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SECURING U.S. NUCLEAR MATERIALS

Poor Planning Has Complicated DOE's Plutonium Consolidation Efforts

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Highlights

Highlights of [GAO-06-164T](#), a testimony before the Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

Plutonium is very hazardous to human health and the environment and requires extensive security because of its potential use in a nuclear weapon. The Department of Energy (DOE) stores about 50 metric tons of plutonium that is no longer needed by the United States for nuclear weapons. Some of this plutonium is in the form of contaminated metal, oxides, solutions, and residues remaining from the nuclear weapons production process. To improve security and reduce storage costs, DOE plans to establish enough storage capacity at its Savannah River Site (SRS) in the event it decides to consolidate its plutonium there until it can be permanently disposed of. GAO was asked to examine (1) the extent to which DOE can consolidate this plutonium at SRS and (2) SRS's capacity to monitor plutonium storage containers.

What GAO Recommends

In its July 2005 report, GAO made two recommendations to ensure that DOE develops a comprehensive strategy for plutonium consolidation, storage, and disposition and that its cleanup plans are consistent with this strategy. DOE generally agreed with the recommendations and stated that its recently created Nuclear Materials Disposition and Consolidation Coordination Committee will develop a strategic plan for the consolidation and disposition of plutonium.

www.gao.gov/cgi-bin/getrpt?GAO-06-164T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Gene Aloise at (202) 512-3841 or aloisee@gao.gov.

SECURING U.S. NUCLEAR MATERIALS

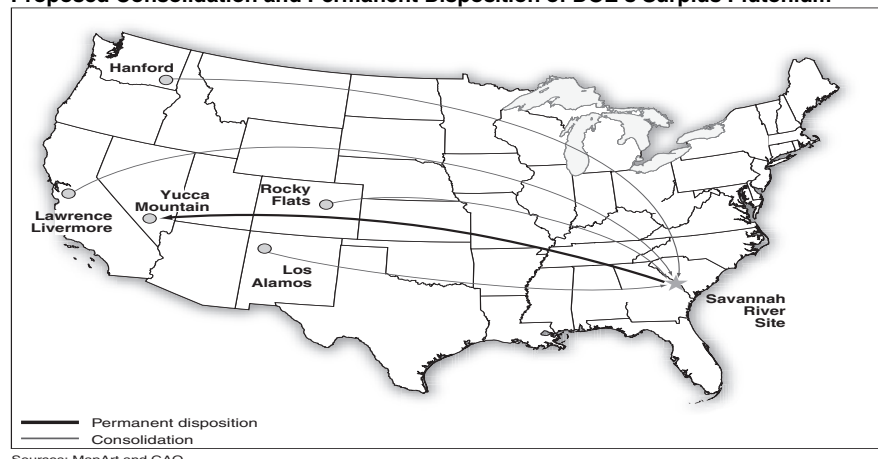
Poor Planning Has Complicated DOE's Plutonium Consolidation Efforts

What GAO Found

As GAO reported in July 2005, DOE cannot yet consolidate its surplus plutonium at SRS for several reasons. First, DOE has not completed a plan to process the plutonium into a form for permanent disposition, as required by the National Defense Authorization Act for Fiscal Year 2002. Without such a plan, DOE cannot ship additional plutonium to SRS. Second, SRS cannot receive all of the plutonium from DOE's Hanford Site because it is not in a form SRS planned to store. Specifically, about 20 percent of Hanford's plutonium is in the form of 12-foot-long nuclear fuel rods, which Hanford had planned to ship intact to SRS as part of its efforts to cleanup and demolish its closed nuclear facilities. However, SRS's storage plan assumed Hanford would package all of its plutonium in DOE's standard storage containers. Until a permanent disposition plan is developed, more plutonium cannot be shipped to SRS and DOE will not achieve the cost savings and security improvements that consolidation could offer. In particular, continued storage at Hanford will cost approximately \$85 million more annually because of increasing security requirements and will threaten that site's achievement of the milestones in its accelerated cleanup plan.

In addition, DOE lacks the necessary capability to fully monitor the condition of the plutonium to ensure continued safe storage. The facility at SRS that DOE plans to use to store plutonium lacks adequate safety systems to conduct monitoring of storage containers. Without a monitoring capability, DOE faces increased risks of an accidental plutonium release that could harm workers, the public, and the environment. DOE had planned to construct a monitoring capability in another building at SRS that already had safety systems needed to work with plutonium. However, this building would not have had sufficient security to conduct all of the required monitoring activities. In addition, this building also has other serious safety problems. Faced with these challenges, DOE announced in April 2005 that it would have SRS's storage facility upgraded to conduct plutonium monitoring.

Proposed Consolidation and Permanent Disposition of DOE's Surplus Plutonium



Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to discuss our work on the Department of Energy's (DOE) efforts to consolidate surplus plutonium. My testimony today is based on our report issued in July 2005, entitled *Securing U.S. Nuclear Materials: DOE Needs to Take Action to Safely Consolidate Plutonium* ([GAO-05-665](#)).

DOE stores about 50 metric tons of plutonium that is no longer needed by the United States for nuclear weapons. Some of this plutonium is in the form of contaminated metal, oxides, solutions, and residues remaining from the nuclear weapons production process. When the United States stopped producing nuclear weapons in 1989, it had plutonium inventories located in numerous DOE facilities throughout the United States, including the Hanford Site in Washington, the Rocky Flats Environmental Technology Site in Colorado, the Los Alamos National Laboratory in New Mexico, the Lawrence Livermore National Laboratory in California, and the Savannah River Site (SRS) in South Carolina. DOE recognizes that consolidation could reduce costs and improve security for stored plutonium. Although DOE has not made a final decision to consolidate, it has proceeded with plans to establish enough storage capacity at SRS in the event it decides to consolidate its plutonium at SRS until it can be processed into a form for permanent disposition and disposed of in a geological repository at Yucca Mountain, Nevada.

Plutonium is very hazardous to human health and the environment. Inhaling a few micrograms creates a long-term risk of lung, liver, and bone cancer and inhaling larger doses can cause immediate lung injuries and death. In certain forms, plutonium can spontaneously combust in the presence of oxygen at temperatures above room temperature. Because of these hazards, plutonium must be stabilized and packaged appropriately to minimize the risk of accidental release. In addition, facilities storing plutonium must be properly equipped with safety systems that prevent it from escaping into the surrounding air, land, or water in the event a storage container is breached.

In 2003, DOE issued a technical standard for plutonium storage that it believes will allow it to safely store plutonium for a minimum of 50 years. DOE is nearing completion of a multiyear effort to stabilize and package plutonium at its sites across the United States into 5-inch-wide, 10-inch-long storage containers. Under DOE's standard, once the plutonium is safely packaged, DOE must periodically monitor the storage containers for changes in the plutonium's condition, particularly any pressurization or

corrosion of the containers. Such monitoring includes annually x-raying a sample of storage containers to evaluate potential pressurization. Storage containers may also be cut open to evaluate the plutonium inside and the container itself for potential corrosion. An effective monitoring program is intended to detect damaged storage containers or inadequately stabilized plutonium and will help ensure the continued safe storage of the material.

In addition to plutonium's health and environmental hazards, DOE has long recognized that a successful terrorist attack on a site containing plutonium could have devastating consequences for the site and its surrounding communities. Therefore, plutonium requires extensive security because of its potential use in a nuclear weapon; to create an improvised nuclear device; and to create a so-called "dirty bomb," in which conventional explosives are used to disperse radioactive material. For many years, a key component of DOE security has been the development of the design basis threat, a classified document that identifies the potential size and capabilities of terrorist forces. Since September 11, 2001, the size of the potential threat has increased significantly and DOE is facing challenges in improving its security measures to respond to the increased threat.¹

Our July 2005 report examined (1) the extent to which DOE can consolidate its plutonium at SRS and (2) SRS's capacity to monitor plutonium storage containers. We reviewed plutonium storage, monitoring, and security plans and reports prepared by DOE's Office of Environmental Management, DOE's Office of Security and Safety Performance Assurance, and National Nuclear Security Administration; DOE's operating contractor for SRS (Westinghouse Savannah River Company); and DOE's security contractor for SRS (Wackenhut Services, Inc.). In addition, we reviewed studies on plutonium storage at SRS and interviewed officials with the Defense Nuclear Facilities Safety Board, an independent federal agency established by the Congress in 1988 to oversee the safety of DOE's nuclear weapons complex. The work on our report was conducted from June 2004 through June 2005 in accordance with generally accepted government auditing standards.

¹See GAO, *Nuclear Security: DOE Needs to Resolve Significant Issues Before It Fully Meets the New Design Basis Threat*, [GAO-04-623](#) (Washington, D.C.: Apr. 27, 2004) and GAO, *Nuclear Security: DOE's Office of the Under Secretary for Energy, Science and Environment Needs to Take Prompt, Coordinated Action to Meet the New Design Basis Threat*, [GAO-05-611](#) (Washington, D.C.: July 15, 2005).

In summary, DOE cannot consolidate all of its plutonium at SRS. DOE has not yet completed a plan to process the plutonium into a form for permanent disposition, as required by the National Defense Authorization Act for Fiscal Year 2002. Without such a plan, DOE cannot ship additional plutonium to SRS. In addition, DOE's plutonium consolidation efforts have been hindered because DOE relied upon its individual sites to independently develop plans to achieve their own goals instead of developing an integrated consolidation plan. Specifically, Hanford was preparing to ship plutonium to SRS as part of its efforts to accelerate the cleanup and demolition of its closed nuclear facilities. About one-fifth of Hanford's plutonium is in the form of 12-foot-long nuclear fuel rods. Because disassembling the fuel rods would delay cleanup activities, Hanford's accelerated cleanup plan calls for shipping these rods intact to SRS inside special shipping containers. However, SRS's storage plan assumed Hanford would disassemble the fuel rods and package the plutonium in DOE's standard storage containers. Despite these inconsistencies, DOE approved both Hanford's accelerated cleanup plan and SRS's plutonium storage plans. Although SRS's plutonium storage facility has sufficient space to store the fuel rods, several steps are necessary before DOE would be able to ship the fuel rods to SRS, including obtaining Department of Transportation certified shipping containers for the fuel rods. However, until DOE develops a plan to process the plutonium for permanent disposition, additional plutonium cannot be shipped to SRS and DOE will not achieve the cost savings and security improvements that plutonium consolidation could offer. In particular, continued plutonium storage at Hanford will cost approximately \$85 million more annually because of increasing security requirements and will threaten that site's achievement of the milestones in its accelerated cleanup plan.

In addition, DOE currently lacks the capability at SRS to fully monitor the plutonium storage containers as required by DOE's storage standard. According to the Safety Board, the facility at SRS that DOE plans to use to store the plutonium—Building 105-K—is not equipped to conduct the needed monitoring of storage containers. In fact, because Building 105-K lacks adequate fire protection, ventilation, and filtration, DOE's standard storage containers cannot be removed from their outer packaging—35-gallon steel drums used to ship the containers to SRS. Without a monitoring capability that would detect whether the stored plutonium is becoming unstable and damaging the storage containers, DOE faces increased risks of an accidental plutonium release at SRS that could harm workers, the public, and the environment. Because Building 105-K lacks the capability to monitor stored plutonium, DOE had planned to construct

a monitoring capability in another building at SRS—Building 235-F—that already had the ventilation and filtration systems needed to work with plutonium. However, following changes in 2004 to DOE’s design basis threat, Building 235-F would not have had sufficient security to conduct all of the monitoring activities required by DOE’s storage standard. In addition, the Defense Nuclear Facilities Safety Board has reported that, like Building 105-K storage facility, Building 235-F lacks adequate fire protection as well as having other serious safety concerns. Given these challenges, DOE announced in April 2005 that it would have Building 105-K upgraded to allow storage and monitoring activities to be centralized in one facility.

In our report, we made two recommendations to ensure that DOE develops a comprehensive strategy for plutonium consolidation, storage, and disposition and that its facilities cleanup plans are consistent with this strategy. DOE generally agreed with our recommendations and stated that its recently created Nuclear Materials Disposition and Consolidation Coordination Committee will develop a strategic plan for the consolidation and disposition of plutonium and highly enriched uranium. Since our report was issued in July 2005, DOE’s committee has been continuing with its work developing the strategic plan.

Background

To address the problems associated with unstable forms of plutonium and inadequate packaging for long-term storage, DOE established a standard for the safe storage of plutonium for a minimum of 50 years that sets plutonium stabilization and packaging requirements. Stabilization is achieved by heating the material to remove moisture that could lead to a buildup of pressure, which would increase the risk of rupturing a container. Plutonium storage containers designed to meet the standard consist of an inner and outer container, each welded shut. The inner container is designed so that it can be monitored for a buildup of pressure using analytical techniques, such as radiography, that do not damage the container. Containers must also be resistant to fire, leakage, and corrosion.

Plutonium stabilization and packaging are completed at Rocky Flats, Hanford, and SRS, and SRS has already received nearly 1,900 containers from Rocky Flats. Stabilization and packaging are still ongoing at Lawrence Livermore and Los Alamos National Laboratories. Once stabilization and packaging are completed, DOE estimates that it will have nearly 5,700 plutonium storage containers stored at locations across the United States that could eventually be shipped to SRS.

SRS's plutonium storage plans originally called for the construction of a state-of-the-art Actinide Packaging and Storage Facility that would have provided long-term storage and monitoring of standard plutonium containers in a secure environment. DOE changed its storage plans and cancelled the project in 2001 because it expected to store the plutonium for only a few years until a facility to process the plutonium for permanent disposition was available. Instead of building a new facility, DOE decided to use two existing buildings at SRS for plutonium storage and monitoring operations: Building 105-K and Building 235-F. Building 105-K was originally a nuclear reactor built in the early 1950s and produced plutonium and tritium until 1988. The reactor was then placed in a cold standby condition until its complete shutdown in 1996. The major reactor components were removed and the facility is now primarily used to store plutonium and highly enriched uranium. Building 235-F was also constructed in the 1950s and was used until the mid-1980s to produce plutonium heat sources that were used to power space probes for the National Aeronautics and Space Administration and the Department of Defense. The building is currently used to store plutonium.

After the design basis threat was changed in October 2004, SRS was forced once again to reevaluate its storage plans. Because the new design basis threat substantially increased the potential threat that SRS must defend against, Building 105-K and Building 235-F would need extensive and expensive upgrades to comply with the new requirements. SRS estimated the total cost of this additional security at over \$300 million. SRS further estimated that it could save more than \$120 million by not using Building 235-F for storage and therefore decided in April 2005 to consolidate plutonium storage in Building 105-K.

DOE Cannot Currently Consolidate Its Plutonium at SRS

DOE cannot consolidate its excess plutonium at SRS for several reasons. First, DOE has not completed a plan to process the plutonium into a form for permanent disposition, as required by the National Defense Authorization Act for Fiscal Year 2002.² DOE proposed two facilities at SRS to process its surplus plutonium into a form for permanent disposition: a mixed oxide fuel fabrication facility to convert plutonium into fuel rods for use in nuclear power plants and a plutonium immobilization plant where plutonium would be mixed with ceramics, the mixture placed in large canisters, and the canisters then filled with high-

²Pub. L. No. 107-107, § 3155, 115 Stat. 1378 (2001).

level radioactive waste. The canisters would then be permanently disposed of at Yucca Mountain. In 2002, citing budgetary constraints, DOE cancelled the plutonium immobilization plant, eliminating the pathway to process its most heavily contaminated plutonium into a form suitable for permanent disposition. Section 3155 of the act provides that if DOE decides not to construct either of two proposed plutonium disposition facilities at SRS, DOE is prohibited from shipping plutonium to SRS until a plan to process the material for permanent disposition is developed and submitted to the Congress. To date, DOE has not developed a disposition plan for the plutonium that would have been processed in the immobilization plant. In its fiscal year 2006 budget, DOE requested \$10 million to initiate conceptual design of a facility that would process this plutonium. However, it is uncertain when this design work would be completed and a plan prepared.

Second, even if a plan to process this plutonium for permanent disposition had been developed and DOE were able to ship the plutonium, SRS would still be unable to accommodate some of Hanford's plutonium because Hanford's accelerated cleanup plans and SRS's storage plans are inconsistent with one another. DOE approved both plans even though Hanford's accelerated cleanup plan called for shipping some of its plutonium to SRS in a form that SRS had not planned on storing.

Hanford stores nearly one-fifth of its plutonium in the form of 12-foot-long nuclear fuel rods, with the remainder in about 2,300 DOE standard 5-inch-wide, 10-inch-long storage containers. The fuel rods were to be used in Hanford's Fast Flux Test Facility reactor. The reactor has been closed, and the fuel rods were never used. Hanford's plutonium is currently being stored at the site's Plutonium Finishing Plant—the storage containers in vaults and the nuclear fuel rods in large casks inside a fenced area. Hanford was preparing to ship plutonium to SRS as part of its efforts to accelerate the cleanup and demolition of its closed nuclear facilities. Although Hanford's original cleanup plan called for demolishing the Plutonium Finishing Plant by 2038, the plan was modified in 2002 to accelerate the site's cleanup. Hanford's accelerated cleanup plan that was approved by DOE's Office of Environmental Management now calls for shipping the storage containers and nuclear fuel rods to SRS by the end of fiscal year 2006 so that Hanford can demolish the Plutonium Finishing Plant by the end of fiscal year 2008. To meet the new deadline, Hanford planned to ship the fuel rods intact to SRS.

Nevertheless, SRS's July 2004 plutonium storage plan stated that Hanford would cut the fuel rods and package the plutonium in approximately 1,000

DOE standard storage containers before shipping the material to SRS. Although Building 105-K has space to store the fuel rods intact, several steps would be necessary before DOE could ship the fuel rods from Hanford to SRS. First, there is currently no Department of Transportation-certified shipping container that could be used to package and ship the fuel rods. In addition, SRS would be required, among other things, to prepare the appropriate analyses and documentation under the National Environmental Policy Act and update Building 105-K's safety documentation to include storage of the fuel rods. Wherever the fuel rods are stored, they would have to be disassembled before processing the plutonium for permanent disposition. Hanford and SRS currently lack the capability to disassemble the fuel rods, but DOE plans to study establishing that capability at SRS as part of its conceptual design of a facility to process the plutonium for disposition.

The challenges DOE faces storing its plutonium stem from the department's failure to adequately plan for plutonium consolidation. DOE has not developed a complexwide, comprehensive strategy for plutonium consolidation and disposition that accounts for each of its facilities' requirements and capabilities. Until DOE is able to develop a permanent disposition plan, additional plutonium cannot be shipped to SRS, and DOE will not achieve the cost savings and security improvements that plutonium consolidation could offer. According to DOE officials, the impact of continued storage at Los Alamos and Lawrence Livermore will be relatively minor because both laboratories had already planned to maintain plutonium storage facilities for other laboratory missions. However, according to Hanford officials, continued storage at Hanford could cost approximately \$85 million more annually because of increasing security requirements and will threaten the achievement of the goals in the site's accelerated cleanup plan. Specifically, maintaining storage vaults at Hanford's Plutonium Finishing Plant will prevent the site from demolishing the plant as scheduled by September 2008.

DOE Cannot Currently Fully Monitor the Condition of Stored Plutonium

Under DOE's plutonium storage standard, storage containers must be periodically monitored to ensure continued safe storage. Without a monitoring capability that can detect whether storage containers are at risk of rupturing, there is an increased risk of an accidental plutonium release that could harm workers, the public, and the environment. Monitoring activities must occur in a facility that, among other things, is equipped to confine accidentally released plutonium through effective ventilation and appropriate filters. In addition, the facility must have a fire

protection system to protect storage containers and prevent their contents from being released in a major fire.

According to the Safety Board, Building 105-K is not currently equipped with adequate ventilation or fire protection. Specifically, SRS removed the High-Efficiency Particulate Air (HEPA) filters that were used in the building's ventilation system when it was a nuclear reactor. Such filters could prevent plutonium from escaping the building in the event of a release from the storage containers. In addition, Building 105-K lacks automatic fire detection or suppression systems. As a result, plutonium storage containers cannot safely be removed from inside the outer packaging used to ship the containers to SRS. The outer package—a 35-gallon steel drum—is used to ship a single storage container and is designed to resist damage during transportation and handling. The outer package confines the plutonium in the event the storage container inside is breached. In addition, the outer package provides an additional layer of protection from fire for the storage container inside.

Because monitoring requires x-raying individual storage containers and, in some cases, puncturing and cutting storage containers to analyze the condition of the container and the plutonium within, the storage containers must be removed from their outer packaging. SRS plans to establish a capability to restabilize the plutonium by heating it in a specialized furnace in the event monitoring determines that the stored plutonium is becoming unstable (i.e., increasing the risk of rupturing a storage container). The restabilized plutonium would then be packaged into new storage containers. The only facility at SRS currently capable of restabilizing and repackaging the plutonium has closed in preparation for decommissioning.³

Because Building 105-K does not have the capability to monitor storage containers, DOE had planned to install monitoring equipment in Building 235-F at SRS. Building 235-F was chosen primarily because it was already equipped with filtered ventilation systems appropriate to handling plutonium—multiple and redundant air supply and exhaust fan systems

³This facility—FB Line—was constructed in the early 1960s to convert plutonium solutions into solid forms to be used in nuclear weapons components. In recent years, its primary mission has been to stabilize scrap plutonium from cleanup operations at SRS and package the stabilized plutonium into storage containers. FB Line ceased operations and transferred its remaining plutonium to Building 105-K in March 2005.

that use HEPA filters. Exhaust from the ventilation system is further filtered through a sand filter before entering the outside atmosphere.⁴

Currently, Building 235-F is limited to removing storage containers from their outer packaging and x-raying the containers to evaluate potential pressurization. Although DOE has installed equipment in Building 235-F that can puncture the storage container to relieve pressure, Building 235-F currently lacks the capability to conduct destructive examinations. Destructive examinations consist of cutting containers open to take samples of and analyze the gases inside and examining the containers themselves for indications of corrosion. In addition, destructive examination allows plutonium inside the container to be analyzed to detect any changes in the plutonium's condition. Building 235-F also currently lacks the capability to restabilize and repackage plutonium.

In addition, Building 235-F faced several other challenges that would have affected its ability to monitor plutonium. Because of changes in the design basis threat, Building 235-F would not have had sufficient security to store Category I quantities of plutonium.⁵ SRS officials estimate that 972 storage containers contain Category I quantities of plutonium metal. Although these storage containers are at relatively low risk for rupture, SRS would have been unable to remove those containers from Building 105-K to monitor their condition. According to SRS officials, security measures could have been established in Building 235-F if a safety issue had arisen that required opening a Category I container.

⁴Sand filters are large, deep beds installed in underground concrete enclosures and filled with up to 10 feet of rock, gravel, and sand. As air flows upward through the bed, the rock, gravel, and sand filter out plutonium and other chemicals. The decontaminated air can then flow into the outside atmosphere. Sand filters have been used in U.S. nuclear facilities since 1948. Although initially expensive, sand filters can remove a large amount of radioactive material, require relatively little maintenance, and are fire resistant.

⁵Category I material includes specified quantities of plutonium or highly enriched uranium in the following forms: (1) assembled nuclear weapons and test devices; (2) pure products containing higher concentrations of plutonium or highly enriched uranium; and (3) high-grade materials, such as carbides, oxides, solutions, and nitrates. The risks associated with Category I special nuclear material vary but include the nuclear detonation of a weapon or test device at or near design yield, the creation of improvised nuclear devices capable of producing a nuclear yield, theft for use in a nuclear weapon, and the potential for sabotage in the form of radioactive dispersal.

Furthermore, the Safety Board identified a number of serious safety concerns with Building 235-F. Specifically, the Safety Board reported the following:

- The building lacks fire suppression systems, and many areas of the building lack fire detection and alarm systems.
- The building's nuclear criticality accident alarm system has been removed. A nuclear criticality accident occurs when enough fissile material, such as plutonium, is brought together to cause a sustained nuclear chain reaction. The immediate result of a nuclear criticality accident is the production of an uncontrolled and unpredictable radiation source that can be lethal to people who are nearby.
- A number of the building's safety systems depend upon electrical cables that are approximately 50 years old and have exceeded their estimated life. When electrical cables age, they become brittle and may crack, increasing the potential for failure.
- SRS has discovered two areas in the soil near the building that could present a hazard in the event of an earthquake.
- The building's ventilation system still contains plutonium from its previous mission of producing plutonium heat sources to power space probes. This highly radioactive plutonium could be released, for example, during a fire or earthquake and could pose a hazard to workers in the building.

Once again, DOE's monitoring challenges demonstrate its failure to adequately plan for plutonium consolidation. Instead of a comprehensive strategy that assessed the monitoring capabilities needed to meet its storage standard, DOE's plans went from constructing a state-of-the-art storage and monitoring facility to using a building that the Safety Board had significant concerns with. Moreover, DOE's plans have subsequently changed again. In April 2005, after spending over \$15 million to begin modifications to Building 235-F, DOE announced that it would only use the building to monitor plutonium temporarily. Now, DOE plans to install the necessary safety systems and monitoring equipment in Building 105-K, a 50-year-old building that was not designed for such functions. This decision underscores that DOE's lack of careful planning has forced SRS to focus on what can be done with existing facilities, eliminating options that could have been both more cost-effective and safer than current plans.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions that you or Members of the Subcommittee may have.

GAO Contact and Staff Acknowledgments

For further information on this testimony, please contact Gene Aloise at (202) 512-3841 or aloisee@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this statement. Sherry McDonald, Assistant Director; and Ryan T. Coles made key contributions to this testimony.

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