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DEPARTMENT OF ENERGY

Plutonium Needs, Costs, and Management Programs

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Resources, Community, and
Economic Development Division

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The Honorable Dan Schaefer
Chairman, Subcommittee on Energy
and Power
Committee on Commerce
House of Representatives

Dear Mr. Chairman:

With the end of the Cold War and the dissolution of the Soviet Union, the Department of Energy (DOE), while continuing to manage weapons-grade plutonium and other nuclear materials used in nuclear weapons, is turning its attention to managing nuclear materials designated as excess to national security requirements and to cleaning up the contamination resulting from 50 years of nuclear weapons production. As part of this transition, the United States has divided its 99.5-metric-ton plutonium inventory into two major categories—that which is allocated for national security needs and that which is designated as excess.

Concerned about DOE's ability to manage the plutonium inventory, you asked us to (1) review how much plutonium the United States allocated for national security needs, how much it designated as excess, and how DOE determined these amounts; (2) review DOE's estimates of the current and near-term costs for managing plutonium; and (3) review DOE's estimates of the long-term costs for managing plutonium.

Results in Brief

The United States allocated 46.8 metric tons of its 99.5-metric-ton plutonium inventory for national security purposes and designated the remaining 52.7 metric tons as excess. To determine how much plutonium was needed for national security, DOE reviewed its plutonium inventory database. In general, the plutonium in the custody of the Department of Defense and some of the plutonium managed by DOE's Defense Programs—the organization responsible for supporting the nation's nuclear weapons—was categorized as needed for national security purposes. The remaining plutonium managed by Defense Programs and other DOE organizations was categorized as excess to national security needs and will ultimately be disposed of. The national security plutonium is further divided into several subcategories.[1] DOE has a technical basis to

[1]The actual inventory amounts allocated among the national security subcategories are classified.

support the need for the amounts of plutonium it holds in most but not all of these subcategories.

From fiscal year 1995 through fiscal year 2002, DOE expects to spend about $18.8 billion[2] on plutonium management and related activities. These costs consist of about $10.5 billion for plutonium inventory management activities, including approximately $1.8 billion for national security plutonium and $8.7 billion for excess plutonium. DOE expects to spend another $8.3 billion for plutonium-related waste management and site cleanup activities. The costs of managing excess plutonium are about four times greater than the costs of managing national security plutonium because much of the excess plutonium is held in unstable forms and requires special management activities, such as handling, processing, and packaging. National security plutonium is generally contained in more stable forms, such as metals and weapons components, and therefore requires less management.

DOE also expects to spend over $3 billion for longer-term plutonium storage and conversion activities through about 2023.[3] This estimate is based on DOE's plans for storing the excess plutonium and converting it to forms that will make it more difficult to reuse in nuclear weapons. However, DOE's cost and schedule estimates are subject to many uncertainties, a number of which stem from the relative immaturity of the planned conversion technologies.

Background

Plutonium is a man-made, radioactive element that exists in different isotopes[4] and physical forms. The different isotopes of plutonium have widely varying half-lives,[5] ranging from 20 minutes to 76 million years. These isotopes are used to define the different grades of plutonium that are used in nuclear warheads and as fuel for nuclear reactors. Physically, plutonium exists in several forms—metal, which is relatively stable if packaged correctly, and other forms that are often unstable, such as

[2]All cost estimates are presented in constant 1996 dollars.

[3]This estimate includes only the costs associated with the long-term storage and disposition of excess weapons-usable plutonium; it excludes the continuing costs of other plutonium management and related activities.

[4]An isotope is any of two or more species of atoms of a chemical element with the same atomic number (i.e., the same number of protons) and chemical behavior but with differing atomic mass (i.e., differing numbers of neutrons plus protons).

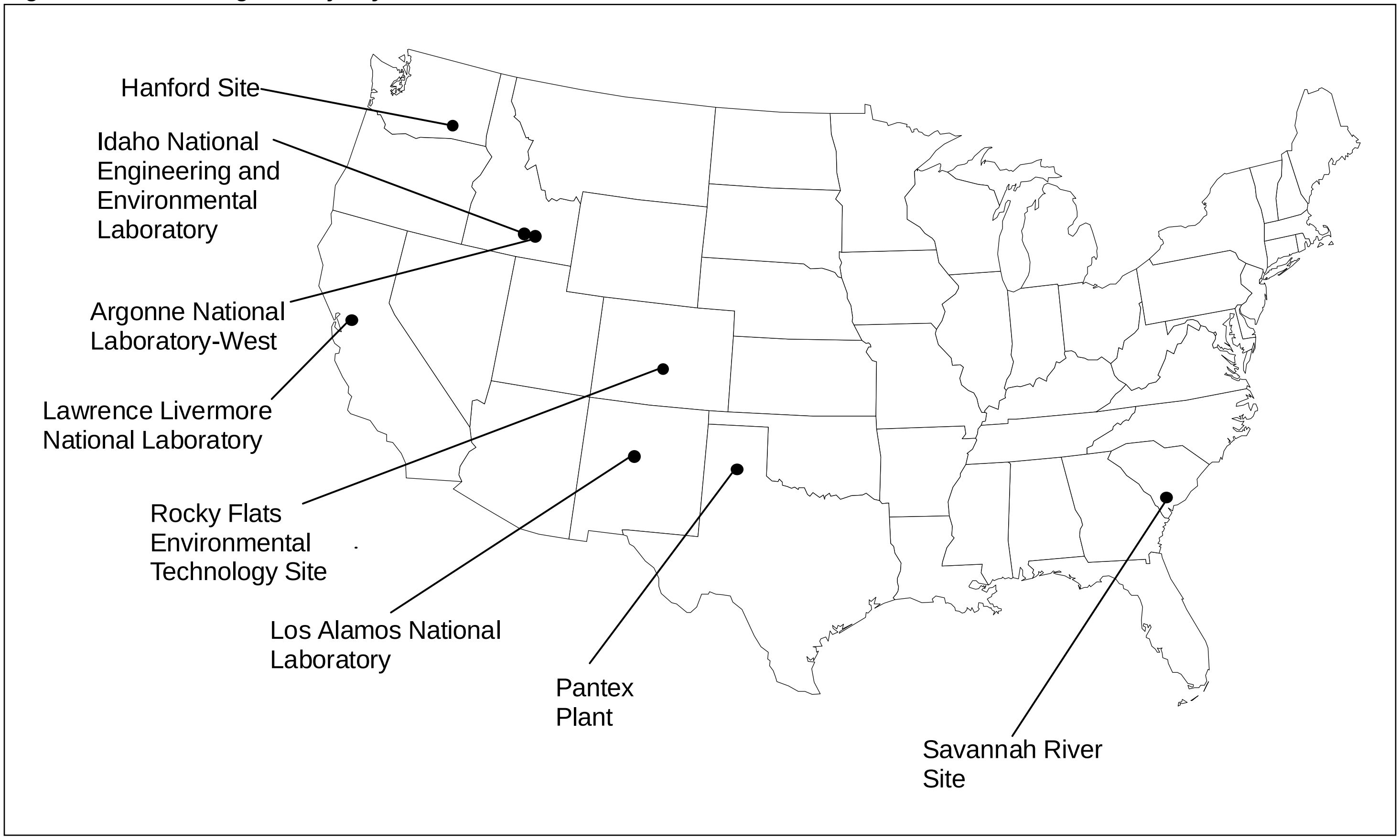
[5]A half-life is the time required for half of an element's atoms to decay.

oxides, solutions, residues, and scraps.[6] During the production era, DOE recycled, purified, and converted the less stable forms of plutonium, which resulted from weapons production activities, into metal for use in nuclear warheads. Much of DOE's excess plutonium was not in a suitable form or packaged for long-term storage when weapons production ceased. As a result, some packaging and related problems have developed over time. (See app. I.)

From World War II to the end of the Cold War, DOE and its predecessor agencies conducted nuclear research, produced plutonium, and manufactured and tested nuclear weapons at sites throughout the United States. No plutonium has been produced for weapons since 1988. The 99.5 metric tons of plutonium that remain in the U.S. government's inventory today is in the custody of the Department of Defense (DOD) and DOE. DOD has custody of the plutonium in warheads in the nuclear weapons stockpile, which are located at military bases around the world, and DOE manages the rest of the plutonium, which is located primarily at eight DOE sites: Argonne National Laboratory-West, Hanford Site, Idaho National Engineering and Environmental Laboratory (INEEL), Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Pantex Plant, Rocky Flats Environmental Technology Site, and Savannah River Site. (See fig. 1.)

[6]Plutonium may be considered unstable if it is (1) in a chemical form which makes its behavior difficult to predict (i.e., some forms can spontaneously combust or oxidize), (2) mixed with hazardous or corrosive materials, or (3) inadequately packaged.

Figure 1: Sites Storing the Majority of DOE's Plutonium



Source: DOE.

Although DOE no longer produces plutonium for weapons, some of the plutonium it produced in the past continues to present environmental, safety, and health hazards, as well as concerns about proliferation, and therefore requires careful management. The hazards and concerns associated with plutonium include the following:

- Plutonium is extremely toxic and can be fatal, especially when inhaled.
- Several kilograms[7] of plutonium are sufficient to make a nuclear bomb. Although attempts are made to control access to nuclear materials, thefts

[7]One kilogram equals 2.205 pounds.

have occurred in the former Soviet Union since the end of the Cold War, raising concerns about nuclear proliferation and international terrorism.[8]

- Today, land, buildings, and equipment used in making nuclear weapons, remain contaminated and present environmental hazards. To address these hazards, DOE expects to spend nearly $229 billion over the next 75 years.[9] Although DOE does not track cleanup costs specifically for plutonium, a major portion of these costs can likely be attributed to plutonium or related activities.

Additional information on the dangers of plutonium is provided in appendix I.

Even though the United States no longer manufactures new nuclear weapons, some plutonium is still used in nuclear weapons and for research, development, and testing programs. DOD establishes nuclear weapons requirements, and DOE subsequently determines how much plutonium is necessary to support these requirements. The Nuclear Weapons Council (NWC)[10] coordinates nuclear program activities between DOD and DOE and submits documents containing weapons requirements to the National Security Council and the President for approval.

DOE Has a Technical Basis for Most but Not All of Its National Security Plutonium

The nation's 99.5-metric-ton inventory of plutonium is divided into two categories—that which is allocated for national security (46.8 metric tons) and that which is designated as excess (52.7 metric tons). The national security plutonium is further allocated among several subcategories. Although DOE could justify most of these allocations, we found that it had no technical basis for the amounts of plutonium allocated for reliability replacement warheads and for the strategic reserve.

United States Declares Excess Plutonium

In 1995, for the first time in the history of the U.S. nuclear weapons program, the United States declared that 38.2 metric tons of weapons-grade plutonium was no longer needed for national security and was, therefore, excess. (In addition, DOE designated 14.5 metric tons of non-weapons-grade plutonium as excess.) According to DOE, this

[8]DOE's Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Excess Plutonium Disposition Alternatives (Jan. 1997).

[9]U.S. Department of Energy Consolidated Financial Statements for Fiscal Year 1996 (Feb. 1997).

[10]Established in 1986, NWC includes the Under Secretary of Defense for Acquisition and Technology; the Vice Chairman of the Joint Chiefs of Staff; and a DOE representative, currently the Deputy Secretary of Energy.

declaration was an important step in implementing the Nonproliferation and Export Control Policy, which was issued by the President in September 1993. This policy calls for the United States to eliminate, where possible, the accumulation of plutonium stockpiles and prevent the proliferation of weapons of mass destruction.

According to DOE officials, DOE reviewed its existing plutonium inventory records to determine how much of its weapons-grade plutonium was needed for national security. All weapons-grade plutonium that was in the custody of DOD in the active and inactive stockpile and some of the weapons-grade plutonium assigned to and managed by DOE's Defense Programs organization was categorized as needed for national security. This plutonium is for use in nuclear weapons; the strategic reserve; mutual defense; and research, development, and testing programs. All other plutonium that was assigned to or managed by any other DOE organizations (as well as the plutonium remaining with Defense Programs that was not required for national security) was categorized as not needed for national security. Ultimately, DOE will dispose of this excess plutonium. On the basis of this inventory review, DOE decided that 46.8 metric tons of weapons-grade plutonium should be held for national security and that the remaining 52.7 metric tons of plutonium—including 38.2 metric tons of weapons-grade and 14.5 metric tons of non-weapons-grade—could be declared excess to national security needs. The categorization of the current U.S. plutonium inventory is shown in table 1.

Table 1: Current U.S. Plutonium Inventory

Amounts in metric tons

Categories of plutonium[a]	Amount
National security weapons-grade	46.8
Excess weapons-grade	38.2
Excess non-weapons-grade	14.5
Total	**99.5**

[a]In DOE's inventory or in nuclear weapons held by DOD.

Source: DOE.

Significant Future Changes in the Categorization of Plutonium Are Unlikely

Significant changes in the amounts of plutonium dedicated to national security are unlikely in the near future. According to DOE officials, the United States has no plans to formally declare additional amounts of plutonium excess to national security needs. According to one DOE official, any future declarations would depend on international agreements or political decisions, such as (1) Russia's ratification of the second Strategic Arms Reduction Treaty (START-II);[11] (2) ratification of possible additional weapons reduction treaties, like START-III; or (3) a change in the role of nuclear weapons in the nation's defense posture. However, even these events would not necessarily result in additional declarations of excess plutonium. Instead, according to a DOE official, decreases in the active stockpile may be offset by reclassifying some of the plutonium from the active stockpile to the inactive stockpile or the strategic reserve. Therefore, even if the number of active warheads decreases, the total amount of plutonium allocated for national security will likely remain at 46.8 metric tons.

DOE Could Justify Most but Not All of Its National Security Plutonium Allocations

The national security plutonium is allocated among four categories, and the amounts in these categories are classified. According to DOE, the allocation for the first and second categories, warheads in the active and inactive nuclear weapons stockpile, are in weapons in the custody of DOD.[12] The remainder of the national security plutonium, managed by DOE, is allocated to the strategic reserve[13] and to mutual defense and research and development programs. Although DOE could justify the amounts of plutonium allocated to most of these categories, it could not provide a technical basis for the amounts allocated for reliability replacement warheads within the inactive stockpile and for the strategic reserve. Table 2 lists the allocations of national security plutonium and their principal uses and indicates whether the allocations have a technical basis.

[11]The two Strategic Arms Reduction Treaties, START-I and START-II, call for the United States and Russia to reduce their deployed strategic nuclear weapons (and remove or destroy these weapons' delivery systems). Additional information on the START treaties appears in app. I.

[12]According to DOE, to determine the amount of plutonium required to support these warheads, DOE multiplies the number of warheads by the amount of plutonium each contains.

[13]According to DOE, a strategic reserve of plutonium is required to support the production of replacement warheads when DOD believes that the number of inactive warheads is insufficient to back up the supply of active warheads.

Table 2: Principal Uses of National Security Plutonium

Allocation	Principal uses	Technical basis for the allocation?
Active nuclear weapons stockpile	Warheads in active nuclear weapons	Yes
Inactive nuclear weapons stockpile		
Augmentation warheads	Warheads in storage that could be returned to the active stockpile	Yes
Reliability replacement warheads	Warheads stored for replacing active stockpile warheads if they develop reliability or safety problems	No
Additional warheads	Warheads stored to replace active stockpile warheads intentionally destroyed during quality assurance and reliability testing	Yes
Strategic reserve	Plutonium stored to replace failed active warheads if there is no backup in the inactive stockpile	No
Mutual defense and research and development	Plutonium held to support agreements with allied countries and DOE's research and development programs	Yes

Source: GAO's analysis based on data from DOE.

As table 2 indicates, DOE appeared to have a technical basis for most of the allocations of national security plutonium. DOE provided the following justifications for these allocations:

- The allocation for the active stockpile is determined through an annual process driven by DOD's nuclear weapons requirements. DOD determines the types and numbers of weapons it wants to support national security needs, and DOE determines how much plutonium is needed for the required warheads and for their support.
- Augmentation warheads in the inactive stockpile are reserved to allow DOD and DOE to raise the active stockpile levels if necessary.
- Additional warheads in the inactive stockpile are held to replace warheads that are removed from the active stockpile and used for testing. The number of warheads needed as replacements is based on requirements of DOE's Quality Assurance and Reliability Testing Program.

- The amount of plutonium held for mutual defense is based on signed agreements between the United States and its allies. The plutonium held for research and development is used by DOE's laboratories and its amount is based on an established forecast and allotment system.

While DOE appeared to have adequate justification for these allocations of national security plutonium, it could not justify the allocations of plutonium for reliability replacement warheads in the inactive stockpile or for the strategic reserve, which represent a significant portion of the national security plutonium:

- Neither DOE nor NWC officials could demonstrate a basis for the number of reliability replacement warheads being held to replace active stockpile warheads in case they develop reliability or safety problems. DOE and NWC could not demonstrate that an analysis of the failure rate for active warheads had been conducted or that a technical assessment had been done to determine the need for this level of backup support.
- According to DOE, the plutonium held in the strategic reserve is for rapidly building warheads to respond to unforeseen events (such as warhead failures) that are not already provided for in the inactive stockpile. However, neither DOE nor NWC officials could demonstrate that a technical analysis had been conducted to justify the amount of plutonium held for this purpose.

DOE officials believe that the allocations of plutonium for reliability replacement warheads and for the strategic reserve are prudent because (1) nuclear weapons are required to deter forces hostile to the United States and its allies; (2) no new nuclear weapons are currently being designed, developed or manufactured; (3) the United States has no active underground nuclear testing program; and (4) nuclear weapons in the stockpile are being retained beyond their original expected service life. For these reasons, DOD and DOE, in deciding how much plutonium to hold for reliability replacement warheads and for the strategic reserve, assume that all of the nuclear warheads in the active stockpile will fail. Therefore, DOD and DOE believe that each active warhead needs to be supported either by a backup warhead in the reliability replacement category or by plutonium in the strategic reserve. While we recognize the prudence of holding some plutonium for these reasons, we question whether there is a technical basis for the amounts of plutonium being held in these two subcategories. Without a technical basis, the United States cannot be sure it is retaining the correct amount of plutonium for national security purposes.

Current and Near-Term Plutonium Activities Are Estimated to Cost Billions of Dollars

DOE estimates that it spends more than $2 billion a year,[14] or over 12 percent of its current annual budget, to manage its plutonium inventory and perform other plutonium-related activities. Because excess plutonium is often held in unstable forms—such as oxides, solutions, residues, and scraps—it requires many management activities and is therefore costly to manage. In contrast, national security plutonium is generally stored in sealed metal weapons components, is relatively stable, and is therefore less costly to manage. However, the costs of managing excess plutonium are expected to decline after it is disposed of in a permanent repository,[15] while the costs of managing national security plutonium are likely to continue indefinitely.

Unstable Excess Plutonium Is Costly to Manage

From fiscal year 1995 through fiscal year 2002, DOE expects to spend about $18.8 billion on plutonium management and related activities at the eight sites responsible for managing most of its plutonium. These costs include about $10.5 billion for plutonium inventory management and about $8.3 billion for plutonium-related waste management and site cleanup. The inventory management costs include about $8.7 billion for excess plutonium and about $1.8 billion for national security plutonium.

The inventory management costs included in DOE's estimate are for (1) storing and maintaining the plutonium inventories, including providing safeguards and security; (2) stabilizing, handling, and packaging the plutonium; (3) performing weapons-related activities, such as disassembling and dismantling weapons, managing the active stockpile, and conducting research and development; and (4) other activities, mainly managing DOE's spent nuclear fuel containing plutonium. Plutonium-related waste management and site cleanup activities are generally attributable to past plutonium production or other plutonium-related activities at the sites. Thus, their associated costs cannot be linked directly to either excess or national security plutonium. Table 3 summarizes DOE's estimates of these costs.

[14]DOE based its estimates of plutonium-related costs, for fiscal year 1995 through fiscal year 2002, on available cost information as well as officials' technical expertise and professional judgment. All cost estimates are presented in constant 1996 dollars.

[15]The Nuclear Waste Policy Act of 1982, as amended, requires the Secretary of Energy to determine, on the basis of an investigation of Yucca Mountain, Nevada, whether this site is suitable for a repository and, if this determination is positive, to recommend to the President that the site be selected for that purpose. If the site is formally selected, DOE must apply to the Nuclear Regulatory Commission for authorization (a license) to construct a repository there.

Table 3: Estimated Current and Near-Term Costs for Plutonium Inventory Management and Related Activities, Fiscal Years 1995-2002

Dollars in millions

Activity	Costs[a] National security plutonium	Excess plutonium	Total
Plutonium inventory management activities			
Storage and maintenance	$1,462	$5,597	$7,059
Stabilization, handling, and packaging	174	655	829
Weapons-related activities[b]	153	0	153
Other[c]	4	2,434	2,438
Subtotal	**$1,793**	**$8,686**	**$10,479**
Plutonium-related management activities			
Waste management	[d]	[d]	6,450
Site cleanup	[d]	[d]	1,835
Subtotal	[d]	[d]	**$8,285**
Total	[e]	[e]	**$18,764**

[a]All dollars are adjusted to constant 1996 dollars.

[b]Includes weapons disassembly and dismantlement, stockpile management support, research and development, and other costs related to plutonium in weapons.

[c]Represents predominantly the cost of managing spent nuclear fuel containing plutonium. Although the plutonium in DOE's spent nuclear fuel is not considered usable for nuclear weapons, it is accounted for in DOE's plutonium inventory.

[d]These costs are not related specifically to either excess or national security plutonium.

[e]Not applicable.

Source: GAO's analysis of data from DOE.

As shown in table 3, over 80 percent ($8,686 million) of DOE's inventory management costs are attributable to excess plutonium, while less than 20 percent ($1,793 million) are attributable to national security plutonium.

The costs of managing excess plutonium are high because much of it—including some oxides, solutions, residues, and scraps—is unstable and requires costly handling, processing, packaging, and storage. At many DOE facilities, the plutonium in these forms remained in an unsafe condition after DOE stopped producing plutonium and nuclear weapons. As a result, contractors at these facilities are still stabilizing the plutonium and correcting packaging problems that remained when weapons production ceased. At Rocky Flats, for example, some of the excess plutonium is contained in highly acidic, corrosive solutions that can damage containers. Plutonium in this form creates a potential for leakage that could, in turn, expose workers to hazards or contaminate the environment. Accordingly, the plutonium in solutions must be stabilized and repackaged.

In contrast, the costs of managing national security plutonium are relatively low because this plutonium is generally stored in sealed metal weapons components (pits), is relatively stable, and requires little near-term management, according to DOE officials. For example, at the Pantex Plant, which stores the majority of DOE's national security plutonium in pits, the plutonium management costs are relatively low.

Although the costs of managing excess plutonium are higher than those of managing national security plutonium, the excess plutonium will eventually be converted to safer forms and disposed of in a permanent underground repository. At that time, its management costs will fall. In contrast, the costs of managing national security plutonium will continue as long as the United States requires plutonium for its nuclear weapons. Given that DOE has no plans to reduce its requirements for national security plutonium or to categorize additional amounts as excess, these costs can be expected to continue into the foreseeable future.

DOE's Storage and Conversion Plan Faces Long-Term Costs and Uncertainties

In addition to the current and near-term costs of managing plutonium from fiscal year 1995 through fiscal year 2002, DOE expects to incur long-term costs, through about 2023, for storing and converting excess plutonium to safer forms that will ultimately be disposed of in a permanent underground repository. On the basis of early conceptual design data and preliminary plans, DOE estimates that these costs will total more than $3 billion. This estimate is based on DOE's January 1997 record of decision,[16] which details the Department's plan for storing and converting excess plutonium to forms that are difficult to reuse in nuclear weapons and are suitable for permanent disposal. To convert the excess plutonium to such forms, DOE has decided to pursue a dual-track strategy: burning the plutonium in reactors and immobilizing it in glass or ceramics. However, uncertainties surrounding both the storage and the conversion parts of DOE's strategy have unknown cost and schedule implications.

[16]DOE's Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Jan. 14, 1997).

DOE's Strategy and Cost Estimates for Storage and Conversion

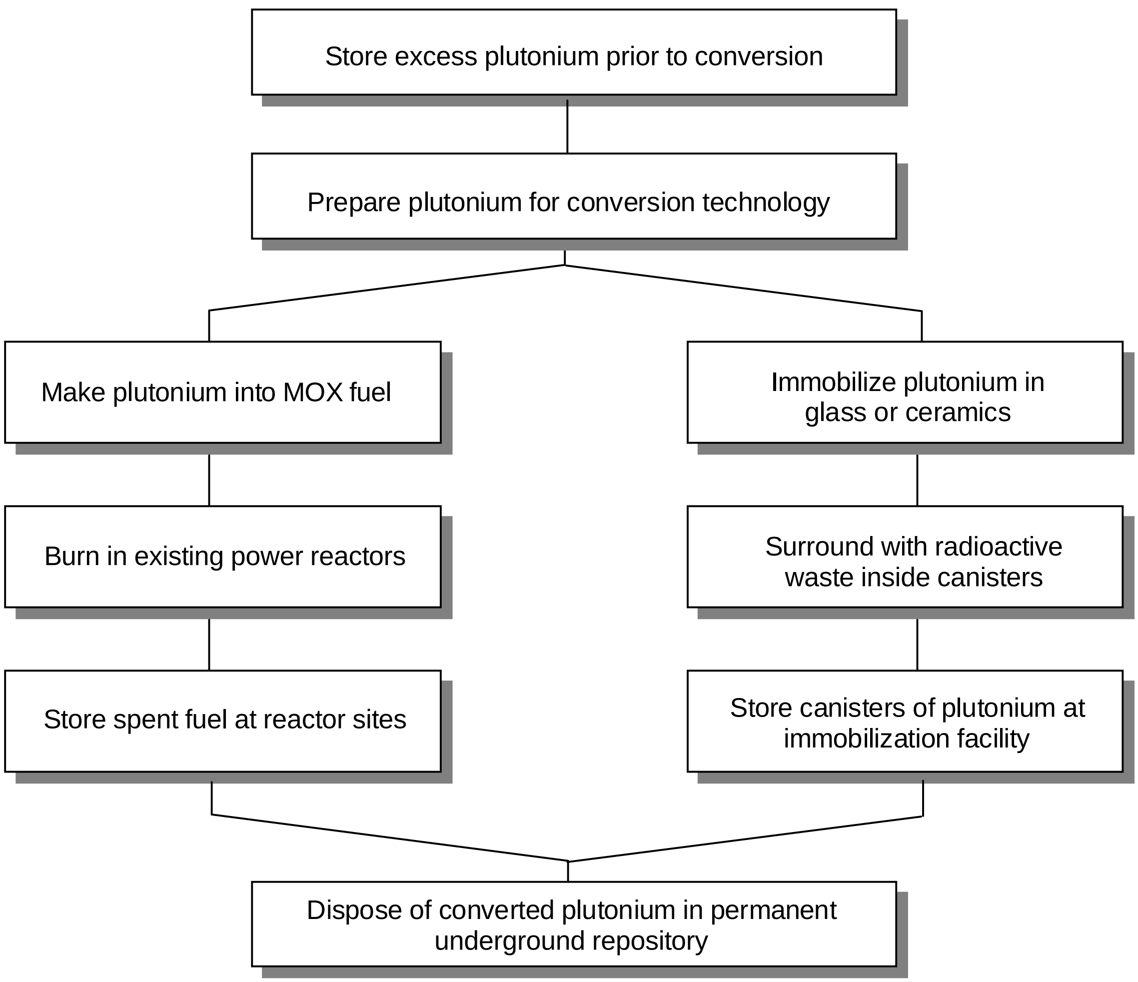
While DOE's recent record of decision focuses on converting the nation's excess plutonium to safer forms for disposal, DOE must store the plutonium until it can be converted and then store the converted plutonium until a repository is available for its disposal. Currently, neither facilities for converting the plutonium nor a repository for its permanent disposal is available. Until DOE has developed and built conversion facilities, it plans to store the excess plutonium at five sites. DOE estimates that this storage could cost over $1 billion from 2002 through 2019.[17] This estimate includes approximately $140 million for constructing a new storage facility at Savannah River; about $390 million for upgrading, expanding, and operating the facilities at Pantex and Savannah River; and as much as $600 million for operating the storage facilities at Hanford, INEEL, and Los Alamos. After the plutonium is converted, DOE plans to store the canisters of immobilized plutonium and the spent fuel at the conversion facilities until a permanent repository is available for their final disposal.

DOE's dual-track strategy calls for the use of two different technologies to convert the plutonium into safer forms that meet the "spent fuel standard." This standard requires that the plutonium be made as inaccessible and unattractive for use in nuclear weapons as the plutonium in spent fuel from commercial nuclear power reactors. One of the conversion tracks involves immobilizing plutonium in either glass or ceramic material within small containers. These containers are placed inside large stainless steel canisters, which are then filled with glass containing high-level waste to provide a radiation barrier.[18] The other track converts plutonium into spent fuel by burning it as fuel in existing commercial reactors. The plutonium is first processed into plutonium dioxide, which is then mixed with uranium dioxide to make mixed oxide (MOX) fuel. The MOX fuel is then burned in a commercial reactor to generate electricity. Regardless of the conversion track used, the end product will meet the spent fuel standard and will ultimately require disposal in a permanent underground repository. Figure 2 illustrates DOE's storage and conversion strategy.

[17]Storage costs of a few million dollars could be incurred at Pantex as early as 1999 or 2000.

[18]This is the "can-in-canister" variation of the immobilization technology, considered the most likely to be used.

Figure 2: DOE's Storage and Conversion Strategy



Source: DOE.

In addition to over $1 billion in storage costs, DOE estimates that implementing its dual-track conversion strategy will cost approximately $2 billion through about 2023. (See app. II for more information on DOE's schedule estimates for conversion.) This cost estimate reflects both investment and operating costs. Investment costs cover research and development, licensing, conceptual design, start-up, engineering, capital equipment, and construction. Operating costs cover staffing, maintenance, consumables, waste management, and decontamination and decommissioning. Also, in estimating the MOX fuel costs, DOE assumed that some costs could be recovered when reactor operators acquire MOX fuel from DOE instead of purchasing conventional reactor fuel. DOE refers to these recovered costs as fuel displacement credits. Table 4 presents a breakdown of DOE's cost estimate for the conversion strategy.

Table 4: Estimated Costs to Implement DOE's Dual-Track Conversion Strategy

Dollars in millions

	Estimated costs[a]			
Facility	**Investment cost**	**Operating cost**	**Fuel displacement credit**	**Total**
Preconversion processing	$ 360	$ 970	$ 0	**$1,330**
Immobilization[b,c]	220	60	0	**280**
MOX fuel fabrication	360	680[d]	(930)	**110**
Reactor[c]	200	90	0	**290**
Repository	0[e]	30	0	**30**
Total	**$1,140**	**$1,830**	**($930)**	**$2,040**

[a]All dollars are adjusted to constant 1996 dollars.

[b]Assumes that the "can-in-canister" method will be used and the immobilization portion of the strategy will have an accelerated start.

[c]Assumes that the purest of the excess plutonium will be burned as MOX fuel and the remainder will be immobilized.

[d]Does not include the costs of implementing an option described by DOE as a remote possibility, namely, that European MOX fuel fabrication facilities will be used to speed up the availability of MOX fuel until the United States builds its own MOX fuel fabrication facility. This option would add $140 million to the MOX fuel operating costs and increase the total cost of the strategy from $2.04 billion to $2.18 billion.

[e]Does not include the investment costs for DOE's underground repository, since they are included under other DOE budgets.

Source: DOE.

DOE's Storage and Conversion Strategy Is Subject to Uncertainties

Although DOE has developed a strategy for storing and converting excess plutonium, this strategy is subject to uncertainties that will affect its implementation. These uncertainties are associated with technology, facility, and nonproliferation issues. How these uncertainties are resolved will determine whether DOE uses one or both of the conversion technologies, how much plutonium will be converted through either technology, and how long the plutonium will have to be stored before and after conversion.

Technology Uncertainties

Uncertainties are associated with developing the immobilization technology and implementing the MOX fuel technology in the United States. Neither technology has yet been proved effective for use in DOE's conversion strategy, and both pose issues that must be addressed prior to implementation:

- Although immobilization has been used for other industrial purposes and other materials, it has never been used on an industrial scale for plutonium. Unresolved questions include how the plutonium will react in the immobilization processing, how stable and durable the immobilized material will be, how difficult recovering the plutonium from the immobilized forms will be, and what percentage of plutonium will be immobilized in glass or ceramics.
- MOX fuel technology is more advanced and has been used in reactors in other countries for many years. However, MOX fuel is not currently being used in reactors in the United States, no U.S. reactors are licensed to use this fuel, and no MOX fuel fabrication facilities exist in the United States. Additional uncertainties surrounding the MOX technology include the percentage of plutonium that will be used in the U.S. MOX fuel (likely to differ from the percentage used in the European MOX fuel) and the potential effects, on the fuel or reactors, of materials that were added to the plutonium used in weapons components.

In addition to fully developing and implementing the two technologies and addressing these uncertainties, DOE must demonstrate the technologies' compliance with regulatory and oversight requirements.

Because both conversion technologies are relatively immature and uncertainties surround their development and implementation, DOE cannot confidently forecast how long it will have to store the excess plutonium before conversion facilities are available. Under DOE's plans, the consolidation and storage of plutonium will be complete in about 2019 at Pantex, about 2011 at Savannah River, and as early as 2006 at the three remaining sites—Hanford, INEEL, and Los Alamos. Delays in conversion would extend the time the plutonium would have to be stored at some or all of the storage sites.

Facility Uncertainties

Questions about facilities also pose uncertainties, most of which stem from the immaturity of the conversion technologies. That is, until the technologies are further developed, DOE cannot decide on the type and number of facilities it will need for immobilization. Furthermore, DOE has not yet decided where to place the facilities that will be required to process the plutonium, whether for immobilization or for use in MOX fuel. Similarly, DOE has not determined the type, number, or locations of the commercial reactors that will be needed to burn the MOX fuel. Resolving these issues will depend not only on the maturation of the conversion technologies but also on such things as contract negotiations with reactor owners, licensing requirements, and environmental reviews.

Further uncertainties are associated with the underground repository where DOE plans to permanently dispose of converted plutonium. Although DOE assumes that a permanent repository will be ready to accept the converted plutonium in 2010 (12 years later than originally expected), DOE cannot be certain that a repository will open on schedule. DOE is currently assessing the Yucca Mountain site to determine its viability for a repository. In January 1997, we reported that several impediments and uncertainties about standards and licensing must be resolved in order for DOE to achieve its revised 2010 opening date.[19] If a repository is not available, the converted plutonium will have to remain in storage at the conversion facilities and the costs of storage will increase.

Nonproliferation Uncertainties

DOE faces uncertainties concerning nonproliferation issues. DOE's conversion strategy was designed, in part, to support U.S. nonproliferation goals. The United States is beginning to implement the dual-track conversion strategy to set an example for Russia and encourage it to take similar actions. However, according to DOE, the schedule for converting the excess U.S. plutonium depends on reaching agreements with Russia concerning reductions of its stockpiles of excess plutonium. To date, no such agreements have been finalized. These agreements will also influence the extent to which DOE relies on each of the two conversion strategies.

Observations

The United States has taken important steps to reduce the dangers of nuclear proliferation associated with holding excess plutonium. However, how accurately DOD and DOE determine the amount of plutonium needed for national security and how much DOE designates as excess may have

[19]See Nuclear Waste: Impediments to Completing the Yucca Mountain Repository Project (GAO/RCED-97-30, Jan. 17, 1997).

important long-term implications. Without a technical basis for its categorizations, we believe that the United States cannot be certain it is retaining the correct amount of plutonium for national security purposes. Potential impacts of not holding the correct amount include the following:

- DOD relies on DOE to provide enough plutonium to support the nuclear stockpile. Without a technical analysis of the amounts required for each of the national security subcategories, DOE cannot ensure that it is holding the correct amount of plutonium to provide this support.
- Conversely, if DOD and DOE are holding more plutonium than is needed for national security, they may not be fully implementing U.S. policies to reduce existing stockpiles of excess weapons-usable plutonium as quickly as practicable.
- Within DOE, plans and budgets depend on how plutonium is categorized. DOE's plan for the long-term storage and management of national security plutonium is based on current allocations to that category. Similarly, DOE's plan for storing and converting excess plutonium relies on the amount categorized as excess. A change in the amount of plutonium allocated to either category could affect DOE's projected costs and schedules for both.

Agency Comments

We provided a draft of this report to DOE, NWC, and DOD for their review and comment. While NWC declined to comment on this report, DOD, as a component of NWC, provided comments on the draft. Although DOE and DOD generally agreed that the information in the report was accurate, they disagreed with our position that a technical basis is lacking for the allocations of national security plutonium for reliability replacement warheads in the inactive nuclear weapons stockpile and for the strategic reserve.

In its response to our draft report, DOE noted that the requirements for reliability replacement warheads and for the strategic reserve are prescribed by DOD. DOE also expressed "high confidence [that] the nuclear force structure, as specified by DOD, is based on solid technical analysis and is consistent with legislation, treaties, and policy decisions." (See app. IV for DOE's comments.)

To follow up on DOE's written comments, we asked the Director of the Office of Nuclear Weapons Management, Defense Programs, to clarify the Department's reference to a "solid technical analysis." While agreeing that DOE could not demonstrate that such an analysis had been conducted for the allocations of plutonium for reliability replacement warheads and for the strategic reserve, he maintained that these allocations are based on prudence and expertise. The Director clarified that the reference to a "solid technical analysis" pertained to the allocations for warheads in the active stockpile, not to the allocations for reliability replacement warheads and for the strategic reserve. As indicated on pages 8 and 9 of this report, we did not question the technical basis for the allocations of plutonium for the active stockpile.

In response to our draft report, the Deputy Assistant to the Secretary of Defense (Nuclear Matters) stated that DOD disagreed with our position that the plutonium allocations for reliability replacement warheads and for the strategic reserve lack a technical basis. (See app. V for DOD's comments.) DOD said that the number of nuclear warheads for reliability replacement and the quantity of plutonium for the strategic reserve are documented in the Nuclear Weapons Stockpile Memorandum and the Long Range Planning Assessment. We agree that these documents specify the amounts of plutonium allocated to these two categories, but these documents do not provide the underlying technical analysis used to determine these amounts.

Throughout our review, DOE and DOD officials were unable to demonstrate an underlying technical basis, using scientific or engineering methods or data, for the allocations of plutonium for reliability replacement warheads and for the strategic reserve plutonium. These officials told us that the allocations assume a 100-percent failure rate for warheads in the active stockpile. As stated, we believe that a technical analysis is needed to support the reasonableness of this assumption. Therefore, we did not change the content of our report in response to this comment. However, both DOE and DOD provided clarifying comments, which we incorporated into our report as appropriate.

To review DOE's categorization of plutonium and cost estimates for managing plutonium, we interviewed DOE officials, reviewed DOE documents, and analyzed cost data obtained through a survey that we sent to the eight sites responsible for managing most of DOE's plutonium inventory. We conducted our work from June 1996 through April 1997 in accordance with generally accepted government auditing standards. Detailed information about our scope and methodology appears in appendix III.

Please contact me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix VI.

Sincerely yours,

Victor S. Rezendes
Director, Energy, Resources,
and Science Issues

Contents

Figures

Abbreviations

DOD	Department of Defense
DOE	Department of Energy
GAO	General Accounting Office
INEEL	Idaho National Engineering and Environmental Laboratory
MOX	mixed oxide (fuel)
NWC	Nuclear Weapons Council
START	Strategic Arms Reduction Treaty

Forms and Dangers of Plutonium

Forms of Plutonium

Plutonium (Pu) is primarily a man-made element, produced by irradiating uranium in nuclear reactors. It exists in various forms and grades and is used in nuclear warheads and as fuel in nuclear reactors. Plutonium-239 is fissile and can sustain a nuclear chain reaction, making this isotope suitable for nuclear weapons. Plutonium-240 is more radioactive and generates more heat than plutonium-239. The percentage of plutonium-240 in plutonium material determines whether it is classified as weapons grade (less than 7 percent Pu-240), fuel grade (7 to 19 percent Pu-240), or reactor grade (more than 19 percent Pu-240). Spent nuclear fuel, a by-product of power generation in nuclear reactors, also contains some plutonium but would require extensive reprocessing to be reused in a weapon or reactor. The different forms of plutonium have varying half-lives—for example, plutonium-239 has a half-life of about 24,000 years.

The plutonium that the Department of Energy (DOE) produced is held in several physical forms, including metals, oxides, solutions, residues, and scraps. Most of DOE's plutonium is stored as a metal because, during the production era, plutonium was recycled and purified to metal form for use in nuclear warheads. Plutonium oxide, a fine powder produced when plutonium metal reacts with oxygen, was formed when weapons were manufactured or when plutonium metal was inadvertently exposed to oxygen. Containers holding acidic and corrosive plutonium solutions are vulnerable to leakage. Residues or scraps, the by-products of past weapons production activities, generally contain plutonium in concentrations of less than 10 percent. Throughout the weapons complex, the plutonium in residues and scraps is mixed with over 100 metric tons of other materials and waste.

Dangers of Plutonium

Although DOE has ceased to manufacture plutonium for use in nuclear weapons, the plutonium produced in the past continues to present hazards. Because plutonium is highly radioactive, it poses acute dangers to human health and the environment, as well as to national security, unless it is properly stored and safeguarded. Land, buildings, equipment, and materials contaminated with plutonium also present environmental hazards that must be cleaned up or contained.

Health, Safety, and Environmental Hazards

When DOE stopped producing nuclear materials, much of its plutonium was improperly stored, posing health, safety, and environmental hazards. If not safely contained and managed, plutonium can be dangerous to human health, even in extremely small quantities. Inhaling a few micrograms of plutonium creates a long-term risk of lung, liver, and bone cancer. Inhaling larger doses can cause immediate lung injuries and death. The potential for exposure occurs when containers or packaging fails to fully contain the plutonium. Leakage from corroded containers or inadvertent accumulations of plutonium dust in piping or duct work present hazards, especially in aging, poorly maintained, or obsolete facilities. After assessing the vulnerabilities associated with its storage of plutonium,[20] DOE began stabilizing, packaging, or repackaging the more unstable forms—including oxides, solutions, residues, and scraps—to properly store them, as well as plutonium metals, while they await disposition.

Proliferation Hazards

Like uranium, plutonium is a key ingredient in nuclear weapons, and several kilograms suffice to make a nuclear bomb. According to DOE, most nations and some terrorist groups would be able to produce nuclear weapons if they had access to sufficient quantities of nuclear materials. Therefore, controls on access to nuclear materials are the primary technical barrier to nuclear proliferation in the world today. Several thefts of weapons-usable nuclear materials in the former Soviet Union have been confirmed since the end of the Cold War, leading the Director of the Central Intelligence Agency to warn that these materials are more available now than ever before in history.

To help reduce the risk of nuclear proliferation posed by plutonium and other nuclear materials, the United States and Russia are working towards nuclear arms reduction treaties. Agreements such as the Strategic Arms Reduction Treaties (START-I and START-II) require that weapons be retired from deployed status and their delivery systems be removed or destroyed. These treaties do not, however, require that the nuclear warheads be dismantled or that their parts and materials, including plutonium, be destroyed. The United States has nevertheless removed some weapons from its stockpile, dismantled their warheads, and stored or disposed of their components and key nuclear materials.

In addition, through a "lead and hedge" approach, the United States is encouraging Russia to reduce both the number of nuclear warheads in its arsenal and the amount of nuclear material it maintains to support these warheads. Specifically, the United States plans to "lead" the Russians by reducing the U.S. arsenal of strategic warheads, as agreed in the START-II

[20]See DOE's Plutonium Working Group Report on Environmental, Safety and Health Vulnerabilities Associated With the Department's Plutonium Storage (Nov. 1994).

treaty. At the same time, it plans to "hedge" by maintaining its ability to return to the levels established under START-I, should the need for additional warheads arise. Although the Congress ratified START-II in January 1996, the Russian parliament has not yet scheduled a vote on it. Because of Russia's delay in ratifying START-II, the Department of Defense (DOD) is evaluating its ability to resume START-I levels of nuclear warheads in the active stockpile.

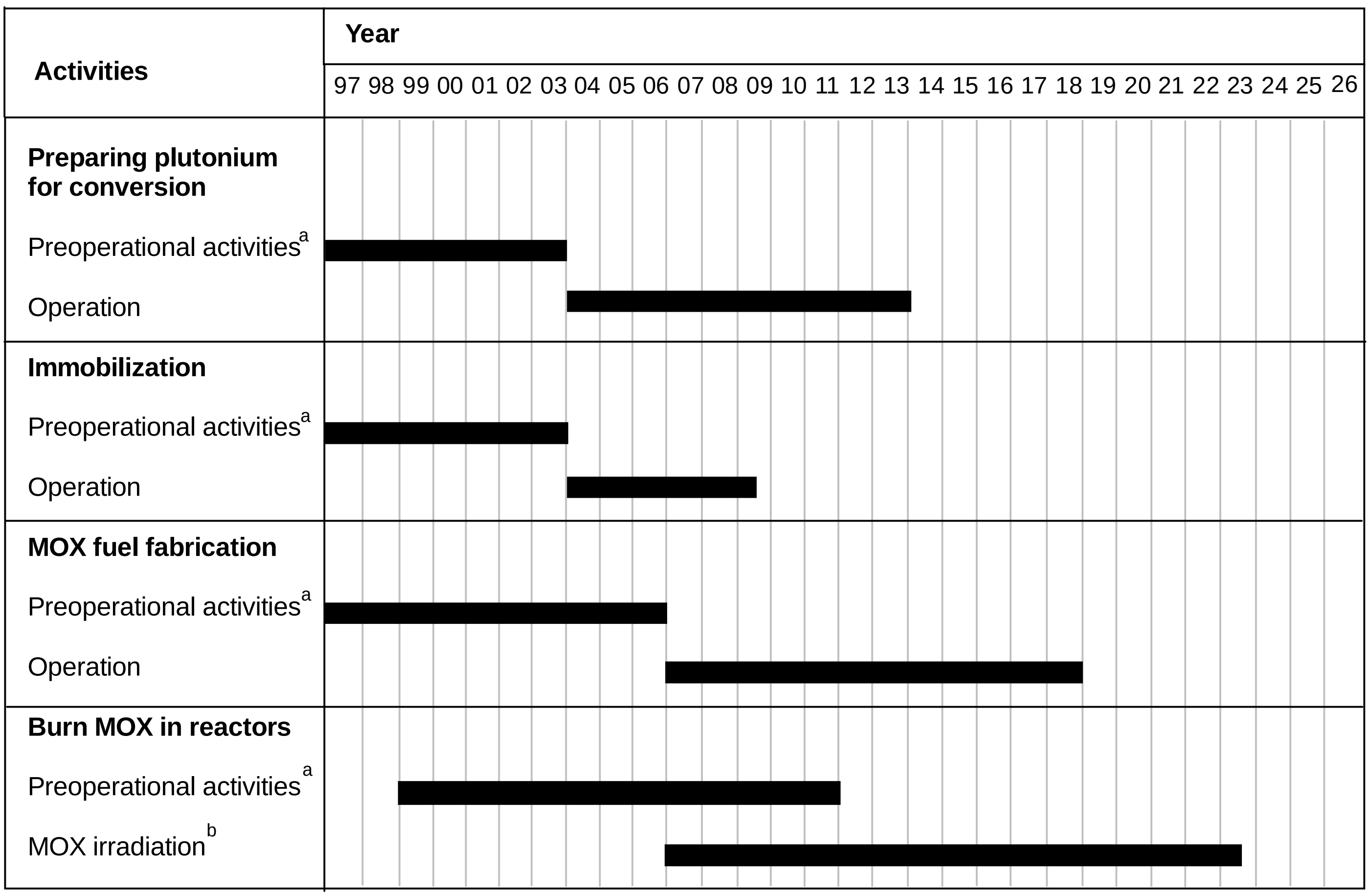
Environmental Cleanup

Now that DOE is no longer producing plutonium for nuclear weapons, it is changing its focus to cleaning up the environmental contamination created by 50 years of production at its facilities. In its consolidated financial statements for fiscal year 1996, DOE estimated that it will spend nearly $229 billion over the next 75 years to clean up sites where plutonium and other nuclear materials were fabricated and used to produce nuclear weapons. DOE has not determined what portion of these costs can be attributed specifically to plutonium or plutonium-related activities.

Schedule for Implementing the Dual-Track Conversion Strategy

Assuming a 1997 start date, DOE estimates the conversion mission will end in 2023. DOE's estimate breaks the schedule into four overlapping activities: (1) preparing the plutonium for conversion, (2) immobilizing the plutonium, (3) fabricating mixed oxide (MOX) fuel, and (4) burning the MOX fuel in reactors. Figure II.1 shows the schedule for these four activities.

Figure II.1: DOE's Schedule for Implementing Its Dual-Track Conversion Strategy



[a]Preoperational activities include research and development and engineering; licensing, permitting and siting; modifications; and selecting a utility or utilities to operate the reactor(s) that will burn the MOX fuel.

[b]The last MOX fuel assembly will achieve the spent fuel standard in about 2020, although irradiation of the fuel will continue into 2023.

Objectives, Scope, and Methodology

Our objectives for this assignment were to (1) review how much plutonium the United States allocated for national security, how much was designated as excess, and how DOE determined these amounts; (2) review DOE's estimates of the current and near-term costs for managing plutonium; and (3) review DOE's estimates of the long-term costs for managing plutonium.

To review DOE's and the Nuclear Weapons Council's (NWC) categorization of plutonium and any changes that have occurred or are projected for the future, we interviewed DOE and NWC officials and gathered and analyzed information from both organizations. As agreed with the requester's office, our study did not include DOD's roles and activities except to the extent that DOD participates in NWC. Therefore, although DOD manages the plutonium contained in active nuclear warheads, we did not include the cost of managing this plutonium.

To determine the current and near-term costs of managing DOE's plutonium, we interviewed officials and gathered and analyzed data from DOE sites and headquarters. We conducted a survey of the eight DOE sites that, according to DOE's 1996 report Plutonium: The First 50 Years, maintain the majority of DOE's plutonium inventory. These sites are Argonne National Laboratory-West, Hanford Site, Idaho National Engineering and Environmental Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Pantex Plant, Rocky Flats Environmental Technology Site, and Savannah River Site. The survey asked each site to identify its (1) actual costs for fiscal years 1995 and 1996, (2) budget estimates for fiscal year 1997, and (3) projected cost estimates for fiscal year 1998 through fiscal year 2002. All cost estimates were adjusted to constant 1996 dollars. We also included each site's share of the program oversight costs incurred by DOE headquarters and operations offices, applying DOE's own standard formula (4.3 percent plus local adjustments) to the cost estimate provided by each site.

DOE's budget and accounting systems do not separately collect or report plutonium-specific costs. Therefore, DOE provided its "best estimates" of plutonium-related costs, based on available cost information as well as officials' technical expertise and professional judgment. We could not readily verify the data's accuracy, as we would have done had the data been derived from a budget and accounting system. However, we discussed our data-gathering approach with cognizant DOE officials, coordinated our request for data through the Office of the Chief Financial Officer, and provided our summarized cost data to DOE officials, who agreed that the data-gathering approach was reasonable and that the data provided by the field sites were probably the best that could be obtained under the circumstances. Similarly, officials from the Congressional Research Service and Congressional Budget Office reviewed the cost data and suggested no changes.

To obtain information on the long-term costs of managing plutonium, we interviewed DOE officials and examined various DOE documents, including the Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement and documents prepared to support it. In addition, we reviewed DOE's consolidated financial statements for fiscal year 1996.

We conducted our review between June 1996 and April 1997 in accordance with generally accepted government auditing standards.

Comments From the Department of Energy

Department of Energy
Washington, DC 20585

March 28, 1997

Mr. Allen Li
Associate Director, Energy,
Resources, and Science Issues
U.S. General Accounting Office
441 G Street, NW
Room 2440
Washington, D.C. 20548

Dear Mr. Li:

Thank you for taking time to meet with Department of Energy (DOE) representatives on March 25, 1997, to hear our concerns about your office's draft report GAO/RCED-97-98 entitled "DEPARTMENT OF ENERGY: Plutonium Needs, Costs, and Management Programs." I believe you will agree the meeting was beneficial and permitted resolution on most issues brought to the meeting by Defense Programs and other Departmental Headquarters program offices. However, agreement could not be reached on several important Defense Programs concerns about the draft report's presentation of information about the DOE technical basis for national security plutonium in the strategic reserve and the reliability replacement warheads held in the inactive weapons stockpile.

As agreed with you and your staff, Defense Programs is providing the following written comments to summarize our concerns for your further consideration and their inclusion in the General Accounting Office (GAO) final report to Congress:

DOE Comments on GAO Draft Report Entitled
DEPARTMENT OF ENERGY
Plutonium Needs, Costs, and Management Programs

The GAO states throughout the draft report (see pages 2, 7, 10, 11, 12, 13, and 26) that DOE does not have a technical basis for national security plutonium in the strategic reserve and the reliability replacement warheads held in the inactive weapons stockpile.

On page 6 of the draft report, GAO states "DOD establishes nuclear weapons requirements, and DOE subsequently determines how much plutonium is necessary to support these requirements." Reference the February 5, 1997, letter with attachments to Ms. Lisa Gardner, U.S. GAO, Denver Regional Office from Fred S. Celec, Deputy Assistant to the Secretary of Defense (Nuclear Matters) for further details on Department of Defense (DOD) analysis and decision-making process in determining active and inactive warhead quantities, as well as the need for the Plutonium Strategic Reserve.

To determine the amount of plutonium required to support the DOD nuclear weapons requirements, as specified by the DOD, DOE simply multiplies the number of warheads by the amount of plutonium each warhead contains. This same approach is used in determining how much plutonium is required to support all categories of weapons as specified by the DOD. The amount of plutonium in a particular warhead type is determined by weapon design parameters which meet the military characteristics (i.e., weight, yield, shape, etc.) for the weapon. The amount of plutonium in a particular warhead type is not dependent on whether the warhead is held in the active, reliability replacement, augmentation, or QART replacement category.

For those active warheads where insufficient inactive warheads are available, the DOD requires the DOE to support production of replacement warheads. During the 1994 to1995 timeframe, DOE's strategy for meeting this requirement was through reuse of existing nuclear components. The analysis supporting this strategy was documented in June 1994 in the Strategic Reserves Program Management Plan (SRPMP). This classified document was provided to the GAO for review and contains the number and types of active warheads that require production of replacement warheads. The SRPMP also identifies the types and quantities of plutonium components necessary for reuse. The plutonium in these reuse components comprise the Plutonium Strategic Reserve.

The DOE has high confidence the nuclear force structure, as specified by the DOD, is based on solid technical analysis and is consistent with legislation, treaties, and policy decisions. The DOD decision-making process and resultant technical documents are identified in the attachments to Mr. Celec's letter to Ms. Gardner. If the GAO wishes to gain a better understanding of the technical basis of the nuclear force structure, they should review the appropriate DOD documents as identified in Mr. Celec's letter.

If you have any questions or require further assistance in connection with our response, please contact Mark Byers at (301) 903-5227.

Sincerely,

Richard D. Hahn

Richard D. Hahn
Director, Office of Nuclear
Weapons Management
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cc:
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Comments From the Department of Defense

ASSISTANT TO THE SECRETARY OF DEFENSE
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ATOMIC ENERGY

March 28, 1997

Ms. Lisa Gardner
US GAO, Denver Regional Office
1244 Speer Blvd., Suite 800
Denver, CO 80204

Dear Ms. Gardner:

On February 5, 1997, in a letter from me and an attachment from the Nuclear Weapons Council staff, I discussed in detail your questions regarding review of the Department of Energy's (DOE) management of plutonium. However, the resulting GAO draft report, *Department of Energy: Plutonium Needs, Costs, and Management Programs*, questions the basis for determining the plutonium allocation for the Reliability Replacement Warheads and the Strategic Plutonium Reserve. The issue was also discussed at some length at the GAO and DOE Exit Conference, March 25, 1997. Let me attempt once again to clarify the issue.

In no case, for the stockpile, active and inactive, does the DOE make an independent assessment of the number of required stockpile warheads. Stockpile requirements are derived from analysis by USSTRATCOM, the Joint Staff, and other elements of the DoD. They are documented by the Nuclear Weapons Council in the Nuclear Weapons Stockpile Memorandum (NWSM) and Long Range Planning Assessment (LRPA). Finally the requirements are reviewed by the National Security Council and codified when the President approves and signs the annual Presidential Decision Directive. The DOE, in turn, must maintain the quantity of plutonium that supports the stockpile requirements contained in these documents.

In the case of Reliability Replacement Warheads, the NWSM and LRPA specify the number of warheads in this category, and DOE translates this requirement directly into the plutonium inventory requirements. For those active warheads where insufficient inactive warheads are available for potential replacement, DoD requires DOE maintain the materials and capability to support the production of replacement warheads. The plutonium required to support production is set aside as the Strategic Reserve. The NWSM and the LRPA specify the quantity of plutonium required for the Strategic Reserve.

This letter represents official Department of Defense comment on the subject GAO draft report. If you need further explanation, please contact me.

Sincerely,

Fred S. Celec
Deputy Assistant to the
Secretary of Defense
(Nuclear Matters)

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Related GAO Products

Department of Energy Contract Management (GAO/HR-97-13, Feb. 1997).

Nuclear Waste: Impediments to Completing the Yucca Mountain Repository Project (GAO/RCED-97-30, Jan. 17, 1997).

Nuclear Waste: Uncertainties About Opening Waste Isolation Pilot Plant (GAO/RCED-96-146, July 16, 1996).

Nuclear Waste: Greater Use of Removal Actions Could Cut Time and Cost for Cleanups (GAO/RCED-96-124, May 23, 1996).

Energy Downsizing: While DOE is Achieving Budget Cuts, It Is Too Soon to Gauge Effects (GAO/RCED-96-154, May 13, 1996).

Nuclear Weapons: Status of DOE's Nuclear Stockpile Surveillance Program (GAO/T-RCED-96-100, Mar. 13, 1996).

Nuclear Nonproliferation: U.S. Efforts to Help Newly Independent States Improve Their Nuclear Material Controls (GAO/T-NSIAD/RCED-96-118, Mar. 13, 1996).

Nuclear Nonproliferation: Status of U.S. Efforts to Improve Nuclear Material Controls in Newly Independent States (GAO/NSIAD/RCED-96-89, Mar. 8, 1996).

Nuclear Nonproliferation: Concerns With the U.S. International Nuclear Materials Tracking System (GAO/T-RCED/AIMD-96-91, Feb. 28, 1996).

Nuclear Waste: Management and Technical Problems Continue to Delay Characterizing Hanford's Tank Waste (GAO/RCED-96-56, Jan. 26, 1996).

Nuclear Safety: Concerns With Nuclear Facilities and Other Sources of Radiation in the Former Soviet Union (GAO/RCED-96-4, Nov. 7, 1995).

Nuclear Waste: Issues Affecting the Opening of DOE's Waste Isolation Pilot Plant (GAO/T-RCED-95-254, July 21, 1995).

Department of Energy: Savings From Deactivating Facilities Can Be Better Estimated (GAO/RCED-95-183, July 7, 1995).

Nuclear Nonproliferation: Information on Nuclear Exports Controlled by U.S.-EURATOM Agreement (GAO/RCED-95-168, June 16, 1995).

Nuclear Facility Cleanup: Centralized Contracting of Laboratory Analysis Would Produce Budgetary Savings (GAO/RCED-95-118, May 8, 1995).

Nuclear Materials: Plutonium Storage at DOE's Rocky Flats Plant (GAO/RCED-95-49, Dec. 29, 1994).

Nuclear Waste: Change in Test Strategy Sound, but DOE Overstated Savings (GAO/RCED-95-44, Dec. 27, 1994).

Nuclear Waste: DOE's Management and Organization of the Nevada Repository Project (GAO/RCED-95-27, Dec. 23, 1994).

Nuclear Waste: Comprehensive Review of the Disposal Program Is Needed (GAO/RCED-94-299, Sept. 27, 1994).

Nuclear Waste: Yucca Mountain Project Behind Schedule and Facing Major Scientific Uncertainties (GAO/RCED-93-124, May 21, 1993).

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