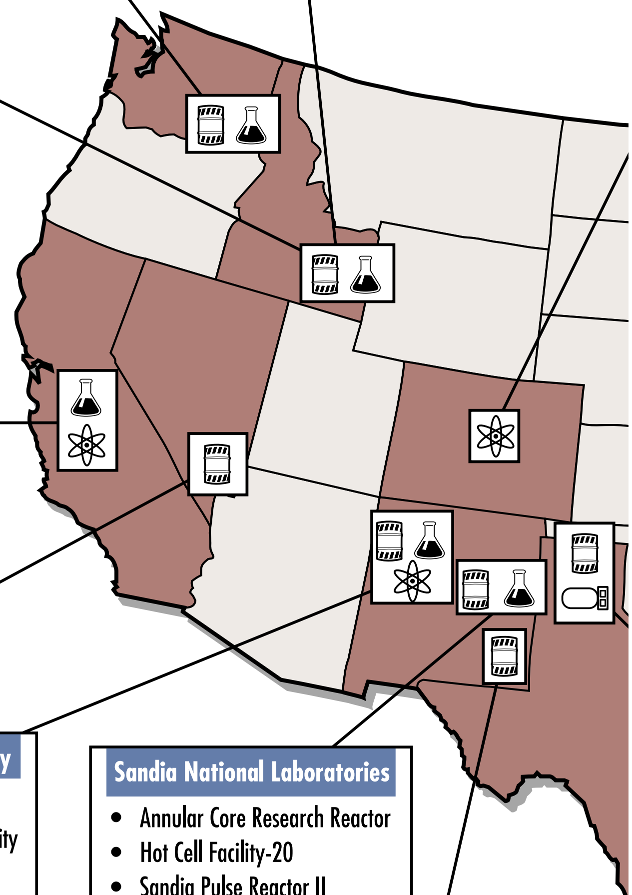
As represented in Figure 2-14, a recent analysis of over 90 key facilities in the Departmental complex indicates that about 60 percent have exceeded 30 years in age and about 10 percent have exceeded 50 years. Many of these facilities have met or exceeded their design life. This underscores the need to complete long-range planning to define future requirements.

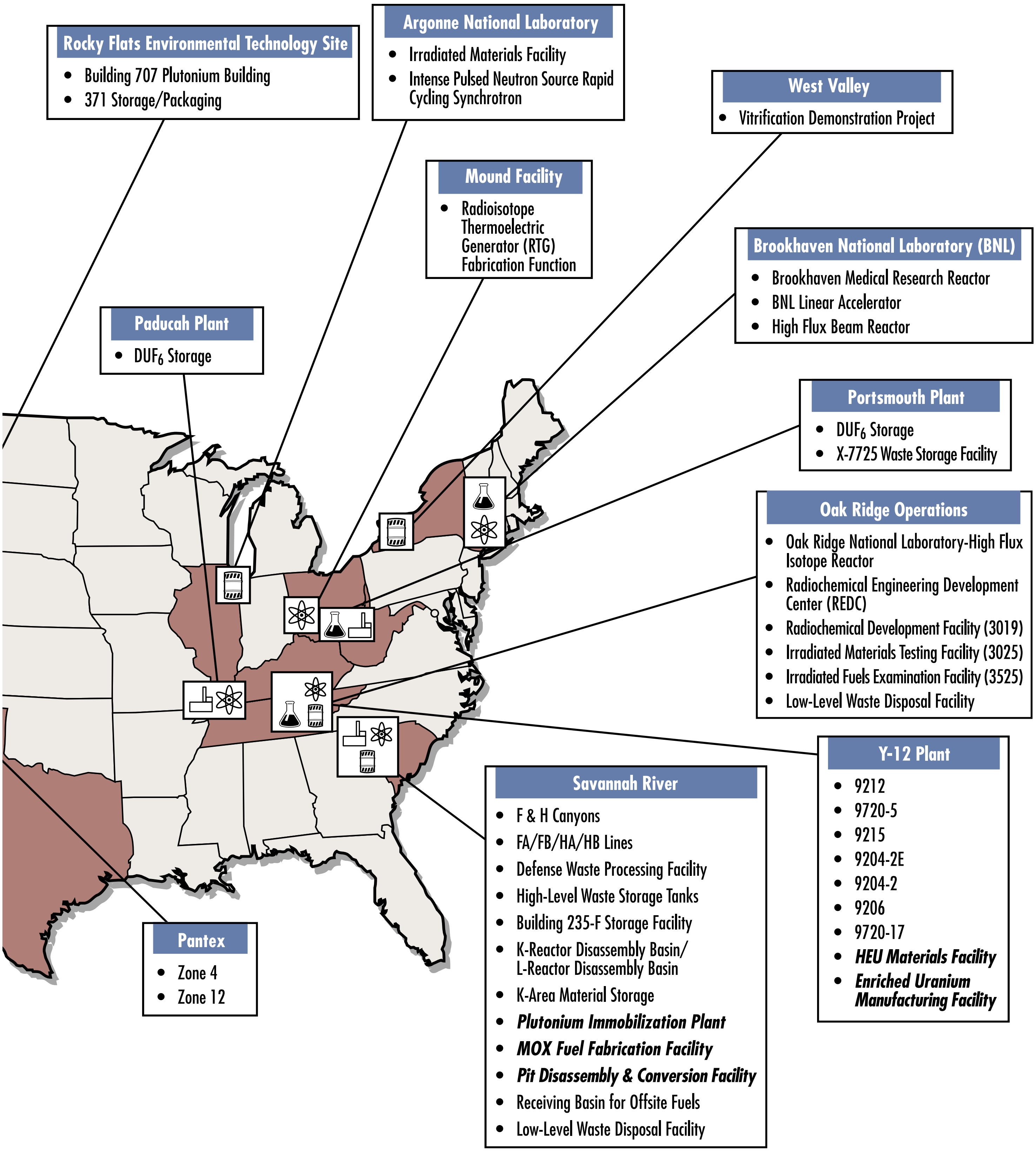
In response to DNFSB Recommendation 94-1 (DNFSB, 1994), an Integrated Facilities Plan was developed in 1995 (DOE, 1995e) to address the facilities issues associated with the stabilization of materials identified as being at risk. The Plan identified facilities required to stabilize at-risk materials and to provide for their safe storage and maintenance pending determination of ultimate disposition options. The Plan assessed the condition and issues associated with each identified facility and mapped the processing stream for each material. It also identified current initiatives and key decision points pertaining to stabilization and disposition of nuclear materials.

To provide further focus for the consolidation and disposition of nuclear materials, closure of facilities, and reduction of operating and maintenance costs, the Department has extended the scope of the Facilities Plan to cover nuclear materials facilities complex-wide. Although this work is continuing, several general observations can be made:

- **The Department's Infrastructure is Aged.** As Figure 2-14 demonstrates, the Department's infrastructure has aged. Countering this fact have been efforts to rebuild systems, modify/update facilities, and install new equipment. Life extensions for old buildings can address health and safety concerns, sometimes yield significant cost benefits, and allow for the continued use of facilities having unique structural/design features. On one hand, reusing old facilities makes sense for some functions. On the other hand, life-cycle cost analysis may show that investment in new facilities could prove to be the most fiscally prudent alternative.
- **Premature Closing Highlights Need for Integrated, Long-Term Planning.** Changes in mission resulted in several sites and about 5,000 surplus facilities being decommissioned during the 1990's. In some cases, events and conditions have caused facility closures prematurely

Figure 2-15 Key Existing or Planned Facilities for Managing Nuclear Materials




Rocky Flats Environmental Technology Site
Building 707 Plutonium Building
371 Storage/Packaging
Argonne National Laboratory
Irradiated Materials Facility
Intense Pulsed Neutron Source Rapid Cycling Synchrotron
West Valley
Vitrification Demonstration Project
Mound Facility
Radioisotope Thermoelectric Generator (RTG) Fabrication Function
Brookhaven National Laboratory (BNL)
Brookhaven Medical Research Reactor
BNL Linear Accelerator
High Flux Beam Reactor
Paducah Plant
DUF_6 Storage
Portsmouth Plant
DUF_6 Storage
X-7725 Waste Storage Facility
Oak Ridge Operations
Oak Ridge National Laboratory-High Flux Isotope Reactor
Radiochemical Engineering Development Center (REDC)
Radiochemical Development Facility (3019)
Irradiated Materials Testing Facility (3025)
Irradiated Fuels Examination Facility (3525)
Low-Level Waste Disposal Facility
Y-12 Plant
9212
9720-5
9215
9204-2E
9204-2
9206
9720-17
HEU Materials Facility
Enriched Uranium Manufacturing Facility
Savannah River
F & H Canyons
FA/FB/HA/HB Lines
Defense Waste Processing Facility
High-Level Waste Storage Tanks
Building 235-F Storage Facility
K-Reactor Disassembly Basin/ L-Reactor Disassembly Basin
K-Area Material Storage
Plutonium Immobilization Plant
MOX Fuel Fabrication Facility
Pit Disassembly & Conversion Facility
Receiving Basin for Offsite Fuels
Low-Level Waste Disposal Facility
Pantex
Zone 4
Zone 12

and those facilities could have, in retrospect, been used for processing surplus nuclear materials. For example:

– The Hanford PUREX facility was closed before processing more than 2,000 tons of irradiated N-Reactor fuel elements that were left, many damaged and all corroded, in the K-Area spent fuel basins.

– The Hanford Remote Mechanical Cell processing facility was closed, leaving significant quantities of solutions unprocessed at the Plutonium Finishing Plant (PFP). Some of these solutions remain unprocessed today and present problems for the Plant's deactivation project.

– The Oak Ridge Y-12 Plant low assay HEU processing facility, Building-9206, was placed in standby in 1994 before purifying the entire inventory of low-assay HEU material, leaving the Department complex with no facility for processing this material. Building-9206 is presently being deactivated.

– A number of hot processing cells have been closed, leaving the disposition of several thousand sealed sources largely undetermined.

These premature closings highlight the need for an integrated facilities planning process. One of the basic objectives of the integrated process will include development and implementation of a protocol for site closings. Among many other factors, the protocol will consider the influence of closings on the complex-wide functional capabilities necessary for the Department to accomplish its nuclear missions.

Today's nuclear materials management complex is increasingly expensive to maintain and operate. Old facilities continue to carry more of the main operating burden. Major decisions about replacing or upgrading critical facilities will be required within the foreseeable future.

An integrated facilities planning process is underway that will support the material management capability requirements of the future. This planning process will be assessed and redirected as needed to ensure that it is comprehensive, institutionalized, and:

- takes a systems approach that focuses on both current and future Department-wide functional requirements rather than on individual materials and program needs (this will move the complex in the direction of optimizing the use of existing facilities, assuring that future closures make "corporate sense," and maximizing the benefits to be gained from future facility investments);
- focuses on life-cycle planning that identifies the alternatives and costs of taking a material through to reuse or disposal (this includes sensitivity analyses to account for uncertainties);
- identifies capabilities of facilities now in the system and assesses their condition; and
- determines the need for new or replacement facilities to meet future requirements in a timely fashion.

Technology

Several Department documents outline technology requirements and R&D plans in support of its nuclear missions. Two documents that provide an integrated perspective on science and technology initiatives are the DOE Research and Development Portfolio (DOE, 1999j) and the Nuclear Science and Technology Infrastructure Roadmap (to be published Summer 2000).

In FY 1999, an R&D portfolio was prepared and has been updated for FY 2000, for each of the Department's four strategic business lines: energy resources, environmental quality, national security, and science. These portfolios define the R&D needs that must be met to accomplish the strategic program goals of the Department. Each business line portfolio integrates the capabilities, policies and requirements of all the Department's programs and laboratories relevant to that business line. Technology roadmapping is being instituted as a planning and decision tool to develop and execute a balanced R&D portfolio in future years.

The Department manages a substantial infrastructure of nuclear science and technology assets that are used for conducting both technology-directed and basic nuclear science research. Many of these assets have been shut down or placed in prolonged standby, while others are operating at or near full capacity. To ensure that the Department has adequate facilities in place to meet future nuclear mission requirements, NE has initiated the development of an infrastructure roadmap. The first phase of this effort produced a draft roadmap, which will be published shortly, of the nation's nuclear R&D infrastructure against likely science and technology requirements through the year 2020 for isotopes, space, nuclear power technology, general nuclear science, and national security missions. Subsequent roadmaps will include the consideration of MD and EM and will conform with the Department's nonproliferation policy.

The Department's science and technology efforts address only the unique mission needs of its principal organizations based on needs assessments and development plans. The mission-specific science and technology initiatives for the various organizations are:

- **Defense Programs**. Technology requirements for the Science-Based Stockpile Stewardship include developing a fundamental understanding of nuclear materials properties, aging phenomena, and high-pressure behavior.

Key Documentation of Departmental R&D Requirements and Plans

Research and Development Council

- Departmental Research and Development Portfolio

Defense Programs/National Security

- DP Enhanced Surveillance Program
- DP Plutonium Strategy
- The Nuclear Infrastructure to meet National Security Requirements

Environmental Management

- EM Strategic Plan for Science and Technology
- EM R&D Program Plan
- Nuclear Materials Focus Area FY 2000 - FY 2004 Multi-Year Program Plan
- Nuclear Materials Focus Area Needs Listing
- Integrated Spent Nuclear Fuel Technology Needs List
- Spent Nuclear Fuels Focus Area Needs Listing
- EM Science Program Needs by Focus Area

Fissile Materials Disposition

- Pit Disassembly and Conversion R&D Plan
- Plutonium Immobilization R&D Plan

Nuclear Energy, Science and Technology

- Nuclear Energy Research Advisory Committee: Long-Term Nuclear Energy Research and Development Plan (October and December Workshop Reports)
- Nuclear Energy Research Initiative
- Nuclear Science and Technology Infrastructure Roadmap
- Notice of Program Interest: Exploratory/ Developmental Programs for Uses of Isotopes in Medicine

Science

- Strategic Plan of the Office of Science

Subcritical experiments are used to benchmark computer simulations and work is ongoing to study the effects of weapons component remanufacturing techniques.

- **Environmental Management**. Science and technology initiatives include developing techniques to stabilize materials, developing technical bases for storage standards, developing approaches for surveillance of stored materials, and developing a more comprehensive understanding of the underlying science of material behavior in storage and transportation environments.
- **Fissile Materials Disposition**. Technology initiatives include automation for dose reduction, decontamination and declassification of components, feed preparation, ceramic formulation, and material characterization.
- **Nuclear Energy, Science and Technology**. Technology initiatives include proliferation-resistant reactor and fuel development, technologies for storage of nuclear waste, fundamental nuclear science and technology, and space power systems.

As the Department proceeds with efforts to ensure an enduring technology infrastructure to meet program needs, complex-wide integration of its R&D efforts will be undertaken to reduce overlapping efforts and optimize existing capabilities of the sites and program offices.

Transportation

Current transportation efforts within the Department are undertaken on a material-specific and program-driven basis. National security shipments use the Department's Transportation Safeguards System, while non-national security shipments are undertaken via Departmental, NRC, or commercial shipping regimes. As the numbers of shipments increase in the coming decades, greater integration effort will be essential. For example, a 28-year shipping campaign would involve moving up to 4,000 canisters of spent fuel to a geologic repository. The National Spent Nuclear Fuel Program is in the initial planning stages for a rail-based transportation system designed to move road-ready packages of spent nuclear fuel to a repository under NRC regulations. Several initiatives are planned and are discussed further in Chapter 3.

Life-Cycle Planning

In order to effectively integrate its nuclear material missions, the Department must complete planning for all nuclear materials through each material's full life-cycle ending in its final disposition (irradiation, separation, storage, reuse/ disposal). The Department has been successful in identifying its nuclear material inventories and in determining disposition paths for a large portion of these materials. Prior planning efforts have focused on functions occurring early in a material's life (production, transportation and storage) and have not always sought to complete the disposition picture. The Department will complete baseline disposition plans for the remaining portion of the inventory. This effort continues as an integral part of the NMSI.

Budget

The Department manages its nuclear materials through 8 major program offices at 36 different locations. Managing (i.e., safely processing, stabilizing, packaging, storing, monitoring, transporting, and disposing) such a wide variety of material types at such diverse sites comes at no small cost to the taxpayer. The exact amount is difficult to capture because the Department structures its budget around direct program missions. Depending on the program, the costs of activities associated with managing nuclear materials, such as information technology or landlord costs, may or may not be separately identified in the budget.

As such, the percentages presented in this section are based on an estimate of the annual cost of managing excess nuclear materials. These estimates do not account for safeguards and security costs nor for the costs associated with implementing the transparency provisions of our international nonproliferation agreements. A more detailed and comprehensive review will be conducted before the Department can confidently provide more complete costs of managing its nuclear materials.

Nuclear materials management costs for each nuclear material category are segmented in two ways: by program and by material management function. Figure 2-16 presents the relative distribution of costs across material types. Figure 2-17 provides a picture of the distribution of materials categories by program and function.

Figure 2-16 Excess Nuclear Materials Management by Material Type (presented as a percent of the total estimated cost of managing excess nuclear materials)

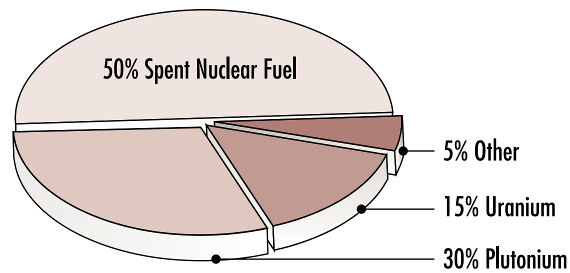
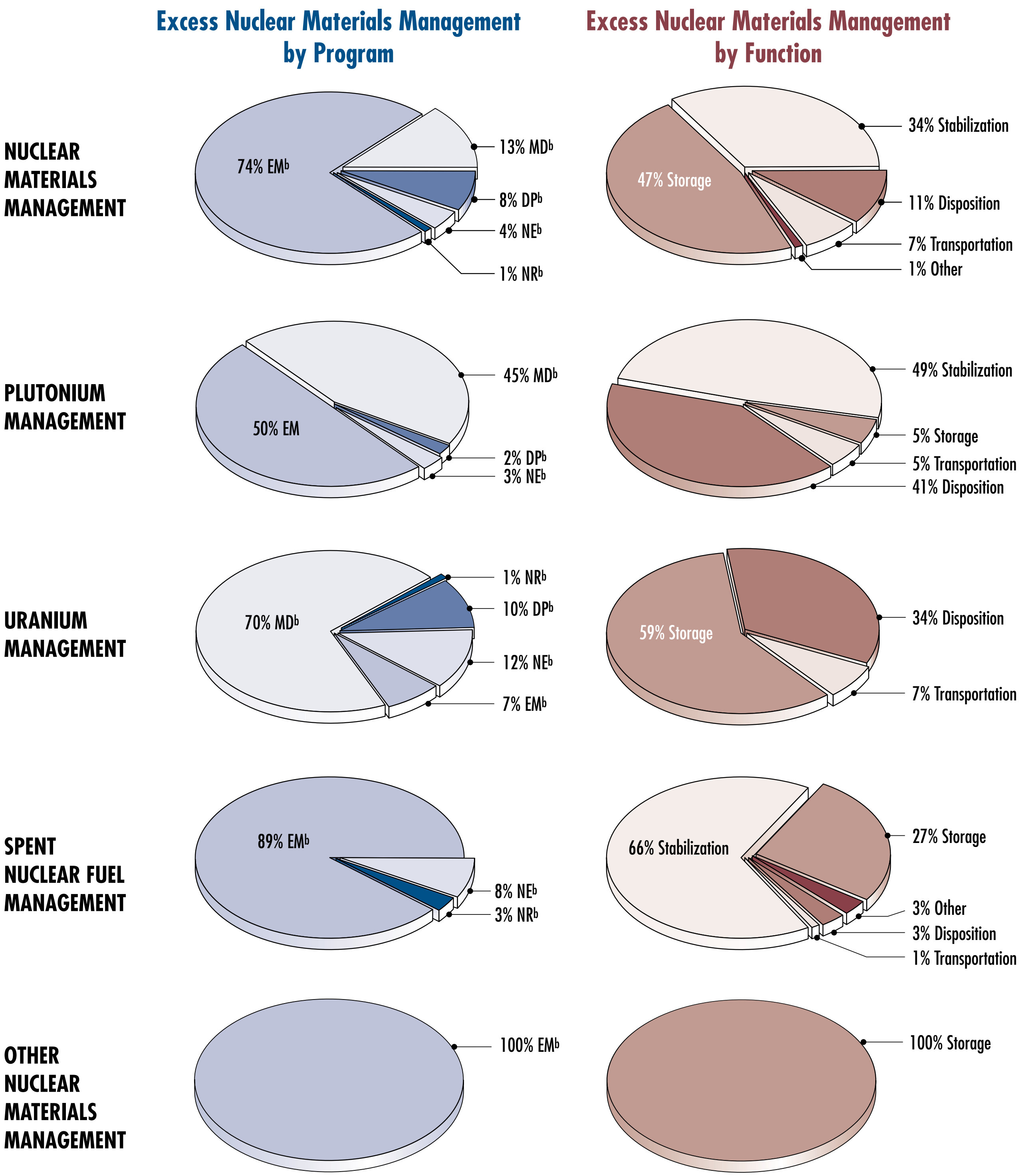


Figure 2-17 Estimated Annual Cost of Managing Excess Nuclear Materials (by Program and Management Function[ab])



[a] Based on preliminary ROM FY 2001 budget, including capital and operating costs.

[b] Does not include all nuclear material management costs from RW, NN, and SC.

Opportunities for Improved Management of Nuclear Materials

Chapter 3

The baseline programs identified in Chapter 2 represent current program plans for managing nuclear materials. This chapter identifies ways the Department can improve management of these materials, by improving coordination and integration of responsibilities for treatment, storage, and disposition among program offices, while cutting costs and achieving other efficiencies. Opportunities identified are divided into two categories:

- *Policy and Organizational Changes* — immediate actions to strengthen policies and organizational efficiency related to the management of nuclear materials.
- *Improving Operations* — near-term improvements for managing materials, focused primarily on integrated assessments of plutonium stabilization, storage, and disposition needs, and the need for processing and consolidated storage of HEU.

The Department will continue to look for additional opportunities in both of these areas.

Policy and Organizational Changes

These actions continue a series of major management reforms of the Department's field operations that were directed by the Secretary on April 21, 1999. The Department established a Lead Program Secretarial Officer management structure under which each field operations office reports to a Headquarters program office. The Secretarial Officers were given clear lines of authority to oversee field office operations and they are held accountable for implementing Department policies at these facilities. The Secretary also established the Field Management Council, led by the Deputy Secretary and Chief Operating Officer of the Department, to coordinate development and implementation of policies affecting field operations. Operations and Field Office Managers were made responsible for all site programs and for project execution, contract management, and facility operations oversight.

On May 11, 1999, the Secretary directed a reorganization to address heightened concerns about the security of the Department's nuclear weapons program. These reforms included the establishment of a new Office of Security and Emergency Operations that is responsible for developing and implementing Department-wide safeguards and security policy, computer security, and emergency operations functions. The Office of Plutonium, Uranium, and Special Nuclear Materials was established within the Office of Security and Emergency Operations to strengthen the Department's focus on materials control and accountability.

On March 1, 2000, the NNSA became operational. It is led by the Under Secretary for Nuclear Security/Administrator for Nuclear Security, while the Under Secretary for Energy, Science and Environment oversees the three other business lines. The respective organizational responsibilities of each Under Secretary are fully represented in the chart located in Appendix III. Clearly, offices with major nuclear materials responsibilities have oversight from both Under Secretaries, emphasizing the important role of nuclear materials in both civilian and national security missions. For this reason, the new NNSA will be an integral part of the Department's efforts to coordinate nuclear materials management.

Launching the Nuclear Materials Stewardship Initiative

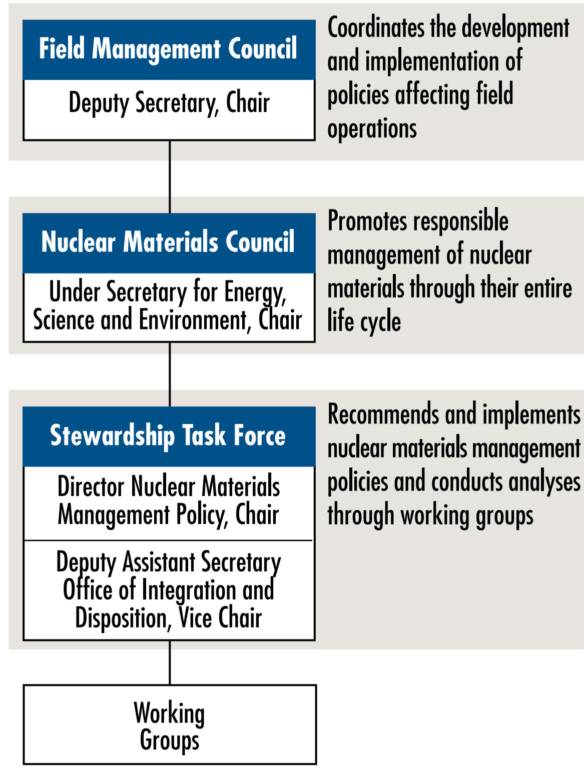
The Department's Field Management Council considered issues concerning nuclear materials management in a September 1999 meeting and concluded that a more focused and integrated Departmental effort should be undertaken for nuclear materials management. The Under Secretary, a member of the Field Management Council, was tasked to lead the effort. The Under Secretary convened all principal Secretarial Officers with responsibilities for nuclear materials to form a Nuclear Materials Council (NMC). The Council completed the charter for the NMSI in January 2000 (see Appendix IV).

NMSI's overall mission is to promote responsible management of nuclear materials through their entire life cycle, from production through ultimate disposition. By cutting across all Departmental program elements, NMSI integrates nuclear materials management responsibilities in order to:

- develop a corporate strategy for nuclear materials management;
- monitor safeguards and security and safety capabilities;
- identify and evaluate opportunities for improved management;
- optimize planning for future requirements;
- address and resolve cross-program issues;
- promote international best practices; and
- reduce overall long-term costs.

The NMC guides and oversees the work of a Stewardship Task Force that carries out the Initiative. The Task Force consists of a senior management-level appointee from each line program with nuclear materials management responsibilities, as well as representatives from the Office of Environment, Safety and Health; Comptroller; General Counsel; and Policy. The Director of a newly established Office of Nuclear Materials Management Policy in the Office of Policy chairs the Task Force. The Deputy Assistant Secretary of the Office of Integration and Disposition in EM serves as the Task Force Vice Chair. The opportunity exists to add a second Vice Chair from the NNSA. The Task Force recommends policies and actions and conducts analyses and studies through working groups composed of program, field, laboratory, and contractor representatives, as needed. Figure 3-1 depicts the organizational structure for the Initiative.

Figure 3-1 Organizational Structure for the Nuclear Materials Stewardship Initiative.



Nuclear Materials Stewardship Initiative

- Nuclear security and strategic reserve materials shall be stored and maintained in a state of readiness.
- Surplus nuclear materials shall be dispositioned in accordance with national nonproliferation policy and international treaties and agreements, and relevant U.S. statutes.
- Other nuclear materials shall be kept as national resources and placed in safe storage or disposed of as waste in accordance with national nonproliferation policy and international treaties and agreements, and relevant U.S. statutes.
- Robust nuclear materials management capabilities shall be available in safe and efficient facilities to support Departmental missions, and the nation's security, economic, and environmental quality objectives.
- A world-class scientific and technical workforce shall be maintained to perform the wide range of functions required for safe and efficient stewardship of nuclear materials.
- Credibility for U.S. leadership, influence, and cooperation in nonproliferation, safe use of nuclear energy, and science and technology shall be paramount.

The Initiative's agenda

The NMSI will continue to be the forum for the Department's integrated management of nuclear materials. Below are several tasks that will be undertaken for this Initiative. The agenda will be regularly reviewed and adjusted as needed.

Task 1: Prepare an Integrated Nuclear Materials Management Plan — This Plan satisfies the requirements of Section 3172 of the National Defense Authorization Act for FY 2000. It advances the Council's agenda and is the first action scheduled for completion in calendar year (CY) 2000.

Task 2: Address high-priority, cross-program issues — Resolution of these issues will eliminate roadblocks to integration and foster corporate decision making. The Council and Task Force will make planning decisions concerning a set of high-priority, cross-program issues that are barriers to an individual program's successfully meeting its mission obligations. Actions on these issues will be scheduled throughout CY 2000, subject to the requirements of NEPA. Several cross-program working groups are undertaking this task. A list of more than 40 cross-program issues has been developed based on inputs from Headquarters and Operations Offices. A description of some priority issues follows:

- *Americium, curium and plutonium-244 (Pu-244) as national resource materials* — The NMC is considering a recommendation to recategorize the tank 17.1 solutions at SRS as surplus materials. If no formal action has been taken to specify a programmatic need for the materials by the time they have been processed, the Department would proceed under NEPA to analyze disposal options. The Mark 18A targets are still under review by the NMC to determine whether they should be kept as national resource materials to allow future recovery of the Pu-244 that they contain. The NMC has scheduled completion of its review and expects to make a decision on the use of these materials by the Summer of 2000.
- *Disposition of U-233 and Np-237* — A decision is needed on whether to retain U-233 and Np-237 as a national resource or dispose of it. Interim issues of management responsibility, storage location, and disposition strategy must also be addressed.
- *Disposition of cesium and strontium* — The Department possesses over 9,000 cesium/strontium items, containing over 71 million curies. Current disposition plans address only about 2,000 items. The remaining items do not have disposition paths and may impact facility and site closure plans and costs.
- *Disposition of Pu-contaminated HEU* — Parts exist at Rocky Flats Environmental Technology Site (RFETS), Y-12, LANL, and LLNL requiring temporary storage pending decisions on ultimate disposition.
- *Cost Sharing for use of services, facilities, or processes* — In some cases, landlord programs subsidize tenant program activities at the expense of landlord mission work. Transportation Safeguards Division (TSD) services are an example. Though operated by DP, other programs such as EM and MD will require substantial TSD support in the future. Alternative funding and shared-cost arrangements will be analyzed by the NMC.

Task 3: Analyze strategic information management system integration options — The NMSI will develop an approach for upgrading and integrating systems for nuclear materials information management and inventory accountability. This will link corporate nuclear materials management and planning needs with inventory accountability requirements. The Department's nuclear materials information system should more effectively support the needs of materials management, life-cycle planning, and disposition. Information technology will minimize redundant databases while accounting for all nuclear materials and nuclear waste at a level of assurance commensurate with the risks they pose.

Task 4: Develop and revise Department Orders, policies, and planning documents, as appropriate — This task will institutionalize changes in management practices and policies that will further integration. Since the chartering of the NMSI, a number of opportunities have been identified for improving the Department's business practices. The Department will, as appropriate, seek public participation in developing these policies.

The following subtasks are included:

- *Subtask 4.1 — Develop/revise Departmental Orders and policies as appropriate*. This could include developing a new Departmental Order on Management of Nuclear Materials (Departmental Policy and Order 5660.1B). Although most program offices now have nuclear materials stewardship responsibilities, a new Order would identify the scope and requirements of a comprehensive, integrated Departmental nuclear materials stewardship program and assign and describe the responsibilities of each program and support element, including an NMSI coordinating function.
- *Subtask 4.2 — Clarify ownership of national resource material.* The Department will prepare a strategy document, coordinated by NE, that will define the technical and infrastructure acceptance criteria, programmatic requirements, and resources needed to enable the transfer of certain nuclear materials to the Department's civilian nuclear energy program. For nuclear materials with clearly identified civilian program uses or those that have been designated as national resources, this strategy document would provide, on a case-by-case basis,

guidance as to which materials could be accepted for management by NE and under what conditions they could be accepted. This strategy document will be completed in time to enable the Department to consider budgetary initiatives in FY 2003.

- *Subtask 4.3 — Establish "national resource materials" policy*. This task will address the issue of whether the Department should retain certain unique nuclear materials as national resources to ensure their availability for future scientific or programmatic use. It will also assess the comparative costs of storing, disposing of, or replacing them at some future date. The portions of the existing supplies that should be retained will be systematically identified, along with the infrastructure needed to store and process the isotopes into their intended forms. To determine what materials should be kept for national needs, the Department is applying the following criteria:

  – *Producibility*. Only materials that require extraordinary time and resources to produce and that cannot be easily replaced will be considered for long-term retention.

  – *Need.* The quantities of material to be retained will be determined by identifying potential needs with additional material reserved for unidentified needs. Potential needs should be categorized and prioritized as follows: (1) uses for which the material is unique and for which there are no practical substitutes, (2) known future uses, and (3) other potential uses.

  – *Inventory quality*. The cost to produce unique materials and their potential uses usually depends upon their isotopic purity. Isotopic purity, material stability, and cost of recovery will be explicitly considered in determining which materials to retain and which to dispose of.

  – *Retention analysis*. The costs of the various options for management of the materials will be considered for their complete future life cycle, including the costs of long-term storage and/or disposal. These estimates will include consideration of associated stabilization, other required processing, extraction (to make the material usable), transportation, and availability of containers and facilities for various phases of management. It is also appropriate to offset costs with income (if any) that the Department might receive due to future use of the materials. Major cost elements that cannot be estimated due to lack of information will be clearly identified for consideration by management.

  This draft policy is being tested through analysis of "keep versus toss" decisions for americium, curium, and U-233. The draft policy will be modified as appropriate based on lessons learned from these examples.

Task 5: Convene a cross-program team to integrate planning for the disposal of defense high-level nuclear waste and Department-owned spent nuclear fuel in a repository and to address safeguards and security licensing requirements — The Department's Draft Strategic Plan calls for a decision in FY 2001 by the Secretary on whether or not to recommend Yucca Mountain as the site of a geologic repository. Current schedules call for the start of repository operations in 2010 if the site is determined suitable by the Secretary, the recommendation is approved by the President and Congress, and the repository is licensed by the NRC. A key requirement is to fully integrate into the repository baseline and planning process the disposal of the Department's high-level nuclear waste, Department-owned spent nuclear fuel generated by nuclear weapons production and the Naval nuclear propulsion program, Department-owned civilian nuclear research and development materials and weapons-capable fissile materials.

Integrated Planning

Such integration offers opportunities to reduce the complexity, costs, and impacts of the management of these materials across the Departmental complex in a number of ways. For example, many of the defense nuclear materials destined for a geologic repository will require interim processing and storage before emplacement. Selecting appropriate processing and storage measures requires knowing what the waste acceptance criteria for the repository will be, so that the processing and packaging of these materials are compatible with the criteria.

Careful coordination of near-term treatment and storage decisions with repository planning could reduce the risk that additional processing steps would be required to put the materials in a form suitable for transportation to and disposal in a repository, thereby avoiding additional costs and worker exposures. On the other hand, further analysis may show that currently planned treatment activities are unnecessary for safe disposal. Since the NRC makes the ultimate determination of what waste forms are acceptable for disposal, careful coordination with decisions concerning licensing can play an important role in realizing potential system benefits.

As another example, large quantities of metals will result from the decommissioning of the Department's nuclear facilities. Some of these metals, such as nickel, might be usable in the engineered barriers of the repository system. Management of these materials could be affected by decisions concerning such possible use.

Once a repository is operating, system-wide integration of plans and schedules for delivery of Department-owned spent nuclear fuel and defense wastes to the repository could lead to cost savings in several ways. Careful sequencing of delivery schedules to a repository could avoid the need for new storage facilities at other sites, increase management flexibility by freeing up existing storage capacity for other uses, or even allow early shutdown and decommissioning of some facilities through removal of relatively small quantities of material.

The Department will conduct a top-level analysis of HLW and spent fuel management integration that will:

- identify linkages among decisions concerning interim management of nuclear materials destined for a repository and current plans for determining the suitability of Yucca Mountain;
- identify opportunities to reduce system cost, avoid unnecessary processing steps, and maximize the compatibility of interim actions with the requirements for disposal;
- identify crosscutting repository-related issues whose early resolution would provide the greatest benefit to interim management of nuclear materials; and
- conduct an integrated programmatic risk analysis to assess the consequences of, and mitigating measures for, delays in availability of a repository.

Safeguards and Security Considerations

The RW approach to implementing safeguards and security at a monitored geologic repository is based on obtaining licensing for a facility that complies with NRC physical protection requirements in 10 Code of Federal Regulations (CFR) Part 73.51 that addresses acceptance of commercial spent nuclear fuel and vitrified HLW. Embedded in this regulatory approach is the fundamental premise that these materials will be unattractive from the standpoint of theft. Many candidate materials being considered for disposal at a monitored geologic repository have characteristics that are very different from commercial spent nuclear fuel and vitrified HLW. Successfully licensing a repository under 10 CFR Part 73.51 will therefore require a demonstration that candidate materials are no more attractive from a theft standpoint than commercial spent nuclear fuel or vitrified HLW and, thus, are adequately protected.

From a licensing perspective, four characteristics are important to demonstrating the unattractiveness of a candidate material from the standpoint of theft:

- size, including overall weight;
- fissile material content;
- relative difficulty of separation; and
- homogeneity and concentration of special nuclear material content.

A candidate material may be processed or packaged so as to satisfy the regulatory requirements inherent in a 10 CFR Part 73.51 approach to repository licensing. Once a candidate material is accepted for disposal, RW may apply additional specific institutional measures at a monitored geologic repository that protect it at an appropriate level, thereby rendering it even more unattractive.

To implement this approach to safeguards and security at a geologic repository, RW will work with waste owners to evaluate their candidate materials against the four characteristics defined above and document the results of that evaluation.

While individual candidate materials may have characteristics, such as radioactivity, that may normally be considered barriers to proliferation, these characteristics will not be utilized as part of the RW licensing approach to safeguards and security at a monitored geologic repository. This conservative approach recognizes that, with the passage of time, the radioactivity of a material decreases, thereby diminishing its effectiveness as a barrier.

Task 6: Establish a corporate level process for facilities strategic planning and decision making — A Department-level process for making decisions about facility commissioning, use, and closure will be evaluated to support the material management capability requirements of the future. This planning process will be comprehensive and institutionalized and will:

- take a systems approach that focuses on both current and future Department-wide functional requirements rather than on individual materials and program needs (this will move the complex in the direction of optimizing the use of existing facilities, assuring that future closures make "system sense," and maximizing the benefits to be gained from future facility investments);
- focus on life-cycle planning that identifies the alternatives and costs of taking a material through to reuse or disposal (this includes sensitivity analyses to account for uncertainties);
- identify capabilities of facilities now in the system and assess their condition; and
- determine the need for new or replacement capabilities to meet future requirements.

Ultimately, the processes could include the following elements:

- a system for maintaining information on facility capabilities, status, and schedules;
- a mechanism for matching material processing needs with facility capabilities;

- a system for modeling and improving facility infrastructure with respect to safety, cost, and national security; and
- a baseline modified through configuration management procedures.

Task 7: Undertake an analysis of the long-term capabilities required by the future nuclear materials complex — Decisions made about the nuclear materials complex in the near-term will have long-term consequences. These decisions must be integrated into a Departmental strategy for maintaining an enduring nuclear materials stewardship mission. The Department must, therefore, extend its planning horizon beyond this decade by applying qualitative and quantitative analysis of long-term requirements. To address the uncertainties inherent in such an analysis, the Department will identify reasonable alternative scenarios that might characterize future uncertainties.

This analysis will maintain the core assumption that the Department is obligated to preserve national security, bolster economic prosperity, and promote U.S. policies. A modern and efficient nuclear materials complex will ensure U.S. leadership in nuclear science and technology.

As the work of furthering the integration of the nuclear materials complex proceeds, the Department will enlarge the information resources it draws on, refine its analytic techniques by using quantitative analyses, and employ decision support tools to ensure a sound foundation for decision making. Moreover, the Department will periodically revisit its assumptions about future requirements in light of changing conditions. Thus, the analyses of long-term requirements for the nuclear materials complex must become an integral part of the Department's dynamic strategic planning process.

Task 8: Analyze whether to consolidate nuclear materials management expertise — Based on experience with the National Spent Nuclear Fuel Program, the Department is considering creation of several nuclear materials management groups. These groups could help maintain the Department's core capabilities and expertise, aid coordination and integration efforts throughout the nuclear materials complex, and support program and field office issue resolution and decision making.

A management group could, for example, dispatch a mobile sample/pack/ship team to small holding sites, closure sites, or sites that lack the capability and resources to sample, characterize, pack, and ship their materials. These groups could be given the responsibility and resources to implement many required activities for a material type. They could support the management of both national security and legacy materials.

Because the groups would provide a mechanism for the integrated management and characterization of nuclear materials, costs associated with handling, packaging, transportation, and disposition should be reduced. Although there are unique issues associated with the management of each material, other programs could similarly expect to achieve savings, avoid future costs, or provide special services to sites that are otherwise without the needed expertise.

Experience with National Spent Nuclear Fuel Program

The National Spent Nuclear Fuel Program, located at INEEL, provides centralized planning and quality assurance functions. It is working closely with RW to integrate Department-owned spent fuel into the repository design basis and EIS, and if the site is found suitable, will do the same for the NRC license application.

The National Spent Nuclear Fuel Program has achieved cost avoidance by eliminating redundancies, coordinating technology development and testing programs, and maintaining a single point-of-contact with RW and the NRC.

In the past, most spent fuel was sent to Idaho or SRS for reprocessing, or retained at Hanford. When reprocessing for recovery of nuclear materials ceased, the focus shifted to treatment and storage and development of alternative disposition technologies. Decisions made in 1995 and 1996 established a strategy for regionalized management of Department-owned spent fuel by fuel type. The management of non-aluminum-based spent fuel was assigned to the Idaho Operations Office, with planning and implementation for aluminum-based fuels assigned to SRS. The Idaho Operations Office was also assigned the role of working with RW to effect repository disposal of Department-owned spent fuel.

The National Spent Nuclear Fuel Program has identified many other materials in the Department's possession that may require geologic disposal. These materials are not currently included in the repository proposed action. For example, unirradiated HEU reactor fuels, special isotopes greater than Class C and special case wastes, and lightly irradiated reactor fuel not managed as spent fuel. The National Spent Nuclear Fuel Program, working with other materials management groups, would provide support for characterization and disposition of these other materials that may require geologic disposal.

Potential Benefits of Consolidating Expertise

Establishing management groups responsible for centralized integrated planning by material type offers the Department an opportunity to ensure that all of its nuclear materials are managed from a corporate perspective. The groups would support management of both national security and legacy materials, providing the following benefits:

- cost avoidances and savings by sharing technical expertise among sites around a strong technical hub,
- reduction of operating costs through improved corporate material and facility planning,
- assurance of the availability and preservation of core competencies for all materials,
- a mechanism for promoting improved multi-program coordination of facility operations,
- consolidated planning and management of each material type,
- improved security and safety by accelerating material deinventory and disposition, and
- support for accelerated site closure.

The creation of nuclear materials management groups for plutonium, uranium, heavy isotopes, and non-actinide isotopes and sealed sources will be evaluated, at potential sites where the groups would be established. Management groups, if established, would be assigned to sites with past experience managing that material and having significant materials management infrastructure. An important consideration will be the cost of developing these groups in relation to their potential benefits.

Improving Operations

The Department has identified and is considering operational changes that could significantly improve its management of nuclear materials. In preparing this Plan, the Department took a bottom-up approach, using several workshops and reviews to help identify specific opportunities for improving its management of plutonium, uranium, spent nuclear fuel, and other nuclear materials. These opportunities, when fully integrated with today's baseline activities, would afford the greatest near-term return on investment and are described in detail below. They fall within the following categories:

- surplus plutonium management, including storage, stabilization, and disposition;
- uranium management, including storage, recovery, and blend-down; and
- issues that "crosscut" material categories, including packaging, transportation, and technology.

The criteria used to select opportunities for further evaluation, and which will be applied in more detailed evaluations, include the following:

- further reduces radiological risk,
- reduces or avoids costs,
- advances integrated management of nuclear materials,
- improves the efficiency and effectiveness of Departmental operations, and
- promotes nonproliferation/arms control.

Some opportunities are ready for implementation. For others, assessments will be conducted to determine their value within the context of existing and planned operations, and to establish the information base needed to support decision making. Decisions will be made through the Department's established decision making processes, including NEPA requirements, as appropriate.

Improving Operations for Plutonium Management

Plutonium programs are currently being reassessed in light of rapidly changing missions involving Science Based Stockpile Stewardship, arms control agreements, legacy cleanup, and implementation of the plutonium disposition mission. DP and EM, for example, are stabilizing plutonium residues to reduce existing safety vulnerabilities. As another example, the Department is reevaluating its plutonium stabilization, storage, and disposition activities for integration opportunities based on the Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement (DOE, 2000a) which designated SRS as a key management site for surplus plutonium disposition. Preliminary assessments of integration options have been conducted and preliminary conclusions are presented in this section. Additional assessment will be necessary over the next 6 months to finalize preferred planning options that could result in cost savings/avoidance and improvements in overall program execution.

Nuclear material operations (including plutonium) are expensive, and the Department operates facilities at Rocky Flats, Hanford, ANL-W, LANL, LLNL, and SRS. There are other sites handling smaller quantities of plutonium as well. In some cases, decisions made at Savannah River have large cost impacts at the other sites. Figure 3-2 depicts the Department's plutonium management activities as they are conducted today.

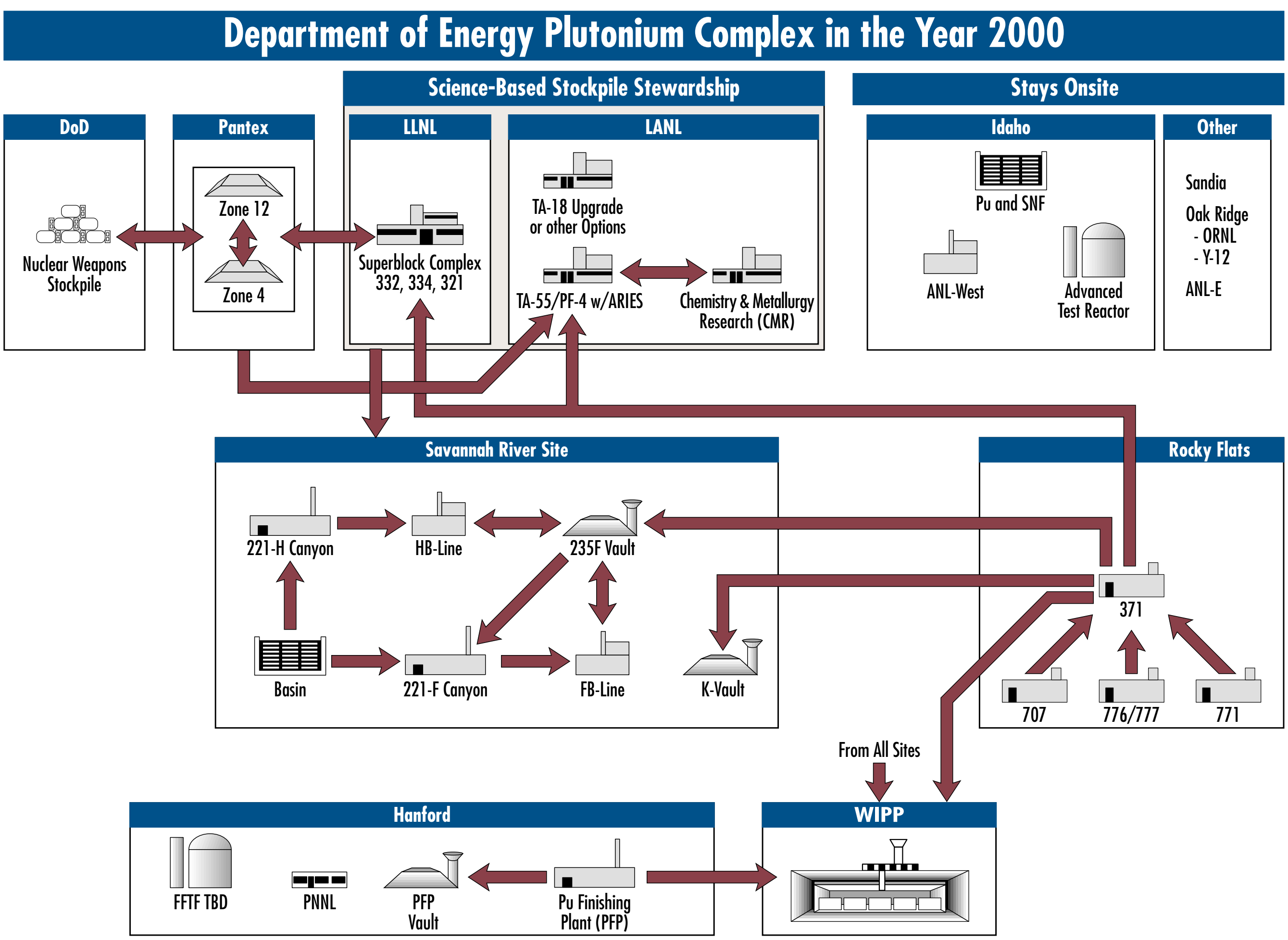
Several specific improvements have been evaluated. These are in the areas of plutonium stabilization and storage. Figure 3-3 depicts how the plutonium complex will look in 2010 with the planned plutonium materials disposition facilities all online, based on current Department planning.

Rough order-of-magnitude projections indicate that the Department could realize a funding shortfall of between 5 and 20 percent during the period of FY 2001 and FY 2006 if funding for the plutonium management operations represented in Figure 3-2 remains constant for the next several years. In light of this possibility, the Department recognizes the importance of identifying opportunities to minimize future costs for managing these materials.

Ways to Improve the Department's Management of Plutonium Stabilization

Stored plutonium poses a variety of potential hazards that must be considered to ensure safe operations. These hazards are greater when the plutonium is in a form that is unsuitable for long-term storage, such as when it is in solution. Plutonium stabilization is important for both safety and cost reasons and is a high priority. The DNFSB has urged the Department to expedite stabilization of its plutonium materials in DNFSB Recommendations 94-1 and 2000-1 (DNFSB, 1994 and 2000) and, indeed, the Department itself has confirmed the need to perform this vital function in its own analyses (DOE, 1994). Execution of the 94-1 implementation plan to stabilize surplus plutonium has been underway since 1995. While much of that program has been completed, there have been delays and increased costs as a result of operational difficulties, unanticipated material characterization issues, and uncertainties in the development of appropriate stabilization technologies. Presently, program plans are being developed for completion of all milestones committed to the DNFSB.

Figure 3-2 The Department's Plutonium Complex in the Year 2000



As noted in Chapter 2, the Department has decided to pursue a modification of its previous plans for stabilization and storage of materials at SRS. The options that were considered and the results of the analysis that led to the Department's decision are described in this section.

Options for Optimizing Plutonium Stabilization at SRS

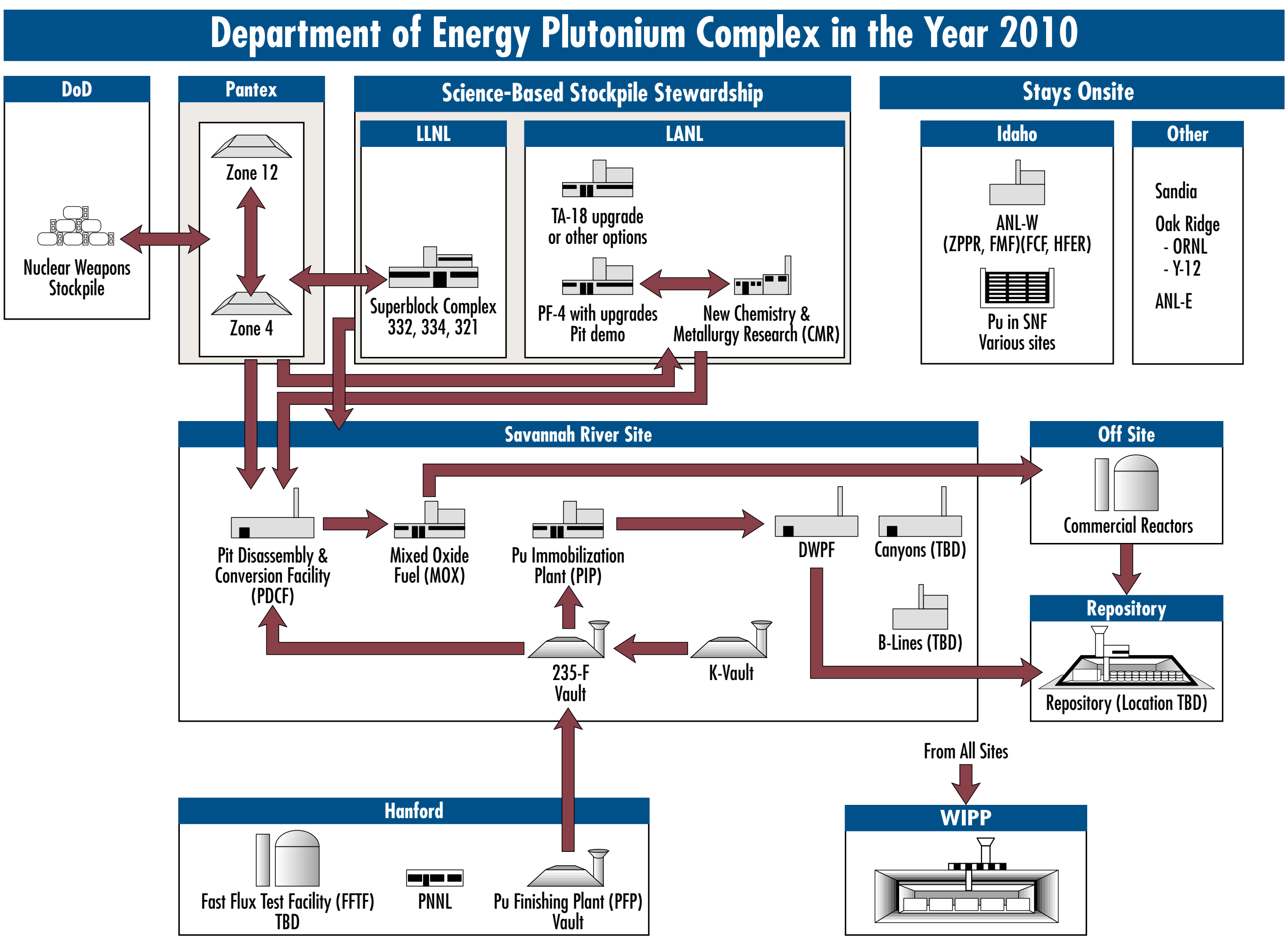
Following is an overview of how options for optimizing plutonium stabilization activities at SRS compared to each other. This overview illustrates many of the factors that influence integration decisions in the context of a large site within the nuclear materials complex.

Reference Option - Since 1994, the baseline approach to stabilizing plutonium materials at SRS involved optimum use of currently operating plutonium processing and storage facilities, along with construction of an Actinide Packaging and Storage Facility (APSF). This approach involved larger SRS operational costs than the current planning option described below because

Opportunities to Optimize Plutonium Management

- **Stabilization** – Determine if there are ways to optimize the Department's plans for stabilizing its inventory of surplus plutonium and achieve cost and risk improvement.
- **Storage** – Examine the Department's current interim and long-range plutonium storage plans to determine if the cost and risk associated with these plans can be reduced.
- **Disposition** – Configure plutonium facilities to take advantage of existing and planned infrastructure to achieve improved schedules, cost savings or avoidance, and other programmatic synergies.

Figure 3-3 The Department's Plutonium Complex in the Year 2010 (Based on Current Departmental Planning)



the reference option added the capital funding for construction of the new APSF to the cost of currently operating facilities.

The APSF was put on hold in December 1998 because the construction costs had increased several times and no project baseline had yet been established. Also, this approach did not consider new requirements or efficiencies that could be gained through integrated planning with the Department's program for plutonium disposition.

Current Planning Option – As a result of the Department's concerns with the APSF project, analyses were initiated to determine a more cost-effective, better integrated path forward. The approach which has been preliminarily decided upon maintains the existing SRS canyon strategy, which targets the early phase-out of F-Area plutonium-uranium extraction (PUREX) operations as in the reference option, but provides a new plutonium stabilization and packaging system (PuSPS) in building 235-F to convert SRS materials to a form meeting the Department's long-term storage standard. This approach allows SRS to stabilize its materials with fewer near-term costs than in the reference option, and with long-term costs consistent with current outyear funding projections. Stabilization activities in this case are projected to be complete by FY 2009.

Analysis of Stabilization Improvement Options

The options described above were assessed against the five criteria described earlier in this chapter.

(1) Reduce radiological risk – The current planning option completes stabilization of plutonium at about the same time as was projected for the reference option.

Potential Hazards of Improperly Stored Pu-239

- Container/packaging failures can contaminate personnel.
- Exposure of metal to air can cause oxidation and further degradation.
- Plutonium solutions can leak from tanks or piping.
- Corrosive or chemically reactive materials are difficult to contain.
- Old facilities that are poorly maintained or have obsolete designs exacerbate problems.
- Inadvertent accumulations of plutonium in sufficient quantities can result in nuclear criticality events and, thus, radiation emissions.

Criteria for Comparing Stabilization Improvement

- Reduce radiological risks.
- Reduce costs.
- Advance integration.
- Improve effectiveness.
- Further nonproliferation and arms control objectives.

(2) Reduce or avoid cost – By following the current planning option, the capability to package SRS materials to meet the Departmental storage standard can be accomplished via backfitting an existing facility (235-F) for less cost than building a "green field" facility (APSF).

(3) Advance integrated management of materials – One potential mission for APSF had been to assist in consolidated storage of several sites' plutonium at SRS. However, the benefits of that integration capability were not found to be adequate justification for the large capital investment, as further discussed below.

(4) Improve efficiency and effectiveness of operations – The Department has no need to proceed with APSF from a plutonium storage requirements basis, as discussed in the next section. The storage in the KAMS facility and building 235-F can accommodate planned receipts from Rocky Flats, LANL, and LLNL. Further, there appears to be no financial incentive [based on assumed Plutonium Immobilization Plant (PIP)startup] to accelerate relocation of Hanford materials.

(5) Further nonproliferation – The current planning option has the same canyon processing schedule as the reference option.

It is important to acknowledge that selection of this current planning option depends on many factors, including technology maturity, facility and operational readiness, funding availability, and other management decisions. The interface with decisions for improved storage is discussed in the next section.

Ways to Improve the Department's Management of Plutonium Storage

The Department's assessment of the need for expanded storage at SRS for stabilized material must be closely linked to the planned storage at the three MD facilities. The planned storage will accommodate the output product from the PDCF, input feed to the PIP, and MOX fuel fabrication facility.

Some storage at SRS would also be needed for the surplus pits shipped from Pantex, which would be converted to an oxide in the

PDCF before being manufactured into MOX fuel or immobilized. Also, storage would be needed for HEU disassembled from pits that would be ultimately fed back into other uranium streams.

The Department has already consolidated plutonium pits from Rocky Flats to Pantex in order to improve efficiency and reduce costs. The Department is implementing movement of Rocky Flats plutonium to SRS but is reviewing the plans for consolidation of Hanford's plutonium. The Department is evaluating whether to further consolidate materials from LANL and LLNL to SRS, if a cost-effective storage plan can be developed.

Table 3-1 identifies the projected number of "3013" cans containing plutonium metal and oxide items that will ultimately be shipped to SRS. The Department is analyzing several options for expanded plutonium storage at SRS.

Options for Improving Storage Plans

Modify existing storage facilities

The Base Case – This case provides for the shipment of Rocky Flats plutonium metal and oxides to the KAMS at SRS, starting in FY 2000. It includes only materials from Rocky Flats and materials at LANL and LLNL that were exchanged with materials from Rocky Flats. It does not include additional plutonium materials that are part of the scope of the MD program stored at Hanford, LANL, and LLNL.

Option A – Ship MD plutonium to SRS from LANL and LLNL, in addition to Base Case materials. MD program material (270 cans to KAMS) generated from ARIES and immobilization programs at LANL and LLNL would be shipped to SRS, in addition to the Base-Case shipments from Rocky Flats. This option is particularly important to MD because vault storage limitations and ongoing and future DP mission requirements for the LANL and LLNL vaults will preclude future shipment of plutonium to the laboratories until a path for storage of these materials is identified.

*Option A** – Same as Option A above, except that the LANL storage vault within TA-55's plutonium processing building would be modified to store surplus material generated at LANL in support of the MD program.

Option B – Ship plutonium to SRS from Hanford (4,000 items in "3013" cans). This would require modifying the building 235-F vault at SRS to provide up to 3,850 storage positions, but it would eliminate the need for upcoming modifications to Hanford's PFP vault and eliminate MD's need for 1-year storage capacity in the immobilization facility. In addition, when all nuclear material is removed from the PFP, significant safeguards and security costs could be saved.

The options above represent modifications to existing facilities for storage of excess plutonium metal and oxides. DP excess plutonium metal and oxides, 370 items in "3013" cans, under these scenarios would remain at LANL and LLNL until MD's PIP is built.

Table 3-1 Projected Plutonium Inventory and Proposed Shipment Schedule to SRS (expressed in number of items packed in Department Standard 3013 storage containers).

Site	No of 3013s	Shipments by Fiscal Year to SRS						
		2000	2001	2002	2003	2004	2005	2006-2014
Rocky Flats	1900		340	830	730			
Richland	4000							
Store in Plutonium Finishing Plant								4000 (2010-2014)
Store in 235-F							500	1050 (2006) 1225 (2007) 1225 (2008)
LANL								
MD Material to SRS	220	80	70	70				
Store MD Material at LANL								
Rocky Flats Swap	96	60	36					
DP Excess	270							270 (2010)
Subtotal*	**586**							
LLNL								
MD Material	50		20	20	10			
Rocky Flats Swap	65	14	21	21	9			
DP Excess	100							100 (2010)
Subtotal	**215**							
SRS	1539							
TOTAL	**8240**							

* 100 cans of Pu-contaminated HEU also need to be moved out of LANL in 2000-2002 and 40 cans of Pu-contaminated HEU need to be moved out of LLNL in the 2001-2003 timeframe.

Build new storage facilities

The cost effectiveness of building new storage facilities has also been assessed. Options include:

Option C – Construct a new storage facility. A new storage facility with a storage capacity of 5,000 positions in conjunction with continued storage of 3,000 cans in the KAMS.

Option D – Construct a larger facility. A larger facility would have a 10,000 "3013" can capacity without KAMS storage.

The storage options identified above, Base Case plus Options A through D, are summarized in Table 3-2.

Costs of Options

Consolidation of Rocky Flats plutonium metal and oxides at SRS will begin this calendar year. Costs for consolidation of other surplus plutonium materials from the Department's other sites such as LANL and LLNL need to be evaluated and a decision made on interim storage at SRS.

In evaluating consolidation of Hanford material at SRS, the cost avoided from modifications to Hanford's PFP storage vault and elimination of the need for storage in the immobilization facility would approximate the costs of facility modification at SRS. Operating costs are essentially equal. Since it is estimated that no savings would be realized over the anticipated time period for interim storage of Richland plutonium metal and oxides at Savannah River, plutonium will remain in storage at Richland until the MD disposition facilities are operational and the materials can be delivered on a "just-in-time" (JIT) basis.

Construction of a new storage facility at SRS does not appear cost-effective at this time. If a new storage facility were built at SRS, and the MD immobilization facility began operating between 2006 and 2010, the new storage facility would only be needed for a 9- to 13-year period, at a significantly higher cost than use of existing facilities. If the MD immobilization facility is not built, however, the Department will need to construct a long-term storage facility at SRS. The cost analysis of each of these options is included in the Plutonium Storage Study to be issued in the near future.

Ways to Optimize Plutonium Disposition Facilities

In January 2000, MD completed the NEPA review of the various paths for disposition of surplus plutonium. Alternative locations for siting the three functions — Immobilization, Pit Disassembly and Conversion, and Mixed Oxide Fuel Fabrication — were studied, but the decision was made to locate functions at a single site, SRS. Figure 3-4 describes the capabilities required for surplus plutonium disposition.

Table 3-2 Comparative Summary of Consolidated Plutonium Storage Options

Storage Location	No. of Positions	Status	Base Case (RFETS Swap from LANL & LLNL)	Storage Option A (RF & DP JIT to PIP, Move MD Program Material	Storage Option A*	Storage Option B (DPJIT To PIP)	Storage Option C (Storage in KAMS & APSF)	Storage Option D
K Reactor Double Stack	3,000	Operational 2/00	RF 1900 SRS 939 LANL 96 LLNL 65 3000	RF 1900 SRS 939 LANL 96 LLNL 65 3000	RF 2200 SRS 639 LANL 96 LLNL 65 3000	RF 2200 SRS 639 LANL 96 LLNL 65 3000	RF 2200 SRS 639 LANL 96 LLNL 65 3000	
235-F Existing Vault	665	Operational	SRS 800	SRS 600 LLNL 50 650	SRS 600 LLNL 50 650			
K Reactor Triple Stack	Additional 1,400 positions	Pre-conceptual design complete		LANL 220*		LANL 220* LLNL 50* RL 750 1021		
235-F Vault Modifications	3,850	Pre-conceptual design complete				SRS 600 RL 3250 3850		
New Vault (5000 positions)	5,000	Final Design					5,000 (Richland, LANL, LLNL & SRS Material)	
Large New Vault	10,000	Concept						10,000

Base Case-3611 cans   Option A-3881 cans   Option B-7881 cans   Options C&D-8251 cans   JIT-Just in Time

*MD Program Material

The Department will apply value engineering practices during the design phase of each individual facility to determine the most effective manner in which to optimize it within the infrastructure at SRS to achieve improved schedules, secure cost savings, avoid future costs, and accomplish other programmatic synergies.

The Stewardship Task Force initially proposed a value engineering analysis covering the integration of some or all of the functions to be performed at these separate facilities in an attempt to achieve cost savings and other programmatic synergies. In considering this integrated concept, however, the Task Force accounted for two important factors: (1) integration could significantly limit programmatic, schedule, and operational flexibilities required for successful implementation of the plutonium disposition program; and (2) the U.S.-Russian plutonium disposition agreement undergoing final interagency review in both countries reflects the three-facility approach. In light of these factors, the Department believes that three individual, stand-alone facilities offer important insurance against technical, schedule, cost or institutional barriers; ensure the U.S. meets the terms of its potential bilateral agreement with Russia; and provide the best option for implementing the hybrid approach for plutonium disposition.

Optimizing Uranium Missions and Facilities

As described in Chapter 2, the Department currently maintains uranium materials in safe interim storage, with stabilization and blend-down as needed, pending their reuse in national defense or other programmatic applications or their disposition as surplus uranium. With respect to disposition, the Department prefers to maximize the reuse of surplus uranium materials to the extent that they meet, or can be processed to meet, specifications for commercial use. To date, detailed plans have been established for commercial reuse of surplus HEU only. For DU in the form of DUF_6, a long-term management strategy has been evaluated, although additional NEPA analysis will be required. Planning and evaluations are in the early stages for determining potential reuse or other disposition of U-233, LEU, and NU.

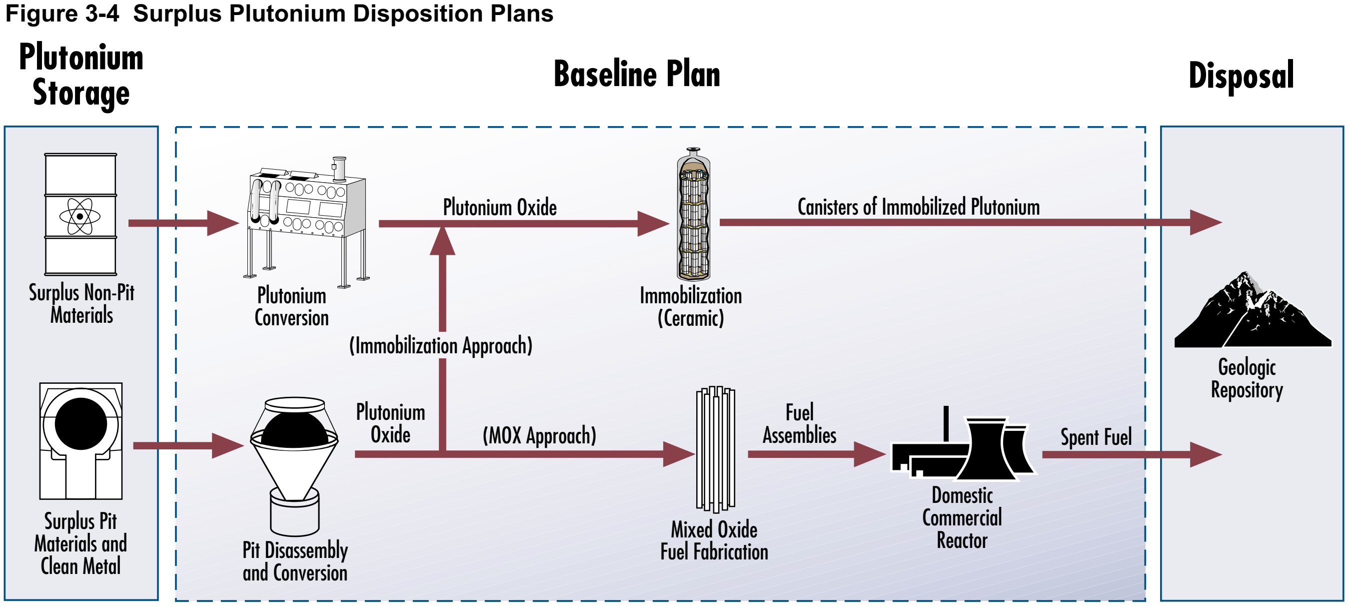
This section describes options for optimizing uranium missions and facilities in order to further integration and avoid future costs.

Ensure Adequate Uranium Processing/ Blending Facilities

HEU characterized as "national security" or "programmatic" is managed primarily at the Oak Ridge Y-12 Plant. These materials are classified shapes and must be made available for reuse in national security programs, or they are contained in the large backlog of nuclear materials awaiting recovery. As part of the manufacturing process, HEU is sometimes blended down to a lower assay of enriched uranium before being made into a final product. Such blending has been ongoing at the Y-12 Plant for many years.

Disposition of excess uranium materials includes the processing of HEU. Large inventories of uranium-bearing materials await processing to ensure that safe, reliable forms of uranium are available for reuse as reactor fuel or are in a form that is suitable for interim and/or long-term storage.

Figure 3-4 Surplus Plutonium Disposition Plans



Blending and processing achieve nonproliferation objectives consistent with U.S. nuclear materials policies. Maintaining uranium processing capability will support near-term, multi-program requirements including:

- weapons program/special projects,
- disposition of surplus HEU,
- production of research reactor fuel, and
- production of tritium fuel.

A rigorous options study will be completed by the Department. One option for location of this capability is at an upgraded Y-12 Plant at the Oak Ridge site. Other options include the H Canyon at SRS and commercial facilities owned by Nuclear Fuel Services and BWX Technologies.

A modernized enriched uranium processing facility would provide renewed capabilities for processing all forms of enriched uranium required for national security and other programs. A downsized, modern facility would function more cost-effectively, be seismically safe in its design and construction, and provide increased security at reduced costs. This facility could manufacture weapons components for the Stockpile Stewardship program, provide purified enriched uranium to the Department's domestic and foreign customers, and continue the recycling of enriched uranium-bearing salvage to optimize the Department's resources.

Consolidate Storage of Uranium Materials

Highly enriched uranium. The Department has approximately 174 MT of surplus HEU (1994 inventory) in a variety of physical forms such as metal, oxides, solutions, and spent nuclear fuel, at 10 sites in the United States. At present, a portion of this surplus has been down-blended, transferred from the Department, or relocated. The current total quantity and locations of HEU included in the national security reserve are classified.

Even though a viable and tested disposition path for surplus HEU is available through isotopic dilution and use as commercial LEU reactor fuel, we will have to store surplus HEU for many years to come. At present, excess material is stored at the Oak Ridge Y-12 Plant, together with the national security reserve. Also, surplus HEU from other sites is being consolidated at the Y-12 Plant, and additional HEU may be removed from the active weapons stockpile subject to implementation of future treaties.

Consolidation of HEU storage can accelerate site closures (e.g., at Rocky Flats) and produce considerable cost-savings. Safeguarding facilities is expensive. Thus, consolidating materials and reducing the number of facilities can reduce safeguards costs dramatically. Furthermore, facilities cannot be decontaminated and dismantled until nuclear materials have been removed. Currently, consolidation of HEU occurs on an ad-hoc basis, as a result of direct negotiations between shipper and receiver sites, usually in an effort to reduce costs at sites with smaller inventories and/or at sites having no defined use for the materials.

The fact that a new HEU Materials Storage Facility to support national security needs is in final conceptual design for the Y-12 Plant provides an opportunity to promote consolidation of HEU. The design studies include options for additional storage capacity. The Department will begin additional studies to evaluate the economics of expanding this facility to serve as a multi-program consolidation site for all excess non-spent nuclear fuel HEU. This study will be integrated with other consolidation activities, as maximum cost savings are not realized until all nuclear materials are removed from a facility and it is closed.

Low-enriched uranium, natural uranium, and depleted uranium. Approximately 85 percent of LEU/NU/DU materials do not have defined and/or agreed upon disposition paths. Possible disposition options include blending, either for disposal as LLW or potential commercial use. EM is conducting an analysis of management options for these materials. This analysis will be completed in the near future and will result in alternatives for these materials which will be evaluated through the NEPA process. The exception to this is the DU in the form of DUF_6. A DUF_6 program was announced by NE and is not considered further here.

The Department will analyze the value of processing its inventory of LEU for sale or blend-down purposes and will compare it with the cost of disposition, for materials for which disposal is an option.

Applying Proceeds from Material Sales Toward Implementation of Opportunities

Safe and secure management and disposition of nuclear materials over the next 10 years will cost billions of dollars. Some of these costs can be offset through material sales. This approach provides a common sense business model that can greatly benefit the Department and the taxpayer.

Managing excess property entails high surveillance and maintenance costs, but disposal requires a large up-front investment to achieve long-term savings or cost avoidance. The Secretary has made asset management and disposition a high priority and integration can yield further improvements. This may include legislative reform that would establish a special account into which the Department would be permitted to deposit the proceeds from the sale/disposal of excess property rather than having those proceeds revert to the Treasury. Such reform would provide the Department and its contractors with more incentive to disposition excess property. The Department has used a similar approach to good effect in managing special isotope materials. The proceeds of isotope sales are returned to the Department to be used in the production of more isotopes.

Optimizing Transportation and Packaging Strategies

A major function of materials management is safe and timely transportation of nuclear materials and waste. The Department has been shipping waste and nuclear materials for years and has an excellent safety record. However, shipping campaigns, including packaging, can still be improved. The opportunities identified below would better coordinate shipping activities, coordinate planning of individual shipping campaigns, and elevate transportation to a corporate activity. The need for improvement is driven by the significant increase in transportation requirements in the near future.

It should be noted that national security shipments made by the Transportation Safeguards System (TSS) involve additional requirements and need to be considered separately from non-security shipments.

Coordinated Planning of Shipping Campaigns

Transportation planning must be coordinated across programs and sites. The lack of coordination leads to inefficient use of limited transportation resources, as well as a disjointed approach to stakeholder interactions associated with various shipping campaigns. Increased shipments of plutonium, uranium, spent nuclear fuel, and other materials will exacerbate this inefficiency over the next 5 years. Three activities could benefit the Department's shipment planning:

- **Transportation protocols.** The Department has undertaken an initiative to identify and evaluate the different shipping protocols and practices used by all Department shippers of radioactive materials and wastes. Where appropriate, it will establish standardized transportation protocols and practices, and where standardization is not appropriate, explain why not. Standard protocols and practices for all radioactive material and waste shipments are currently being drafted and reviewed by Department shipping programs and key stakeholders.

  This task is scheduled for completion by the end of Fiscal Year 2000. Benefits include good internal coordination regarding radioactive material shipments, better communication with stakeholders, and streamlined planning and preparation for future shipping campaigns.

- **Coordinating shipping model and shared costs.** Recent enhancements to transportation security and projected increases in shipments will strain existing transportation resources. This is especially the case for "out-of-commerce" national security shipments performed in the TSS. Significant opportunities exist for optimizing transportation across the Department by coordinating the planning and scheduling of shipments of national security materials and other nuclear materials.

  The Department is developing a modeling tool to help determine the best use of TSS resources to meet all secure shipping requirements. With minor modifications, this model has potential applicability to other nuclear material and waste shipments. To offset the increased resource requirements on the TSS, a financial chargeback approach will be implemented on non-national security shipments. The timing for integration is under development and will coincide with the FY 2002 budget cycle.

Packaging Management

To successfully execute a shipping campaign, programs must begin the planning process early. Many of the steps that are key to implementing such a campaign are lengthy and require a long-range plan. Identifying packaging suitable for shipping a nuclear material is one of the critical steps in this process. Packaging certification must be accommodated and optimized to avoid operational delays.

Packaging

Packaging management consists of a number of components, many of which contain opportunities for improvement. The components include:

- Material characterization and hazard classification is based on the material's physical (solid, liquid, gas) and chemical forms, radiological hazards, the quantity to be transported, and the U.S. Department of Transportation hazard classification.
- Packaging type (strong-tight, industrial, Type A or B fissile packagings), where the robustness of the packaging is determined by the hazard of the materials.
- Packaging design, which addresses the specific packaging type and is described in a Safety Analysis Report for the packaging.

- Packaging fabrication, during which a qualified packaging fabricator is identified to manufacture the packaging to meet client needs.
- Packaging inventory, warehousing, and tracking, which address the location of the packaging and logistics for delivery to a central location or for pickup by carrier.
- Packaging maintenance, which addresses who maintains packagings, the frequency they are serviced, and acceptance criteria for continued use of packaging.
- Quality assurance, which identifies the appropriate quality assurance programs for each of the above elements and the standard to be met (the Department's, ASME, ISO), and the response to failure to meet any element of a quality assurance program.
- Packaging certification, which determines if the packaging meets the regulatory requirements prior to fabrication.

An evaluation of the components of packaging management will be completed by October 2000 and will present recommendations for program and process efficiencies and improvements. Additionally, the Department will establish a Department-wide Package Management and Planning Working Group, which will oversee the development of new packaging and the use of existing packagings. Further, this group will, to the extent practicable, identify areas where inefficiencies caused by duplication of packagings and resources can be eliminated.

Standardize Packaging

Currently, each Departmental program that ships nuclear materials develops its own packaging. Sometimes different sites within a program develop and/or purchase a different packaging. This packaging is costly, and it is designated for use only by the site or program that paid for it. Smaller sites can be left out of the planning for packaging use, causing potential delays in closure schedules. With individual sites and programs owning this packaging, defining who performs maintenance and determining reuse often becomes a problem. A corporate approach to packaging could leverage savings through larger procurements and maintenance of containers.

To make this process more efficient, the Department will take the following actions:

- *Establish multi-use packaging criteria.* Programmatic decisions to expand the use of containers, making them multi-application containers, would reduce the total number that the Department needs to buy and maintain. Two multi-use packagings are now being developed: one for plutonium materials and one for spent nuclear fuel and HLW. Building on this concept, all material to be disposed of will be reviewed against multi-use packaging criteria. Where it is possible to easily modify existing containers, rather than creating and certifying new packaging, the Department will accomplish this.
- *Shift packaging ownership to programs or site material management groups.* Packaging is currently owned by sites. This causes disputes over who gets to use the container and when. It slants certification toward use by the site that owns it. The shipping needs of small sites with limited resources may be a low priority. Transferring ownership of packagings to a program or a nuclear materials management group could produce efficiency in purchasing and resource management. Similar to the approach being used for resource management of the TSS, resource management of the packaging fleet should also be considered. Programmatic fleet management could reduce shipment costs by reducing the number of containers that would have to be purchased, increasing the efficiency of fleet management by gaining greater use from each container and rotating maintenance to limit packaging down-time.

Overall, the focus of these opportunities is on doing business in a more corporate fashion and making better use of resources across the Department.

Optimizing Technology Investments

Technology development within the weapons complex has traditionally involved "suppliers" in the form of the laboratories, and "customers" in the form of program offices. In very general terms, the needs of each customer were unique, and R&D was assigned either to a laboratory that competed successfully for the work, or to an informally recognized center of excellence. In addition, the production sites had "process development" organizations that fine-tuned the production, recovery, and manufacturing processes devised by the major laboratories.

The transition from yesterday's weapons production focus to today's much more diverse mission set, represented by multiple programs, has created a situation in which customers may have overlapping needs. Also, technological expertise is much more diverse and is spread among several laboratories.

Today, the customers are the programs and projects in the various program Secretarial Offices. In many cases, overlapping needs are evident. The technology "suppliers" continue to be the national laboratories and process development groups at the sites. "Centers of excellence" exist for technology development. These include national laboratories and sites, such as Rocky Flats and the Savannah River Technology Center at SRS. As a consequence, the possibility of duplicative effort has arisen.

To assess the extent of overlapping initiatives, the Department reviewed the many program documents identified in Chapter 2 to comprehensively identify technology requirements and impacts. Examples of current efforts that are integrated opportunities for improved integration, and a management structure to foster improved integration are described below.

Documentation of Department technology requirements and plans

Many Department documents outline technology requirements and R&D plans for executing missions. Some of the documents are still in draft form, but they are a good source of information about the Department's principal technology initiatives.

For example, the DOE FY 2000 Research and Development Portfolio provides a comprehensive list of current Department R&D activities and budgets. Future versions will reflect technology roadmapping, which will provide a more comprehensive framework for technology integration.

By analyzing these sources, several areas of technology development and core competencies common to multiple Departmental program offices were identified. Table 3-3 shows the main areas of overlapping interests.

Technology integration

There are several examples of integration associated with the broad areas identified in Table 3-3. One is related to development of safe storage standards for nuclear materials. The latest revision of DOE-STD-3013 for long-term storage of plutonium metal and oxide is a cooperative effort among DP, EM, and MD. In another example, the Department's National Transportation Program and the Nuclear Materials Stewardship Technology Program (EM) have created a Hydrogen Generation Working Group to facilitate communication, reduce duplication, and enhance synergy among researchers investigating the generation of hydrogen gas in radioactive materials. Ultimately this will benefit every program that stores or transports gas-generating nuclear materials, including wastes.

A number of integrating mechanisms have been established over time. Laboratory managers involved in analytical chemistry have formed a working group among the sites involved in large-scale analytical operations to compare initiatives and share ideas. This group, the Department Analytical Managers, has been meeting annually for 16 years. Professional conferences and symposia provide a forum for technical peer reviews and foster collaborative relationships.

Significant near-term opportunities

With the diversity and complexity of Departmental programs and technology initiatives, more can and should be done to increase technology integration. For nuclear instrumentation, the Office of Defense Nuclear Nonproliferation is concerned with development of improved and more automated safeguards and security systems that DP, EM, and MD can use in nuclear materials storage facilities. All programs would benefit if collaboration among programs allowed sites to use their own facilities as a test bed for new instruments.

For storage surveillance and monitoring, as various programs package material for long-term storage,

Table 3-3 Overlapping Technology Development Interests

Technology Development Areas	Organization
Nuclear Instrumentation, Measurements, NDA/NDE Technology Development	DP, EM, MD, NN, SO, SC
Chemical Processing Technology Development (aqueous, pyrochemistry, immobilization, waste minimization)	DP, EM, MD, NE, SC
Analytical Chemistry Development	DP, EM, MD, NE
Materials Science/Materials Characterization	DP, EM, NE, SC
Separations Technology Development	DP, EM, NE
Nuclear Material Packaging, Storage, Monitoring and Surveillance Technology	DP, EM, MD, NE
Spent Fuel Packaging, Storage, Monitoring and Surveillance Technology	EM, NR, RW
Robotics/Automation	DP, EM, MD, NE

surveillance approaches and technologies should be integrated. For waste minimization, emerging requirements to reduce waste volumes and lower the actinide content of wastes would have a significant impact on the technologies used to handle nuclear materials. Although some programs have been organized to address this initiative, further integration would pool resources so they could be used more effectively.

Management structure to improve technology integration

The process already initiated to develop and maintain the R&D portfolio will play an important role in providing a framework for technology integration. The Department's R&D Council, composed of key principal secretarial officers and chaired by the Under Secretary for Energy, Science, and Environment, oversees the portfolio and directs technology policies and priorities.

The NMC will charter a Nuclear Materials Stewardship Task Force Working Group to focus attention on opportunities to better integrate nuclear materials technology initiatives. This will more closely couple technology initiatives with mission drivers, ensure that the technology initiatives are relevant, and provide the best forum for prioritizing the integrated technology investments.

This working group will be staffed by members assigned by the Stewardship Task Force to identify the needs of various customers, and, with their help, to prioritize those needs. The working group will assess the capabilities of the various suppliers and coordinate their related programs. Finally, the working group will recommend funding for cost-effective nuclear materials-related R&D focused on meeting mission objectives. This approach can leverage R&D funding, minimize cost, eliminate gaps and overlaps, and identify high-return-on-investment opportunities.

While it is not yet possible to estimate cost savings from better coordination and integration of technology initiatives, there is a significant potential for pooling of resources.

Summary of Proposed Operational Improvements

The Department has identified a number of near-term actions that promise to strengthen and integrate management of nuclear materials. Implementing them can help ensure that the treatment, storage, and disposition of nuclear materials will be managed economically and efficiently, and that the nuclear materials complex will be adequately prepared to meet mission requirements over the coming decades.

Summary of Significant Progress, Plans for Next Steps

Chapter 4

This Integrated Nuclear Materials Management Plan is the product of an initiative at the highest levels of the Department, and it responds to a congressional directive. The Department launched the NMSI to accelerate the work of achieving integration and reducing future costs associated with the management of nuclear materials. Chartered in January 2000, the principal focus of NMSI is excess materials.

This chapter closes the Department's discussion of opportunities to integrate and optimize the way in which it manages nuclear materials. Recent progress in the field in reducing risks associated with our nuclear materials inventory and progress in more closely integrating management of them is recapped here. The chapter also offers a summary of actions that will be undertaken to move the Department toward a more corporate approach to nuclear materials management, support strategic long-term planning, and minimize future costs.

Estimates of the annual cost of managing these materials demonstrate that they demand a significant portion of the Department's annual budget. The Department's baseline plans for the next decade call for capital spending on upgraded or new facilities in order to carry out surplus materials disposition and other missions. Additional capital spending may also be necessary if the nation is to maintain a robust nuclear materials complex for the decades ahead. Furthermore, in order to achieve substantial savings over the long term, increased investments may be needed in the near term. In light of these realities, it is therefore particularly crucial that nuclear materials management is optimized for integration and efficiency.

The Department has identified a number of near-term actions that promise to strengthen and integrate management of nuclear materials. Implementing these actions will help ensure that the treatment, storage, and disposition of nuclear materials will be managed economically and efficiently, and that the nuclear materials complex will be adequately prepared to meet mission requirements over the coming decades. The Council's multi-year agenda is summarized in Table 4-1. As the NMC continues to implement this important agenda over the next few years, the Department will report on its progress in the Strategic Plan and through its annual budget requests. This agenda will be regularly reviewed and adjusted as needed to accommodate changing circumstances.

Building on Success

The Department has made significant progress reducing risks from nuclear materials storage conditions and in responding to concerns raised by the DNFSB. It is also moving ahead with plans for the disposition of surplus fissile materials, including Pu-239 and HEU. Highlights are summarized below.

Stabilization and storage

- Most sites have repackaged plutonium metal and oxides that were in unstable packaging configurations. The Department is now stabilizing and packaging nuclear materials and repackaging certain pits.
- Deteriorating spent fuel elements at INEEL have been moved to a basin where control of water purity is much better, and both INEEL and Hanford are developing dry storage facilities so that fuel can be moved from wet to dry storage.
- Substantial amounts of at-risk spent nuclear fuel and targets have been chemically processed to place them into forms suitable for long-term storage.
- Most of the plutonium solutions at SRS and Rocky Flats have been converted to metal and oxide, respectively, and packaged for safe, long-term storage.
- Plutonium residues are being repackaged, with some stabilization and blending, so they can be shipped to WIPP, which is now an operating disposal site for TRU waste.
- It is planned to convert DUF_6 into more stable forms of metal or oxide or both for long-term storage pending reuse and to stabilize U-233 for long-term storage pending reuse or disposal.

Disposition of excess materials

The Department now has disposition paths for excess plutonium and surplus HEU, as a result of Records of Decision under NEPA. The hybrid approach for disposition of excess plutonium, will use both immobilization and MOX fuel technologies. The endpoint will be disposal of immobilized plutonium or spent MOX fuel in a geologic repository. HEU will be blended down to LEU for use as commercial reactor fuel or for disposal.

The Department will continue to identify and evaluate options for dispositioning excess materials that currently lack disposition paths. These materials include surplus HEU, NU, DU, and various orphan materials.

Facility life-cycle planning and mortgage reduction

The Department has a substantial investment in the facilities needed to manage its large inventory of nuclear materials. These facilities are distributed at sites throughout the country and among many program offices. The facilities are continually being maintained, modified, or closed based on site or programmatic drivers. In 1998, the Department revised its Life-Cycle Asset

Table 4-1 Multi-year Agenda for the Nuclear Materials Council

Policy and Organizational Changes

- Policy
  1. Revise the Department's Strategic Plan to ensure that Nuclear Materials Stewardship is integrated into the Department's major missions.
  2. Update DOE Order 5660.1B - Management of Nuclear Materials - to include nuclear materials stewardship missions, including the responsibilities of the Nuclear Materials Council and the Nuclear Materials Stewardship Task Force.
  3. Establish a "National Resource Policy" that identifies the criteria to be applied when determining whether excess legacy nuclear materials that do not currently have a disposition path specified should be maintained for a future use or disposed of.
- Organization and Budget
  4. Review the costs for managing nuclear materials within the Department.
  5. Develop options and select an approach for institutionalizing a Nuclear Materials Stewardship staff coordination function.
  6. Evaluate the costs and benefits of establishing nuclear material management groups and formally charter those that will serve corporate nuclear materials management needs.
  7. Complete, in time for the FY 2003 budget process, a strategy document to establish the acceptance criteria, programmatic requirements, and budget requirements needed to guide any future transfer of certain "national resource" materials to the Office of Nuclear Energy, Science and Technology.
  8. Investigate opportunities to apply proceeds from surplus materials sales to help offset their disposition costs.
- Planning, Analysis, and Decision Making
  9. Make planning decisions, subject to NEPA review, concerning high-priority, cross-program issues, including the disposition of legacy nuclear materials, americium, curium, neptunium, uranium-233, strontium and cesium, among others.
  10. Complete a cost/benefit, business-case analysis of alternatives for improving the Department's nuclear materials information management and inventory accountability system and upgrade and integrate to the degree appropriate.
  11. Convene a cross-program team to integrate planning for the disposal of defense high-level nuclear waste and Department-owned spent nuclear fuel in a repository and to address safeguards and security licensing requirements.
  12. Establish an integrated planning and decision making process for facilities and infrastructure required to meet the needs of a modernized nuclear materials management complex.
  13. Perform a qualitative and quantitative projection of the long-term capabilities needed to perform the Department's nuclear materials management missions.
  14. Develop policy-level decision support tools to support long-term planning and decision making.
  15. Assess opportunities to integrate and enhance nuclear materials research and development.
  16. Develop Web-based tools for sharing information and facilitating coordination among Departmental programs and between Headquarters and the field on topics directly related to the Council's evolving agenda.
- Stakeholder and Public Involvement
  17. Establish appropriate mechanisms and opportunities for involving the public on issues that could affect them.

Improving Operations

- Plutonium
  18. Implement decisions from integrated assessment of plutonium storage consolidation.
  19. Implement decisions from integrated assessment of plutonium stabilization.
  20. Configure the three plutonium disposition facilities to take advantage of existing and planned infrastructure to achieve improved schedules, cost savings, and other programmatic synergies.
- Uranium
  21. Complete integrated assessment of uranium missions and facilities, including a method for consolidating uranium storage.
  22. Complete analysis of non-HEU opportunities and recommend improvements.
- Transportation and Containers
  23. Evaluate the protocols and practices used by shippers of radioactive materials and wastes.
  24. Design a financial charge-back approach for non-national security shipments of nuclear materials.
  25. Evaluate consolidation and streamlining of nuclear materials package management.

Management Order [DOE Order 430.1A] to address the challenges of decontaminating and decommissioning excess facilities. The Department's Field Management Council, chaired by the Deputy Secretary, is currently addressing implementation issues associated with the transfer of excess facilities for disposition to EM.

The Department has declared excess and is in the process of decontaminating and decommissioning 5,000 of the 20,000 facilities in the complex. The Department will continue its effort to reduce the "mortgage" associated with maintaining excess facilities so that it can reapply savings to other nuclear materials management priorities such as reducing vulnerability of at-risk materials, cleanup, and repairs to facilities.

An integrated Department-level process for making decisions about facility commissioning, use, and closure and for future facilities planning will become institutionalized.

Organizational and Policy Change

The NMSI was chartered by the Under Secretary to better coordinate efforts across the Department's program offices. NMSI both institutionalizes and formalizes the decision-making process for the cross-program management of nuclear materials. High priority cross-program issues already being addressed include the following:

- disposition of americium and curium, U-233, cesium and strontium, and plutonium-contaminated HEU and maintaining certain of these materials as "national resources;" and
- cost sharing for use of services, facilities, or processes.

Other immediate and near-term actions being implemented are the following:

- The Department will continue to aggressively work cross-program issues and reach timely decisions in order to ensure safe storage and disposition and meet mission needs. NMSI follows a systematic process for making decisions on cross-program issues. A decision could require analyses under the NEPA process or specific fact-finding by one or more program offices.
- The Department will establish a policy for determining if surplus nuclear materials that do not currently have a disposition path defined are to be maintained as a national resource or disposed of, and the Department will assign program responsibility for implementing the outcome of each decision.
- The Department will complete a business case analysis for meeting its nuclear materials information management and inventory accountability needs. The analysis is underway, involves all programs and field offices with nuclear materials management responsibilities, and is being accomplished in partnership with the Department's Chief Information Officer.
- The Department will evaluate the option of establishing nuclear material management groups. To help maintain a core level of technical expertise and facility processing capability and to facilitate integration, the Department will evaluate the following nuclear materials management groups similar to the National Spent Nuclear Fuel Program established in 1996 at INEEL:
  - plutonium management group,
  - uranium management group,
  - non-actinide isotopes and sealed sources management group, and
  - heavy isotopes group.

Improving Future Operations

Storage and stabilization

The Department will continue to address near-term storage vulnerabilities by stabilizing at-risk materials and placing them in safer packages and facilities. Since storage represents about half the costs associated with management of nuclear materials, integration or consolidation of materials storage and stabilization should produce meaningful cost savings, as well as boost efficiency. We are currently addressing the following operational improvements:

- backfitting an existing facility for stabilizing and packaging SRS plutonium rather than build a new facility;
- consolidating storage for stabilized materials from Rocky Flats, LLNL, and LANL that can be provided by a facility such as the SRS KAMS facility; and
- consolidating HEU storage at Oak Ridge's Y-12 Plant to accelerate site closures and avoid storage costs and reallocating them to meet unfunded liabilities relating to at-risk materials and safe facilities.

The Department will conduct further analyses, including NEPA analysis as appropriate, for some options before making decisions.

Involving the Public in Departmental Decision Making

For unclassified matters pertaining to management of nuclear materials, the Department seeks the benefit of diverse views and expertise. The Department will use established mechanisms to involve its stakeholders and the general public in its activities. Cross-program decisions could require NEPA analyses that will provide opportunities for public involvement. The Department will also continue interactions and discussions with stakeholders through:

- early and continuing coordination with Site-Specific Advisory Boards, and other public groups at affected sites;
- periodic meetings with members of congressional delegations and State, Tribal, and local governments;
- continued dialogue through existing forums on the national level, such as with the National Governors' Association, State and Tribal Government Working Group, the Energy Communities Alliance, Site-Specific Advisory Board Chairs, and Environmental Management Advisory Board and other Department advisory groups; and
- continued dialogue with organized non-govermental organizations who claim a stake in these issues.

Acronym List

ANL	Argonne National Laboratory; East (-E) and West (-W)
APSF	Actinide Packaging and Storage Facility
ARIES	Advanced Recovery and Isotope Extraction System
BNL	Brookhaven National Laboratory
CFR	Code of Federal Regulations
CMR	Chemistry and Metallurgy Research
CY	Calendar Year
DNFSB	Defense Nuclear Facilities Safety Board
DoD	U.S. Department of Defense
the Department	U.S. Department of Energy
DP	DOE Office of Defense Programs (DOE/DP)
DU	Depleted Uranium
DUF_6	Depleted Uranium Hexafluoride
DWPF	Defense Waste Processing Facility
EIS	Environmental Impact Statement
EM	DOE Office of Environmental Management (DOE/EM)
EUO	Enriched Uranium Operations
FAST	Fluorinel and Storage Facility
FFTF	Fast Flux Test Facility
FMCT	Fissile Material Cut-Off Treaty
FY	Fiscal Year
HEU	Highly Enriched Uranium (greater than 20 percent uranium-235)
HLW	High-Level Waste
HSM	Horizontal Storage Module(s)
IAEA	International Atomic Energy Agency
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
JIT	Just-In-Time
KAMS	K-Area Material Storage
LANL	Los Alamos National Laboratory
LEU	Low-Enriched Uranium
LLNL	Lawrence Livermore National Laboratory
LLW	Low-Level Waste
LWBR	Light-Water Breeder Reactor
LWR	Light Water Reactor
MD	DOE Office of Fissile Materials Disposition (DOE/MD)
MOX	Mixed Oxide
MT	Metric Ton (tonne)
MTHM	Metric Tons of Heavy Metal
NASA	National Aeronautics and Space Administration
NE	DOE Office of Nuclear Energy, Science and Technology (DOE/NE)
NEPA	National Environmental Policy Act
NISS	Non-Actinide Isotopes and Sealed Sources
NMC	Nuclear Materials Council
NMI	Nuclear Materials Integration
NMSI	Nuclear Materials Stewardship Initiative
NN	DOE Office of Defense Nuclear Nonproliferation (DOE/NN)
NNSA	National Nuclear Security Administration
NOI	Notice of Intent
Np	Neptunium
NPT	Treaty on the Non-Proliferation of Nuclear Weapons
NR	DOE Office of Naval Reactors (DOE/NR)

NRC	U.S. Nuclear Regulatory Commission
NU	Natural Uranium
NWPA	Nuclear Waste Policy Act
ORNL	Oak Ridge National Laboratory
PDCF	Pit Disassembly and Conversion Facility
PEIS	Programmatic Environmental Impact Statement
PFP	Plutonium Finishing Plant
PIP	Plutonium Immobilization Plant
Pu	Plutonium
PUREX	Plutonium-Uranium Extraction
PuSPS	Plutonium Stabilization and Packaging System
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
REDC	Radiochemical Engineering Development Center
RFP	Request for Proposal
RFETS/Rocky Flats	Rocky Flats Environmental Technology Site
ROM	Rough Order-of-Magnitude
RTG	Radioisotope Thermoelectric Generator
RW	DOE Office of Civilian Radioactive Waste Management (DOE/RW)
SC	DOE Office of Science (DOE/SC)
SNL	Sandia National Laboratories
SRS	Savannah River Site
START	Strategic Arms Reduction Treaty
STF	Stewardship Task Force
TMI	Three Mile Island
TRIGA	Training, Research, Isotope Production, General Atomics
TRU	Transuranic (waste)
TSD	Transportation Safeguards Division
TSS	Transportation Safeguards System
TVA	Tennessee Valley Authority
U	Uranium
UF_6	Uranium Hexafluoride
USEC	United States Enrichment Corporation
WIPP	Waste Isolation Pilot Plant
WMD	Weapons of Mass Destruction
Y-12 Plant	Oak Ridge Y-12 Plant
ZPPR	Zero Power Physics Reactor

Glossary

Atom. The basic component of all matter. The atom is the smallest particle of an element that has all of the chemical properties of that element. Atoms consist of a nucleus of protons and neutrons surrounded by electrons.

Canyon. A vernacular term for a chemical separations plant, inspired by the plant's long, high, narrow structure (e.g., F and H Canyons at the Savannah River Site). Not all chemical separations plants are canyons.

Cesium. An element chemically similar to sodium and potassium. The isotope cesium-137 is one of the most important fission products with a half-life of about 30 years.

Chemical separation. A process for extracting uranium, plutonium, and other radionuclides from dissolved spent nuclear fuel and irradiated targets. The fission products that are left behind are high-level waste. Chemical separation is also known as reprocessing.

Cladding. The outer layer of metal over the fissile material of a nuclear fuel element. Cladding on the Department's spent nuclear fuel is usually aluminum, zirconium, or stainless steel.

Cold War. A conflict over ideological differences between the United States and the Soviet Union and their allies lasting from the late 1940's until the early 1990's and carried on by methods short of sustained military action.

Cost Avoidance. A cost that is not in the budget base but that was projected to have been required at some point in the future if the action to avoid the cost had not taken place. There are no resources which can be applied for other purposes in the budget.

Cost Saving. An actual reduction in an amount that is in the budget base from prior years. In the budget year, this typically means that the actual resources saved can be moved and used for other purposes.

Criticality. A term describing the conditions necessary for a sustained nuclear chain reaction.

Curie. The amount of radioactivity in 1 gram of the isotope radium-226. One curie is 37 billion radioactive disintegrations per second.

Deactivation. Activities that ensure surplus facilities are secure in a safe and stable condition pending their ultimate disposition. Includes eliminating immediate safety and environmental hazards as well as removing most contaminants within the facility.

Decommissioning. Retirement of a nuclear facility, including decontamination and/or dismantlement.

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

Department of Energy (DOE). The cabinet-level U.S. Government agency responsible for nuclear weapons production and energy research and the cleanup of hazardous and radioactive waste at its sites. It succeeded predecessor agencies, such as the Energy Research and Development Administration and the Atomic Energy Commission.

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 in some parts of nuclear weapons as a raw material for plutonium production, as a shielding material, and in other applications.

Detection level. The level above which a constituent (e.g., metal, organic) can be detected in a medium through sampling and analysis.

Disposition. Reuse, recycling, sale, transfer, storage, treatment, consumption, or disposal.

DOE Complex. The research, development, and production facilities overseen by U.S. Department of Energy Headquarters and Field Office personnel.

Enrichment. See isotope separation.

Excess materials. Nuclear materials not needed to support national security requirements; only Pu-239 and highly enriched uranium formally have been declared excess.

Fissile. Capable of being split by a low-energy neutron. The most common fissile isotopes are uranium-235 and plutonium-239.

Fission. The splitting or breaking apart of the nucleus of a heavy atom usually caused by the absorption of a neutron. Large amounts of energy and one or more neutrons are released when an atom fissions.

Fuel, nuclear. Fissile material, usually natural or enriched uranium that sustains the fission chain reaction in a nuclear reactor. Also refers to the entire fuel element, including structural materials and cladding. Also known as reactor fuel.

Fuel and target fabrication. Foundry, preparation, and machining operations required to convert uranium or other fissile feed material into nuclear fuel elements; or precursor isotopes into target elements for the production of other isotopes.

Gamma radiation. High-energy, highly penetrating electromagnetic radiation emitted in the radioactive decay of many radionuclides. Gamma rays are similar to X-rays.

Gas centrifuge. A uranium enrichment process that uses a large number of rotating cylinders in a series. The lighter uranium-235 isotope concentrates at the center of a spinning centrifuge of gaseous uranium hexafluoride. This method produced the first gram quantities of enriched uranium in 1944.

Gaseous diffusion. A uranium enrichment process based on the difference in rates at which uranium isotopes in the form of gaseous uranium hexafluoride diffuse through a porous barrier. This process is used to enrich uranium in the United States. The full scale K-25 gaseous diffusion plant was completed and operational at Oak Ridge, Tennessee, in August 1945. Two additional, currently operating, gaseous diffusion plants previously used by the Atomic Energy Commission and Department of Energy for weapons production are located at Paducah, Kentucky and Piketon, Ohio.

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

Half-life. Half-life is the amount of time needed for half of the atoms of a radioactive material to disintegrate or decay.

Hazardous waste. Defined under the Resource Recovery and Conservation Act (RCRA) and its implementing regulations in Title 40 of the Code of Federal Regulations, Parts 260 to 279, and corresponding state regulations. A material is a hazardous waste under RCRA if it meets the definition of a solid waste as well as certain criteria for a hazardous characteristic or listing.

High-level waste. Highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations. High-level waste includes other highly radioactive materials that the NRC, consistent with existing law, determines by rule requires permanent isolation.

Highly-enriched uranium. Uranium with more than 20 percent of the uranium-235 isotope, used for making nuclear weapons and also as fuel for some isotope-production, research, and power reactors. Weapons-capable uranium is a subset of this group.

Irradiate. To expose to ionizing radiation, usually in a nuclear reactor. Targets are irradiated to produce isotopes.

Isotope separation (enrichment). The process of separating different isotopes of the same element. The three elements that have been isotopically enriched in large quantities for use in nuclear weapons production are uranium, lithium, and hydrogen.

Isotopes. 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 more isotopes have been produced in nuclear reactors and accelerators.

Low-enriched uranium. Uranium that has been enriched until it consists of up to 20 percent uranium-235 and 80 percent uranium-238. It is used as nuclear reactor fuel, which is generally manufactured at below five percent uranium-235.

Low-level waste. Any radioactive waste that is not spent fuel, high-level or transuranic waste, or IIe (2) byproduct material (tailings/waste from uranium ore processing).

National Environmental Policy Act. 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 decision-making processes.

Natural uranium. Uranium that has not been through the enrichment process. It is made of 99.3 percent uranium-238 and 0.7 percent uranium-235.

Naval Nuclear Propulsion Program. A joint Department of Energy and Department of Navy program responsible for activities relating to the use of nuclear power in surface warships and submarines.

Neutron. A massive, uncharged particle that comprises part of an atomic nucleus. Uranium and plutonium atoms fission when they absorb neutrons. The chain reactions that make nuclear reactors and weapons work thus depend on neutrons. Manmade elements can be manufactured by bombarding other elements with neutrons in production reactors.

Nuclear Materials Council (NMC). The NMC is chaired by the Under Secretary and is made up of members from the Secretarial Offices that have nuclear materials management responsibilities. The NMC establishes policy, provides personnel and financial resources, approves NEPA compliance and public involvement strategies, approves (or recommends approval of) Stewardship Task Force (STF) deliverables, and oversees STF activities.

Nuclear reactor. A device that sustains a controlled nuclear fission chain reaction.

Nuclear Regulatory Commission (NRC). An independent agency of the Federal Government created by the Energy Reorganization Act of 1974, which abolished the Atomic Energy Commission and transferred its regulatory function to the NRC. The agency is responsible for ensuring adequate protection of public health and safety, the common defense and security, and the environment in the use of nuclear materials in the United States. It is also responsible for regulation of commercial nuclear power reactors; non-power research, test, and training reactors; fuel cycle facilities; medical, academic, and industrial uses of nuclear materials; and the transport, storage, and disposal of nuclear materials as waste.

Nuclear Waste Policy Act of 1982 (Public Law 97-425), as amended. The Federal law that provides for the development of geologic repositories for disposal of high-level waste and spent nuclear fuel and establishes a program of research, development, and demonstration regarding disposal of high-level waste and spent nuclear fuel.

Nuclear weapons complex. The chain of foundries, uranium enrichment plants, nuclear reactors, chemical separation plants, factories, laboratories, assembly plants, and test sites that produce nuclear weapons.

Pit. The central core of the primary stage of a nuclear weapon consisting of fissile materials surrounded by the tamper and sometimes by a sealed metal shell.

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

Plutonium residues. Materials left over from the processing of plutonium that contain enough plutonium to have previously made its recovery economically attractive when the United States was producing plutonium for weapons purposes. As excess materials, some plutonium residues could be disposed of directly as wastes.

Production reactor. A nuclear reactor designed to produce manmade isotopes. Tritium and plutonium are made in production reactors. The Department has 14 such reactors, 9 at the Hanford Site and 5 at the Savannah River Site. All have been closed.

PUREX. An acronym for plutonium-uranium extraction, the name of a chemical process used to reprocess spent nuclear fuel and irradiated targets. Also refers to the chemical separation plants at the Hanford Site and Savannah River built to use this process. The PUREX Plants operated from 1957 to 1972 and from 1983 to 1988.

Radiation. Energy transferred through space or other media in the form of particles or waves. Certain radiation types are capable of breaking up atoms or molecules. The splitting, or decay, of unstable atoms emits ionizing radiation.

Radioactive. Of, caused by, or exhibiting radioactivity.

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

Radionuclide. A radioactive species of an atom. For example, tritium and strontium-90 are radionuclides of elements of hydrogen and strontium, respectively.

Reactor fuel. Synonymous with nuclear fuel.

Reactor operations. Includes fuel and target loading and removal, reactor maintenance, and operation of the reactor itself.

Reprocessing. Synonymous with chemical separation.

Resource Conservation and Recovery Act (RCRA). (Public Law 94-580). A Federal law enacted in 1976 to address the treatment, storage, and disposal of hazardous waste.

Research reactor. A class of nuclear reactors used to do research into nuclear physics, reactor materials and design, and nuclear medicine. Some research reactors also produce isotopes for industrial and medical use.

Sealed source. A small package of radioactive materials used as a portable source of radiation packaged to minimize the possibility of dispersion of its radioactive contents.

Source material. Uranium or thorium in any physical or chemical form, and ores containing at least 0.05 percent uranium or thorium. Source material does not include special nuclear material or byproduct material.

Special nuclear material (SNM). Defined under the Atomic Energy Act as plutonium, uranium-233, and uranium enriched in the isotopes uranium-233 or uranium-235. Special nuclear material does not include source material such as natural uranium or thorium.

Spent nuclear fuel. Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

Stabilization. Conversion of chemically active or readily dispersible matter into an inert or less harmful form. Also, activities to reduce the active management required for surplus facilities (such as burial ground stabilization and closure).

Stewardship Task Force (STF). The Nuclear Materials Stewardship Initiative effort is being carried out by an STF chaired by the Director of the Office of Nuclear Materials Management Policy and consists of a senior management-level appointee from each of the Department's programs with a nuclear materials management responsibility. The role of the STF is to establish and implement nuclear materials management policies and goals through specific working groups comprising program, field, laboratory, and contractor representatives, as needed.

Surplus materials. Nuclear materials that are not required for any Department need.

Target. Material placed in a nuclear reactor to be bombarded with neutrons in order to produce isotopes that do not occur naturally in significant quantities. Uranium-238 targets are used to make plutonium; lithium targets are used to make tritium.

Transuranic waste. Waste contaminated with uranium-233 or transuranic elements having half-lives of over 20 years in concentrations more than 1 ten-millionth of a curie per gram of waste.

Tritium. The heaviest isotope of the element hydrogen. Tritium is produced in nuclear reactors and is three times heavier than ordinary hydrogen. Tritium gas is used to boost the explosive power of most modern nuclear weapons. Tritium has a half-life of approximately 12 years.

Uranium. The basic material for nuclear technology. This element is naturally slightly radioactive and can be refined from its ore to a heavy metal more dense than lead.

Uranium hexafluoride (UF_6). A gaseous form of uranium used in the gaseous diffusion enrichment process.

Uranium-233 (^{233}U). A man-made fissile isotope of uranium.

Uranium-235 (^{235}U). The lighter of the two main isotopes of uranium; it is the only naturally occurring fissile element. Uranium-235 makes up 0.7 percent of the uranium that is mined from the ground. It has a half-life of 704 million years.

Uranium-238 (^{238}U). The heavier of the two main isotopes of uranium. Uranium-238 makes up over 99 percent of uranium that is mined from the ground. It has a half-life of 4.5 billion years and is not easily split by neutrons.

Vitrification. A process that stabilizes nuclear waste by mixing it with molten glass. The glass mixture is poured into cylindrical metal canisters, where it hardens. Plants for vitrifying high-level waste have been built in the United States at West Valley, New York and the Savannah River Site, South Carolina.

Waste. Includes high-level, transuranic, low-level, mixed low-level, and IIe (2) byproduct material.

Weapons-capable materials. Materials that are capable of use in a nuclear weapon (e.g., plutonium that contains at least 93 percent of plutonium-239 by mass, and highly enriched uranium that contains at least 20 percent of uranium-235).

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History of Production Mission

Appendix I

Five Decades of a Weapons Production Mission

During World War II, the U.S. Government committed physical, financial, and human resources to harnessing the power of nuclear fission for military weapons. This effort, commonly known as the Manhattan Project, required the United States to construct a large, top secret research and industrial complex to produce and process tons of unique materials.

Most of the nuclear weapons complex was devoted to producing fissile and other nuclear materials. Nuclear materials production started with mined and milled uranium. The eight key steps of the weapons production process are provided in Figure I-1.

Soon after the destructiveness of nuclear weapons was demonstrated by the bombing of Hiroshima and Nagasaki, the U.S. Congress acted to put the immense power and possibilities of atomic energy under civilian control. The Atomic Energy Act of 1946 established the Atomic Energy Commission to administer and regulate the production and uses of atomic power.

Between 1944 and 1988, the U.S. built and operated 14 plutonium-production reactors at the Hanford Site in Washington and the SRS in South Carolina, producing a total of about 100 MT of plutonium. Because only a small fraction of the uranium in fuel and targets was converted to plutonium during each cycle through a reactor, workers at Hanford and Savannah River processed hundreds of thousands of tons of uranium. The production reactors at Savannah River also made tritium.

A dismantled nuclear weapon

The work of the Commission expanded quickly from building a stockpile of nuclear weapons to investigating peaceful uses of atomic energy (such as research on, and regulation of, the production of electrical power). It also conducted studies on the health and safety hazards of radioactive materials.

In 1975, the Atomic Energy Commission was replaced by two new Federal agencies: the NRC, which was charged with regulating the civilian uses of atomic energy (mainly commercial nuclear power plants), and the Energy Research and Development Administration, whose duties included the control of the nuclear weapons complex. In 1977, these duties were transferred to the newly created Department of Energy.

Beginning with the "Atoms for Peace" program, which started in the 1950's, the United States provided peaceful nuclear technology to foreign nations in exchange for their promise to forego development of nuclear weapons. This program provided research reactor technology and the enriched uranium necessary to fuel research reactors, both domestically and abroad. Research reactors have since played a vital role in medical, agricultural, and industrial applications, and they provide a tool for fundamental scientific research. They also

Figure I-1 Eight Key Steps of the Weapons Production Process

Uranium Mining, Milling, and Refining involved extracting uranium ore from the earth's crust and chemically processing it to prepare uranium concentrate (U_3O_8), or yellowcake, which was refined or chemically converted to purified forms suitable as feed materials for enrichment at gaseous diffusion plants or for fuel and target fabrication. About half of the uranium used in the weapons complex was imported from Canada, Africa, and other areas. The remainder came from the domestic uranium industry that grew rapidly in the 1950's.

Isotope Separation (Enrichment) involved separating naturally occurring isotopes of the same element. The three elements that were isotopically enriched in large quantities for use in the weapons complex were uranium, lithium, and hydrogen. Uranium enrichment began with NU and resulted in enriched uranium and DU. HEU was fashioned into weapons components and used as reactor fuel. LEU and NU were used as reactor fuel for the production of plutonium. The first U.S. uranium enrichment facilities were located in Oak Ridge, Tennessee. Additional enrichment plants (using gaseous diffusion) were later built in Piketon, Ohio (Portsmouth) and Paducah, Kentucky.

Fuel and Target Fabrication was required to convert uranium feed material, principally metal, into fuel and target elements used in nuclear materials production reactors. This was initially carried out by private contractors and at the Hanford, Washington and Savannah River, South Carolina production reactor sites. Within a decade, Government-owned plants in Fernald, Ohio and Weldon Spring, Missouri took over part of this mission, supplying the fuel manufacturing plants at Hanford and SRS.

Reactor Operations included fuel and target loading and removal, reactor maintenance, and operation of the reactor itself. Experimental reactors were built in the Chicago area and at Oak Ridge and Hanford. Nine full-scale production reactors were located at Hanford, and five others were at SRS.

Chemical Separation was the process of dissolving spent nuclear fuel and targets and isolating and concentrating the plutonium, uranium, and other nuclear materials they contained. This also included the reprocessing of spent nuclear fuel to recover, purify, and recycle uranium for reuse in the nuclear weapons programs and the recovery of uranium from HLW at Hanford. Chemical separation plants were located at Hanford, Washington; the Savannah River Site, South Carolina; and the Idaho National Engineering and Environmental Laboratory, Idaho.

Component Fabrication included the manufacturing, assembly, inspection, bench testing, and verification of specialized nuclear and non-nuclear parts and major subassemblies. It also involved chemical processing to recover, purify, and recycle plutonium, uranium, tritium, and lithium from retired warheads, and from component production scrap and residues, as well as the maintenance, recharging, dismantlement, and materials recovery conducted separately on individual components. The major nuclear component fabrication sites were LANL in New Mexico; the Rocky Flats Plant in Colorado; the Y-12 Plant in Oak Ridge, Tennessee; and the PFP in Hanford, Washington. Non-nuclear components were manufactured chiefly at the Mound Plant in Ohio, the Kansas City Plant in Missouri, the Pinellas Plant in Florida, and the Pantex Plant in Texas.

Weapons Operations included the assembly, maintenance, and dismantlement of nuclear weapons. Assembly was the final process of joining together separately-manufactured components and major parts into complete, functional, and certified nuclear weapon warheads for delivery to DoD. Maintenance included the modification and upkeep of a nuclear weapon during its life cycle. Dismantlement involved the reduction of retired warheads to a nonfunctional state and the disposition of their component parts. Weapons operations were chiefly done at the Pantex Plant in Texas; the Iowa Army Ordnance Plant; Technical Area 2 of SNL in New Mexico; and the Clarksville, Tennessee and Medina, Texas modification centers.

Research, Development and Testing includes the design, development, and testing of nuclear weapons and their effects. The main research, development and testing facilities are at LANL, LLNL, and SNL.

Source: *Linking Legacies – Connecting the Cold War Nuclear Weapons Production Processes To Their Environmental Consequences* (DOE, 1997d)

The primary assembly of a nuclear weapon – the "pit" – is typically composed of Pu-239 and/or HEU, and other materials.

support irradiation testing of materials and fuel forms, including safety experimentation, to support advanced fuel designs and development of waste management technologies.

To further nonproliferation objectives, the United States requires that any nuclear technology provided to other nations shall be subject to international safeguards and inspections to prevent diversion of materials or technology to nuclear weapons activities. Peaceful nuclear cooperation, under international safeguards, has since been a critical component of U.S. nuclear weapons nonproliferation policy.

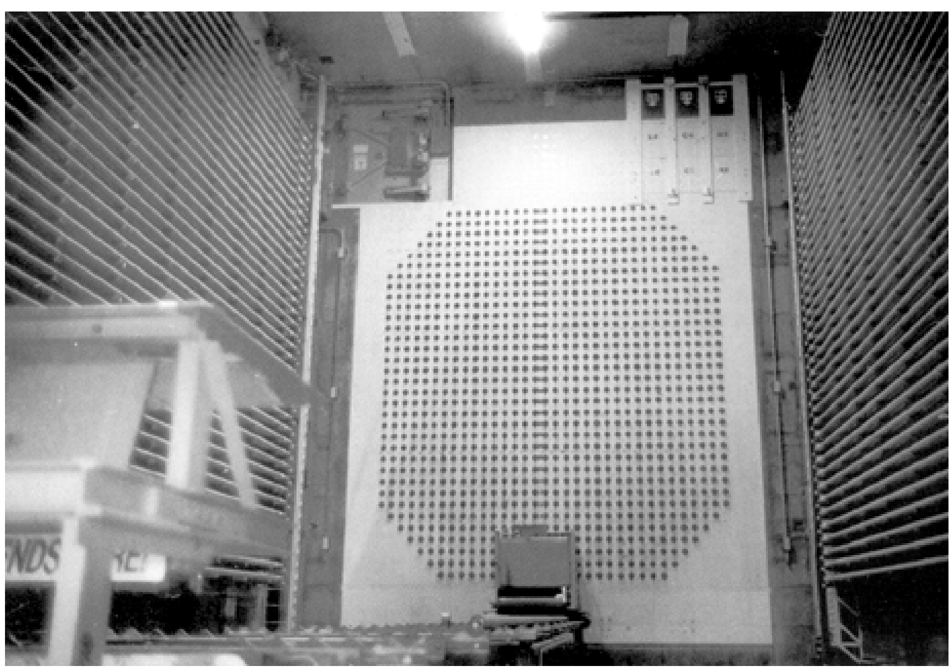
In the late 1980's and early 1990's, growing concerns about environmental and safety problems caused the Department to suspend temporarily various operations throughout the weapons complex. Many of these temporary shutdowns became permanent with the end of the Cold War and the collapse of the Soviet Union. However, because the shutdowns were viewed as temporary at the time, the Department did not make long-term storage or disposition plans for surplus materials prior to suspending operations.

The Legacy Left Over from the Weapons Production Mission

Every step in the production of materials and parts for nuclear warheads generated nuclear materials scrap, waste, and byproducts. While most of this material is stable and stored in safe conditions, some of the materials require stabilization and repackaging for safe long-term storage, and all of them require decisions and a path forward regarding their ultimate disposition – whether it is reuse for Government or commercial applications or permanent disposal. A summary of these legacy materials and wastes is provided below.

Nuclear Materials. The Department is storing most of its materials (plutonium, uranium, spent nuclear fuel, and others) at 11 major production sites and at many of its research laboratories. Until recently, the Department did not have a full understanding of the chemical and physical forms of all of the materials in inventory on a complex-wide basis and the problems associated with the management and disposition of these varied forms. In 1996, the Department undertook a Materials in Inventory Initiative (DOE, 1996f) as a Department-wide effort to analyze the state of its knowledge concerning its inventories and to lay the groundwork for developing plans to disposition surplus materials (disposition in this Plan refers to either recycle and reuse or disposal). The first corporate-level inventory of materials was published in the 1996 report.

Hanford's N Reactor was one of 14 plutonium production reactors that the Department operated during the Cold War to produce plutonium. Shown at right is the face of the reactor's graphite core, which held nuclear fuel and uranium "target" slugs.



A more recent initiative, the Nuclear Materials Integration Project, is continuing the effort to improve complex-wide inventory reporting and analyses and is in the process of updating the 1996 inventories. However, according to the 1996 Materials in Inventory report, the Department has approximately 820 million kilograms of materials in inventory (mostly DU). This is roughly equal to 2,255 fully-loaded Boeing 747 aircraft. The report notes that it is difficult to provide a meaningful combined volume of materials in inventory because the materials have different densities and forms. For example, spent nuclear fuel is reported as a mass of heavy metal in the fuel. Plutonium and natural and enriched uranium are stored in thousands of individual containers. Examples of the nuclear materials in the Department's inventory, which are the subject of this Plan, are provided in Figure I-2.

Figure I-2

Legacy of Nuclear Materials Left Over from the Cold War

- Approximately 100 MT of Pu-239 at 8 sites. Greater than 50 MT is excess and is stored at 7 sites in a wide variety of forms and storage configurations (the majority in clean metal form and others as metals, oxides, alloys, and reactor fuel).
- 174 MT of excess HEU at 10 sites, half of which is in the form of metal and the other half in a variety of forms (oxide, reactor fuel, compound, irradiated fuel and targets, and others). The total quantity and locations of HEU is classified.
- Over 4,700 MT of LEU at 28 sites. The largest blocks are in the forms of alloyed and unalloyed metals and oxides, residing primarily at the Hanford and Fernald sites, and UF_6, residing at Paducah.
- Over 760,000 MT of DU at 34 sites. Most of this is in the form of depleted UF_6 and is stored at the three gaseous diffusion plants – the former K-25 at Oak Ridge, Paducah, and Portsmouth.
- Over 1,900 kilograms of U-233 at 21 sites, with the bulk at the INEEL (irradiated and unirradiated fuels) and ORNL (recovered uranium oxide).
- About 2,500 MT of spent nuclear fuel stored at 4 sites pending disposal in a geologic repository.

Not covered in this Plan are wastes and contaminated media. Also see Figure I-3.

Wastes. Every gram of plutonium, each reactor fuel element, every container of enriched uranium, and each canister of DU has radioactive waste associated with it. For example, the acid used to extract plutonium is now HLW (intensely radioactive). Irradiated parts and worker shoes and clothing are now low-level or TRU waste. These are described in Figure I-3 for perspective. However, disposition plans for these wastes and byproducts are addressed by EM in various other plans and NEPA documentation and are not the subject of this Plan.

Contaminated Media. Hazardous and radioactive substances from the weapons complex and other programs of the Department have contaminated environmental media (including soil, sediment, groundwater, and surface water) on and around Department sites. Over 1,500 million cubic meters of contaminated water and 73 million cubic meters of contaminated solid media have resulted from nuclear weapons production activities, while nonweapons activities contaminated an additional 350 million cubic meters of water and 5.8 million cubic meters of solid media. EM is actively remediating sites and facilities. While mentioned here for perspective, these efforts are not addressed in this Plan.

Figure I-3

Legacy of Wastes Left Over from the Cold War

- About 100 million gallons of HLW – enough to fill about 10,000 tanker trucks – the largest volume of waste in the Department's inventory. Most has been stored in 243 underground tanks at Hanford, SRS, INEEL, and the West Valley Demonstration Project in New York. Some of this waste has been vitrified for disposal in a geologic repository.
- About 100,000 cubic meters of TRU waste (materials containing significant quantities of plutonium, americium, or other elements whose atomic weights exceed those of uranium), or the rough equivalent of half a million 55-gallon drums, stored throughout the complex. Much of this waste will be disposed of in a geologic salt repository at the WIPP, which opened in 1999. Some of this waste is mixed with hazardous constituents regulated under RCRA, as amended.
- Over 3 million cubic meters of LLW packaged in drums or boxes remaining to be disposed of in shallow pits and trenches (over 300,000 cubic meters have already been disposed in this manner). Also, about 146,000 cubic meters of mixed LLW (which requires treatment prior to disposal) and hundreds of thousands of gallons of contaminated waste water requiring treatment.

U.S. Nonproliferation Commitments and Goals

Appendix II

President Clinton, on September 27, 1993, established specific U.S. policy objectives regarding all Weapons of Mass Destruction (WMD) and the means to deliver them, and stated that the Administration's pursuit of these objectives is to be guided by three major considerations:

- National security requires according a higher priority to nonproliferation, and to making it an integral element of our relations with other countries.
- The United States will actively seek expanded trade and technology exchange with nations, including former adversaries, that abide by global nonproliferation norms that will strengthen U.S. economic growth, democratization abroad, and international stability.
- The United States needs to build a new consensus – embracing the Executive and Legislative branches, industry and public, and friends abroad – to promote effective nonproliferation efforts and integrate our nonproliferation and economic goals.

The President reaffirmed U.S. support for a strong, effective nonproliferation regime that enjoys broad multilateral support and employs all the means at U.S. disposal to advance U.S. objectives. Consistent with the nuclear nonproliferation principles presented above, the President's policy sets the following priorities for nuclear nonproliferation with regard to fissile materials and international nonproliferation regimes.

- Address the growing accumulation of fissile materials from dismantled nuclear weapons and civil nuclear programs, by seeking to eliminate where possible the accumulation of stockpiles of HEU and plutonium, and ensuring that existing stocks of these materials are subject to the highest standards of safety, security, and international accountability.
- Promote treaty or treaties prohibiting the production of HEU or separation of plutonium for nuclear explosives or outside of international safeguards (such as the potential Fissile Material cut-off Treaty).
- Encourage more restrictive regional arrangements to constrain fissile material production in regions of instability and high proliferation risk.
- Make U.S. fissile material that is no longer needed for defense available to safeguarding by the IAEA, consistent with plans for treatment, storage, and disposition.
- Explore means to limit the stockpiling of plutonium from civil nuclear programs and seek to minimize the civil use of HEU.
- Initiate a comprehensive review of long-term options for plutonium disposition, taking into account technical, nonproliferation, environmental, budgetary, and economic considerations.
- Pursue policy not to encourage the civil use of plutonium in an open cycle or engage in plutonium reprocessing, but to maintain existing commitments in Western Europe and Japan.
- Strengthen the IAEA ability to detect clandestine nuclear activities.
- Adhere to voluntary safeguards offers.
- Ensure that the IAEA has the resources needed to implement its vital safeguards responsibilities.

The Department's Annual Performance Plan for FY 2001 specifically includes the following nonproliferation and national security strategic objectives:

- Provide policy leadership, technology development, and program implementation to prevent the proliferation of WMD; detect WMD proliferation; monitor WMD treaties and agreements; improve international nuclear safety, security, and accounting of weapons-usable nuclear materials; and counter WMD terrorism.
- Reduce inventories of U.S. and Russian excess weapons fissile materials in a transparent and irreversible manner.
- Provide the U.S. Navy with safe, militarily effective nuclear propulsion plants, and ensure their continued safe and reliable operations.
- Ensure the security of the Department's nuclear materials, facilities, and information assets.

The Department uses a process of extensive program reviews to evaluate progress against established plans and milestones in support of international treaties and agreements and, in some cases, bilateral or multilateral committees review the operations and responsibilities under these treaties and agreements and/or international commitments. These committees typically review cost, schedules, and status reporting in addition to technical review and program operations.

In addition to the interagency roles noted above, the Department performs nonproliferation assessments for Records of Decision on management of nuclear materials at the Department's domestic facilities. In these assessments, specific technical and policy factors guide Department decision making. For example, the metrics used for the final decision on storage of weapons-usable fissile material and excess disposition included the following:

Technical Factors

- Degree to which the disposition options result in forms that meet the spent fuel standard.
- Until final disposition occurs, the degree to which storage options meet the "stored weapons standard."
- Time to implement option, to determine how soon non-proliferation benefits can be achieved.
- Degree to which the option permits international monitoring to confirm U.S. commitments while still protecting sensitive information and facilities (i.e., "managed access").
- Storage options should provide high levels of security to prevent theft of nuclear materials and should provide access to international monitors.
- To the extent possible, excess weapons materials in storage should be available for bilateral U.S.-Russian monitoring and IAEA safeguards, while protecting proliferation-sensitive information.
- Degree of transparency to domestic and international community in the Department's management of materials, facilities, and processes in the nuclear fuel cycle.
- Degree of irreversibility of processes for arms reduction.
- Degree to which options encourage/enable international cooperative development and testing of transparency measures to be used by other countries.
- Degree to which short-term risks introduced by increased transportation and processing of materials are compensated for by the long-term nonproliferation benefits.

Policy Factors

- Impact on similar materials management programs internationally, particularly in Russia.
- Effect on nuclear arms reduction efforts, including the extent to which U.S. decisions ensure the irreversibility of the arms reduction process.
- Impact on fuel cycle policy and choices by other nations, especially with regard to excess stockpiles of weapons-usable fissile material.
- Political implementability of each option.

U.S. Nonproliferation Policy: Implementation by the Department

Many Federal offices and agencies have a role in implementing U.S. nonproliferation policy. These include several White House offices; traditional national security elements in the intelligence community and at the Departments of State, Defense, and Energy (including the national laboratories); as well as the Departments of Justice, Commerce, Treasury, Health and Human Services, and Agriculture. The Federal Government's approach to combating the proliferation of WMD depends on an effective interagency process among these many offices and agencies.

Within the Department of Energy, NN is the lead decision unit for activities and programs that support U.S. arms control and nonproliferation policies, goals, and objectives, as well as statutorily mandated activities. The office provides leadership and representation for the Department in the international arms control and nonproliferation community and the U.S. Government's interagency process, as well as for the U.S. Government in national and international arms control and nonproliferation negotiations, agreements, and interactions. NN is also responsible within the Department for technology development and program implementation to prevent the proliferation of nuclear weapons, detect nuclear proliferation, monitor nonproliferation and arms control treaties and agreements, and improve transparency technologies for managing the back end of the fuel cycle during storage and final disposal in a geologic repository. MD will continue to look for opportunities in all nuclear materials management programs to demonstrate transparency and to showcase state-of-the art materials protection, control, and accounting technologies to the international community.

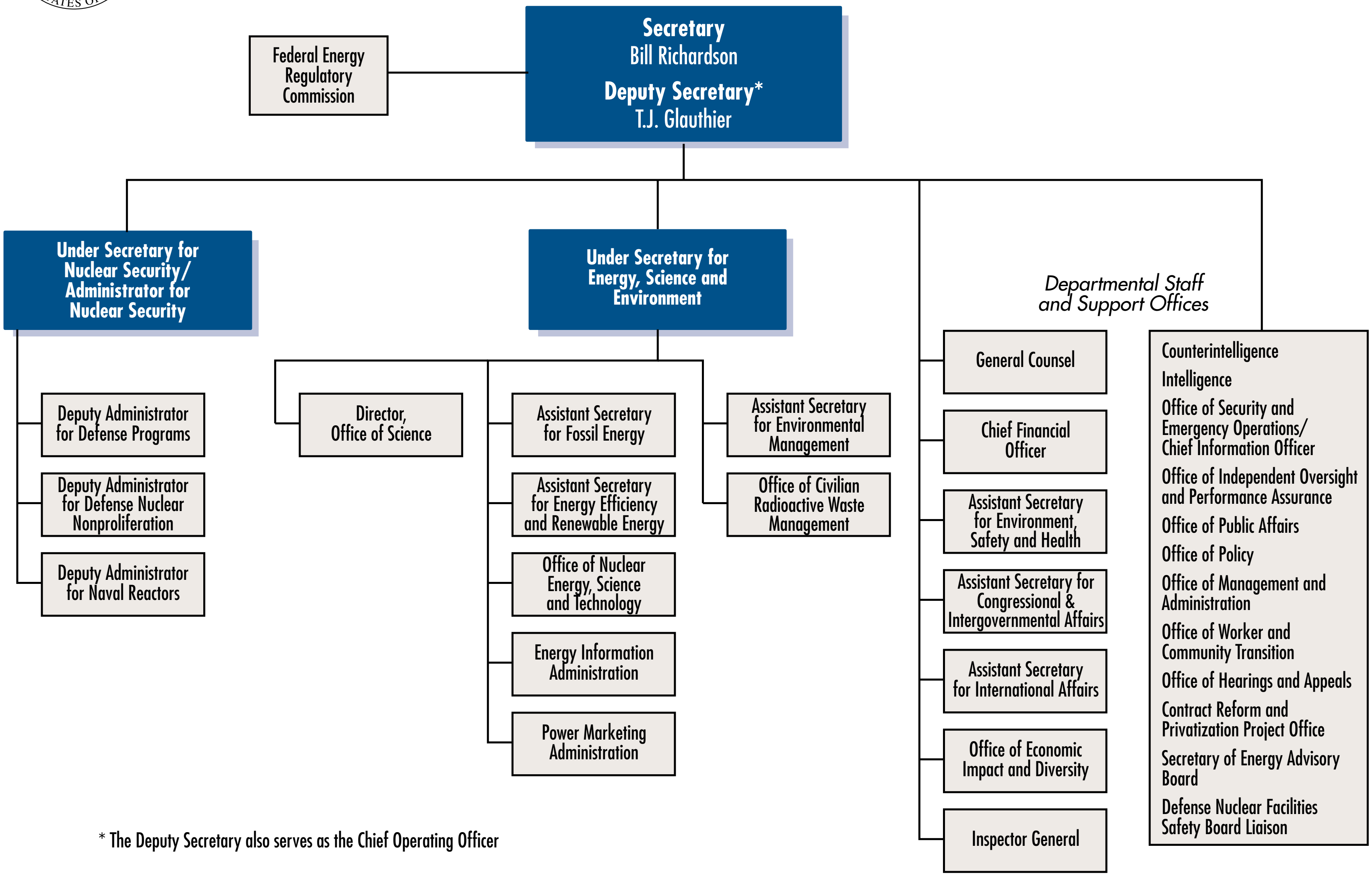
Implementation Considerations for Departmental Nuclear Materials Management – Opportunities for Leadership

In September 1993, Present Clinton announced that the United States would place material identified as excess to defense needs under IAEA safeguards. During 1994 and 1995, the IAEA began safeguarding approximately 10 tons of HEU at the Y-12 facility at Oak Ridge, and approximately a ton of plutonium each at the Hanford and Rocky Flats sites. At the September 1996 IAEA General Conference, Energy Secretary O'Leary committed the United States to place an additional 26 tons of material under IAEA safeguards by September 1999. Other recent developments regarding IAEA safeguards in the United States include the placing of the Portsmouth and Paducah Gaseous Diffusion Plants and WIPP on the list of facilities eligible for safeguards under the voluntary offer, and monitoring by the IAEA of the blend-down of HEU from Kazakhstan. These voluntary offers have enhanced U.S. leadership in nonproliferation efforts, and enable the United States to influence the adoption of new standards for state-of-the-art safeguards technologies by the IAEA.

Every Departmental program involved in nuclear materials management offers similar opportunities for U.S. leadership in nonproliferation efforts. Specific nonproliferation treaties, agreements, and negotiations that are currently being supported by the Department include START III, a U.S.-Russia Plutonium Disposition Agreement, the HEU Purchase Agreement, the Comprehensive Test Ban Treaty, the U.S.-Russia-IAEA Trilateral Initiative, a potential Fissile Material Cut-Off Treaty, the Chemical Weapons Conversion, the Biological Weapons Convention, and the strengthened IAEA safeguards systems. These treaties and agreements will necessitate increases in managed access at Department facilities, transparency in the accountancy of domestic materials, physical protection, and verification measures of irreversibility of the arms reduction process. In some instances, new technical approaches may be required.

U.S. Department of Energy Organization Chart
Appendix III

Department of Energy



* The Deputy Secretary also serves as the Chief Operating Officer

Nuclear Materials Stewardship Initiative Charter

Appendix IV

The Under Secretary of Energy
Washington, DC 20585

January 19, 2000

MEMORANDUM FOR HEADS OF DEPARTMENTAL ELEMENTS

FROM: THE UNDER SECRETARY

SUBJECT: Nuclear Materials Stewardship Initiative

This memorandum is to formalize the undertaking of a Nuclear Materials Stewardship Initiative over the next year, including the completion of a congressionally mandated Integrated Nuclear Materials Management Plan for completion March 31, 2000. A *Nuclear Materials Stewardship Initiative Charter* is attached that highlights the project mission, organizational structure, and decision-making process.

The mission of the Nuclear Materials Stewardship Initiative is to promote the responsible management of nuclear materials across their entire life cycle, through processes of production, use, recycle and recovery, storage, transportation and disposition. Stewardship represents recognition of the Department's enduring obligation to protect national security while managing nuclear materials efficiently, in a safe and environmentally sound manner, and with appropriate nonproliferation-driven transparency.

As noted previously, Congress directed that we address our management of nuclear materials in an integrated plan. Last year, a multi-program, field, and laboratory Nuclear Materials Working Group proposed a nuclear materials stewardship initiative to promote a corporate approach to managing nuclear materials, particularly those that are surplus to mission needs. The Field Management Council considered the proposed initiative and embraced the recommendations.

The actions for completion under the Charter are underway with support from the programs and the field. The actions are as follows:

1. Complete an integrated nuclear materials management plan. This product will a) respond to Section 3172 of the National Defense Authorization Act for fiscal year 2000 and include all fissile materials; b) address non-fissile materials to the extent practical; and c) incorporate an integrated conceptual plan for facilities and other infrastructure needed to meet the Department's current and future mission requirements. We will complete this task by March 31, 2000.

2. Make planning decisions concerning a select set of high priority cross-program issues that are barriers to an individual program successfully meeting its mission obligations. We will schedule actions on these issues throughout CY2000, subject to the requirements of the National Environmental Policy Act.
3. Complete a business case for upgrading and integrating the nuclear materials information management and inventory accountability systems for completion by June 30, 2000.

Each program with a nuclear materials management responsibility is charged to supply staff and financial resources to help achieve success. This support is generally commensurate with each program's nuclear materials management responsibilities.

The work is assigned to a senior manager-level task force consisting of an appointee from each of the Programs that has a nuclear materials management responsibility. The Policy Office's Director of the Office of Nuclear Materials Management Policy chairs the Stewardship Task Force and directs the project. The Environmental Management's Deputy Assistant Secretary for Integration and Disposition serves as the vice-chair. The Task Force has organized the necessary number of program, field, laboratory, and contractor supported working groups. The Task Force will meet at least monthly through the life of the project.

A Nuclear Materials Council has been convened and is chaired by me. Other members consist of the program secretarial officers with nuclear materials management-related responsibilities. The Council approves the mission, goals, policies, and project deliverables. The Council also acts on policy issues that are in dispute and cannot be resolved by the Task Force.

The Nuclear Materials Stewardship Initiative will address significant issues that could affect each of our programs and sites that have nuclear materials management responsibilities. Thank you for your cooperation and support toward the success of this very important initiative.

Attachment

cc:
T.J. Glauthier, Deputy Secretary
Phillip Niedzielski-Eichner, Director
Office of Nuclear Materials Management Policy, PO
David Huizenga, Deputy Assistant Secretary
Office of Integration and Disposition, EM
Mary Louise Wagner, Senior Policy Advisor to the Secretary

3

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CHARTER
for the
NUCLEAR MATERIALS STEWARDSHIP INITIATIVE

Purpose. The purpose of the Nuclear Materials Stewardship Initiative is to provide for the integration of cross-cutting nuclear materials management responsibilities in order to develop a corporate strategy for nuclear materials management, strengthen safeguard and security and safety capabilities, optimize planning for future requirements, promote international best practices, and reduce overall costs.

Background. Nuclear materials present a compelling and enduring obligation that demands Department of Energy (DOE) leadership, vigilance, and best management practices. To meet the challenges posed by this responsibility, DOE must have a coherent corporate strategy that is integrated across programs and within the field complex. The strategy must be driven by a long-term vision that addresses infrastructure, personnel, transportation, and information management requirements.

A multi-program, field, and laboratory Nuclear Materials Working Group has proposed a near-term set of initiatives to promote improved corporate management of nuclear materials, particularly those that are excess to mission needs. The Field Management Council has embraced the Working Group's recommendations and the Under Secretary will oversee their implementation.

Mission. The mission of the Nuclear Materials Stewardship Initiative is to promote the responsible management of nuclear materials across their entire life cycle, through processes of production, use, recycle and recovery, storage, transportation and disposition. Stewardship represents DOE's recognition of an enduring obligation to protect national security while managing nuclear materials efficiently, in a safe and environmentally sound manner and with appropriate nonproliferation-driven transparency.

Actions. The actions to be completed are as follows.

1. Complete an integrated nuclear materials management plan. This product will 1) respond to Sec. 3172 of the National Defense Authorization Act for Fiscal Year 2000 and include all fissile materials; 2) address non-fissile materials to the extent practical; and 3) incorporate an integrated conceptual plan for facilities and other infrastructure needed to meet the Department's current and future mission requirements. This task will be completed by March 31, 2000.

2. Make planning decisions concerning a select set of high priority cross-program issues that are barriers to an individual program successfully meeting its mission obligations. The issues will be nominated by individual programs and selected for action by agreement of the Nuclear Materials Council. Action on these issues will be scheduled throughout CY2000, subject to the requirements of the National Environmental Policy Act.

A key component of this activity will be determining whether selected excess nuclear materials should be maintained as national resources. A Departmental policy will be crafted to apply to any legacy materials deemed to have potential resource value. A draft policy will be developed and applied to at least four "pilot" materials for process lessons learned before the policy is presented for concurrence review. Candidate materials for review include Americium/Curium, ^{233}Uranium, Plutonium-contaminated Highly Enriched Uranium, ^{137}Cesium, Strontium, slightly irradiated fuel, ^{237}Neptunium, and ^{226}Radium

3. Complete a business case for upgrading and integrating the Department's nuclear materials information management and inventory accountability systems. The business case will be completed by June 30, 2000.

These activities will build on past successful corporate efforts and will integrate existing relevant program and field initiatives. Each program with a nuclear materials management responsibility is expected to supply staff and financial resources to complete the three activities commensurate with its nuclear materials management responsibilities.

Methodology. This Initiative will be implemented within a system-engineering framework and with appropriate National Environmental Policy Act (NEPA) review.

Guided by the mission statement, top-level management functions and requirements for stewardship of DOE-owned nuclear materials will be established. Both fissile and non-fissile materials will be included to ensure programmatic and physical interfaces between them are understood. A functions and requirements document will be issued and maintained under configuration control. A baseline of how DOE is currently performing various nuclear materials management functions will be defined. Alternative performance scenarios will be evaluated for increased effectiveness and cost savings.

A NEPA-compliance and public-involvement strategy will be prepared

Policy-Making and Project Management. A Stewardship Task Force (STF) will be established to organize the program, field, laboratory, and contractor supported working groups necessary to accomplish the initiative. The STF will consist of a senior management-level appointee from each of the programs that has a nuclear materials management responsibility.

The participating offices will be the Offices of Defense Programs (DP), Environmental Management (EM), Fissile Materials Disposition (MD), Naval Reactors (NE-60), Nuclear Energy, Science and Technology (NE), Nonproliferation and National Security (NN), Civilian Radioactive Waste Management (RW), Science (SC), and Security and Emergency Operations (SO). The Offices of the Chief Financial Office (CFO), Environmental Safety and Health (EH), and General Counsel (GC) will also provide representation. Operations Office managers or senior designees will be invited to participate on the Task Force. The national laboratories will be invited to designate a senior-level manager to participate on the Task Force.

The Director of the Office of Nuclear Materials Management Policy will chair the STF. Environmental Management's Deputy Assistant Secretary for Integration and Disposition will serve as vice-chair. An additional vice-chair may be added if necessary. The STF Chair will organize working groups to accomplish the project elements and will maintain a small team of support and technical staff to help administer the working groups, monitor milestones, provide status reports, agendas and documents to STF and Council members prior to meetings.

The Under Secretary will chair a Nuclear Materials Council that will approve the STF mission, goals, policies, resource plan and project deliverables. The Council will also act on policy issues that are in dispute and cannot be resolved by the STF. The Council will consist of the principal secretarial officers (PSOs) from each of the Program offices represented on STF. In addition, Operations Office Managers will be invited to participate on the Council when issues relevant to their sites come before the Council for consideration.

Exhibit 1 further elaborates on the policy-making and project management organization.

Performance Indicators. The Nuclear Materials Stewardship Initiative will require cross-program cooperation and timely response. The STF will draft interim milestones for each project element and will present these for Council use in order to monitor progress

Exhibit 1. Policy-Making and Project Management Organizational Structure Nuclear Materials Stewardship Initiative

Nuclear Materials Council

- Membership: Under Secretary will serve as Chairman. Secretarial Officers who have a nuclear materials management responsibility will serve as members. Secretarial Officers of Environmental Safety and Health, Chief Financial Officer, and General Counsel will also serve. Operations Office Managers will be invited to participate on the Council when issues relevant to their sites come before it for consideration.
- Roles and Responsibilities:
  - Establish policy
  - Provide personnel and financial resources.
  - Approve a NEPA-compliance and public involvement-strategy.
  - Approve (or recommend approval) of Stewardship Task Force deliverables.
  - Oversee activities of the Stewardship Task Force.

Stewardship Task Force (STF)

- Membership: Director of the Office of Nuclear Materials Policy serves as Chair. The Environmental Management's Deputy Assistant Secretary for Integration and Disposition will serve as Vice-chair. An additional vice-chair may be added if necessary. Appointees from each of the programs represented on the Nuclear Materials Council will serve as members, as do managers or their designees from interested Operations Offices. The Task Force Chair will maintain support staff.
- Roles and Responsibilities
  - Recommend policy.
  - Establish and direct working groups.
  - Recommend approval of deliverables
  - Issue and maintain functions and requirements baseline document.
- Support Staff will:
  - Track milestones and support working groups.
  - Ensure quality control and coordination of working group deliverables
  - Forward deliverables to the STF and Council for review and comment.
  - Coordinate and document resolution of STF and Council comments.
  - Maintain project records.
  - Coordinate Council and STF meetings and agendas.

STF Working Groups

- Membership: The STF Chairman will establish Working Group Leads. Program, operations office, field office, laboratory, and contractor personnel will serve as members.
- Roles and Responsibilities
  - Identify and define policy issues
  - Complete STF deliverables.
  - Provide periodic progress and status reports.

Charter for Nuclear Material Stewardship *final:12/10/99*
Page 4 of 4