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NUCLEAR WASTE

Disposal Challenges and Lessons Learned from Yucca Mountain

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Natural Resources and Environment

June 1, 2011

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Highlights

Highlights of GAO-11-731T, a testimony before the Subcommittee on Environment and the Economy, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

The United States has generated over 75,000 metric tons of spent nuclear fuel and high-level nuclear waste—extremely hazardous substances—at 80 sites in 35 states and is expected to more than double that amount by 2055. The Nuclear Waste Policy Act of 1982 (NWPA) required the Department of Energy (DOE) to investigate a geologic repository for nuclear waste. In 1987, Congress amended NWPA to direct DOE to focus on a repository at Yucca Mountain, Nevada. In 2008, DOE submitted a license application for the repository but in March 2010 moved to withdraw it. However, the Nuclear Regulatory Commission (NRC) or the courts—as a result of federal lawsuits—might compel DOE to resume the licensing process. GAO has reported on options for interim storage of this waste and the effects a Yucca Mountain termination could have on both commercial waste and DOE-managed waste. This testimony is based on that prior work and discusses (1) the status of the Yucca Mountain repository and national policy for nuclear waste disposal, (2) options for storing nuclear waste and their benefits and challenges, and (3) principal lessons that can be learned from past nuclear waste management efforts.

What GAO Recommends

GAO is making no new recommendations at this time and continues to believe that implementing the recommendations in its March (GAO-11-230) and April 2011 (GAO-11-229) reports could improve DOE's efforts to manage and store nuclear waste.

View GAO-11-731T or key components. For more information, contact Mark Gaffigan at (202) 512-3841 or gaffiganm@gao.gov

What GAO Found

Uncertainties exist about the direction of the nation's policy for nuclear waste disposal. Under NWPA, DOE investigated Yucca Mountain as a site for a repository. In 2002, DOE recommended the site to the President and in 2008 submitted a license application to NRC. DOE is now seeking to withdraw the application from NRC's Atomic Safety and Licensing Board. DOE did not cite technical or safety issues but stated that Yucca Mountain is not a workable option because of a lack of public acceptance by the people of Nevada. On June 29, 2010, the board denied DOE's motion, ruling that NWPA requires DOE to continue the licensing effort. The NRC commissioners announced they might consider reviewing the board's decision, but as of May 26, 2011, no review had been announced. Separately, state and local governments and a private party filed suit in federal court against DOE and NRC in an effort to stop the repository termination. The court has not yet ruled. Amid this uncertainty, DOE took steps to shut down Yucca Mountain by September 30, 2010. DOE also established a Blue Ribbon Commission to evaluate alternatives for nuclear waste disposal, which plans to report by January 2012.

Three primary waste storage options offer benefits but also face challenges, including high costs. Two options are for interim storage—continued on-site or centralized storage—which could allow time for research into new approaches that might have wider public acceptance than the Yucca Mountain permanent repository. Continued on-site storage would require less effort to implement since it is the current method of waste storage. However, this option could trigger significant financial liabilities as a result of industry lawsuits stemming from DOE's failure to accept the waste in 1998, as required under NWPA. The federal government has already paid $956 million, and future liabilities are estimated to be at least $15.4 billion through 2020. DOE and the Navy also might not meet certain commitments to remove their waste from two states, which could bring penalties and a suspension of the Navy's shipments of spent fuel, raising concerns about the Navy's ability to refuel its nuclear-powered warships. The second interim option, centralized interim storage, may face challenges because DOE states that it currently has no authority to implement this option. The third option, a geologic repository, is widely considered the only currently feasible option for permanently disposing of nuclear waste. DOE has faced challenges in identifying an acceptable site for permanent geologic disposal. Restarting the search would likely take decades and cost billions of dollars.

Published reports and interviews—with federal, state, and local government officials and representatives of various organizations—suggest two broad lessons that can be learned from past nuclear waste management efforts. First, transparency, economic incentives, and education are important tools for gaining public acceptance. Second, it is important for any waste management strategy to have consistent policy, funding, and leadership, particularly since the process will take decades. An independent organization with a more predictable funding mechanism may be better suited than DOE to oversee nuclear waste management.

Chairman Shimkus, Ranking Member Green, and Members of the Subcommittee:

I am pleased to be here today to discuss our recent work evaluating efforts to manage and store spent nuclear fuel and high-level nuclear waste in the United States. Nuclear energy generates about 20 percent of the nation's electric power and, as a domestic source of electricity with low emissions, is a critical part of our energy infrastructure. In addition, military use of nuclear material—in nuclear weapons and nuclear-powered warships—plays a vital role in our national defense. However, both of these activities generate nuclear waste—referred to as spent nuclear fuel in the case of fuel removed from a reactor and as high-level waste for material that is a by-product of weapons production and other defense-related activities. This nuclear waste has been accumulating since the mid-1940s and currently totals over 75,000 metric tons at 80 sites in 35 states, enough to fill a football field about 15 feet deep. Furthermore, this waste is expected to increase by about 2,000 metric tons per year, more than doubling, to 153,000 metric tons by 2055.[1]

Although these nuclear technologies have been in use for decades, the United States has yet to implement a plan for permanently disposing of its nuclear waste. Since the publication of a 1957 report by the National Academy of Sciences, a geological repository[2] has been considered the safest and most secure method of disposing of nuclear waste. During the 1960s and 1970s, the United States embarked on several efforts to evaluate potential disposal sites for a permanent repository but no repository resulted from these efforts. Then, in the 1980s, the Nuclear Waste Policy Act of 1982 (NWPA) established a federal policy for the disposal of spent nuclear fuel and high-level waste. Under NWPA, the Department of Energy (DOE) was directed with investigating sites for a federal deep geologic repository to dispose of spent nuclear fuel and high-level nuclear waste. In 1987, Congress amended NWPA to direct DOE to focus its effort solely on Yucca Mountain—a site about 100 miles northwest of Las Vegas, Nevada.

[1]The majority of this nuclear waste is expected to be spent nuclear fuel from commercial operators. An estimated 13,000 metric tons of this waste, however, is managed by DOE at five of its sites. Existing nuclear waste already exceeds the 70,000 metric ton capacity of the proposed Yucca Mountain repository.

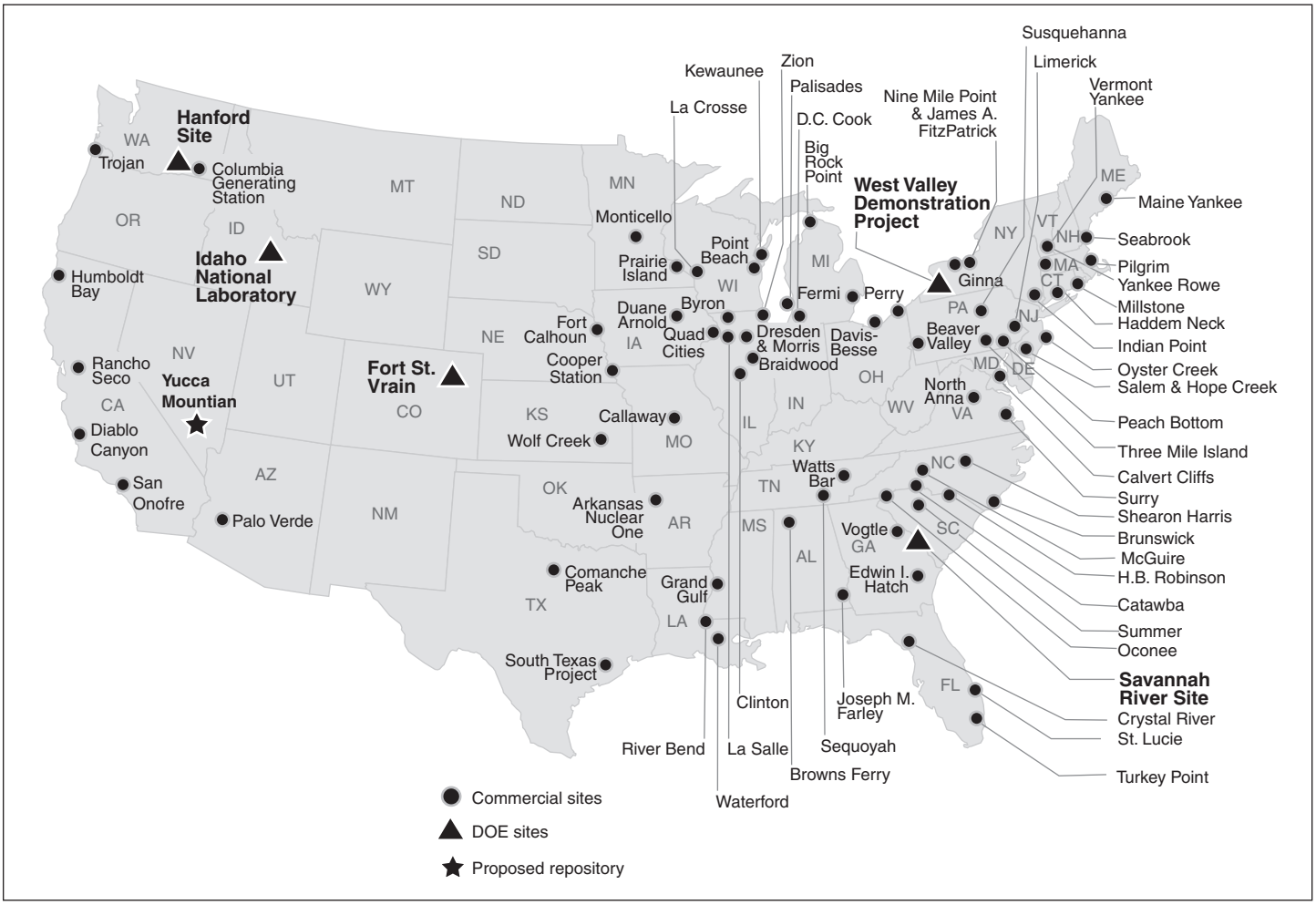
[2]According to NRC, a geological repository is an excavated, underground facility that is designed, constructed and operated for safe and secure permanent disposal of high-level radioactive waste.

After more than 2 decades and spending nearly $15 billion,[3] in 2008, DOE submitted a license application to the Nuclear Regulatory Commission (NRC) seeking authorization to construct a high-level waste repository at Yucca Mountain.[4] DOE planned to open the repository in 2017, although it later delayed the planned opening date to 2020 (see fig. 1 for the current storage sites and proposed repository).

[3]All costs are in constant 2010 dollars, unless otherwise noted. Numbers taken from our 2009 report on Yucca Mountain and potential alternatives were estimated in 2009 constant dollars and are reported with no further change. See GAO, *Nuclear Waste Management: Key Attributes, Challenges, and Costs for the Yucca Mountain Repository and Two Potential Alternatives*, GAO-10-48 (Washington, D.C.: Nov. 4, 2009).

[4]NRC has regulatory authority to authorize the construction of a repository as well as its operations and closure.

Figure 1: Current Storage Sites and Proposed Repository for High-Level Nuclear Waste



Source: DOE.

Note: Locations are approximate. DOE has reported that it is responsible for managing nuclear waste at additional sites but these generally include research reactors that generate small amounts of waste that will be consolidated at the Idaho National Laboratory for packaging prior to disposal.

In March 2009, however, the Secretary of Energy announced plans to terminate the Yucca Mountain repository program and instead study other options for nuclear waste management. The President's fiscal year 2011 budget proposed eliminating all funding for the program, including the DOE office that managed it, the Office of Civilian Radioactive Waste

Management. The administration directed DOE to establish a Blue Ribbon Commission[5] of recognized experts to study nuclear waste management alternatives. The commission is scheduled to issue a final report by January 2012.

My testimony is based on three of our recently issued reports on the storage of spent nuclear fuel and high-level nuclear waste,[6] updated with recent information from DOE, NRC, federal court proceedings, and the Blue Ribbon Commission's preliminary recommendations. It addresses (1) the status of the Yucca Mountain repository and national policy for nuclear waste disposal, (2) options for storing spent nuclear fuel and high-level nuclear waste and the key benefits and challenges of each option, and (3) the principal lessons learned from past nuclear waste management efforts and how these lessons might be applied to future efforts. A detailed description of our methodologies can be found in our published reports. We conducted this work in accordance with generally accepted government auditing standards.

Background

Spent nuclear fuel and high-level nuclear waste are considered some of the most hazardous substances on earth. Without protective shielding, the intense radioactivity can kill a person immediately or cause cancer for those who receive smaller doses. Nuclear waste can remain radioactively dangerous for tens of thousands of years. This waste is the result of both commercial and noncommercial activities.

The majority of spent nuclear fuel is generated from commercial power plant operations. After the nuclear fuel is used, or "spent," and removed from the reactors, operators must actively manage the spent nuclear fuel by isolating and continually monitoring it to keep humans and the environment safe. Most spent nuclear fuel is stored at operating reactor sites, immersed in pools of water designed to cool it and isolate it from the environment. With no offsite storage or disposal option for the spent nuclear fuel, some of the racks in the pools holding spent nuclear fuel

[5]The President directed the creation of the Blue Ribbon Commission on America's Nuclear Future in January 2010.

[6]GAO, *Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned*, GAO-11-229 (Washington, D.C.: Apr. 8, 2011); *DOE Nuclear Waste: Better Information Needed on Waste Storage at DOE Sites as a Result of Yucca Mountain Shutdown*, GAO-11-230 (Washington, D.C.: Mar. 23, 2011); GAO-10-48.

have been be rearranged to allow for more dense storage. Despite this re-racking, spent nuclear fuel pools in the United States are reaching their capacities. Even before the March 2011 earthquake and tsunami in Japan that resulted in the release of radiation from the damaged reactors at Fukushima Daiichi Nuclear Power Station, concerns had been expressed about the possibility of an accident involving radiation release. The concerns were that an overcrowded spent nuclear fuel pool could release large amounts of radiation if an accident or other event caused the pool to lose water, potentially leading to a fire that could disperse radioactive material. As U.S. reactor operators have run out of space in their spent nuclear fuel pools, they have turned in increasing numbers to dry cask storage systems, which generally consist of stainless steel canisters placed inside larger stainless steel or concrete casks and stored outside the pools on concrete pads. Without a final disposition pathway, this commercial spent nuclear fuel generally remains where it was generated, including nine sites where the reactors have been decommissioned.[7]

In addition to spent nuclear fuel generated from commercial purposes, DOE manages an inventory of about 13,000 metric tons of spent nuclear fuel and high-level nuclear waste at five DOE sites. From 1944 until the 1980s, the United States used nuclear reactors to produce plutonium and other materials for nuclear weapons. As a result of these activities, after the shutdown of weapons production and of some reprocessing plants at the end of the Cold War, DOE retained an inventory of spent nuclear fuel that had not been reprocessed, as well as high-level nuclear waste—which is one of the byproducts of reprocessing. Weapons production and related defense activities—such as the reprocessing of the Navy's spent nuclear fuel to produce new fuel, which also created high-level nuclear waste—are the source of about 87 percent of DOE's inventory of spent nuclear fuel and almost its entire inventory of high-level waste. Because weapons production and reprocessing of the Navy's spent nuclear fuel have ended, DOE's inventories of this waste are largely fixed.

DOE is also responsible for managing nuclear waste from a variety of other sources. For example, DOE is responsible for managing spent

[7]Not only is DOE responsible for spent nuclear fuel and high-level waste, but also so-called greater than class C nuclear waste. The nation generates greater than class C nuclear waste from the maintenance and decommissioning of nuclear power plants, from radioactive materials that were once used for food irradiation or for medical purposes, and from miscellaneous radioactive waste, such as contaminated equipment from industrial research and development. DOE is required to dispose of this nuclear waste.

nuclear fuel from the Navy through the Naval Nuclear Propulsion Program, which is jointly operated by DOE and the Navy. The remainder of DOE's inventory of nuclear waste comes from various nondefense sources, including research activities and foreign research reactors. The United States operates a program to take custody of spent nuclear fuel from foreign research reactors, which supports a U.S. policy to prevent the proliferation of nuclear weapons; this program is scheduled for completion in 2019. In general, DOE stores this waste at five sites: the Hanford Site in Washington state, the Savannah River Site in South Carolina, Idaho National Laboratory in Idaho, the Fort St. Vrain Site in Colorado, and the West Valley Site in New York.[8] As with commercial sites, DOE currently stores spent nuclear fuel in either cooling ponds or dry cask storage. Much of the high-level nuclear waste is currently stored in liquid or semiliquid form in large underground tanks and requires further processing before it can be safely stored or disposed of.

The Status of the Yucca Mountain Repository

Uncertainties exist about the direction of the nation's policy for nuclear waste disposal. Under NWPA, as amended, Yucca Mountain is the only site that DOE is to investigate for suitability as a permanent nuclear waste repository. DOE investigated Yucca Mountain; in 2002 recommended the site to the President; and in 2008 submitted a license application to NRC. On March 3, 2010, however, DOE submitted a motion to NRC's Atomic Safety and Licensing Board to withdraw its application with prejudice, which DOE said would mean that the Yucca Mountain site would be excluded from further consideration as a repository. DOE did not cite technical or safety issues as the reason for its decision to withdraw the license application. In a May 2010 reply DOE filed before NRC's Atomic Safety and Licensing Board, the department explained that the Secretary's judgment is not that Yucca Mountain is unsafe or that there are flaws in the license application, but rather that Yucca Mountain is not a workable option and that alternatives will better serve the public interest. DOE stated that a key aspect of the problem was the continuing lack of public support for the repository among the people of the state of Nevada and that public acceptance is a key component of a workable solution to permanent disposal of nuclear waste.

[8]DOE has reported that it is responsible for managing nuclear waste at additional sites but these generally include research reactors that generate small amounts of waste that will be consolidated at the Idaho National Laboratory for packaging prior to disposal.

On June 29, 2010, the licensing board denied DOE's motion, ruling that DOE was obligated under NWPA, as amended, to continue with the licensing effort. On June 30, 2010, the day after the Atomic Safety and Licensing Board denied DOE's motion to withdraw its license application with prejudice, the NRC commissioners issued an order inviting parties—including the state of Nevada, local counties, and industry—to file briefs addressing whether the commissioners should review the board's decision and, if so, whether they should uphold or reverse it. As of May 26, 2011, however, the commissioners have yet to announce whether they plan to review the board's decision.

Separately, the states of South Carolina and Washington, Aiken County in South Carolina, and a private party have sued DOE and NRC, arguing that DOE had no authority to terminate the proposed Yucca Mountain repository. The U.S. District Court of Appeals for the District of Columbia Circuit, which is hearing the lawsuits, initially decided to stay its proceedings until the NRC commissioners ruled on the board's decision but agreed to hear oral arguments on March 22, 2011. As of May 27, 2011, the court has not ruled on the case. The Atomic Safety and Licensing Board, with no further input from the NRC commissioners or federal courts, announced its intention to continue with its consideration of the challenges to the license application. In these proceedings, the board will consider approximately 300 contentions submitted by stakeholders questioning certain aspects of DOE's license application and related participant filings and evidence. It is not yet clear whether NRC or the court will rule that the license application review process should resume.

Amid uncertainties about the status of the repository license, DOE took steps to shut down the Yucca Mountain program and the Office of Civilian Radioactive Waste Management by September 30, 2010, when funding would have ended under the President's budget proposal. Specifically, DOE eliminated the jobs of all federal employees working on the program, terminated program activities by contractors, and disposed of office and other equipment. DOE took steps to preserve scientific and other data, including data stored in the Licensing Support Network. The data in this network had been maintained and made accessible to others through the NRC Web site. The network facilitates the exchange of documents among the parties involved in the review process by making the parties' documents publicly accessible over the internet. However, NRC's Licensing Support Network Administrator stated that, under the administration's budget proposal for fiscal year 2012, the NRC's Licensing Support Network faces a shutdown on October 1, 2011, and would no longer be accessible by scientists and the public. In response, the Atomic

Safety and Licensing Board expressed concerns that the Licensing Support Network might no longer be available as it considers challenges to the license application. On April 11, 2011, the board ordered parties involved in the review process to preserve all the Licensing Support Network documents in "PDF" format and submit them to NRC by August 31, 2011, for inclusion in its publicly accessible database called the Agencywide Documents Access and Management System or ADAMS. On April 21, 2011, NRC filed a motion to the board that asked the board to reconsider its order due to the unanticipated expense. As of May 26, 2011, the board has not ruled on the motion. Separately, a DOE official stated that it had already planned to make its Licensing Support Network documents available to the public upon written request.

In our April 2011 report,[9] we raised concerns about DOE's lack of a formal approved plan to guide shutdown activities or assess related risks, given the uncertainty about whether DOE will be compelled by either NRC or the courts to resume the license application review process. Both federal internal control standards and DOE orders require that DOE sufficiently plan for major activities—including shutdowns—and assess the risks of these activities. DOE officials stated that they held frequent meetings and focus groups to help guide the shutdown. DOE's Inspector General, in a report, also expressed concern about the lack of a formal plan, given the scope and complexity of the shutdown and the possible effects on areas such as the preservation of intellectual, scientific, and technological information and on the disposition of property.[10] In addition, as we reported, the loss of staff with experience at Yucca Mountain could hinder the license review if the process is resumed. Furthermore, several DOE and NRC officials and industry representatives said that ending the license review process before allowing NRC to review the merits of the application represented a loss of potentially valuable information that might have been useful in the search and licensing of an alternate site.

DOE plans to wait for the Blue Ribbon Commission's final recommendations, before deciding on a direction for future nuclear waste storage efforts. In the meantime, it is not clear whether or how the nation's nuclear waste policy will change. The commission has taken steps to

[9]GAO-11-229.

[10]DOE Office of Inspector General, *Special Report: Need for Enhanced Surveillance During the Yucca Mountain Project Shut Down*, OAS-SR-10-01 (Washington, D.C.: July 2010).

identify alternatives to meet the nation's nuclear waste storage needs. After receiving input from numerous experts and sources, on May 13, 2011, at a public meeting, the commission subcommittees released draft recommendations for public comment. At this meeting, each of the three subcommittees—disposal, reactor and fuel cycle technology, and transportation and storage—presented preliminary recommendations from its draft report to the rest of the commission and the public. The disposal subcommittee's preliminary recommendation stated that geologic disposal is the most promising and technically accepted option available for safely isolating high-level nuclear wastes for very long periods of time and will be needed under all reasonably foreseeable scenarios, a recommendation that echoes a 1957 National Academy of Sciences study. Until geologic disposal is available, the transportation and storage subcommittee's preliminary recommendation was to establish one or more centralized interim storage facilities. According to the commission's Web site, the subcommittees will now revisit their draft reports as necessary and will issue those draft reports for public comment by the end of May.

Each Storage Option Offers Benefits but Poses Challenges, Including High Costs

The three primary nuclear waste storage and disposal options we have reported on—continued on-site storage, interim storage at a centralized facility, and permanent disposal in a geologic repository[11]—offer benefits as well as challenges, including significant costs. Two of the options—which could be used in the interim before permanent disposal is available—provide the nation with additional time to seek approaches to nuclear waste management and disposal that might achieve broader acceptance than the Yucca Mountain permanent repository. NRC has stated that continued on-site storage is safe for up to 60 years beyond the life of a reactor, and at DOE sites storing spent nuclear fuel regulated by NRC. Interim storage in general comes with benefits and challenges. DOE has stated that recent advances in dry cask storage systems allow spent nuclear fuel to be stored above ground for as long as 300 years. Another benefit is that nuclear waste in continued on-site storage or interim centralized storage is more easily retrievable. Easy retrieval is important when considering approaches, such as reprocessing, a process that could eventually be used to recycle parts of the spent nuclear fuel for further power production. An important challenge, however, is that interim storage is not a permanent solution and would require active controls, such as continued monitoring and security measures to prevent human

[11]GAO-10-48.

and environmental exposure. In addition, nuclear waste in interim storage may need to be repackaged after 100 years, at a cost of $180 million to $500 million.[12] Furthermore, interim storage, if used for a long time period, would pass responsibility for a permanent solution to future generations, who may not be willing or able to either maintain the interim storage facilities or to develop and implement some permanent waste management solution.

Continued on-site storage. We have reported on the following benefits of continued on-site storage:

- Requires minimal near-term effort. Continued on-site storage is the de facto approach for managing nuclear waste.
- Reduces transportation risks. The waste will only have to be transported once, to a final disposal site, and it will become cooler and less radioactive over time.

Continued on-site storage also presents challenges, including the following:

- The continued on-site storage option, assuming geologic disposal in 100 years, would cost from $20 billion to $97 billion.[13] It would also result in costs to the federal government such as
  - exposure to liabilities resulting from lawsuits against DOE, which committed to take custody of commercial nuclear waste in 1998, as required by NWPA, as amended. The federal government has paid $956 million through the Department of Treasury's judgment fund, and DOE estimates future liability to be about $15.4 billion through 2020, plus $500 million every year after that.[14]
  - potential penalties of $75,000 per day, or about $27.4 million per year if DOE and the Navy fail to meet commitments to remove their spent

[12]GAO-11-229.

[13]GAO-10-48.

[14]All liability and penalty values are in current dollars. Not all of the lawsuits have been resolved. Also, the Department of Justice has already incurred over $168 million through fiscal year 2010 to defend DOE in litigation. With ongoing litigation, these costs will continue.

nuclear fuel from DOE-sites in Idaho and Colorado by January 1, 2035.

- DOE will likely incur costs of $918 million to maintain storage at DOE sites if its waste remained there through 2040, and another $300 million for additional storage at the Hanford Site.[15]

- likely repackaging of spent nuclear fuel if it is stored in dry-casks for over 100 years, at a potential cost of $180 million to $500 million.[16]

- it could contribute to community opposition to license extensions of currently operating reactors or license applications for new reactors.

- It could raise national security concerns, according to Navy officials, if Idaho can suspend further shipments of Navy spent nuclear fuel to DOE's Idaho site until the agreement with the state for removal of such fuel is met, because the Navy depends on this site as part of the process of refueling its nuclear warships.

Interim storage at a centralized facility. Potential benefits of centralized interim storage include the following:

- Nuclear waste from decommissioned reactors could be consolidated, decreasing the complexity of monitoring and securing the waste and freeing the land for other uses.

- DOE could fulfill its obligation to take custody of spent nuclear fuel until a long-term strategy is implemented, thus avoiding additional liabilities as the result of lawsuits.

- Reactor operators may choose to thin out spent nuclear fuel assemblies from densely packed pools, which could reduce risk and may save reactor operators the cost of building dry storage cask systems at each reactor location.

Centralized interim storage also poses challenges, including the following:

[15]GAO-11-230. The costs we previously reported include earlier estimates of these costs.

[16]GAO-11-229. We also previously reported estimates of these costs in a 500-year projection in GAO-10-48.

- Interim storage could take years to site and construct. We have reported that a federal centralized storage option with two locations, assuming geologic disposal in 100 years, would take about 19 years to implement and would cost from $23 billion to $81 billion, although private industry could likely develop centralized interim storage in less time and for less cost.[17]

- Provisions in NWPA, as amended, that would allow DOE to arrange for centralized storage have either expired or are unusable because they are tied to milestones in repository development that have not been met.[18]

- A centralized storage facility will likely face intense state or local opposition, particularly if there is no final disposition pathway or other benefits that would accompany it. Even if a local community supported a centralized storage facility, a state may not.

- Any nuclear waste stored at a centralized site could create increased safety concerns because it would have to be transported twice—once to the centralized site and from there to a repository.

Permanent disposal in a geologic repository. Experts generally agree that, based on current technology, the only safe and secure permanent solution for nuclear waste is disposal in a geologic repository. We drew this conclusion in our November 2009 report, as did the National Research Council in 2001 and the Blue Ribbon Commission in 2011 in their respective publications. Other permanent disposal options—such as narrow shafts bored deep into the ground—could be feasible, but face cost or technical constraints. Technologies are available that could reduce the radioactivity or volume of spent nuclear fuel—namely, reprocessing and advanced reactors—but they do not eliminate the need for a geologic repository. The National Research Council of the National Academies reported that developing other alternatives is not likely for the foreseeable future.

[17]GAO-10-48.

[18]DOE acknowledged that the Atomic Energy Act of 1954, as amended, does provide the authority for DOE to accept and store spent nuclear fuel under certain circumstances, and DOE has done so in the past, such as U.S.-supplied spent nuclear fuel from foreign reactors, as well as damaged and spent nuclear fuel from the Three Mile Island reactor site. However, DOE asserts that NWPA's detailed statutory scheme limits its authority to accept spent nuclear fuel under Atomic Energy Act authority except in compelling circumstances, such as an emergency involving spent nuclear fuel threatening public health.

Key challenges to a geologic repository are the cost and time required to site and build it and the need to gain public acceptance for the project. The nation has already spent nearly $15 billion on developing a repository and, as we reported in November 2009, completing, operating, and closing the Yucca Mountain repository would likely have cost between $41 billion and $67 billion more. If the nation halts the effort at Yucca Mountain, it will need to restart the search for an alternate repository or other solution and, based on past experience, this could take decades, cost billions of dollars, and face public opposition. Although some past efforts have had local community support, they have also faced public opposition, including Yucca Mountain.

Principal Lessons Learned That Could Facilitate Future Nuclear Waste Storage or Disposal Efforts

Our review of reports and interviews with DOE and NRC officials and representatives of various national associations, local and state governments, and community organizations, suggest two broad lessons for future waste storage or disposal efforts. First, overcoming social and political opposition and gaining public acceptance is crucial, and the federal government has several tools for doing so. One important tool is cooperation with key stakeholders, as we reported[19] and the Blue Ribbon Commission stated in its most recent public meeting, on May 13, 2011. Specifically, in our April 2011 report, we cited the need for the federal government to involve stakeholders but also to be transparent and cooperative. Similarly, in its preliminary recommendations for public comment, the Blue Ribbon Commission stated that all affected levels of government must have, at a minimum, a meaningful consultative role in important decisions. As state government officials told us, if local communities or states feel that the federal government is not willing to address their concerns in a transparent way, they will be less inclined to work cooperatively with the federal government. Another important factor is allowing states to have an oversight role. One reason for the success of the Waste Isolation Pilot Plant—a permanent repository for transuranic waste[20] in New Mexico—was that DOE conceded some of its authority to the state and worked collaboratively with state officials. States are important partly because they have broader constituencies than local

[19]GAO-11-229.

[20]The Waste Isolation Pilot Plant was designed to accept transuranic waste, not spent nuclear fuel. Generally, transuranic waste consists of clothing, tools, rags, residues, debris, soil, and other items contaminated with radioactive elements heavier than uranium, mostly plutonium, as a result of work related to the defense industry.

communities and are more likely to raise objections. Other considerations for overcoming social and political opposition include long-term incentives and education. Substantial, long-term federal investments in the host community and state can help win support by keeping key parties committed to a repository over the several decades of development. Education has also helped foster public acceptance. For example, DOE's contractor at the Waste Isolation Pilot Plant gained public acceptance through education and training programs on the safe transportation of radioactive waste. One important aspect of education has been to dispel the inaccurate perception that nuclear waste poses risks comparable to nuclear weapons.

A second broad lesson is that, in developing storage or disposal options, it is important to have consistent policy, funding, and leadership, since any such effort will take decades. We reported in April 2011 that policies must be credible and consistent to be effectively implemented and that inconsistent policies may contribute to public opposition.[21] Stakeholders told us that the siting process and safety standards changed over time at both the Waste Isolation Pilot Plant and Yucca Mountain, contributing to public opposition. Similarly, a program should also have consistent funding. The Office of Civilian Radioactive Waste Management budget was not predictable and varied by as much as 20 percent from year to year, with an average annual shortfall of appropriations from its budget requests of about $90 million each year. Stakeholders, including former DOE officials, told us that this made long-term planning difficult. Finally, continuity in leadership can help address societal and public opposition to a repository. In contrast, the Office of Civilian Radioactive Waste Management operated with a revolving-door style of management; it had 17 directors over 27 years, hurting relationships with local and state governments. Just as important, according to some former DOE officials and industry representatives, the program was not always a high priority and the quality of managers running the program varied. Some stakeholders said this illustrated a lack of commitment and undermined public trust.

Because the nation has not resolved how to manage spent nuclear fuel and high-level waste and because any future endeavor is likely to take decades and cost billions of dollars more, in our April 2011 report we raised matters Congress may wish to consider to improve the success of future

[21] GAO-11-229.

nuclear waste disposal efforts. Specifically, Congress may wish to consider whether a more predictable funding mechanism and an independent organization, outside of DOE, may be more effective in developing a permanent solution to nuclear waste management. In addition, because DOE shut down the Yucca Mountain repository without planning for continuing work on it, should it be compelled to do so, we recommended that the Secretary of Energy assess the risks of shutting down the repository and develop a preliminary plan for restarting work on it. In addition, because DOE had not planned for long-term storage, in our March 2011 report on DOE-managed waste, we recommended that DOE assess the condition of existing nuclear waste storage facilities and identify any gaps and actions that might be needed to address long-term storage requirements.

Chairman Shimkus, this concludes my prepared statement. I would be pleased to answer any questions that you, Ranking Member Green, or other Members of the Subcommittee may have at this time.

GAO Contacts and Staff Acknowledgments

For further information about this testimony, please contact Mark Gaffigan at (202) 512-3841 or gaffiganm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. Janet Frisch, Assistant Director, and Gene Aloise, Kevin Bray, Terry Hanford, Cristian Ion, Mehrzad Nadji, Robert Sanchez, Ben Shouse, and Kiki Theodoropoulos made key contributions to this statement.

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