United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Energy and Power, Committee on Commerce, House of Representatives

April 1998

DEPARTMENT OF ENERGY

Problems and Progress in Managing Plutonium

GAO/RCED-98-68

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-279070

April 17, 1998

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

Dear Mr. Chairman:

In response to your request, this report examines the status of the Department of Energy's efforts to stabilize, package, and store its plutonium, specifically (1) plutonium that is not in the form of nuclear weapons components, or "pits," and (2) plutonium in pits.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will provide copies of the report to the Secretary of Energy; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others upon request.

Please call me on (202) 512-8021 if you or your staff have any questions. Major contributors to this report are listed in appendix II.

Sincerely yours,

Gary L. Jones
Associate Director, Energy,
Resources, and Science Issues

Executive Summary

Purpose

Workers at Department of Energy (DOE) facilities must be protected from plutonium because exposure to small quantities is dangerous to human health, and if not safely contained and managed, plutonium can be unstable and can even spontaneously ignite under certain conditions. When DOE ceased nuclear weapons production in the late 1980s, much of its plutonium was either not in a suitable form or not packaged for long-term storage. Furthermore, since the late 1980s, the United States has retired and dismantled many nuclear weapons, creating the need to store thousands of plutonium nuclear weapons components known as "pits." DOE currently holds approximately 10,000 of these pits at its Pantex Plant, near Amarillo, Texas, and the number continues to increase as additional nuclear weapons are retired and dismantled.

Concerned about the adequacy of DOE's program to safely store plutonium for the long term, the Chairman of the Subcommittee on Energy and Power, House Committee on Commerce, asked GAO to review DOE's management of its plutonium. Specifically, GAO was asked to review DOE's efforts to stabilize, package, and store its plutonium, including problems DOE has encountered or anticipates in accomplishing these activities, specifically for (1) plutonium that is not in the form of nuclear weapons components, or pits, and (2) plutonium in the form of pits.

Background

Plutonium is a man-made radioactive element produced by irradiating uranium in nuclear reactors. The plutonium DOE possesses is in several physical forms, including metals, oxides (fine powders), residues and solutions (materials with a lower plutonium content), as well as the roughly 10,000 pits. The spherical central core of a nuclear weapon, a pit is compressed with high explosives to create a nuclear explosion.

During the weapons production era, DOE continuously recycled its plutonium to be made into pits for nuclear weapons. Since it had never had to store plutonium for any prolonged time, when the Department ceased its production of nuclear weapons, much of the plutonium was not packaged adequately for long-term storage. As a result, problems occurred at many of the sites throughout the Department, such as plutonium that was packaged in contact with plastic, which made the containers susceptible to leaks or ruptures—possibly exposing the workers to the plutonium.

In 1994, the Defense Nuclear Facilities Safety Board[1] and DOE[2] identified environmental, safety, and health problems at the Department's nuclear weapons facilities, including problems with how its plutonium was packaged and stored. The Board then recommended that DOE correct the identified problems within suggested time frames. DOE responded with an implementation plan containing milestones for corrective actions at specific DOE sites, including stabilizing and packaging plutonium metals and oxides for long-term storage by May 2002.

Stabilization includes activities such as brushing loose oxides from the plutonium metals and heating plutonium oxides to a high temperature to remove moisture and to reduce the potential for dispersal. Once stabilized, plutonium metals and oxides are to be packaged in approved, sealed double containers to isolate the plutonium from the outside environment and to prevent its release.

These activities are guided by standards that DOE developed for the long-term storage of plutonium metals and oxides and for the interim storage of "plutonium-bearing solids," including residues. Because pits are made of plutonium metal that is sealed inside a nonradioactive metal shell, they were considered more stable and safer and were specifically excluded from these standards.

In a January 1997 record of decision, DOE detailed its plan for the disposition of much of the plutonium it is stabilizing, packaging, and storing—that which is excess to national security requirements. DOE plans to convert this plutonium through two disposition technologies—(1) immobilizing it in glass or ceramic material and (2) burning it as fuel in nuclear reactors—to make it unattractive for use in nuclear weapons until it can ultimately be disposed of.[3] A small portion of DOE's pits will not be disposed of but instead will be retained as strategic reserves, for use in weapons in the future if necessary.

[1]The Defense Nuclear Facilities Safety Board is an independent agency created by the Congress in 1988 to oversee DOE's defense nuclear facilities and to ensure that public health and safety are protected.

[2]Plutonium Working Group Report on Environmental, Safety and Health Vulnerabilities Associated With the Department's Plutonium Storage (DOE/EH-0415, Nov. 1994).

[3]Some low-risk residues with low plutonium content do not have to be converted through either technology as they can be disposed of in the Waste Isolation Pilot Plant when it becomes available.

Results in Brief

Although DOE has made some progress in stabilizing its plutonium, the Department is unlikely to meet its May 2002 target date to have its plutonium that is not in pits stabilized, packaged, and stored. The DOE sites with the majority of this plutonium have experienced many delays and anticipate more in meeting their implementation plan milestones.[4] Various problems contribute to these delays, including (1) changes from the technologies originally chosen to stabilize plutonium residues at Rocky Flats to meet a security requirement; (2) a suspension of plutonium stabilization operations because of safety infractions at Hanford; (3) competing priorities for funding, staff, and equipment at Los Alamos; and (4) delays in obtaining a system for stabilizing and packaging plutonium at three sites. Given the inherent dangers of plutonium, such delays result in continuing the existing level of risk to workers' health and safety by delaying the risk reduction that is achieved by stabilization and packaging activities.[5] Delays can also result in increased costs. For example, continuing operations for an additional year at one site could increase costs by $20 million for the continued plutonium stabilization and packaging activities at a facility there. Moreover, because DOE has not yet finalized the criteria the plutonium must meet to be acceptable for the disposition technologies, it is unclear if current activities to stabilize, package, and store the plutonium will be compatible with the means of converting it for disposal.

In addition to its delays in stabilizing and packaging its plutonium that is not in pits, DOE is currently storing approximately 10,000 pits in containers that both the Department and the Defense Nuclear Facilities Safety Board believe are not suitable for extended storage, thus risking workers' exposure to plutonium. DOE's ineffective oversight and coordination of the 5-year, $50 million project to design and develop a replacement container led to design flaws that later had to be corrected and a container that was very expensive to produce. DOE now plans to use this container to repackage only about 5 percent of its pits—those considered to be the highest risk. DOE is preparing a plan, which it intends to issue in April 1998, to develop new containers and repackage the remaining 95 percent of the pits. While developing such a plan is a step in the right direction, certain key elements—including the identification of program responsibility and accountability, pit repackaging and storage schedules, and a means to

[4]Five of the sites included in GAO's review—the Hanford Site, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the Rocky Flats Environmental Technology Site, and the Savannah River Site—have inventories of plutonium that is not in pits. A sixth site in our review, the Pantex Plant, stores only plutonium pits.

[5]According to DOE officials, "It must be acknowledged that even after stabilization and packaging, some small level of risk remains associated with handling and storage of plutonium materials."

track progress against those schedules—are not currently addressed. Furthermore, because it will take years to complete the repackaging, DOE laboratories and the Defense Nuclear Facilities Safety Board have proposed that the Department conduct more aggressive pit monitoring to address their safety concerns about the 10,000 pits in prolonged storage in the unsuitable containers. However, without conducting an analysis of the costs or benefits of the laboratories' recommendation for increased monitoring, the Department decided not to change its existing monitoring program, which formally examines about 30 pits per year. DOE hopes that it can repackage the pits before enhanced monitoring is necessary.

Principal Findings

DOE Is Unlikely to Meet Its Commitment Date for Stabilizing, Packaging, and Storing Plutonium That Is Not in Pits

Although the DOE sites are making progress in stabilizing their plutonium and reducing the risk to workers' health and safety, the Department is unlikely to meet the commitment made in its implementation plan to stabilize and package its plutonium metals and oxides for long-term storage (50 years) by May 2002. In the meantime, according to agency officials, the sites are meeting DOE's criteria for interim storage (5 to 20 years). However, the criteria for interim storage do not provide the level of safety afforded by DOE's standard for the long-term storage of plutonium. According to DOE site officials and a Defense Nuclear Facilities Safety Board staff member, until the plutonium metals and oxides meet the standard for long-term storage, there is a continuing risk to workers' health and safety.

The five sites holding the majority of DOE's plutonium that is not in pits have stabilized a portion of their plutonium, including some of the higher-risk plutonium. For example, Rocky Flats and Savannah River have repackaged their plutonium that was in contact with plastic, thus reducing the risk to workers' health and safety. However, the sites have experienced numerous delays in meeting milestones. They also anticipate additional delays in the future—the work for over half of the future milestones is either already delayed or at risk of delay—and in some cases, the delay is anticipated to be for a year or more beyond the original date.

DOE site officials estimate that Hanford will miss the May 2002 date by 7 months, and Los Alamos may miss it by up to 3 years. These delays in meeting DOE's final commitment date have not been formally approved by

DOE headquarters. Officials at the other three sites plan to complete their activities by May 2002 despite the delays that have occurred so far. However, the officials at Rocky Flats may be overly optimistic because the work for half of its remaining milestones is at risk of delay. Furthermore, the site has many of the more unstable forms of plutonium, including residues and solutions, but limited capability to process them.

According to DOE site officials, the delays in meeting the implementation plan milestones are attributable to several factors. Changes from the originally chosen technologies to stabilize plutonium residues to meet a security requirement and a suspension of plutonium stabilization operations due to safety infractions have caused some of the more significant delays at Rocky Flats and Hanford, respectively. Los Alamos officials cited competing priorities for funding, staff, and equipment as the major cause of their anticipated delay of up to 3 years for completing activities. Furthermore, three sites are experiencing delays in obtaining a plutonium stabilization and packaging system.

These delays not only continue the existing level of risk to workers but also result in increased costs to DOE and taxpayers. For example, Rocky Flats' unexpected need to use a new technology to stabilize plutonium residues in salts is expected to cost an additional $14.5 million, and Hanford's suspension of plutonium stabilization activities and other delays will lead to an accelerated work schedule of three shifts per day, 7 days per week, to make up for lost time. According to a site official, if Hanford is required to operate its plutonium stabilization and packaging facility for an additional year, the cost will be an extra $20 million. In addition to the costs for the continued operation of facilities, there are other added costs for the continuation of other expensive activities, such as providing safeguards and security, as long as plutonium remains in the facilities.

In addition to problems in stabilizing, packaging, and storing plutonium, it is unclear if DOE's long-term storage standard and disposition criteria will be compatible. DOE is many years away from implementing its January 1997 decision to dispose of much of its plutonium, and the Department has not yet determined how the plutonium must be processed and packaged to be ready for the disposition technologies, which will be used to convert it to forms less useful for nuclear weapons. In the absence of final disposition criteria, the sites are proceeding to stabilize and package their plutonium to meet the existing standards—especially DOE's standard for long-term storage. However, several site officials expressed concern that plutonium that is stabilized and packaged to meet the

long-term storage standard may not be compatible with DOE's final disposition criteria, due out in June 1998, possibly necessitating additional activities or processing steps and costs to ready the plutonium for disposition. At present, the draft disposition criteria, produced in July 1997, diverge from the current standard for long-term storage in some significant ways. For example, the draft disposition criteria would require information about the plutonium—such as its processing history, likely impurities, and physical condition—that is not currently required by the storage standard. If this information is unavailable, the draft criteria would require sampling of the plutonium that could be expensive and time-consuming. The DOE headquarters organizations responsible for the storage standards and the disposition criteria have begun to work together to address the differences between the long-term storage standard and draft disposition criteria. However, it is too early to determine whether DOE's final disposition criteria will be compatible with the existing long-term storage standard to avoid added processing costs for the plutonium during disposition.

DOE's Storage of Plutonium Pits Risks Exposure to Workers

Since the end of the Cold War, DOE has dismantled large numbers of retired nuclear weapons and ceased recycling the plutonium pits from these weapons and, for the first time, has had to store the pits for a prolonged period of time. Because long-term storage had never been required, DOE had no containers specifically designed for that purpose. Beginning in 1989, DOE has stored its pits in a container known as the AL-R8, which was designed to transport the pits. However, since that time, both DOE and the Defense Nuclear Facilities Safety Board have indicated that pits should not be stored in AL-R8 containers for extended periods. These containers are unsuitable for prolonged storage because their liner absorbs moisture and chloride, which could accelerate the pits' corrosion.[6] If corrosion causes a pit to crack, the AL-R8 may not contain the plutonium, thus posing a risk of workers' exposure. Despite this concern, about 10,000 pits at DOE's Pantex Plant are stored in AL-R8 containers, and the number continues to grow as additional weapons are retired and dismantled.

In an attempt to remedy this problem, in 1992 DOE began developing a new container for both transporting and storing pits, known as the AT400A container, which would replace the AL-R8. However, DOE did not adequately oversee the project to coordinate the work of the three DOE

[6]According to DOE and laboratory officials, some pits are more susceptible to corrosion than others, depending on the metal used to encase the pit.

laboratories that were involved in designing and developing different parts of the container, or involve Pantex—the ultimate user of the container—in the design and development process. The resulting design contained safety flaws, such as locating the container's weld directly over the pit, which, along with a defective safety system, could have allowed the welder to burn through the container into the pit. DOE recognized that its failure to adequately coordinate the work among the laboratories and Pantex contributed to these problems. After 5 years and nearly $50 million spent, DOE ultimately determined that the replacement container was too expensive to use extensively. At about $8,000 per container, the costs for the containers alone for the 10,000 pits being stored at the Pantex Plant would have totaled approximately $80 million. As a result, DOE has largely abandoned its plan to repackage its pits into the AT400A and now intends to use this container to repackage only about 5 percent of its pits—those considered to be the highest risk. However, this decision left the Department with no formal plan or schedules to repackage about 95 percent of its plutonium pits.

According to DOE officials, a "retrofit" to the AL-R8 container is the most likely option for repackaging the remaining 95 percent of the pits. Development efforts for a retrofit of the AL-R8 container began in August 1997, and DOE is considering alternative designs developed by two of the Department's laboratories and Pantex. DOE's preliminary estimates of the costs to repackage 12,000 pits range from $35.5 million to $59.4 million. Once DOE has settled on a design and procured the containers, officials estimate that actually removing the pits and repackaging them into the modified containers could take from 4 to 7 years. Furthermore, DOE has yet to decide how to store those pits deemed strategic reserves, which must be retained for a longer time than the pits destined for disposal, and whether to store them in different containers from those for the pits destined for disposal.

DOE officials stated that the Department is developing a pit repackaging and storage plan that it hopes to issue by April 1998. As of February 1998, many sections of a preliminary draft of the plan were only in brief outline form, so GAO was unable to determine if the plan will adequately address the identified problems in storing pits. For example, the draft did not contain schedules or cost estimates for selecting a design, procuring the replacement containers, or repackaging the pits, nor a means to track progress against those schedules. Furthermore, although the draft described the various organizations within DOE and its contractors involved with repackaging and storing pits, the document did not define

how these organizations will interact and did not assign program responsibility and accountability for overseeing all facets of the program to ensure its success.

Because of the continuing threat of corrosion and the length of time pits may be stored in AL-R8 containers, DOE laboratories and the Defense Nuclear Facilities Safety Board have expressed concern about the frequency of pit monitoring at Pantex—currently approximately 30 of the 10,000 pits are formally monitored per year.[7] Although the laboratories have recommended a more aggressive program for monitoring pits (covering about 2,000 pits per year), according to DOE officials the Department has decided not to implement this recommendation. DOE officials told us they had not conducted an analysis of the costs or benefits of this enhanced monitoring program, but they believed that the cost to implement it would be "significant and perhaps prohibitive." These officials explained that they hope to have the pits repackaged before enhanced monitoring is necessary. However, some of the pits have already been in the unsuitable containers for over 8 years, and it will be several more years before the pits can be repackaged.

Recommendations

GAO recommends that the Secretary of Energy ensure the timely and cost-effective resolution of the wide range of issues surrounding pit storage, including ensuring that the plan being developed by the Department addresses such key items as a clear definition of responsibility and accountability for program activities; realistic cost estimates and a program budget; and detailed schedules for designing and developing replacement containers and repackaging the pits, as well as a means to track progress against these schedules. In addition, given the length of time pits will be stored in unsuitable containers, GAO recommends that the Secretary, in cooperation with the DOE laboratories and the Defense Nuclear Facilities Safety Board, conduct a thorough safety analysis of the recommended enhanced pit monitoring program as well as other possible monitoring options to identify the most appropriate and cost-effective approach to ensure the specified safety concerns about the prolonged storage of pits in the unsuitable containers are resolved.

[7]According to DOE, in recent years, some additional pits that have been stored in AL-R8 containers have been visually inspected, which has not detected corrosion-related damage to date. However, these inspections are much less extensive than the testing and analyses performed as part of the formal monitoring program.

Agency Comments

GAO provided a draft of this report to DOE for its review and comment. The Department concurred with all but one part of one recommendation. The Department concurred with GAO's recommendation for the timely and cost-effective resolution of the issues surrounding pit storage and agreed to include the recommended key items in its Integrated Pit Storage Program Plan, due out in April 1998. In addition, DOE concurred with the portion of GAO's recommendation calling for the Secretary to work closely with the DOE laboratories and the Defense Nuclear Facilities Safety Board to address their concerns about the prolonged storage of pits in unsuitable containers. The Department stated that it has worked with the laboratories and the Board in the past to address concerns about pit storage activities and will continue to do so. In contrast, DOE raised concerns about GAO's recommendation that the Department conduct a safety analysis of the enhanced pit monitoring program and other possible monitoring options and requested that GAO clarify the basis for this recommendation. DOE stated that it has "approved safety analyses for operations at the Pantex Plant, which provide coverage for pit storage activities." However, GAO's review of DOE's safety analyses revealed that they were conducted before the laboratories and the Defense Nuclear Facilities Safety Board identified safety problems of pits in prolonged storage in AL-R8 containers and the resultant need for increased monitoring. Therefore, these problems were not addressed in these safety analyses. In light of the prolonged storage of pits in the AL-R8 containers and the fact that safety concerns about these pits were not addressed in DOE's safety analyses, GAO continues to recommend that the Secretary conduct a thorough safety analysis of DOE's pit monitoring options, including the enhanced monitoring program recommended by the laboratories, to ensure that the specific concerns raised are resolved.

In addition, DOE raised a general concern that GAO's report "does not present complete and accurate information about many important DOE initiatives to meet the challenges for managing plutonium. . . ." GAO disagrees. The report describes initiatives that the Department raised in its comments—the disposition program for excess plutonium and that program's implications for plutonium storage; the revisions to Los Alamos National Laboratory's plutonium stabilization program; and the development of a plan for repackaging the pits out of the AL-R8 containers, expected to be issued in April 1998. On the basis of DOE's comments, GAO updated information on these initiatives and added information on additional pit surveillance activities to the report's discussion of pit monitoring issues. Furthermore, the Department's comments on this report discussed an initiative to revise its

implementation plan for plutonium stabilization to integrate nuclear materials management activities complexwide. This initiative was not included in this report because Department officials did not mention it in GAO's meetings with them in February; the Department's comments on this report were the first indication that such an initiative was formally under way.

The Department also provided a number of more detailed or technical comments, and the report has been revised, where appropriate, to reflect these specific comments. The Department's comments and GAO's responses are presented in appendix I.

Contents

Figures

Abbreviations

DOE	Department of Energy
GAO	General Accounting Office

Introduction

The safe storage of plutonium has become increasingly important for the Department of Energy (DOE) since it ceased producing nuclear weapons in 1989. Although DOE no longer manufactures plutonium for use in nuclear weapons, the plutonium it produced in the past by irradiating uranium in nuclear reactors poses hazards to workers' health and safety. The majority of DOE's plutonium inventory (excluding reactor fuel, spent nuclear fuel, and special isotopes) is stored at five sites that formerly developed or produced nuclear weapons components or materials and a sixth facility where those weapons are now dismantled.

Prior to 1989, DOE usually stored plutonium only temporarily because the Department continually recycled it for use in nuclear weapons. In 1994, both DOE and the Defense Nuclear Facilities Safety Board identified problems with how the Department stored its plutonium. In an effort to remediate these problems, DOE developed and began implementing a plan to stabilize and package its plutonium that was not in nuclear weapons components. Plutonium in nuclear weapons components was excluded because it was considered to be relatively safe and stable compared to other forms of plutonium. Although it recently decided to dispose of the United States' excess plutonium inventory, DOE is many years away from implementing this decision and must safely store these materials in the interim.

Inadequately Packaged Plutonium Poses Hazards

Plutonium, a radioactive element, exists in several forms, including metals, oxides, residues, and solutions. Plutonium metals are stable if packaged correctly. The remainder of DOE's plutonium—oxides, residues, and solutions—is in forms that are less stable.[1] Plutonium oxides are fine powders produced when plutonium metals react with oxygen—during processing of plutonium for weapons or other uses, or during storage. Plutonium residues are the by-products of plutonium processing and generally contain plutonium in concentrations of less than 10 percent. These residues include plutonium mixed with other materials, such as impure plutonium metals and oxides, ash, contaminated glass and metals, and other items. Plutonium solutions are acidic and corrosive, making their containers vulnerable to leakage. Most of DOE's plutonium is stored as metals because during the production era, plutonium in other forms was recycled and purified into metals to be used in pits for nuclear warheads. A plutonium pit is a nuclear weapons component, made up of a plutonium metal sphere encased in a nonradioactive metal shell, which

[1]Plutonium may be considered unstable if it is (1) in a form that could spontaneously ignite or oxidize, (2) mixed with hazardous or corrosive materials, or (3) inadequately packaged.

can be compressed by detonating high explosives inside a weapon to create a nuclear explosion.

If not safely contained and managed, plutonium can be dangerous to human health, even in small (microgram) quantities. Inhaling a large dose of plutonium particles can cause lung injuries and death, while exposure to a small dose creates a long-term risk of lung, liver, and bone cancer. When the container or packaging (and the metal shell for pits) fails to fully contain the plutonium, the potential for exposure exists. Leakage from corroded containers or inadvertent accumulations of plutonium dust in piping or duct work pose health and safety hazards, especially in aging, poorly maintained, or obsolete facilities. When DOE stopped producing nuclear weapons in 1989, much of its plutonium was either not in a suitable form, such as plutonium in solutions, or was not packaged for long-term storage.

The Majority of DOE's Plutonium Is Located at Six Sites

DOE's plutonium inventory is stored primarily at six sites. Five of these sites formerly developed or produced nuclear materials or weapons: the Hanford Site, in Washington; Lawrence Livermore National Laboratory, in California; Los Alamos National Laboratory, in New Mexico; the Rocky Flats Environmental Technology Site, in Colorado; and the Savannah River Site, in South Carolina. The remaining site, the Pantex Plant, in Texas, is predominantly a nuclear weapons dismantlement site, where the majority of DOE's plutonium pits are stored. Pantex does not store plutonium that is not in pits. (See fig. 1.1.)

Figure 1.1: Sites Storing the Majority of DOE's Plutonium

Note: The figure considers plutonium in the form of metals, oxides, residues, solutions, and pits.

Source: Produced by GAO using data provided by DOE.

The former weapons production sites have different amounts and forms of plutonium not in pits. For example, the Rocky Flats Environmental Technology Site, with about 12.7 metric tons of this plutonium, has the largest inventory of plutonium and many of the more unstable forms, including residues, while the other four sites have different amounts and forms of plutonium, as shown in table 1.1.

Table 1.1: Plutonium Inventory, by Form, at Five DOE Sites With Plutonium Stabilization Activities

Metric tons

Site	Total plutonium inventory[a]	Plutonium metals	Plutonium oxides	Plutonium residues	Plutonium solutions
Rocky Flats Environmental Technology Site	12.7	6.5	1.6	4.5	0.1
Hanford Site	3.5	0.8	2.0	0.4	0.3
Savannah River Site	1.8	0.7	0.7	0.1	0.3
Los Alamos National Laboratory	2.5	1.2	0.0	1.3	0.0
Lawrence Livermore National Laboratory	0.3	0.1	0.1	0.1	0.0
Total	**20.8**	**9.3**	**4.4**	**6.4**	**0.7**

[a]Inventory amounts are as of 1994; any updated amounts would be classified information. Amounts exclude spent nuclear fuel, reactor fuel, and special isotopes of plutonium.

Source: DOE headquarters.

Even though the United States no longer manufactures new nuclear weapons, some of DOE's plutonium is still needed to support the U.S. nuclear weapons stockpile. The plutonium pits in DOE's custody that are needed for national security purposes are stored primarily at the Pantex Plant. As part of the U.S. nuclear strategic reserves, these pits will be retained for an indeterminate amount of time, in case the plutonium is ever needed for use in nuclear weapons.

DOE Has Developed a Plan to Address Problems With Plutonium That Is Not in Pits

In 1994, both DOE and the Defense Nuclear Facilities Safety Board[2] noted safety problems with DOE's storage of plutonium not in pits. DOE subsequently developed an implementation plan to address these safety problems by having much of this plutonium stabilized and packaged for safe long-term storage by May 2002.

DOE and the Defense Nuclear Facilities Safety Board Identified Problems With Plutonium Storage

In March 1994, the Secretary of Energy requested that DOE's Office of Environment, Safety and Health conduct a comprehensive assessment to identify the risks of storing plutonium in DOE facilities and to determine which were the most dangerous and urgent. The assessment, which

[2]The Defense Nuclear Facilities Safety Board is an independent agency created by the Congress in 1988 to oversee DOE's defense nuclear facilities and to ensure that public health and safety are protected.

considered both plutonium not in pits and plutonium in pits, identified such vulnerabilities as the degradation of plutonium materials and packaging and weaknesses in facilities and administrative controls.[3] These vulnerabilities are important because they could cause inadvertent releases of plutonium, which could expose workers.

In April 1994, the Defense Nuclear Facilities Safety Board issued a report describing problems with plutonium storage safety at four of the Department's sites with large inventories of plutonium. Subsequently, in May 1994, the Board recommended that the Department take action to safely store its plutonium. In this recommendation, the Board expressed concern that the cessation of nuclear weapons production had left plutonium in an unsafe state that should be remediated. For example, when packaging the plutonium not in pits, some sites used plastic inner liners, which could react with the plutonium to form a buildup of hydrogen gas that could bulge and even rupture the outer containers or cause the plutonium to spontaneously ignite. The Board also identified specific materials, in the form of plutonium residues, that it believed to be higher-risk because of their unstable nature, uncertainty about what the plutonium was mixed with, or the inappropriate packaging of the materials. According to a Board staff member, the Board excluded plutonium in pits from its recommendation because it believed that in the near term, storage problems were not as severe for pits as for the other forms of plutonium.

DOE's Implementation Plan Sets Forth Milestones to Stabilize and Package Plutonium That Is Not in Pits

As required by statute, the Secretary of Energy prepared an implementation plan responding to the Defense Nuclear Facilities Safety Board's 1994 recommendation.[4] In that plan, DOE established milestones for stabilizing and packaging its plutonium not in pits, including metals, oxides, residues, and solutions.

Stabilizing plutonium not in pits includes such activities as brushing loose oxides from the plutonium metals and heating plutonium oxides to a high temperature to (1) remove any moisture that could cause the buildup of gases that could burst the containers and (2) make the oxides into larger particles to reduce the potential for dispersal. Plutonium residues are typically stabilized by either converting them into plutonium oxides

[3]Plutonium Working Group Report on Environmental, Safety and Health Vulnerabilities Associated With the Department's Plutonium Storage (DOE/EH-0415, Nov. 1994).

[4]The 1988 statute establishing the Defense Nuclear Facilities Safety Board requires that DOE respond to any recommendation by the Board that is accepted by the Secretary of Energy with a plan for implementing the recommendation; 42 U.S.C., section 2286.

through various processes or by blending them with other materials for disposal at the Waste Isolation Pilot Plant when this facility becomes available.[5] Plutonium solutions are not appropriate for storage and have to be processed into a solid form before the plutonium can be stored. DOE requires that stabilized plutonium metals that are not in pits and oxides be packaged in approved, sealed double containers to isolate the plutonium from the outside environment and to prevent its release.[6] In April 1997, we reported that DOE estimated that its plutonium management activities, including stabilization and storage, at eight sites across the complex would cost approximately $7.9 billion, in constant 1996 dollars, from fiscal year 1995 through fiscal year 2002.[7,8] However, DOE does not specifically break out its costs for stabilizing, packaging, and storing its plutonium from that total.

DOE's Disposition of Its Excess Plutonium Is Still Years Away

In January 1997, DOE formally decided how it would dispose of its plutonium that is excess to national security requirements. The Department plans to convert excess plutonium into forms that are difficult to reuse in nuclear weapons and are suitable for permanent disposal and to store the plutonium until the conversion can be completed.[9] To convert its excess plutonium to other forms, DOE intends to pursue a hybrid strategy: (1) burning the plutonium as fuel in power reactors and (2) immobilizing it in glass or ceramic material. As described in our April 1997 report, DOE's estimated cost to implement its hybrid strategy would be approximately $2 billion, in constant 1996 dollars. This strategy, however, is subject to technical, institutional, and cost uncertainties. For example, DOE has not yet determined where the disposition facilities will be located or which technology will be used for immobilization. DOE is currently assessing the possible environmental impacts of several likely sites where plutonium disposition activities may take place and plans to have a final decision in late 1998 or early 1999.

[5]For information concerning when the Waste Isolation Pilot Plant will be available, see Nuclear Waste: Uncertainties About Opening Waste Isolation Pilot Plant (GAO/RCED-96-146, July 16, 1996).

[6]Because plutonium pits are made of relatively stable plutonium metals sealed inside nonradioactive metal casings that provide some level of protection from the environment, pits do not require stabilization activities.

[7] These eight sites are the six included in our review plus two others—Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West—excluded from this review because the bulk of their plutonium is in the form of spent nuclear fuel or reactor fuel.

[8] Department of Energy: Plutonium Needs, Costs, and Management Programs (GAO/RCED-97-98, Apr. 17, 1997).

[9]Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials, Final Programmatic Environmental Impact Statement, DOE (Jan. 14, 1997); 62 Fed. Reg. 3014 (1997).

While DOE's January 1997 record of decision on disposition strategies focuses on converting the nation's excess plutonium to safer forms for disposal, DOE must safely store its excess plutonium until disposition facilities are built and available for converting the plutonium. In April 1997, we reported that DOE anticipates completing its conversion activities by 2023.

Objectives, Scope, and Methodology

The Chairman of the Subcommittee on Energy and Power, House Committee on Commerce, asked us to review DOE's efforts to stabilize, package, and store its plutonium, including problems the Department has encountered or anticipates in accomplishing these activities, specifically for (1) plutonium that is not in the form of nuclear weapons components, or pits, and (2) plutonium in the form of pits.

To review DOE's management of its plutonium that is not in pits (excluding reactor fuel, spent nuclear fuel, and special isotopes), we obtained and analyzed DOE's 1994 plutonium vulnerability assessment, its plutonium storage standards, and its implementation plan for stabilizing and packaging the plutonium. We identified progress in meeting milestones in the plan by interviewing officials and gathering and analyzing data from the Defense Nuclear Facilities Safety Board, DOE headquarters, and the DOE sites that maintain the majority of DOE's plutonium not in pits. These sites are the Hanford Site, near Richland, Washington; Lawrence Livermore National Laboratory, in Livermore, California; Los Alamos National Laboratory, in Los Alamos, New Mexico; the Rocky Flats Environmental Technology Site, near Denver, Colorado; and the Savannah River Site, near Aiken, South Carolina.

To review DOE's management of its plutonium pits, we reviewed and analyzed DOE's 1994 plutonium vulnerability assessment and reviewed and analyzed the subsequent Pantex Corrective Action Plan. We also interviewed officials and gathered and analyzed data from the Defense Nuclear Facilities Safety Board, DOE headquarters, DOE's Albuquerque Operations Office, Los Alamos National Laboratory, and the Pantex Plant, near Amarillo, Texas.

The Department of Energy provided written comments on a draft of this report. These comments are presented and evaluated at the end of chapters 2 and 3. The full text of the Department's comments is provided in appendix I. We conducted our review from May 1997 through

February 1998 in accordance with generally accepted government auditing standards.

DOE Is Unlikely to Meet Its Commitment Date for Stabilizing, Packaging, and Storing Its Plutonium That Is Not in Pits

DOE's activities to stabilize, package, and store its plutonium not in pits are primarily guided by two DOE standards governing plutonium storage and the Department's implementation plan, which commits the Department to stabilize and package its plutonium metals and oxides for long-term storage by May 2002. While the five DOE sites with the majority of the plutonium not in pits have made progress in stabilizing their plutonium, all have had delays in meeting implementation plan milestones, including some critical ones for higher-risk plutonium, and the sites anticipate more delays. Various problems contribute to these delays in meeting milestones, including (1) changes from the technologies originally chosen by Rocky Flats to stabilize plutonium to meet a security requirement; (2) a suspension of plutonium stabilization operations due to safety problems at Hanford; (3) competing priorities for funding, staff, and equipment at Los Alamos; and (4) delays in obtaining a system for stabilizing and packaging plutonium at three sites. Missing these milestones will result in some sites' not having all of their plutonium metals and oxides stabilized and packaged by May 2002. Given the inherent dangers of plutonium, such delays result in a continuing risk to workers' health and safety and increased costs. Although DOE is planning to dispose of its excess plutonium, it has yet to develop final disposition criteria. As a result, it is unknown whether current activities to stabilize and package plutonium for long-term storage will be compatible with the activities required for the disposition of this plutonium.

DOE's Stabilization, Packaging, and Storage Activities Are Driven by Its Standards and Implementation Plan

DOE's activities to stabilize, package, and store its plutonium not in pits are based primarily on three DOE documents: (1) Criteria for Preparing and Packaging Plutonium Metals and Oxides for Long-Term Storage, dated September 1996 (DOE Standard 3013); (2) Defense Nuclear Facilities Safety Board Recommendation 94-1 Implementation Plan, dated February 1995; and (3) Criteria for Interim Safe Storage of Plutonium-Bearing Solid Materials, dated November 1995.[1] DOE Standard 3013 establishes safety criteria for packaging plutonium metals and stabilized plutonium oxides for long-term storage. This standard prescribes the form the plutonium must be in and processes for stabilization. For example, Standard 3013 requires that plutonium oxides be stabilized by heating them in air to a very high temperature—approximately 950 degrees celsius or higher—for at least 2 hours. The standard also contains requirements for plutonium packaging and for inspection, surveillance, documentation, and quality assurance and control. According to DOE Standard 3013, plutonium that is

[1]Plutonium in pits was specifically excluded from these standards because pits are "sealed" and considered to be safer.

stabilized and packaged to meet this requirement should be safe for storage for at least 50 years.

DOE's implementation plan established milestones to address the Defense Nuclear Facilities Safety Board's 1994 recommendation to the Secretary of Energy for the safe storage of the Department's nuclear materials, including plutonium not in pits. In its implementation plan, DOE agreed to have all of its plutonium metals and oxides stabilized and packaged to meet DOE Standard 3013 by May 2002.[2]

Until their plutonium metals and oxides meet Standard 3013, officials at the five sites that we visited stated that they are meeting DOE's criteria for interim storage. Issued in November 1995, the interim storage criteria—for storage from 5 to 20 years—define an acceptable interim state for plutonium residues until they are converted to oxides and meet Standard 3013 or are shipped to the Waste Isolation Pilot Plant. To provide flexibility to address the broad range of materials and differences among facilities, the interim storage criteria are very general in nature and allow for a variety of approaches. However, the criteria are less stringent than Standard 3013 and do not provide the level of storage safety afforded by the standard. According to DOE site officials and a Defense Nuclear Facilities Safety Board staff member, until the plutonium metals and oxides meet Standard 3013, there is a continuing risk to workers' health and safety.

DOE Is Facing Delays in Stabilizing and Packaging Its Plutonium Not in Pits for Long-Term Storage

The five sites we reviewed have made progress in stabilizing their plutonium. According to DOE officials, plutonium stabilization activities have focused on getting the plutonium into safer forms or packaging to reduce the risk to workers' health and safety. For example, Rocky Flats has drained plutonium solutions from 15 tanks and processed many of these solutions into solid forms, thus reducing the risk. In addition, Rocky Flats and Savannah River have repackaged all of their plutonium that was in direct contact with plastic—a condition that is dangerous because the plastic can react with the plutonium to form a buildup of gas that can cause the containers to rupture and possibly ignite spontaneously if exposed to air.

[2]Although the implementation plan also applied to plutonium residues and solutions, they are handled differently from metals and oxides. Residues need to be either converted to oxides and then stabilized and packaged for long-term storage by May 2002 or disposed of at the Waste Isolation Pilot Plant in New Mexico when this facility becomes available. Plutonium-bearing solutions are not appropriate for storage and have to be processed to a solid form, usually an oxide, which is then subject to Standard 3013.

But due to the numerous past and anticipated future delays at the various sites, it seems unlikely that DOE will meet its May 2002 date for stabilizing, packaging, and storing its plutonium that is not in pits. DOE established 98 milestones for its plutonium stabilization and packaging activities at the five sites we visited, ranging from 9 milestones at Lawrence Livermore to 37 at Rocky Flats. Half of these (49 of 98) mark activities that have been completed at the five sites. These milestones focused on two primary areas: (1) preliminary activities required for subsequent stabilization activities, such as preparing environmental impact statements, and (2) stabilizing higher-risk plutonium, such as plutonium in contact with plastic. Of the remaining 49 milestones, 59 percent have already been delayed or are at risk of delay. These remaining milestones include activities for completing the stabilization and packaging to ready plutonium metals and oxides for long-term storage. All five sites have identified milestones that are at risk of delay, and over 40 percent of these delays are expected to be for 1 year or more from the original due dates in the implementation plan.

Notwithstanding the risk of potential delays, DOE officials at three of the sites believe they will meet the May 2002 commitment date, but officials at two of the sites told us they will not. Officials at Rocky Flats, Savannah River, and Lawrence Livermore stated that they plan to have their plutonium metals and oxides stabilized and packaged for long-term storage by May 2002. On the other hand, officials at Hanford and Los Alamos told us that they currently anticipate missing the May 2002 date, although these delays to the Department's commitment date have not been approved by DOE headquarters. Hanford officials estimate that their completion date will slip by 7 months because of the suspension of the site's plutonium stabilization activities at one facility there. According to Los Alamos officials, their site is planning to delay completing its activities for up to 3 years beyond May 2002. Table 2.1 shows, for the five DOE sites, the status of the implementation plan milestones for stabilizing and packaging plutonium not in pits.

Table 2.1: Status of Implementation Plan Milestones for Plutonium Stabilization and Packaging at DOE Sites

Site	Original milestones	Milestones whose activities have been completed		Remaining milestones		Projected completion (Date)
		Met on time	Delayed	Expected on time	At risk of delay	
Rocky Flats Environmental Technology Site	37	14	5	9	9	On time (May 2002)
Hanford Site	22	7	1	7	7	Delayed by 7 months (Dec 2002)
Savannah River Site	17	6	3	2	6	On time (May 2002)
Los Alamos National Laboratory	13	10	1	0	2	Delayed up to 3 years (May 2005)
Lawrence Livermore National Laboratory	9	1	1	2	5	On time (May 2002)
Total	**98**	**38**	**11**	**20**	**29**	

Source: Based on data provided by DOE.

As shown in table 2.1, all five sites have identified milestones that are at risk of delay, but these milestones and the sites' plans for them vary. For example, although Los Alamos has identified only two milestones at risk of delay, one of these milestones is the ultimate completion of its stabilization and packaging activities. Los Alamos is anticipating up to a 3-year delay beyond May 2002 because of its competing priorities for funding, staff, and equipment. On the other hand, while Lawrence Livermore has seven remaining milestones—five of which are at risk of delay—officials from this site told us that because they have a very small inventory of plutonium to stabilize and repackage, they anticipate meeting the May 2002 date.

Although Rocky Flats officials told us that they plan to meet May 2002, we believe the site may have difficulty meeting this commitment because of the many delays it has already experienced and the additional milestones it anticipates missing in the future. Site officials explained that there may be alternatives to stabilizing plutonium on-site—including shipping some to other sites for stabilization. They also believe that they can achieve higher efficiencies than they originally expected from their new plutonium stabilization and packaging system in readying the metals and oxides for storage. However, many obstacles would have to be overcome to allow the shipment of unstabilized plutonium to other sites, including determining

the receiving sites' future storage capabilities and obtaining approval for shipments. Also, the site's new stabilization and packaging system has not yet been installed or fully tested, and any possible efficiencies in the new system have not been proven. Furthermore, Rocky Flats possesses the most plutonium among the five sites and many of the more unstable residues and solutions, but only limited capability to process these materials.

The Causes and Impacts of Delays Vary

Delays that have occurred or are anticipated in meeting implementation plan milestones are attributable to several factors. For example, unanticipated changes from the technologies originally chosen to stabilize some of the plutonium residues have impeded progress at Rocky Flats, as has the suspension of plutonium stabilization activities at Hanford. In another case, as described, Los Alamos officials cited competing priorities for funding, staff, and equipment as an impediment. Furthermore, three sites are experiencing delays in obtaining a system for stabilizing and packaging their plutonium. These delays result in a continued risk to workers' health and safety and increased costs to DOE and taxpayers.

Changes From the Technologies Originally Chosen Have Caused Some Delays at Rocky Flats

According to DOE officials, unanticipated changes from the technologies originally chosen to stabilize two types of Rocky Flats' plutonium residues have contributed to delays in meeting two of its milestones. Originally, Rocky Flats officials thought that all of the site's residues would be exempted from meeting a DOE security requirement specifying the level of plutonium content acceptable so that the materials will not have to be guarded at the Waste Isolation Pilot Plant. In July 1996, DOE headquarters officials informed Rocky Flats that it had to either comply with this requirement or qualify for a variance. Shortly thereafter, Rocky Flats requested but was subsequently denied a variance for some of its plutonium residues. In particular, Rocky Flats had originally planned to have one type of plutonium residue (graphite fines) stabilized by May 1997. However, since the process it had originally chosen would not meet the security requirement, Rocky Flats selected a different process for stabilizing graphite fines—switching from heating them at a high temperature (calcination) to immobilizing them in molten glass (vitrification). To accommodate this change, the site plans to spend an additional $300,000 and will not have its graphite fines stabilized until September 1998—a delay of 16 months from the original milestone.

In addition, Rocky Flats had originally planned to have the majority of its plutonium salt residues stabilized by May 1997 using an available technology. According to a DOE official, as with the situation with graphite fines, Rocky Flats thought these salts would be exempted from the security requirement specifying the allowable plutonium content. However, for some of these salt residues, the site did not receive a variance, and since the process it had originally chosen would not comply with this requirement, a different technology—a distillation process to separate the salts from the plutonium—was chosen. To accommodate this change, the site plans to spend an additional $14.5 million and does not expect to complete the work for this milestone until January 1999—a 20-month delay from the original date in the implementation plan.

A Suspension of Operations Has Caused Delays at Hanford

Since December 1996, the Hanford Site's stabilization activities have been suspended owing to the shutdown of one of its facilities for safety infractions. The DOE contractor managing this facility failed to comply with operating regulations concerning the safe handling of nuclear materials—leading to the suspension of plutonium stabilization operations at this facility. In order to resume operations, the facility must pass a review by DOE. Hanford officials expect to resume stabilization activities at the plant in March 1998, at the earliest. In addition to the suspension of stabilization activities, because of budget cutbacks Hanford expects delays in installing its new plutonium stabilization and packaging system. To make up for these delays, Hanford officials told us that when this new system becomes operational, they plan to go from a 5-day-per-week, three-shift-per-day work schedule to a 7-day-per-week, three-shift-per-day schedule. This increase would last about 3 years—beginning late in 2000, when the site's plutonium stabilization and packaging system is planned to become fully operational, and continuing into December 2002, when Hanford officials plan to have all of the site's plutonium metals and oxides stabilized and packaged for long-term storage. Hanford officials were unable to estimate the likely costs of the approximately 2-year expanded work schedule, and given the site's budget constraints, they were unsure whether funds for this work schedule would be available. In commenting on a draft of this report, the Department stated that questions remain about how plutonium stabilization work will be prioritized by the site. The Department believes that if the risk is determined to be high enough, funds will be provided.

Competing Priorities Have Also Caused Delays at Los Alamos

According to Los Alamos officials, competing priorities for site funding, staff, and equipment have caused delays there. These officials stated that the site may not have its plutonium stabilized and packaged for long-term storage by May 2002 and plans to delay its completion date by up to 3 years—possibly until 2005. According to site officials, an assessment it conducted in mid-1997 shows a marginal increase in risk due to the delay. According to site officials, the site's stabilization program lost momentum because of budget reallocations in fiscal year 1997, and they expect additional funding reallocations for fiscal year 1998. In commenting on our draft report, the Department clarified that as DOE reduces the overall size of its weapons complex, missions and programs considered still vital to national defense are being relocated and consolidated at the Department's remaining operational sites. Los Alamos has become the new site for some of these relocated missions and programs. Plutonium stabilization activities must compete with these defense missions and programs for financial resources, personnel, and facilities at the site, and this competition will likely continue in the future as Los Alamos continues to expand its weapons-related mission.[3] However, DOE further commented, "Remediation efforts will continue at Los Alamos, and the Department is reviewing proposals to hire additional personnel and add additional equipment to continue this work in an effective and efficient manner."

Delays Exist in Obtaining a Plutonium Stabilization and Packaging System at Three Sites

Four of the five sites we visited—Rocky Flats, Hanford, Lawrence Livermore, and Savannah River—plan to procure and install a new plutonium stabilization and packaging system for their metals and oxides to meet DOE's long-term storage standard.[4] The sites will have variations of this system, with costs ranging from nearly $1.9 million for a manual packaging system at Lawrence Livermore to $28.9 million for the prototype automated version of the stabilization and packaging system at Rocky Flats.

Three sites have identified milestones that are at risk because of delays in procuring this new system. Rocky Flats and Hanford anticipate delays ranging from 6 to 18 months in having their stabilization and packaging systems operational—contributing to difficulties in meeting the May 2002 date. The third site that is experiencing delays in using this system is

[3]Los Alamos is managed by the DOE organization that manages nuclear weapons development (the Office of Defense Programs)—unlike most sites with stabilization activities, which are managed by the DOE organization focusing on environmental management and cleanup activities (the Office of Environmental Management).

[4]Los Alamos is the only site not planning to procure this system. Instead, the site plans to use its own processing and packaging equipment to meet the standard.

Lawrence Livermore; however, this site is purchasing a manual packaging unit, has only a small quantity of plutonium to package, and anticipates meeting the May 2002 commitment date.

Delays Result in Continuing Risk to Workers and Cost Increases

DOE's plutonium stabilization and packaging activities are focused on getting the Department's plutonium that is not in pits into safe long-term storage. Due to the nature of plutonium, if it is not stabilized and stored properly for the long term, it could become airborne—thereby exposing workers to it. As described, plutonium can be dangerous to human health, even in small quantities, and site officials acknowledge that any delays in stabilizing, packaging, and storing the plutonium result in continuing the existing level of risk to workers' health and safety by delaying the risk reduction that is achieved by those activities.

Delays also result in increased costs. For example, according to a Hanford official, continuing plutonium stabilization and packaging operations at the site would cost $20 million per year, at current costs. While Savannah River anticipates meeting the May 2002 date, it anticipates an intermediate delay that will result in the continued operation of one of its processing facilities for an extra year, at a cost of $16 million. Delays also prevent DOE from achieving cost reductions from deactivating sites or facilities, as safeguards and security must be provided as long as plutonium or other nuclear materials remain there.

It Is Unclear If the Disposition Criteria Will Be Compatible With the Long-Term Storage Standard

As noted earlier in chapter 1, the Department plans to convert the nation's excess plutonium through two technologies—burning the plutonium in reactors and immobilizing it in glass or ceramics—to make it difficult to reuse in nuclear weapons and suitable for permanent disposal.[5] Until DOE has developed and built facilities for both of these options, it plans to store the excess plutonium at several DOE sites.

Although DOE announced its decision to dispose of the excess plutonium, it has not finalized the criteria the plutonium must meet to be acceptable for disposition.[6] According to a DOE official, at the time the decision was announced, in January 1997, the two disposition technologies were not

[5]Some low-risk residues with low plutonium content do not have to be converted through either technology as they can be disposed of in the Waste Isolation Pilot Plant when it becomes available.

[6]The disposition criteria will apply to both plutonium in pits and not in pits (excluding residues and solutions with low plutonium content). According to DOE officials, because pits are made of high-grade metals, the method for their disposition is fairly well defined at this point. However, uncertainty remains for plutonium that is not in pits.

mature enough for disposition criteria to be developed. Since then, DOE produced a draft of the disposition criteria in July 1997, and final criteria are expected in June 1998.

Without final disposition criteria available, the sites are proceeding to stabilize and package their plutonium that is not in pits according to the existing storage standards—especially DOE Standard 3013. However, DOE Standard 3013 for long-term storage and the draft criteria for disposition vary in some significant ways, which could result in additional activities or processing steps and increased costs. For example, according to DOE, the draft disposition criteria would require the sites to provide historical information on how the plutonium was processed, what impurities are likely to be included with it, and what the physical condition of the plutonium is. However, under Standard 3013, the sites are not currently required to retain this information with the plutonium. If the necessary information was not available, the draft criteria for disposition would require the sites to sample their plutonium to gather it. Sampling of the plutonium is not required by Standard 3013 and, as described in the draft disposition criteria, would require additional and potentially expensive equipment and activities by the sites prior to shipping the plutonium to the disposition facilities. The additional equipment and activities would add to the cost and time required for disposing of the plutonium. According to officials from both the Office of Environmental Management and the Office of Fissile Materials Disposition—the DOE headquarters organizations responsible for stabilization, packaging, and storage activities and for disposition activities, respectively—there has been some coordination between the two organizations to attempt to resolve differences between DOE Standard 3013 and the draft disposition criteria.

However, in a December 8, 1997, letter to the Secretary of Energy, the Chairman of the Defense Nuclear Facilities Safety Board cited problems with DOE headquarters' integration of stabilization and disposition and concluded that these problems had contributed to delays in meeting implementation plan milestones and unacceptable postponement of stabilizing materials, along with significantly greater budget requirements. Specifically, the letter noted that there was no organization with crosscutting authority and resources within the Department to integrate stabilization and disposition activities across the DOE complex. To remedy this problem, the Board suggested that DOE designate a lead officer with primary responsibility for the program as a whole. According to a Board staff member, DOE has not responded to the December 8, 1997, letter.

In addition to the Board's concerns, several site officials told us that they are concerned about whether plutonium that is stabilized and packaged to meet the standard for long-term storage will be compatible with DOE's final disposition criteria. Several site officials also stated that the DOE headquarters organizations responsible for these two activities need to work out differences between the long-term storage and disposition requirements to preclude additional activities or processing steps, which would add to the cost and time required. One contractor official told us that if the bridge between stabilization and disposition were fully understood, complications with disposition could be avoided.

Conclusions

DOE is taking important steps to reduce the dangers of plutonium that is not in pits by beginning to stabilize and package it for long-term storage. For example, the sites have stabilized the majority of the higher-risk residues to reduce the risk to workers' health and safety. However, given its history of delays and the anticipated future delays in meeting many of its milestones, DOE is unlikely to meet its commitment to stabilize, package, and store its plutonium metals and oxides by May 2002. Delaying these activities will result in continuing health and safety risks to workers and increased costs at DOE facilities.

As stabilization, packaging, and storage activities progress to meet DOE Standard 3013 for long-term storage, the Department is also moving toward the disposition of excess plutonium. The headquarters organizations responsible for these two sets of activities—the Office of Environmental Management and the Office of Fissile Materials Disposition—have coordinated some, but the Defense Nuclear Facilities Safety Board has recently cited problems with the integration of these activities across the DOE complex. Furthermore, several site officials have suggested that the two organizations need to work out any differences between the final disposition criteria (due out in June 1998) and DOE Standard 3013 to avoid unnecessary rework and costs.

Agency Comments and Our Evaluation

In overall comments concerning its stabilization program, the Department stated that the program has now moved into a phase that requires extensive integration among deactivation programs, disposition programs and active weapons programs. Furthermore, the implementation of several policy decisions—including polices regarding stewardship of the nuclear weapons stockpile, the disposition of "weapons-usable" fissile materials, and accelerated cleanup—has required the Department to reevaluate many

of its stabilization plans, "to define a technically and managerially sound path forward." According to the Department, activities have been initiated to produce a fully integrated and optimized revision to the implementation plan for plutonium stabilization, complex wide. The Department is proposing a two-path approach to formally revise its commitment in the implementation plan: (1) as soon as possible, forward known changes and decision paths to the Defense Nuclear Facilities Safety Board and (2) by the end of December 1998, submit an integrated revision of the implementation plan to DOE management and the Board for approval.

We agree with the Department's commitment to define a technically and managerially sound path in revising its implementation plan. Furthermore, as reflected in our conclusions, we support the Department's stated intent to integrate its plutonium management across the complex. However, based on its comments, the Department appears to be totally reassessing its existing implementation plan in light of the opportunities for this integration and departmental policy decisions about such as stewardship of the stockpile and accelerated cleanup. Until the Department's complexwide plan is complete—scheduled for the end of December 1998—we cannot speculate on the impact in terms of costs; timeframes for completing plutonium stabilization, packaging, and storage activities; or the risk to the workers.

DOE further commented that the statement "The Department is unlikely to meet its May 2002 target date . . ." does not convey the fact that a large percentage of the stabilization work will be done by May 2002, even if that milestone for final repackaging of the plutonium is missed at some sites. While we agree that much of the stabilization work could be done by May 2002, we cannot project with any degree of certainty the actual extent to which it will be completed. Furthermore, while stabilization is a critical step in this process, the risk reduction to workers anticipated by the Defense Nuclear Facilities Safety Board's 1994 recommendation and the Department's implementation plan will not be fully achieved until the plutonium is packaged for safe long-term storage. While some sites are currently projecting that they will have all of their stabilization and packaging activities completed by May 2002, others are anticipating delays. Therefore, DOE as a whole is unlikely to meet the May 2002 target date.

In addition to the overall comments cited above, the Department provided a number of more detailed or technical comments, and the report has been

revised as appropriate to reflect these specific comments. The Department's comments and our responses are presented in appendix I.

DOE's Storage of Pits Risks Workers' Exposure to Plutonium

Since the end of the Cold War, DOE has retired and dismantled large numbers of nuclear weapons and curtailed recycling the plutonium into new nuclear weapons. As a result, the Department has had to store the plutonium pits for prolonged periods of time. However, because extended storage had never been required, DOE had no containers specifically designed for that purpose. Since 1989, DOE has stored pits in a type of container known as the AL-R8, which was designed to transport pits. However, since that time, both DOE and the Defense Nuclear Facilities Safety Board have indicated that pits should not be stored in these containers for an extended period. These containers are unsuitable for extended storage because moisture absorbed by their cushioning liner could accelerate some pits' corrosion, increasing the possibility that a pit will crack. Should that occur, the container may not contain the plutonium, thus risking workers' exposure to it. To remedy this safety problem, DOE spent nearly $50 million over 5 years to develop a replacement container, but because each container will cost about $8,000, the Department plans to use the new container to repackage only about 5 percent of its pits.

Currently, DOE has no formal plan or schedules to repackage the remaining 95 percent of its pits. However, DOE is evaluating options for another replacement container and intends to choose a design and have a repackaging plan by April 1998. As of February 1998, only a preliminary draft of the plan was available—much of it only in outline format—so we were unable to determine if it will adequately address the outstanding issues in storing pits. In the meantime, about 10,000 pits at DOE's Pantex Plant have been stored in the AL-R8 containers, posing a risk to workers' health and safety, and DOE has only preliminary estimates of what it will cost to resolve this problem. Moreover, as DOE continues to dismantle weapons, the number of pits stored in these containers continues to grow. Although the Defense Nuclear Facilities Safety Board and DOE laboratories have criticized the limited monitoring program for the pits stored for an extended period in AL-R8 containers at Pantex, the Department has decided not to implement the aggressive monitoring program recommended by the laboratories to maintain safety.

Storage of Pits Poses Risk to Workers' Health and Safety

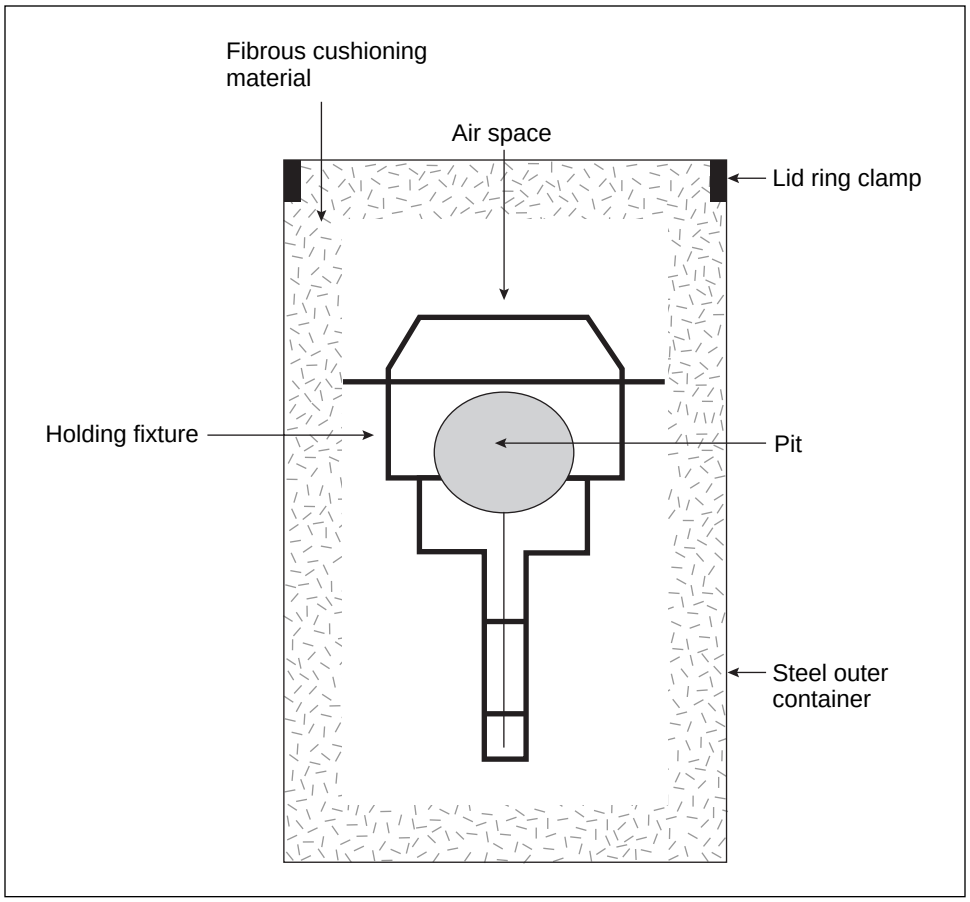
Since the end of the Cold War and the dissolution of the Soviet Union, the United States has entered into international agreements and established national policy to retire and dismantle thousands of nuclear weapons. As it removed pits from these weapons, DOE no longer recycled the plutonium for use in manufacturing new weapons, but, for the first time, had to store

these pits for a prolonged period. However, DOE had no containers specifically designed for that purpose. As a result, in 1989, when DOE started storing increasing numbers of pits, the Department decided to store them in existing AL-R8 containers, which were designed for transporting the pits. According to the DOE official responsible for overseeing the storage of pits, in 1989 the Department may have assumed that because the AL-R8 containers had been certified to transport pits and met requirements to withstand various accident scenarios, they could also be used to store the pits.[1] The basis for this assumption, however, is unclear, and DOE officials were unable to provide any analysis supporting the 1989 decision.

An AL-R8 container consists of an outer steel drum with a clamped (but unsealed) lid. Inside this steel drum, the pit is secured on a metal frame and surrounded by a fibrous cushioning liner. Normally, pits are placed into AL-R8 containers after they have been removed from retired nuclear weapons during the dismantlement process at Pantex. See figure 3.1 for an illustration of an AL-R8 container.

[1]DOE officials also explained that, at that time, the Department intended to use the AL-R8 containers to store pits until plutonium recycling resumed. A final decision that plutonium recycling would not resume was made in January 1992.

Figure 3.1: Side View of a Pit in an Al-R8 Container



Source: GAO's adaptation of an illustration from DOE.

In 1990, the AL-R8 container was decertified for transportation because it could not meet updated shipping requirements, such as crush and leak tests. Within 1 year, DOE's Albuquerque Operations Office sent a letter to Pantex and Rocky Flats directing that the AL-R8 not be used to transport pits off-site but allowing the continued use of the container for storing them. However, DOE was unable to provide documentation or related analysis explaining the basis of this decision. According to DOE officials, in 1992 the Department decided that the AL-R8 containers were the best it had available at that time for storing pits. However, again, DOE had no technical analysis to determine whether these containers were adequate for storing pits for an extended period of time.

Using the AL-R8 container for storing pits poses a risk to workers' health and safety. A DOE study and, more recently, DOE laboratory officials have expressed concerns about the continued use of the AL-R8 container to store pits. DOE's 1994 vulnerability assessment noted that "being unsealed, the AL-R8 container does not keep out airborne contaminants and would not totally contain plutonium released from a failed pit."[2] In 1995, DOE's Los Alamos and Lawrence Livermore national laboratories—the two laboratories that had designed the pits—jointly recommended that all pits be removed from the AL-R8s as soon as possible because of potential problems with corrosion resulting from moisture and chloride absorbed by the containers' cushioning liner. According to the laboratories, the moisture and chloride can accelerate the pits' aging process, which could lead to a pit's cracking and the release of plutonium, thereby potentially exposing workers at Pantex. DOE and laboratory officials have also expressed concern over the aging of the pits and the extended period that some have been stored in the AL-R8 containers. Some of DOE's pits are over 36 years old, and some have been stored in these containers for over 8 years.

DOE Has Largely Abandoned Its Container Replacement Plan Because of Cost

In late 1992, after the AL-R8 was decertified for transportation, DOE began a project to replace the container and, in 1993, clarified that this replacement container—known as the AT400A—had to be designed for both the transportation and storage of pits. Although it subsequently invested a great deal of time and nearly $50 million in this effort, DOE recently decided to use the AT400A to repackage only about 5 percent of its pits. At this time, DOE has no formal plan or schedules for repackaging approximately 95 percent of the pits. However, according to DOE officials, while a formal decision has not yet been made, the Department is developing a plan, which it intends to issue in April 1998. DOE officials believe that a "retrofit" of the AL-R8 is the most likely option and that it will be several more years before all the pits currently stored in the AL-R8 containers can be repackaged.

DOE Has Had Little Success in Developing a Replacement Container

In late 1992, after the AL-R8 failed to meet new transportation standards, the Department undertook a project to design a replacement container, called the AT400A. In addition to being used for transporting pits, DOE decided that the container had to also be able to store them for at least 20 years. However, DOE has not been successful in developing a cost-effective

[2]When DOE identified these problems, it had approximately 6,300 pits stored in AL-R8s and has since placed about 3,700 additional pits into them.

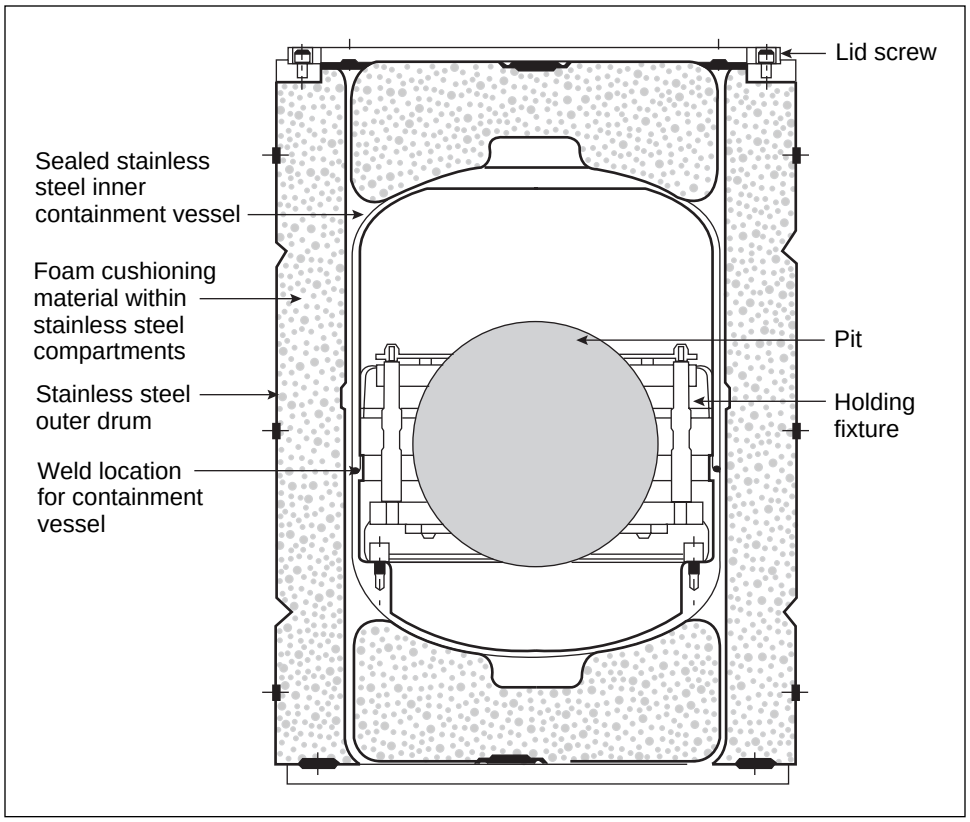
container that provides safe long-term storage and can also be used to transport pits. According to some DOE officials, to be cost-effective, a transportation container must be reusable. In contrast, a storage container, as illustrated by the problems with the AL-R8, needs to be sealed to keep out moisture and to keep the plutonium contained in the event that the pit would crack. Nonetheless, DOE attempted to design and develop a container that could be used for both purposes. After investing a great deal of time and nearly $50 million to design and develop the replacement container,[3] DOE found that it is not cost-effective for extensive use in either capacity. According to DOE officials, at a cost of about $8,000 per container (largely due to transportation requirements), the AT400A is not cost-effective for use as a storage container (the containers alone for 10,000 pits would cost about $80 million). Furthermore, according to DOE officials, the AT400A is not cost-effective for multiple shipments between sites because it is designed to be welded shut for storage purposes and therefore is not reusable.[4]

The AT400A container consists of an outer stainless steel container that surrounds an inner, sealed container, within which a pit is secured by a metal fixture. Unlike the case with the AL-R8 container, the pit inside an AT400A is in a sealed environment and is not directly in contact with the cushioning material that could absorb moisture. Figure 3.2 shows an AT400A container.

[3]The figure includes the estimated costs for establishing repackaging facilities and equipment for the AT400A at Pantex.

[4]DOE has been using a reusable container—designated as the FL container—that was certified in 1991 and recertified in 1997 for transporting pits. DOE does not plan to use these containers for long-term storage because there are only about 292 of them in service at this time; they are very expensive at about $10,000 each; and they were designed for transporting pits, not storing them.

Figure 3.2: Side View of a Pit in an At400a Container



Source: GAO's adaptation of an illustration from DOE.

In addition to problems with developing a cost-effective dual-purpose design, DOE did not provide effective oversight or coordinate the work of its laboratories and Pantex in developing the AT400A container. DOE tasked three of its national laboratories to work on various aspects of the project: Sandia National Laboratory developed the container and the system to weld it shut, while Los Alamos and Lawrence Livermore national laboratories jointly developed the fixture to hold the pit inside the container. However, DOE did not ensure that the work of the laboratories was adequately coordinated and did not adequately involve Pantex safety experts in the design and development process. As a result, according to DOE and Pantex officials, after the design phase was complete, Pantex safety experts had to compensate for design flaws, which included a defective safety system and a weld directly over the pit, which could have allowed the welder to burn through the container into the pit. To resolve

these major design problems, Pantex needed to commit additional time and expense. DOE project officials acknowledge that the Department did not adequately manage the development of the AT400A container and that design flaws occurred because of a lack of good coordination and communication among the four sites.

DOE Has Abandoned Its Original Repackaging Plan but Has Yet to Develop a New One

DOE's 1994 plutonium vulnerability assessment first identified problems with using the AL-R8 container for storing pits, but the Department has yet to resolve these problems. In June 1995, DOE developed a corrective action plan, and even though the AT400A container was then only under development, the Department regarded it as the container that would correct all the problems with the AL-R8 and developed schedules to repackage all the pits at the Pantex Plant into the new container by 2006.[5] However, after determining that the cost to use the new container to repackage all of the pits was prohibitive, DOE decided to use the AT400A for only about 5 percent of the pits—those it considered to be at higher risk of cracking.[6] Thus, DOE has essentially abandoned its initial plan and, as of January 1998, had not developed a formal plan and schedules to repackage the remaining 95 percent of the plutonium pits stored in AL-R8 containers.[7]

According to DOE officials, the Department is developing a plan for repackaging these pits, which it intends to issue in April 1998, and begin repackaging in late 1998. However, in a preliminary draft of the plan provided by officials in February 1998, many sections were in only a cursory outline form, so we were unable to determine if the plan will be adequate to ensure the problems in storing pits will be addressed. For example, at that time, the draft did not contain schedules or cost estimates for selecting a design, procuring the containers, or repackaging the pits. Furthermore, this draft included a listing of the numerous entities involved with repackaging and storage—within various organizations of the Department and its contractors—however, it did not define how these entities will interact or how their efforts will be coordinated, nor did it clearly delineate program responsibility and accountability for overseeing

[5]Repackaging schedules also included projections for additional pits from the dismantling of additional weapons, for a total of about 14,000 pits.

[6]A pit of this design cracked in November 1992 during a weapon's disassembly. Repackaging of these pits into AT400As, which was originally scheduled to begin by December 1995, started in a limited fashion in late August 1997, according to the DOE official responsible for oversight of the repackaging operation. This official indicated that as of January 1998, only 20 of these pits had been repackaged.

[7]This percentage includes the pits from weapons already dismantled at Pantex as well as those from weapons awaiting dismantlement.

the various facets of the pit repackaging and storage program to ensure its success.

DOE is developing a repackaging alternative that officials believe will be more cost-effective and will allow quicker repackaging than using the AT400A. As they describe it, this alternative will probably involve a retrofit of the original AL-R8 container by removing the pit from it, sealing the pit inside an inner container, and placing that inner container back into the AL-R8 outer container. DOE is currently reviewing alternative designs developed by Lawrence Livermore, Sandia, and Pantex and plans to have a decision by April 1998. The Department's preliminary estimates of the costs to repackage 12,000 pits into retrofitted AL-R8 containers range from $35.5 million to $59.4 million.[8] These estimates are based on the cost to purchase the containers (ranging from $20.5 million to $40.4 million), as well as start-up costs (from $1.2 million to $1.6 million) and operating costs (from $13.8 million to $17.4 million) for repackaging the pits. DOE officials estimate that, at the earliest, the repackaging could begin around the end of 1998. Given the number of pits to be repackaged and competing demands on equipment and facilities at Pantex,[9] they estimate that it may take from 4 to 7 years to complete repackaging once the process begins. Thus, the potential exists for the unsuitable AL-R8 containers to be used for storing pits for up to 16 years.[10]

Additional Decisions Are Needed to Resolve Problems in Storing Pits

DOE has yet to make several critical decisions concerning pit storage in the future. First, according to DOE officials, pits that are being retained as strategic reserves for possible future use in nuclear weapons will require longer storage than pits that are excess to national security needs and that will eventually be disposed of. Currently, DOE officials expect the AL-R8 retrofit to safely store pits for approximately 20 to 25 years. However, the Department has not decided if it will store the strategic reserve pits in the AT400A container or the retrofit of the AL-R8 container or if it will develop another container for lengthier storage. According to DOE officials, the Department is evaluating this issue, and they expect a decision by April 1998.

[8]These estimates are in fiscal year 1998 dollars and exclude Pantex's overhead costs.

[9]Various activities at Pantex, including weapons dismantlement and pit repackaging, share some common equipment and facilities and must compete for these shared resources, according to DOE officials.

[10]This includes the use of AL-R8s for pit storage since 1989, about 1 year to develop the retrofit, and 4 to 7 years to complete repackaging.

Second, because the threat of corrosion increases the longer that pits remain in the existing AL-R8 containers, DOE laboratories have recommended that the containers not be used for storing pits and that the Department implement an aggressive monitoring program to help ensure the pits are safely stored until they are repackaged. Specifically, in August 1995 Los Alamos and Lawrence Livermore national laboratories recommended that if DOE continues to store pits in AL-R8 containers for longer than 10 years,[11] it should implement an aggressive monitoring program to examine 20 percent of the pits each year. With about 10,000 pits in storage now, monitoring 2,000 pits per year is a sizable increase over the current 30 pits per year that DOE now formally monitors.[12]

According to DOE and Pantex officials, implementing the monitoring program recommended by the laboratories would likely require constructing additional facilities, procuring additional equipment, and hiring and training additional staff. Although they had not conducted analyses of the costs or benefits of the enhanced monitoring program and were unable to provide a cost estimate, DOE officials told us that they believed the cost of implementing this program would be "significant and perhaps prohibitive." They also thought the program would increase workers' exposure to radiation from frequent handling and moving of the pits. Because the officials hope to have the pits repackaged before this type of aggressive monitoring becomes necessary, they have decided not to implement such a program. Nonetheless, as explained, some pits have already been stored in AL-R8 containers for over 8 years, and it will be several more years before all the pits can be repackaged. Although the Department has decided against the enhanced monitoring of its pits while they remain in the existing AL-R8 containers, DOE officials point out that they plan to conduct a visual examination and to check for contamination as each pit is repackaged.

In its November 1997 report, the Defense Nuclear Facilities Safety Board also criticized DOE's monitoring program of pits stored in AL-R8 containers

[11]The laboratories recommend that the aggressive monitoring begin after 5 years' storage for strategic reserve pits to ensure reliability for future use in weapons and about 10 years' storage for excess pits to ensure storage safety.

[12]According to DOE officials, in recent years, additional pits have been visually inspected. For example, from May 1997 through February 1998 approximately 550 pits that had been stored in AL-R8 containers at Rocky Flats were visually inspected when they were transferred to Pantex, prior to being repackaged into AL-R8 containers. According to the officials, to date, these visual inspections have not detected anomalies. However, such inspections are much less extensive than the testing and analysis performed as part of the formal monitoring program. Furthermore, the pits that were visually inspected were not representative of the universe of pits at Pantex and were selected on an exception basis—when warranted by other factors, such as the transfer to Pantex, which required their repackaging—rather than selected randomly at regular intervals.

at Pantex.[13] In its report, the Board concluded that DOE's current program to monitor the condition of these pits was insufficient because the number of pits currently monitored each year (approximately 30) was small compared to the thousands of pits stored there. The Board also noted that the variety of pits would require additional monitoring work to gather an adequate amount of data for an informed judgment about each type of pit. According to a Board staff member, monitoring the safety of the pits is most critical while they remain in the existing AL-R8 containers—once the pits have been repackaged into containers more suitable for extended storage, monitoring will be less important. To date, DOE has not responded to the Board's report nor addressed the Board's conclusion that the current monitoring program is insufficient to determine the condition of the pits stored at Pantex.

Conclusions

Since 1989, DOE has stored its pits in containers that are not suitable for extended storage. The Department has not effectively managed its problems in storing pits, developed a cost-effective replacement container to repackage the pits, or performed adequate monitoring to ensure the pits are safe. DOE currently lacks a plan and schedules to repackage 95 percent of its pits, and workers' health and safety have been placed at risk; the problem will continue to grow as DOE continues to retire and dismantle nuclear weapons and place additional pits into AL-R8 containers. Responsibility for addressing the issue of safely storing pits has been decentralized, with the involvement of various DOE organizations and contractor-managed laboratories and sites. While DOE officials have told us they are developing a plan for repackaging pits, there is currently only a preliminary draft, and it is too early to determine if the plan will adequately address the outstanding issues. However, at this time, certain key elements are not addressed, including comprehensive cost estimates and program budgeting; a clear delineation of program responsibility and accountability; and schedules for repackaging and storage and a system for tracking progress in meeting these schedules.

Finally, the Department has not thoroughly analyzed or resolved the concerns raised by its own laboratories and the Defense Nuclear Facilities Safety Board about monitoring the safety of pits while they remain in unsuitable AL-R8 containers. Although DOE did not conduct analyses and therefore had no estimate of the costs and benefits of an enhanced monitoring program, the Department nonetheless decided not to implement such a program. However, even under optimal circumstances,

[13]Review of the Safety of Storing Plutonium Pits at the Pantex Plant (DNFSB/TECH-18, Nov. 25, 1997).

it will be many years before DOE can repackage all of its plutonium pits into safer containers, and therefore pits will continue to be stored in the unsuitable AL-R8 containers well past the time recommended by the laboratories to begin aggressive monitoring. Furthermore, the history of delays in DOE's program for repackaging pits lends added significance to the need for ensuring their safety while they continue to be stored in AL-R8 containers.

Recommendations

We recommend that the Secretary of Energy ensure the timely and cost-effective resolution of the wide range of issues surrounding pit storage, including ensuring that the plan being developed by the Department addresses such key items as a clear definition of responsibility and accountability for program activities; realistic cost estimates and a program budget; and detailed schedules for designing and developing replacement containers and repackaging the pits, as well as a means to track progress against these schedules. In addition, given the length of time pits will be stored in unsuitable containers, we recommend that the Secretary, in cooperation with the DOE laboratories and the Defense Nuclear Facilities Safety Board, conduct a thorough safety analysis of the recommended enhanced pit monitoring program as well as other possible monitoring options to identify the most appropriate and cost-effective approach to ensure the specified safety concerns about the prolonged storage of pits in the unsuitable containers are resolved.

Agency Comments and Our Evaluation

In its comments on our draft report, DOE concurred with all but one part of one of our recommendations. The Department concurred with our recommendation for the timely and cost-effective resolution of the issues surrounding pit storage and agreed to include the recommended key items in its Integrated Pit Storage Program Plan, which it expects to issue in April 1998. In addition, the Department concurred with the portion of our recommendation calling for the Secretary to work closely with the DOE laboratories and the Defense Nuclear Facilities Safety Board to identify the most appropriate and cost-effective approach to address their concerns about the prolonged storage of pits in unsuitable containers. The Department stated that it has worked with the laboratories and the Board in the past to address concerns about storage activities at Pantex and will continue to do so. In contrast, DOE raised concerns about our recommendation that the Department conduct a safety analysis of the enhanced pit monitoring program as well as other possible monitoring options, stating the Department has "approved safety analyses for

operations at the Pantex Plant, which provide coverage for pit storage activities." The Department further requested that we clarify our basis for this recommendation. Our review of DOE's safety analyses for Pantex's operations revealed that these analyses were conducted before the DOE laboratories and the Defense Nuclear Facilities Safety Board identified the safety problems of pits in prolonged storage in AL-R8 containers and the resultant need for increased monitoring. Therefore, these specific issues were not addressed in DOE's safety analyses. While DOE's analyses considered the AL-R8s as the baseline containers for storing pits, they did not include a detailed evaluation showing that these containers were safe for extended storage. Therefore, we continue to recommend, in light of the prolonged storage of pits in the AL-R8 containers and the fact that safety concerns about these pits were not addressed in DOE's safety analyses, that the Secretary conduct a thorough safety analysis of the Department's pit monitoring options, including the enhanced monitoring program recommended by the laboratories, to ensure that the specific concerns raised are resolved.

In addition, the Department raised a general concern that our report "does not present complete and accurate information about many important DOE initiatives to meet the challenges for managing plutonium in an environmentally safe and reliable manner which protects workers as well as the general population." We disagree. Our report describes initiatives that the Department raised in its comments—the disposition program for excess plutonium and that program's implications for plutonium storage; the revisions to Los Alamos National Laboratory's plutonium stabilization program; and the development of a plan for repackaging the pits out of the AL-R8 containers, expected to be issued in April 1998. On the basis of DOE's comments, we updated information on these initiatives and added information on additional pit surveillance activities to the report's discussion of pit monitoring issues. Furthermore, the Department's comments on our report discussed an initiative to revise its implementation plan for plutonium stabilization to integrate nuclear materials management activities complexwide. This initiative was not included in our report because Department officials did not mention it in our meetings with them in February; the Department's comments on this report were the first indication that such an initiative was formally under way.

In its comments, the Department noted that the final disposition plans for surplus plutonium and ongoing nonproliferation initiatives (i.e., bilateral and trilateral inspection agreements) are examples of the types of issues

that have made it difficult to develop storage containers for pits. While we recognize that there are many outside factors that have affected and will continue to affect DOE's management of its pits, we do not believe that these factors should have prevented the Department from resolving its pit storage problems. We note that despite the factors cited, the Department invested 5 years and nearly $50 million to develop a replacement container for the AL-R8, although this replacement container was ultimately determined to be too expensive.

Comments From the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

Department of Energy
Washington, DC 20585

March 18, 1998

Ms. Gary Jones
Associate Director, Energy, Resources,
and Science Issues
Resources, Community, and Economic
Development Division
U.S. General Accounting Office
Room 2962
Washington, D.C. 20548

Dear Ms. Jones:

The Department of Energy (DOE) is providing comments on the General Accounting Office draft report, GAO/RCED-98-68, entitled "Progress and Problems in Managing Plutonium." The report was reviewed by the major Departmental organizations involved in efforts to stabilize, package, and store plutonium metals and oxides in both non-pit form, and in pits. The Departmental organizations providing comments on the report include the Office of Defense Programs; Office of Environmental Management; Office of Fissile Materials Disposition; Office of Environment, Safety, and Health; and the Albuquerque Operations Office.

Based on the comments received from these organizations, it is the Department's overall consensus that the report does not present complete and accurate information about many important DOE initiatives to meet the challenges for managing plutonium in an environmentally safe and reliable manner which protects workers as well as the general population. It is my understanding that during earlier exit briefings with Departmental organizations, your staff was provided comments on the factual accuracy of the report. The Department believes that some of these comments were not adequately addressed and the comments, along with additional comments on the Executive Summary, Conclusion, and Recommendation sections are enclosed for your consideration. I urge you to review the general comments from the Office of Defense Programs and the Office of Environmental Management which provide an overview of the history of the Department's plutonium stabilization program and the efforts associated with developing a program for the long-term storage of plutonium pits.

After careful review, the Department provides the following response to the recommendations outlined in the report:

RECOMMENDATION 1
"We recommend that the Secretary of Energy ensure timely and cost-effective resolution of the wide range of issues surrounding pit storage, to include ensuring that the plan being developed by the Department addresses such key items as clear definition of responsibility and accountability for program activities; realistic cost estimates and a program budget; and detailed schedules for designing and developing replacement containers and repackaging the pits, as well as a means to track progress against these schedules."

CONCUR: The Department is currently working on the Integrated Pit Storage Program Plan (IPSPP). The IPSPP contains the information outlined in the recommendation section, including a decision on storage containers. The Department expects to issue the IPSPP in April 1998.

RECOMMENDATION 2
"In addition, given the length of time pits will be stored in unsuitable containers, we recommend that the Secretary conduct safety analyses of the enhanced pit monitoring program recommended by the laboratories, as well as other possible monitoring options."

NON-CONCUR: The basis for this recommendation is unclear to the Department, especially since there are approved safety analyses for operations at the Pantex Plant, which provide coverage for pit storage activities. The Department requests that the General Accounting Office provide clarification for this recommendation.

RECOMMENDATION 3
"The Secretary should work closely with the laboratories and the Board to identify the most appropriate and cost-effective approach to address their specific safety concerns about the prolonged storage of pits in the unsuitable containers."

CONCUR: The Department has been working with the laboratories and the Defense Nuclear Facilities Safety Board (DNFSB) and staff to address concerns associated with pit storage activities at Pantex. Throughout the development of the IPSPP, the Department consulted with the laboratories and DNFSB to ensure that all concerns have been addressed. The Department will continue working with these organizations to address any future safety concerns regarding pit storage activities.

Thank you for the opportunity to provide comments on the draft report. If you require additional assistance or have questions about the comments, please refer them to Joe Hobbs of my staff on (301) 903-3454.

Sincerely,

Victor H. Reis
Assistant Secretary
for Defense Programs

Enclosure

See comment 1.

Defense Programs[1] Comments on the Draft General Accounting Office Report, "Problems and Progress in Managing Plutonium"

General

Stabilization Activities at Los Alamos National Laboratory (LANL): As the weapon complex reduces its overall size, missions and programs still vital to the national defense are being relocated and consolidated at the DOE's remaining operational sites. LANL is one of those sites that has an ongoing mission and is having more work transferred to its facilities to support the missions and programs of the Department's Defense Programs. Portions of that shifted work is now being carried out at LANL's Technical Area 55, which is also the location of the Department's efforts to remediate LANL's plutonium residues. This new work and the remediation work use many of the same highly skilled and technical personnel to perform critical functions.

When the initial schedule for residue remediation work at LANL was proposed and approved, these transferred missions and programs were being carried out elsewhere in the DOE weapons complex and were not envisioned to be carried out at LANL. This has required a significant effort to maximize the utilization of the equipment and personnel as well as the budgeted dollars to perform the required work. This effort has allowed for most of the goals of all the competing programs to be met, with only a small delay to completion of the remediation of LANL's high risk items by the end of March 1998.

After careful review of the entire plutonium residue inventory and programmatic requirements at LANL, the Department has decided to redefine the scope of its plutonium remediation efforts at the laboratory. Due to mission growth in several areas, including weapons programs and material disposition programs, an increase in the demand for limited resources is being felt for those personnel and the specialized equipment that were primarily designated for remediating the legacy materials at LLNL. Additionally, the creation of a risk based profiling system for residues at the site has allowed the Department to prioritize all the residues based on their expected risk to the worker. Over the last three years, this effort has identified residue materials that have been recently generated that are of a higher risk to the worker than the legacy materials identified under Recommendation 94-1, and therefore, a reconfiguration of the priority of materials for remediation is underway. As a result, the Department is moving forward with an integrated plutonium remediation and scrap recovery program which will revise the residue remediation schedule to maximize the amount of risk reduction. This program takes into consideration the entire site inventory as well as the Department's programmatic requirements. While this change will extend the remediation of the remaining lower risk legacy items until possibly Fiscal Year 2005, it is anticipated that the program will demonstrate a greater risk reduction for the worker through applying this

[1]Includes comments from the Albuquerque Operations Office

integrated approach. This proposed change to the Department's remediation efforts at LANL has been briefed to the Defense Nuclear Facilities Safety Board (DNFSB) with a favorable reception. The Department will submit a formal change to the LANL 94-1 Implementation Plan to the DNFSB for formal review in the near future.

See comment 2.

Use of AL-R8 Containers for Storage: The report inaccurately refers to the AL-R8 container as being unsuitable for storage. The Department has determined that the AL-R8 may be unsuitable for extended storage of some pits due to corrosion concerns; however, to date the Department has found no concerns during short-term storage.

See comment 3.

Additional Pit Surveillance Activities: Although approximately 30 pits are formally surveyed each year, several more are handled regularly in other routine activities such as disassembly, repackaging, and shipment. All activities require visual checks and radiation swipes which would detect the concerns referred to in this report. An example of these activities is the transfer of around 550 pits from Rocky Flats Environmental Technology Site (RFETS) to Pantex for storage. These pits, which were stored in AL-R8 containers at RFETS, were inspected at Pantex without any evidence of corrosion-related damage. This report does not convey these additional activities performed by the Department.

See comment 4.

Pit Repacking Program Plan: In several places, the report does not present a complete picture of the pit repacking efforts underway by the Department. The Department is currently preparing a plan for repackaging pits located at Pantex, and anticipates that the plan will be completed in April 1998. As it is currently envisioned, repacking activities will be completed over a 4 to 7 year time frame. The plan will evaluate container designs including a modification to the existing AL-R8 container. Preliminary costs estimates for hardware procurement and repackaging activities for the modified AL-R8 container ranging from $35.5M to $59.4 M for 12,000 pits.

See comment 5.

External Factors Influencing Pit Storage Activities: An area of concern is the report's criticism of containers for long-term storage of plutonium pits without any reference to the other mitigating factors that impact the Department's decision-making processes on the long-term storage of plutonium. The Department acknowledges that it has encountered difficulties with managing plutonium pit storage, and the report should include information about the difficulties. The final disposition plans for surplus plutonium and ongoing nonproliferation initiatives (i.e. bilateral and trilateral inspection agreements) are examples of the types of issues which influence decision-making about specifications for storage containers. The Department is committed to reducing the risk of storing pits, and it will continue to work with the laboratories to develop an appropriate repackaging program that will address concerns regarding pit storage.

See comment 6.

Now on p. 22.
See comment 6.

Now on p. 28.
See comment 7.

Now on p. 34.
See comment 8.

Now on p. 35.
See comment 9.

Now on p. 38.
See comment 10.

Now on p. 40.
See comment 11.

Now on p. 42.
See comment 8.

Specific Comments

Page 4, third paragraph, third sentence: In addition to competing priorities, longer than previously expected processing times for the remaining and more stable, lower risk residues have also contributed to delays in meeting implementation plan milestones at LANL.

Page 23, first paragraph, third sentence: See comment for page 4 referring to additional delays in meeting implementation plan milestones.

Page 31, first paragraph, first sentence: As the DOE weapon's complex shrinks in overall size, LANL became the new site for some of these relocated programs needed for the national defense. Remediation efforts will continue at LANL, and the Department is reviewing proposals to hire additional personnel and add additional equipment to continue this work in an effective and efficient manner.

Page 37, top of page: There needs to be a distinction between the 1995 recommendation by the laboratory for performing monitoring versus monitoring the pits in accordance with the newer (1997) "Pit Storage Specification".

Page 37, first paragraph, last sentence: In 1992, the Department had initiated work on the AT-400A leading to the reason why the AL-R8 was not conceived as being an extended storage container (see page 39).

Page 41, footnote 21: The FL container was certified in 1991, but it has since been recertified in April 1997 and is good through 2002. The Department's concern over using the FL container for storage is that there are no requirements to use a Type B container for storage and as well as the cost of the FL container, approximately $10,000.

Page 43, footnote 23: The pit that cracked during disassembly did so due to extreme conditions experienced during the disassembly process, conditions which far exceed storage conditions.

Page 45, second paragraph: See comment for page 37 regarding the distinction between 1995 lab recommendation and 1997 lab specification.

Office of Environmental Management's Comments on the Draft General Accounting Office Report, "Problems and Progress in Managing Plutonium"

See comment 12.

General Comments

The activities committed to in the current approved implementation plan for plutonium stabilization have been effective in mitigating the highest risk material vulnerabilities. However, the program has now moved into a stabilization phase which requires extensive integration among deactivation programs, disposition programs and active weapons programs. Several policy decisions have been made by the Department of Energy since the approval of the initial implementation plan which have impacted the stabilization activities originally planned. These include policies regarding Stockpile Stewardship, Disposition of Weapons Usable Fissile Materials, and Accelerated Cleanup. Implementation of these policies has required the Department to reevaluate many of the stabilization plans for materials in light of their ultimate disposition paths.

The present integration challenges for programs involving plutonium management are being addressed in a manner to define a technically and managerially sound path forward. Activities have already been initiated to produce a fully integrated and optimized revision to the implementation plan for plutonium stabilization. Ongoing studies of topics such as accelerating plutonium shipments, obtaining variances from security requirements where appropriate, and integration of nuclear materials management activities complex wide, have potential significant impacts on the planned stabilization activities. The Department is proposing a two-path approach to formally revise the implementation plan commitment, i.e., as soon as possible forward known changes and decision paths to the Defense Nuclear Facilities Safety Board, and by the end of December 1998, submit an integrated Implementation Plan revision package to DOE management and the Board for approval.

Specific Comments on Chapters 1 and 2 of the Report

See comment 13.

Page 4, last paragraph and several other places: "DOE is unlikely to meet its May 2002 target date to have its plutonium that is not in pits stabilized, packaged and stored." The statement does not convey the fact that a large percentage of the stabilization work will be done by May 2002, even if that milestone is missed for the final repackaging of the plutonium at some sites.

See comment 14.

Page 4, last sentence and several other places: Delays in stabilization and packaging will lead to a continuing risk to workers' health and safety. It must be acknowledged that even after stabilization and packaging, some small level of risk remains associated with handling and storage of plutonium materials. The effect of any delays in stabilization and packaging, therefore, is to delay the reduction in risk that is achieved by those activities.

Now on p. 5.
See comment 15.

Page 6, first paragraph, last sentence talks about the interim storage criteria and risk to workers. The GAO comment leads the reader to believe that the interim storage criteria is somehow unsafe. The interim storage criteria is based on worker safety and provides adequate safety in the interim period.

Now on p. 24.
See comment 16.

Page 26, last paragraph: Hanford date will slip seven months. DOE believes that the safety significance of this slip is manageable.

Now on p. 27.
See comment 17.

Page 30, first paragraph, last sentence: Hanford officials unsure about funds. Hanford funding will be available in the future. The real question is where the plutonium stabilization work will fall on the overall site priority list. If the risks are high enough, as determined by DOE, tribes, and stakeholders, funds will be provided.

Office of Fissile Materials Disposition Comments on the Draft General Accounting Office Report, "Problems and Progress in Managing Plutonium"

Now on p. 3.
See comment 18.

Page 4, second paragraph: This paragraph relates to the January 1997 record of decision, and provides a conditional last sentence regarding the strategic reserves. It is suggested that another conditional sentence be added, that this record of decision does not address plutonium residues of less than 50-percent plutonium by weight. The record of decision made a clear distinction of which materials were considered in the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement.

Now on p. 19.
See comment 19.

Page 21, first paragraph, last sentence: In our previous comments on the Statement of Facts document, the following was provided to clarify the schedule dates: replace the last sentence with "DOE is currently preparing an Environmental Impact Statement (EIS) to select one or more sites where plutonium disposition will take place. The final EIS is scheduled to be completed in late 1998, with the Record of Decision following approximately one month later."

Regarding the "uncertainties" discussed in this paragraph, there are other equally important uncertainties. Technical, institutional and cost uncertainties exist with both the immobilization and reactor options. Accordingly, the department will complete the necessary tests, process development, technology demonstrations, site-specific environmental reviews and detailed cost proposals for both approaches. Final decisions to use either or both of the technology options depend on the results of this work, as well as nonproliferation considerations and progress in efforts and negotiations with Russia and other nations. This approach gives the President the flexibility to begin plutonium disposition either multilaterally or bilaterally through negotiations or unilaterally as an example to Russia and other nations.

Now on p. 22.
See comment 20.

Page 23, first paragraph, last two sentences: Regarding the "final disposition criteria," the interim report on the disposition criteria that was developed in July 1997, was a pre-decisional document. A draft report was released in December 1997 for formal comments, and a final criteria report is scheduled for June 1998. It should be footnoted here that these disposition criteria do not apply to plutonium residues and solutions.

Now on p. 30.
See comment 20.

Page 33, second paragraph, last sentence: Change "July 1997" to "December 1997" (see comment above).

Now on p. 30.
See comment 21.

Page 33, third paragraph, fourth sentence: The word "requires" should be changed to "would desire." The high-firing of Pu Materials to stabilize them is undesirable from a disposition standpoint, because the resulting, increased particle sizes adds to the time required to dissolve plutonium oxide into the immobilization matrix. However, additional size reduction will be required for immobilization regardless of firing temperature, and immobilization is scheduled to have this capability; Environmental Management's (EM) high-firing the oxides is no longer a key issue for the Office of Fissile Materials Disposition (MD). There are differences in the information required to meet the 3013 standard and the information necessary to do immobilization. Immobilization will need to know about material history, likely impurities, physical condition, etc. -- these are not required for the long-term storage standard.

EM has initiated an effort to develop a new standard for the stabilization, packaging and storage of plutonium bearing materials. This is a coordinated effort with participation by MD.

Now on p. 30.
See comment 22.

Page 34, second paragraph: MD did not contribute to delays in meeting implementation plan milestones, as inferred in the first sentence, and to characterize the MD Program in this manner is inaccurate. The delays in meeting implementation plan milestones cited in the December 8, 1997, letter, relate to stabilization activities and proposed changes to processing scenarios. In fact, some of the changes cited in the December 8, 1997, letter have the potential to allow greater volumes to be processed per batch, thereby possibly accelerating stabilization and hence risk reduction, which pleased the Defense Board. In accordance with the January 1997 record of decision, MD has responsibility for dispositioning surplus, weapons-usable plutonium that is stabilized. Again, MD and EM have two separate missions whereby nothing to date makes the two missions incompatible.

6

Office of Environment, Safety and Health Comments on the Draft General Accounting Office Report, "Problems and Progress in Managing Plutonium"

We appreciate the opportunity to review the subject draft document before being issued. The following comments resulted from this review.

See comment 23.

Page 2, first paragraph, first sentence: "Workers at Department of Energy (DOE) facilities must be protected from plutonium because exposure to extremely small quantities is dangerous to human health, and plutonium can be unstable and volatile, even spontaneously igniting under certain conditions." The premise that workers must be protected is correct, but the non specific assertion to "extremely small," unstable, volatile, and spontaneous ignition are not technically correct. The purpose of the lead in sentence is to alert the reader that Plutonium is hazardous and workers must be protected from it. The additional assertions only detract from the basic premise.

See comment 24.

Page 4, third paragraph, Results in Brief: The DOE contractors have chosen to curtail plutonium operations because of perceived safety conditions. This reflects their priorities which have not totally coincided with those of the DNFSB Recommendation 94-1. It is unfortunate that the work stoppages have occurred. The DOE contractors who work with plutonium feel that the progress to date has been sufficient to mitigate the serious safety issues associated with the storage of plutonium.

Now on p. 7.
See comment 24.

Page 8, first paragraph: The draft disposition criteria does not coincide with the long-term storage standard. This is largely due to the basis of the storage standard being 50 years in a robust container capable of withstanding all safety impositions. The disposal criteria should apply to plutonium not destined for long term-storage. When completed, the two standards/criteria should complement each other.

See comment 25.

Page 15, second paragraph: Plutonium in "extremely" small microgram quantities is dangerous to human health. It is currently estimated that a microgram of plutonium deposited in the deep recesses of the lungs has a one in seven thousand chance of causing a cancer, based on animal studies. It should be noted that no one in the United States has ever died because of plutonium uptake. It is therefore difficult to quantify how dangerous plutonium is to the worker.

Now on p. 16.

Page 17, first paragraph: Table 1.1 should be capitalized.

Now on p. 19.
See comment 26.

Page 20, last reference: Fed. Reg. 3014 should be 1997.

7

The following are GAO's comments on the Department of Energy's letter dated March 18, 1998.

1. To address the Department's comment concerning the transfer of national defense missions to Los Alamos, we added the following to our report: "In commenting on our draft report, the Department clarified that as DOE reduces the overall size of its weapons complex, missions and programs considered still vital to national defense are being relocated and consolidated at the Department's remaining operational sites. Los Alamos has become the new site for some of these relocated missions and programs." The remainder of this comment provides information on the Department's redefinition of the scope of plutonium remediation efforts at Los Alamos. However, this information generally supports rather than contradicts the information contained in our report that competing priorities, between national defense work and other activities, have caused delays in Los Alamos' ability to meet its implementation plan milestone to have its plutonium stabilized and packaged for long-term storage. Therefore we made no additional changes to the report.

2. The Department has not defined "short-term storage" nor provided evidence that the AL-R8 containers are safe for any length of storage. However, to address this comment, we limited our use of the term "unsuitable" to discussions of the use of AL-R8 containers for extended or prolonged storage of pits. We also added footnote 6 in the "Executive Summary," which states that, "According to DOE and laboratory officials, some pits are more susceptible to corrosion than others, depending on the metal used to encase the pit."

3. To respond to this comment concerning the Department's formal pit monitoring efforts and other inspections of its pits, we revised the report to read, 30 pits are "formally" monitored per year. Furthermore, on the basis of this comment and additional information provided by the Department, we added footnotes to the report that provide additional information on visual inspections of pits transferred from Rocky Flats to Pantex. In its comments, DOE states that, in addition to the formal monitoring effort, "several more [pits] are handled regularly in other routine activities" and that these activities "require visual checks and radiation swipes which would detect the concerns referred to in this report." However, since these statements were not supported by the information provided by the Department, we did not revise the report. The information provided supported only that additional pits have been visually inspected on specific occasions but did not support a systematic

program of visual inspection. The additional visual inspections cited were due to extraordinary events (such as the pits' transfer to Pantex from Rocky Flats); they were not presented as a regular occurrence or as a planned addition to the formal monitoring program. We note that visual inspections are much less extensive than the testing and analysis performed as part of the formal monitoring program, and the officials did not provide information that these inspections would be able to detect the problems cited. Therefore, we do not believe that the visual inspections that have been conducted take the place of formal monitoring or negate our recommendation that the Department carefully analyze the need for enhanced monitoring to resolve safety concerns raised by the laboratories and the Defense Nuclear Facilities Safety Board.

4. The Department's development of a repackaging plan for the pits at Pantex is discussed in detail in chapter 3 of our report. This discussion includes the selection of a replacement container, the time frame for repackaging, and the Department's preliminary cost estimates. However, we revised the report to include the range "from 4 to 7 years" for repackaging the pits. Furthermore, on the basis of additional information provided by the Department, we revised the report to reflect DOE's most recent preliminary cost estimates for repackaging 12,000 pits and included a footnote to reflect that these estimates are in fiscal year 1998 dollars and exclude Pantex's overhead costs.

5. We address this comment regarding external factors influencing pit storage activities under the heading "Agency Comments and Our Evaluation" at the end of chapter 3.

6. Although we requested documentation or other information to support the comment that "longer than previously expected processing times . . . have also contributed to delays in meeting implementation plan milestones," the additional information provided by the Department did not do so. Therefore, no revision was made to the report.

7. See comment 1 above for information added to the report to address DOE's comment concerning the relocation of programs from other sites in the DOE weapons complex to Los Alamos. We also revised the report to reflect the Department's position that remediation efforts will continue at Los Alamos, and that the Department is reviewing proposals for additional personnel and equipment.

8. We did not revise the report to reflect DOE's comment on the distinction between the 1995 recommendation by the laboratories and the 1997 "Pit Storage Specification." As discussed in our report, the 1995 recommendation by the laboratories concerns the need for increased monitoring of the pits while they remain in the existing AL-R8 containers. The 1997 "Pit Storage Specification" will apply to pits as they are repackaged out of the AL-R8 containers. According to DOE and laboratory officials, pits currently packaged in AL-R8 containers cannot comply with this specification. Furthermore, the 1997 specification does not negate the laboratories' 1995 recommendation for increased pit monitoring. Rather, the specification states, "Increased sampling may be required if . . . aspects of this specification are not met"—which is exactly the case while the pits remain in AL-R8 containers.

9. The development of the AT400A container is discussed in our report. No changes were made to the report because the Department did not provide support for the suggestion that the work on the AT400A was the reason the AL-R8 was not viewed as an extended storage container.

10. On the basis of additional information provided by the Department, we revised the footnote to describe the 1997 recertification of the FL containers for transportation, revised the number of FL containers in service at this time, and included two additional reasons the Department provided for not using these containers for long-term storage: They are very expensive, at approximately $10,000 per container; and they were designed for transporting pits not storing them.

11. We did not revise the footnote concerning the pit that cracked because the Department did not provide additional support for the statement that this occurred "due to extreme conditions experienced during the disassembly process, which far exceed storage conditions."

12. These general comments concerning the integration of stabilization activities with other departmental activities and the revision of the implementation plan are addressed under the heading "Agency Comments and Our Evaluation" at the end of chapter 2.

13. This comment concerning the stabilization work that may be done by May 2002 is addressed in the "Agency Comments and Our Evaluation" section of chapter 2.

14. We added a footnote to the report quoting DOE's point that "It must be acknowledged that even after stabilization and packaging, some small level of risk remains associated with handling and storage of plutonium materials." In addition, we revised the report to clarify that delays result in continuing the existing level of risk to workers' health and safety by delaying the risk reduction that is achieved by stabilization and packaging activities.

15. We revised the report to clarify that the interim storage criteria do not provide the level of safety afforded by DOE Standard 3013 and explicitly attributed the comments about the continuing risk to workers' health and safety to DOE site officials and a Defense Nuclear Facilities Safety Board staff member.

16. We did not revise the report because the Department did not provide support for the statement that the "safety significance" of the delay at Hanford is "manageable."

17. To reflect this information about future funding at Hanford, we added the following to the report: "In commenting on a draft of this report, the Department stated that questions remain about how plutonium stabilization work will be prioritized by the site. The Department believes that if the risk is determined to be high enough, funds will be provided."

18. We added a footnote to the report that reads, "Some low-risk residues with low plutonium content do not have to be converted through either technology as they can be disposed of in the Waste Isolation Pilot Plant when it becomes available." In addition, we revised a later footnote to reflect this information.

19. We revised the report to read, "DOE is currently assessing the possible environmental impacts of several likely sites where plutonium disposition activities may take place and plans to have a final decision in late 1998 or early 1999." We further revised the report to indicate that there are technical, institutional, and cost uncertainties and that the uncertainties cited are examples, not an all-inclusive list.

20. The Department comments that a more recent draft of the disposition criteria, dated December 1997, has been issued. However, we were not able to include the details of this draft because it was not available at the time of our review.

21. We revised the report to remove the issue of stabilization temperatures because the Office of Fissile Materials Disposition is planning to address this issue through an additional processing step. However, there are still issues to be resolved regarding differences between the draft disposition criteria and the current standard for plutonium storage. Therefore, on the basis of DOE's comments, we included examples of the differences between the information that would be required by the draft disposition criteria and the information currently required by DOE Standard 3013 for long-term storage. Finally, we did not revise the report to address the effort by the Office of Environmental Management to develop a new standard, as this initiative is still in its preliminary stages.

22. The statements about delays in meeting implementation plan milestones are not our conclusions, but the comments of the Defense Nuclear Facilities Safety Board (and are cited as such in the report). Therefore, we did not revise the report.

23. On the basis of further discussions with DOE officials, we revised the report to read, "Workers at Department of Energy (DOE) facilities must be protected from plutonium because exposure to small quantities is dangerous to human health, and if not safely contained and managed, plutonium can be unstable and can even spontaneously ignite under certain conditions."

24. In further discussions with DOE officials, they stated that these comments were informational and that the Department did not require any change to the report.

25. We revised the report on the basis of a further discussion with DOE officials concerning the dangers of plutonium. During this discussion, the officials agreed that the Department's concerns would be addressed if we deleted the word "extremely" from the report.

26. We revised the report as suggested, changing the referenced date to "1997."

Major Contributors to This Report

Resources, Community, and Economic Development Division

Lisa P. Gardner
Ronald J. Guthrie
Christopher M. Pacheco
Victor S. Rezendes
John H. Skeen, III
Pamela J. Timmerman

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 37050
Washington, DC 20013

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (202) 512-6061, or TDD (202) 512-2537.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested