



Testimony

Before the Committee on Energy and
Natural Resources, United States Senate

For Release on Delivery
Expected at 10:00 a.m. EDT
Thursday, September 30, 2004

**LOW-LEVEL
RADIOACTIVE WASTE**

**Future Waste Volumes and
Disposal Options Are
Uncertain**

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Natural Resources and Environment



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Highlights

Highlights of [GAO-04-1097T](#), testimony before the Committee on Energy and Natural Resources, U.S. Senate

Why GAO Did This Study

Low-level radioactive waste (LLRW) management concerns persist despite the LLRW Policy Act of 1980, as amended, which made states responsible for providing for disposal of class A, B, and C LLRW and made the Department of Energy (DOE) responsible for the disposal of greater-than-class C LLRW. This testimony is based on GAO's June 2004 report, which examined the adequacy of disposal availability for class A, B, and C wastes, and GAO's April 2003 report, which assessed recovery efforts involving greater-than-class-C waste. This testimony examines (1) changes in LLRW disposal availability since 1999, (2) recent LLRW disposal volumes and potential future volumes, (3) any current or anticipated shortfalls in disposal availability, (4) the potential effects of any such shortfalls, (5) the effectiveness of the Act in developing regional disposal options for class A, B, and C wastes, and (6) the status of DOE's effort to dispose of greater-than-class-C waste.

What We Recommend

The reports recommended that DOE improve its database and the management of greater-than-class C wastes. DOE is implementing most of these recommendations. In addition, GAO suggested that the Congress may wish to consider directing the Nuclear Regulatory Commission to report if LLRW conditions change enough to warrant legislative intervention.

www.gao.gov/cgi-bin/getrpt?GAO-04-1097T.

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

LOW-LEVEL RADIOACTIVE WASTE

Future Waste Volumes and Disposal Options Are Uncertain

What GAO Found

GAO's June 2004 report identified several changes since 1999 that have affected, or might affect, LLRW disposal availability and federal oversight. Specifically, one disposal facility plans to close its doors to most states, but new options are evolving that might offset this shortfall.

According to data from the three commercial disposal facility operators, annual LLRW disposal volumes have increased in recent years. In conducting this assessment, GAO relied on data from the operators because DOE's national LLRW database was unreliable. The timing and volume of future waste needing disposal are uncertain because of the difficulty in forecasting disposal shipments from DOE and nuclear utilities.

At current LLRW disposal volumes, disposal availability for class A waste is not a problem in the short or longer term. Disposal availability appears adequate until mid-2008 for class B and C wastes when, if disposal conditions do not change, most states will not have a place to dispose of these wastes.

Nevertheless, users of radioactive materials can continue to minimize waste generation, process waste into safer forms, and store waste if there are no disposal options for class B and C wastes after 2008. While these approaches are costly, GAO did not identify other immediate widespread effects.

The Act has not resulted in the development of additional regional disposal capacity for class A, B, and C wastes. Factors limiting further development include less waste, adequate disposal capacity, rising development costs, and public and political resistance in states designated to host these facilities.

DOE has not yet provided a facility for the permanent disposal of greater-than-class-C waste, but it is collecting this material to address security concerns in the interim.

Lowering Radioactive Waste into a Concrete Barrier at a Commercial Disposal Facility



Source: US Ecology, Inc.

Mr. Chairman and Members of the Committee:

We are pleased to be here today to discuss our past and ongoing work on the management of low-level radioactive waste (LLRW). LLRW is an inevitable byproduct of nuclear power generation and of government, industrial, academic, and medical uses of radioisotopes. LLRW includes items such as rags, paper, liquid, glass, metal components, resins, filters, and protective clothing that have been exposed to radioactivity or contaminated with radioactive material. States' management of LLRW continues to be a concern despite two-decade-old federal legislation addressing the need for disposal. Under the LLRW Policy Act of 1980, as amended (the Act), each state is responsible for providing for disposal of LLRW generated within the state, either by itself or in cooperation with other states, with the exception of waste produced by the Department of Energy (DOE) and the nuclear propulsion component of the Department of Navy. The aim of the Act was to provide for more LLRW disposal capacity on a regional basis and to more equitably distribute responsibility for the management of LLRW among the states. As an incentive for states to manage waste on a regional basis, the Congress consented to the formation of interstate agreements, known as compacts, and granted compact member states the authority to exclude LLRW from other compacts or unaffiliated states.¹

The Nuclear Regulatory Commission (NRC) is responsible for licensing LLRW disposal sites and has divided the wastes covered by the Act into categories of increasing levels of hazard exposure, beginning with class A, followed by class B and C.² There are currently three commercial LLRW disposal facilities where these wastes can be disposed of—the Chem-Nuclear Systems facility in Barnwell County, South Carolina, the Envirocare facility in Tooele County, Utah, and the US Ecology facility in Benton County, Washington. DOE is responsible for disposing of a fourth category of LLRW, known as

¹ Generators of LLRW located in compact or unaffiliated states that do not have their own disposal facility can contract with a disposal facility in another compact if this compact allows them to do so.

² Radioactive waste is classified by type of radionuclide (e.g., americium-241) and concentration of radioactivity (often measured in curies per gram).

greater-than-class-C waste. This latter waste is not generally acceptable for disposal near the surface like the other three waste classes.

Our testimony today is based on two reports: (1) our June 2004 report in which we examined the adequacy of LLRW disposal availability for class A, B, and C wastes;³ this report updated a 1999 report, in which we found that states were not developing new disposal facilities and that within 10 years the only facility available to waste generators in most states for class B and C wastes could be full,⁴ and (2) an April 2003 report addressing the status of DOE's program to dispose of greater-than-class-C waste.⁵ As you requested, our testimony examines the findings and conclusions of these reports and offers a perspective on the effectiveness of the Act. Specifically, our testimony examines (1) changes in LLRW disposal since 1999 that we identified in our 2004 report, (2) recent LLRW disposal volumes and potential future volumes, (3) any current or anticipated shortfalls in disposal availability, (4) the potential effects of any such shortfalls, (5) the effectiveness of the Act in developing regional disposal options for class A, B, and C wastes, and (6) the status of DOE's effort to dispose of greater-than-class-C material.

In summary:

In June 2004, we identified several changes since 1999 that have affected, or might affect, LLRW disposal availability and federal oversight. These changes include South Carolina's decision to close the Barnwell facility to noncompact states by mid-2008, issuance of a license for the Envirocare facility to accept class B and C wastes pending approval by the Utah legislature and governor, the potential licensing of a new facility in Texas, and the state of Nebraska's litigation settlement with the Central Interstate Compact for renegeing on its compact obligations to build a new facility. We also

³ GAO, *Low-Level Radioactive Waste: Disposal Availability Adequate in the Short Term, but Oversight Needed to Identify Any Future Shortfalls*. GAO-04-604 (Washington, D.C.: June 9, 2004).

⁴ GAO, *Low-Level Radioactive Wastes: States Are Not Developing Disposal Facilities*, GAO/RCED-99-238 (Washington, D.C.: Sept. 17, 1999).

⁵ GAO, *Nuclear Nonproliferation: DOE Action Needed to Ensure Continued Recovery of Unwanted Sealed Radioactive Sources*. GAO-03-483 (Washington, D.C. April 15, 2003).

identified changes in federal agency monitoring of LLRW management. DOE no longer has appropriated funds to provide technical assistance to the states, and the annual requirement that DOE report to the Congress on LLRW disposal was terminated effective 2003. Furthermore, in the late 1990s, NRC decreased its involvement in LLRW because no disposal sites were being developed.

Annual LLRW disposal volumes have increased in recent years; however, the timing and level of future volumes needing disposal are uncertain. According to data provided by the three commercial LLRW disposal facility operators, disposal volumes grew to about 12 million cubic feet in 2003, an increase of 200 percent over 1999. Class A waste accounted for 99 percent of the disposal volume—DOE's cleanup program generated about 78 percent of the total class A waste. The Envirocare facility disposed of 99 percent of the nation's class A waste disposed of in commercial facilities in 2003 while the Barnwell facility disposed of 99 percent of the class B and C wastes that went to commercial disposal. We relied on data from these operators because the national LLRW database maintained by DOE lacked data on the department's waste shipped for commercial disposal and had other deficiencies. Even if the data problems are resolved, uncertainties will remain regarding the timing and volume of LLRW needing disposal in the future, which will largely depend on the disposal decisions made by DOE and nuclear utility companies.

There appears to be enough disposal availability to serve the nation's needs at least until mid-2008, when generators in many states might have a shortfall in disposal availability for their class B and C wastes. Disposal availability for class A waste is not a problem in the short or longer term, provided that the Envirocare facility continues in operation. According to Envirocare, the disposal facility can take 20 years or more of such waste under its current license. Capacity at the Barnwell and Richland facilities, which are licensed to accept all three classes of LLRW, is more than sufficient to serve the needs of the 14 states within the compacts served by these facilities. However, South Carolina has enacted legislation to terminate noncompact states' access to this facility after mid-

2008. This action will affect the 36 states that currently rely on Barnwell to dispose of their class B and C wastes but are not members of the Atlantic compact.

Users of radioactive materials can continue to minimize waste generation, process waste into safer forms, and store waste if there are no disposal options for class B and C wastes after 2008. These approaches, however, can be costly, with a higher financial burden on some licensees than others. Notwithstanding these business costs, we did not identify other effects of any shortfalls in disposal availability that might have wider implications.

The Act has not resulted in the development of additional regional disposal capacity for class A, B and C wastes. As we previously reported, several reasons account for this lack of progress: decreased waste generation, adequate disposal capacity, the rising cost of developing disposal facilities, and public and political resistance in states designated to host these facilities.

We reported in April 2003 on DOE's lack of progress in providing a permanent disposal facility for greater-than-class-C waste. DOE created the Off-Site Source Recovery Project as an interim step toward meeting its obligation under the Act. The project provides secure storage for material that could be particularly attractive for use in a radiological dispersion device, or "dirty bomb." As we reported, the project has experienced a number of problems. For example, we noted that DOE had inadequate capacity to store certain isotopes, particularly sources containing plutonium-239 that in sufficient quantity could be used to fabricate a crude nuclear weapon. Such sources, in some cases, were not being securely stored and most holders of the material expressed their desire to dispose of it as quickly as possible.

The two reports discussed in this testimony contained a number of recommendations. In our June 2004 report on disposal availability, we recommended that the Secretary of Energy halt the dissemination of information in its national LLRW database as long as the database has shortcomings in its usefulness and reliability. DOE decided to leave the

database online but has added a notice to users of the database regarding inaccuracies and is taking steps to identify and update erroneous data. Our report also suggested that the Congress might wish to consider directing NRC to report to it if LLRW disposal and storage conditions should change enough to warrant consideration of new legislation to improve the reliability and cost-effectiveness of disposal availability. Our April 2003 report on DOE's Off-Site Source Recovery Project recommended that DOE (1) determine whether the priority given to the recovery project was commensurate with the threat posed by greater-than-class-C sealed sources, (2) provide, as soon as possible, storage space for sealed sources containing the isotopes plutonium-239, strontium-90, and cesium-137 with the appropriate level of security, and (3) initiate the process to develop a permanent disposal facility for greater-than-class-C radioactive waste, develop a plan to help manage this process, and develop a plan to ensure the continued recovery and storage of greater-than-class-C sealed sources until such a disposal facility is available. As a result of our recommendation, DOE moved the program and realigned management responsibility for the project out of the Office of Environmental Management and into the National Nuclear Security Administration (NNSA) in order to better address the national security risks posed by these materials.⁶ To date, over 10,000 sources have been recovered, but more still need to be collected. In addition, DOE has added more storage space and is again recovering sources containing plutonium-239. DOE is also planning to conduct the initial environmental analysis required to develop a permanent disposal facility for this waste.

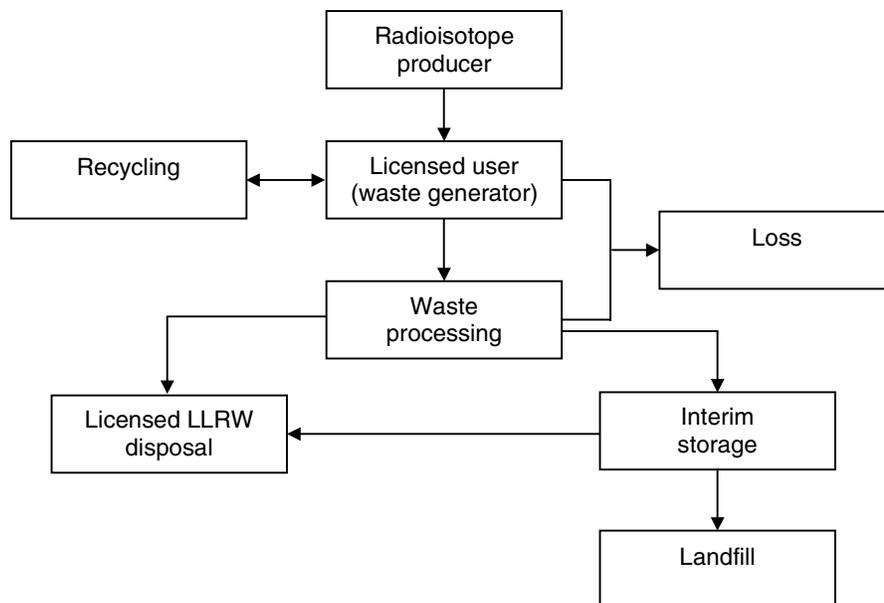
Background

The disposal of LLRW is the end of the radioactive material life cycle that spans production, use, processing, interim storage, and disposal. In general, the life cycle starts with the procurement of the radioactive isotopes that have medical, industrial, agricultural, and research applications. The isotopes come in either sealed or unsealed sources. While a metal container shields a sealed source, unsealed sources remain

⁶ NNSA has combined the recovery project with other nonproliferation activities under the U.S. Radiological Threat Reduction Program.

accessible in a glass vial or other type of container. Common uses of this radioactive material are in radiotherapy, radiography, smoke detectors, the irradiation and sterilization of food and materials, gauging, and illumination of emergency exit signs. In the course of working with these materials, other material, such as protective clothing and gloves, pipes, filters, and concrete that come in contact with them will become contaminated. The nuclear utility industry generates the bulk of this LLRW through the normal operation and maintenance of nuclear power plants, and through the decommissioning of these plants. Some sealed sources can be recycled for other uses that require less radioactivity. Once these materials have served their purpose, they become LLRW. Specialized companies or those licensed to use these materials can reduce the volume and sometimes the radioactivity level of the waste through processing before it is either put into a licensed interim storage or a disposal facility. After a period of storage, some LLRW can decay to the point that it is safe for disposal in regulated landfill sites. During the life cycle, there will also be some loss of radioactive materials to abandonment, misplacement and theft. Figure 1 diagrams the life-cycle process for radioactive materials.

Figure 1: Conceptual Flow Diagram of Radioactive Sources from Production to Disposal



Source: GAO.

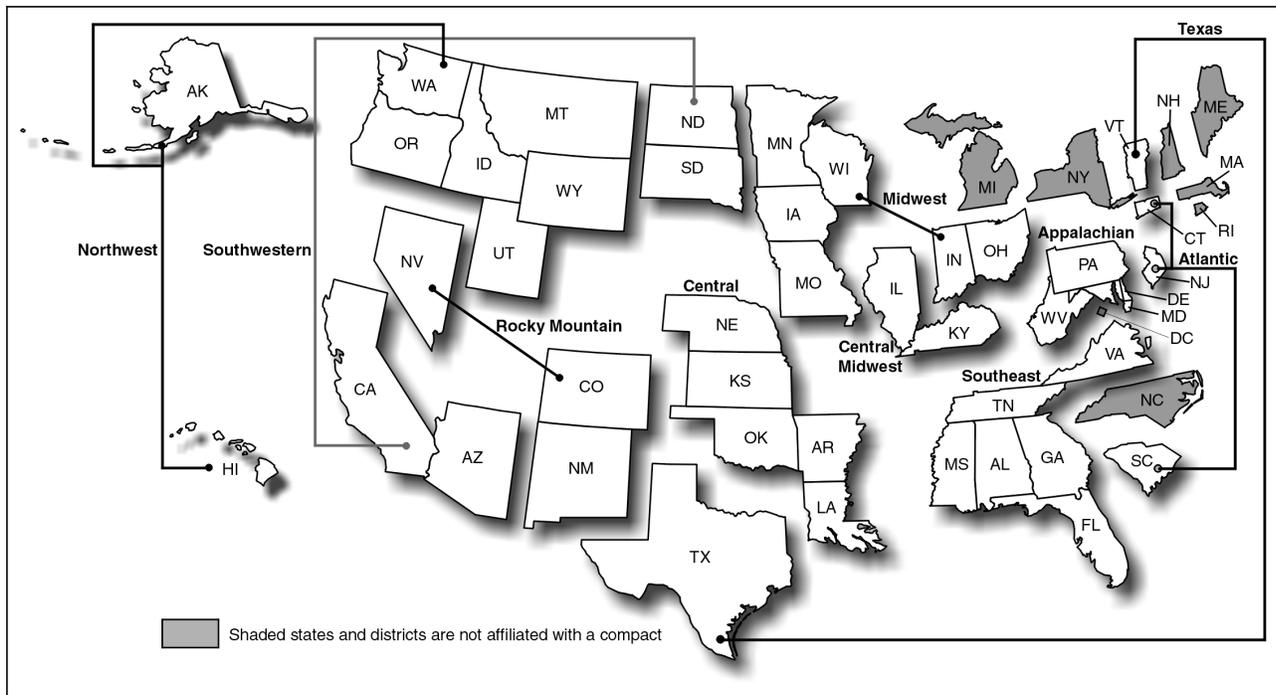
In the 1960s, the Atomic Energy Commission began to encourage the development of commercial LLRW disposal facilities to accommodate the increased volume of commercial waste that was being generated. Six such disposal facilities were licensed, two of which, the facility in Washington State, licensed in 1965, and in South Carolina, licensed in 1971, remain open today.⁷ Each of these facilities is located within the boundaries of or adjacent to a much larger site owned by DOE. The third facility in Utah is about 80 miles west of Salt Lake City. Utah initially licensed the Envirocare facility in 1988 to accept naturally occurring radioactive waste. In 1991, Utah amended the license to permit the disposal of some LLRW, and the Northwest Compact agreed to allow Envirocare to accept these wastes from noncompact states. By 2001, the facility was allowed to accept all types of class A waste. Because of its higher radioactive content, greater-than-class-C waste cannot be disposed of in these commercial disposal facilities. Instead, the Act requires DOE to provide a facility for disposing of all greater-than-class-C radioactive waste.

Currently, 10 compacts include 43 states: the Appalachian, Atlantic, Central, Central Midwest, Northwest, Midwest, Rocky Mountain, Southeast, Southwestern, and Texas

⁷ Under the auspices of the Atomic Energy Commission, four other commercial disposal facilities were licensed in the 1960s, including facilities in Illinois, Kentucky, Nevada, and New York.

compacts. Seven states, as well as the District of Columbia and Puerto Rico, are unaffiliated. Figure 2 shows the state LLRW compacts and unaffiliated states.

Figure 2: State LLRW Compacts and Unaffiliated States



Source: NRC and Low-level Waste Forum.

Since 1999, LLRW Disposal Availability and Federal Oversight Have Changed

In June 2004, we identified a number of important changes that had occurred since our 1999 report; these changes have affected, or might affect, future disposal availability for these wastes and federal oversight of states' LLRW management. Changes that might have implications for long-term disposal availability include the following:

- In 2001, South Carolina enacted legislation restricting the use of the Barnwell disposal facility to generators in the three-member Atlantic compact after mid-2008. In the past, the state legislature has changed its position on restricting access to this facility, both closing and reopening the facility to noncompact member states over the years.

- In 2001, Envirocare received a license from the state regulatory authority to accept class B and C wastes pending approval by the Utah legislature and governor. Currently, the state has imposed a moratorium on approving the use of this license until February 2005, after a review of the recommendations of a hazardous waste regulation and policy task force. The task force is expected to issue its final report by November 2004. Granting approval for Envirocare to use its class B and C wastes license could help to alleviate a shortfall in disposal availability for class B and C wastes.
- In 2003, Texas enacted legislation designating a geographic area in the state as acceptable for a new LLRW disposal facility, and the state regulator developed a license application process for this facility. In August 2004, a private company submitted a license application to the Texas Commission on Environmental Quality for approval to construct and operate a disposal facility 30 miles west of Andrews, Texas. Current projections by the state of Texas suggest that the earliest a facility could be licensed is 2007. Non-compact states' access to this facility has not been determined. If the Texas facility were allowed to accept waste nationally, it would mitigate a potential shortfall in disposal availability for class B and C wastes.
- In 2004, the Court of Appeals for the 8th Circuit affirmed a federal district court decision that Nebraska, as a designated host state, is liable for \$151 million in damages for renegeing on its obligations to the Central Compact to build a disposal facility. Since the issuance of our June 2004 report, the Central Interstate Compact voted to accept a settlement with Nebraska for \$141 million plus interest. Under the settlement, if Nebraska and other compact members negotiate access to the proposed disposal facility in Texas, the amount Nebraska would have to pay would be reduced to \$130 million plus interest.

The remaining changes affect federal agency guidance and oversight of LLRW management by the states. These include the following:

- In 2001, DOE significantly diminished its involvement in guiding and overseeing LLRW management by the states. DOE's reporting requirement on LLRW management, as originally required by the Act, terminated effective May 2000. In addition, DOE's technical assistance activities under the Act have essentially ended after a period of shifting emphasis and decline.
- Since the late 1990s, NRC has decreased its direct involvement in states' LLRW management because no new disposal sites were being developed and more states have taken on the responsibility for the regulation of radioactive material from NRC.

Annual LLRW Disposal Volumes Have Increased, but Future Volumes Are Uncertain

Annual LLRW disposal volumes have increased significantly in recent years, primarily the result of cleaning up DOE sites and decommissioning nuclear power plants. To obtain disposal volume information, we relied on data from the three commercial disposal facility operators because the Manifest Management Information System (MIMS)—the online commercial disposal LLRW database maintained by DOE—is not as up-to-date as the facilities' data and has other deficiencies. Future disposal volumes remain uncertain and will depend largely on waste disposal decisions by DOE and nuclear utility companies.

LLRW Disposal Volumes Have Increased Significantly Since 1999

Since the beginning of 1999, disposal volumes have steadily increased to over 12 million cubic feet in 2003, an increase of over 200 percent. Class A waste accounted for 99 percent of all waste disposed of at the three commercial disposal facilities. The Envirocare facility received 99 percent of this class A waste, and about 78 percent of this

class A waste came from DOE clean up sites. According to Envirocare, DOE has increased its shipment of waste to the facility from about 36,000 cubic feet in 1994 (6.6 percent of the class A waste disposed) to almost 9.3 million cubic feet in 2003 (77.8 percent of the class A waste disposed). In contrast, disposal volumes of commercial class B waste declined 47 percent, from about 23,500 cubic feet in 1999, to about 12,400 cubic feet by 2003. Commercial class C waste disposal volumes were more volatile, changing as much as 107 percent in a single year. The total annual disposal volume of class C waste alternately rose and fell between 1999 and 2003, with the annual total reaching over 20,000 cubic feet in 1999, falling as low as about 11,000 cubic feet in 2002, then rising to over 23,000 cubic feet in 2003. Of the total class B and C wastes disposed of in commercial facilities in 2003, 99 percent went to Barnwell.

Concerns about the Completeness and Reliability of National LLRW Database

Because of concerns about data completeness and reliability, we did not use the database that DOE maintains and operates for the LLRW community and public when we determined recent disposal volumes. Nor did we use other information in this database to analyze sources of LLRW by state, compact, and generator type because of shortcomings in its usefulness and reliability. Instead, we relied on data supplied to us from the three commercial disposal operators for our analysis because these data include DOE waste volumes sent for commercial disposal, are more up to date and are the primary source data input into MIMS.

With respect to data completeness, even though DOE ships large quantities of LLRW to a commercial disposal facility, this information is not captured in MIMS. Also, other types of information, such as the storage of waste and volume of waste reduction, are not collected in this database. The consensus among the compact and unaffiliated state officials we surveyed was that they could more effectively regulate and monitor LLRW in their compacts and states if MIMS offered more comprehensive and reliable data. Despite these shortcomings, these officials have sometimes used MIMS data as a convenient source of information for public, media, and stakeholder inquiries, as a means of monitoring LLRW within their compact or region, and as an external check on

the LLRW interstate shipment data reported to compact and state regulators by the disposal operators.

We also identified shortcomings in the reliability of the MIMS database. We found inconsistencies between what the disposal facility operators claimed had been disposed of at their facilities and what was recorded in this database. For example, excluding waste generated by DOE, the volumes of LLRW reported to us by Envirocare for 1999 to 2003 totaled 10.4 million cubic feet, compared to the 15.7 million cubic feet reported in MIMS. There were also problems with other kinds of data in MIMS. States and compacts have also identified discrepancies that undermine the data's usefulness, particularly regarding the state-specific information on the origins of waste. For example, Tennessee, which is the base of operations for companies that transport and process the waste from generators in other states prior to disposal, reports that it is erroneously recorded in MIMS as the state of origin of this waste.

The data DOE puts into MIMS comes from the three commercial LLRW disposal facility operators in electronic format. DOE pays each operator varying amounts of money to extract data from the records accompanying shipments of LLRW that provide information on the volume, radioactivity level, source, and other information about the waste. These records are called manifests, and NRC requires their use to track shipment of radioactive materials. The disposal operator then transmits some of this information to DOE for entry into MIMS. Each disposal facility operator is responsible for ensuring the validity of these data, but DOE's contracts with these operators leave to them what steps, if any, should be taken to validate the data. DOE takes no responsibility for verifying the accuracy of the data supplied by the disposal facility operators.

Furthermore, while DOE takes some steps to ensure that it accurately uploads operator-supplied data into MIMS, it does not perform other systematic quality checks on the data, such as "reasonableness" checks, cross tabulations, or exceptions reports. As a result, the lack of consistent and comprehensive internal controls, such as controls over information processing, undermine our confidence in the data output in MIMS for several

types of information, including sources of waste coming from states, compacts, and generator types.

We recommended in our June 2004 report that the Secretary of Energy halt dissemination of information in DOE's national LLRW database as long as the database has shortcomings in its usefulness and reliability. DOE subsequently decided to leave the database online but has added a notice to users of the database regarding inaccuracies and is taking steps to identify and update erroneous data.

Uncertainties Surround Projecting Future LLRW Disposal Volumes

Notwithstanding problems obtaining comprehensive and reliable LLRW disposal data, uncertainties remain concerning the timing and volume of LLRW needing disposal in the future, which largely will depend on the disposal decisions made by nuclear utility companies and DOE, as well as on possible changes in regulatory standards for what constitutes LLRW. For example, officials at DOE told us that projections for sites now being cleaned up have not proven very accurate, and have tended to significantly overestimate waste volumes that would require disposal as LLRW. They cited several reasons for this difficulty: records from "legacy" sites—former nuclear weapons production sites that DOE is cleaning up—have not proven to be reliable; the decay rate of known buried radioactive wastes have often been higher than expected so wastes that were expected to need disposal as LLRW can instead be legally classified as radioactive waste mixed with nonradioactive but hazardous wastes and sent to less expensive disposal facilities; contractors have become more innovative and skilled in sorting and segregating hazardous and mixed wastes from LLRW so that a higher percentage of wastes can be disposed of as hazardous or mixed wastes rather than LLRW; and some debris and material from site cleanup projected to be LLRW has no appreciable radioactivity when generated and can therefore be disposed in sanitary landfills or other non-LLRW disposal facilities. There are some indications that the volume of DOE cleanup waste likely to be sent to commercial LLRW disposal facilities could currently be at or near a peak and could soon rapidly decline as cleanup at some DOE sites winds down and as cleanup activity shifts to other DOE sites that have considerable on-site

disposal capacity. As a result, DOE officials expect the use of commercial LLRW disposal facilities will start declining after 2006 and will stay comparatively low until another anticipated spike in 2014. DOE officials stressed, however, that “high confidence numbers” are not yet available because the department is still in the process of reorganizing and developing new baselines for its accelerated cleanup projects, and it does not have a management system in place to develop corresponding waste projections.

Potential changes to the threshold at which waste is classified as LLRW are currently under consideration and could affect the amount of waste needing disposal in the future. The National Research Council and the Environmental Protection Agency (EPA) are separately studying this issue and considering possible changes that might affect the future management of LLRW. The National Research Council is studying the issue because members of its Board on Radioactive Waste Management are concerned that the statutes and regulations governing LLRW management may be overly restrictive in some cases, leading to excessive costs and other burdens on the waste generator and, in other cases, may lead to an exaggeration of the potential risks posed by these materials. EPA is examining its existing waste regulations and has begun soliciting public comment as it considers new rulemaking in this area. Specifically, EPA is exploring an option with NRC to establish a regulatory framework that allows some of the lower activity radioactive waste to be disposed of at non-LLRW disposal facilities. Finally, and in a similar vein, government and industry LLRW stakeholders have discussed harmonizing U.S. standards with the prevailing international standards for LLRW under consideration by the International Atomic Energy Agency. Such a change could prompt U.S. regulators to consider raising the threshold at which the radioactivity of waste would trigger regulation as LLRW and would allow for lower activity LLRW to be disposed of under other regulatory regimes.

LLRW Disposal Availability Appears Adequate Until Mid-2008

Disposal availability appears adequate to serve the nation's needs at least until mid-2008, when many states might lose disposal access for their class B and C wastes. Disposal availability for class A waste is not a problem in the short or longer term. According to Envirocare representatives, their disposal site, which accepted over 99 percent of the nation's commercially disposed of class A waste in 2003, has enough capacity to accept this waste at the current volume levels for more than 20 years. The Richland facility has about 21 million cubic feet of capacity remaining for all classes of waste, which is more than enough to accommodate the LLRW coming from the 11 states in the Northwest and Rocky Mountain compacts until the expected closure of this facility in 2056. The Barnwell disposal facility has about 2.7 million cubic feet of remaining capacity, most of which has been set aside for waste from generators in the Atlantic Compact until 2050. Barnwell also appears to have enough disposal capacity to continue accepting class B and C wastes from other states until mid-2008, when it is scheduled to close to all but the three Atlantic compact states. According to the Director of Disposal Services at Chem-Nuclear Systems, the operator of the Barnwell facility, there should be enough space at the facility to accommodate the typical 20,000 to 25,000 cubic feet of class B and C wastes accepted at this facility in recent years. This representative told us that many generators have already contracted to dispose of their B and C wastes in the short-term, and any generator outside of the Atlantic Compact anticipating a need to dispose of these wastes could still contract for the necessary space until mid- 2008.

A number of factors support the likelihood that disposal space for class B and C wastes will be available at Barnwell until mid-2008, if disposal volumes do not exceed anticipated levels. Based on current space commitments at this disposal facility under the conditions of the volume caps set by the South Carolina legislature, there remains between 24,500 to 44,500 cubic feet of uncommitted space until 2008. The amount of space available depends on whether Atlantic Compact generators use all of their set-aside space through 2008. In addition, utilities are likely to take more aggressive efforts to ensure sufficient space for class B and C wastes at Barnwell. Industry officials said

utilities might consider several initiatives and conditions that could alleviate the diminishing disposal availability for class B and C wastes. For example, utilities could send class A waste to Envirocare rather than Barnwell to save the remaining space at Barnwell for class B and C wastes. In addition, utilities might increase waste reduction efforts and storage.

After 2008, disposal availability for the class B and C wastes generated in the 36 states outside the Northwest, Rocky Mountain, and Atlantic compacts is more uncertain. Disposal availability for these states will depend on a number of possibilities, including extending access to Barnwell beyond mid-2008 or creating new disposal options for these classes of waste. The Barnwell facility has opened and closed to noncompact member states before and could again. Given the difficulties of attracting class A waste to Barnwell because of the high disposal fees, and the fairly consistent level of class B and C wastes shipped to this site each year, the facility might not even reach its volume cap of 35,000 cubic feet per year after 2008. In addition, the set-aside of 2.2 million cubic feet for Atlantic Compact generators through 2050 may be negotiated downward, freeing up additional space at this disposal facility. It is also possible that new disposal options will become available in the future that could alleviate any disposal crisis for class B and C wastes. Finally, regardless of the outcome, representatives of the Nuclear Energy Institute, the policy organization of the nuclear energy industry, said that utilities, the greatest generator of class B and C wastes, can store these wastes on site if they have no disposal option.

Any LLRW Disposal Shortfall After Mid-2008 Unlikely to Pose Immediate Problem

If after mid-2008, there are no new disposal options for class B and C wastes, licensed users of radioactive materials can continue to minimize waste generation, process waste into safer forms, and store waste pending the development of additional disposal options. These approaches, however, can be costly, with a higher financial burden on

some licensees than others. Notwithstanding these business costs, we did not identify other effects of any shortfalls in disposal availability that might have wider implications.

LLRW Minimization and Storage Can Lessen Effects of Any Disposal Shortfall

The licensed users of radioactive materials that must eventually dispose of their LLRW have employed a variety of techniques to both minimize and process this waste to reduce its volume before storage and eventual disposal. These techniques include substituting nonradioactive materials for radioactive materials, separating radioactive materials from nonradioactive materials, recycling, compaction, dilution, and incineration. For example, it is reported that most large research institutions make concerted efforts to find suitable and appropriate alternatives to the use of radioactive materials. One university official told us that such efforts have reduced LLRW generation at his institution by 30 percent in the last 5 years. The Electric Power Research Institute is encouraging nuclear utilities to use vendor volume reduction programs for resins, the single largest component of class B and C wastes, to reduce volume. Some licensees have used processors to super-compact class A waste to achieve up to a 5,000 percent reduction in volume, or to reduce this waste to ash through incineration, albeit increasing the concentration of radioisotopes.

In addition to minimizing LLRW, licensees can decide to store this waste when no disposal option is available to them. In order to obtain a license to possess radioactive materials, entities must demonstrate the technical capability to safely manage them. These entities give various reasons for storing waste, including allowing short-lived radioactive materials to decay to innocuous levels to avoid the need for disposal in a more expensive LLRW facility, the prohibitively high cost of disposal for some licensees, and concerns about the potential liability of sending the waste to a disposal site. Universities and biomedical companies generally rely on storage for decay for their LLRW, although finding space within large research institutions in urban settings is more difficult. The high cost of LLRW disposal can also pose financial problems for some licensees. Over the last 25 years, disposal costs have risen from \$1 per cubic foot of

LLRW to over \$400 per cubic foot, with projections of well over \$1,000 per cubic foot in the future. For some LLRW, the Barnwell disposal facility now charges \$1,625 per cubic foot. These disposal costs can reach hundreds of millions of dollars for utility companies that are decommissioning their nuclear power plants. NRC reported to us that the cost to fully decommission a plant could run as high as \$675 million. Finally, some licensees will not send their LLRW to disposal facilities because they are concerned that the mixing of their waste with other waste might draw them into litigation if the disposal site should ever require cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (commonly referred to as Superfund).

While NRC policy favors disposal rather than storage over the long-term, since the mid-1990s the Commission has allowed on-site storage of LLRW without a specified time limit as long as it is safe. The Commission took this approach in part because LLRW can be stored and the states were not developing any new disposal facilities. NRC's and Agreement States' (that is, states that have taken over the responsibility for regulating radioactive materials from NRC) license and inspection programs help ensure the safe management of stored LLRW. However, some licensees are concerned that a fire, flood, or earthquake might cause an unintended radioactive release. If an emergency ever should arise from stored LLRW, NRC has authority under the Act to override any compact restrictions to allow shipment of LLRW to a regional or other nonfederal disposal facility, if necessary under narrowly defined conditions, and to eliminate an immediate and serious threat to the public health and safety or to the common defense and security. Since September 11, 2001, the perception of the risks posed by potential use of stored LLRW by terrorists has increased. A recent report found that at least a few radioisotopes of greatest security concern are classified as LLRW. According to the report, while radiological dispersal devices, such as a dirty bomb, are not weapons of mass destruction, they could cause mass disruption, dislocation, and adverse financial consequences associated with decontamination and rebuilding. NRC officials told us that as the volume and duration of stored LLRW increases so might the safety and security risks.

LLRW Minimization and Storage Can Be Costly

Waste minimization and storage can alleviate the need for disposal, but they can be costly. The licensees that we interviewed provided many instances of the high cost of managing LLRW. For example, one university recently built a \$12 million combined hazardous and radioactive waste management facility, of which two-thirds is devoted to processing and temporarily storing class A waste. A medical center official took us to a small (12' x12') LLRW interim storage and processing room that cost the institution about \$150,000 to construct to meet stringent health and environmental standards. Costs are also associated with operating storage facilities. Representatives from one university system told us that the system spends about \$100,000 annually to maintain its interim storage building in a remote area of the state. Added to the cost of building and operating a storage facility is the cost of securing it. Such costs have been accounted for in higher utility rates, university overhead charges, drug prices, and medical treatments. These costs of doing business are more difficult for some entities to absorb than others. Representatives from several biotechnology companies told us that the industry, particularly the smaller start-up companies, are not prepared for the financial cost of storing and securing LLRW.

No Other Widespread Effects Detected of Shortfall in LLRW Disposal Availability

Notwithstanding the cost of minimizing and storing LLRW, we did not detect widespread national impacts on LLRW generators that have resulted or might result from any disposal shortfalls. In a survey we administered to compact and unaffiliated state LLRW officials regarding documented effects on LLRW generators of any restricted disposal availability, the officials raised few concerns. We then sought information from a broader constituency to determine whether any problems were occurring. We collaborated with medical researchers at the University of Texas to seek information from two overlapping groups involved in LLRW management: the approximately 2,000 subscribers of the RadSafe Listserv, a listserv for radiation safety officers, and the approximately 6,000 members of the Health Physics Society, a scientific and professional organization whose members specialize in occupational and environmental radiation

safety. We sought information on any known cases where there have been or might be adverse effects on research activities and clinical practice stemming from costs or difficulties related to the storage and disposal of LLRW. Specifically, we e-mailed questionnaires asking if these factors have caused or might cause a discontinuance or disapproval of any research or clinical endeavors to RadSafe listserv subscribers and placed a notice in the Health Physics Society's newsletter asking for volunteers to answer the same questions we sent to the listserv subscribers. We obtained an extremely low response rate to these questionnaires—14 responses from listserv subscribers and 6 from Health Physics Society members. Because these were a nonprobability sample surveys, the results are not generalizable and can only be used for anecdotal purposes. Of these respondents, only two said that the difficulties associated with LLRW had adversely affected research or clinical practice. Several respondents cited the challenges of dealing with LLRW but also noted that they work around the difficulties through waste minimization, including substituting nonradioactive materials for radioactive materials when possible, and on-site storage as needed. The survey results provided no evidence of any widespread effects on research activities and clinical practice stemming from costs or difficulties related to the storage and disposal of LLRW in the last 5 years. Other published information was largely consistent with our findings.

Owing to the uncertainties regarding future disposal availability and the safety and security of storing waste, our report suggested that the Congress may wish to consider directing NRC to report to it if LLRW disposal and storage conditions should change enough to warrant consideration of new legislation to improve the reliability and cost effectiveness of disposal availability.

The Act Has Not Accomplished Goal of Providing More Region Disposal Capacity

The Act has not effectively facilitated the development of additional regional disposal capacity for class A, B, and C wastes. Although a nuclear industry association estimates that expenditures may now have reached approximately \$1 billion on various facility

development efforts, only one new commercial LLRW disposal facility has been developed since passage of the Act—the Envirocare facility—and this facility was not developed at the instigation of the compact in which it operates. As we reported in 2004, the conditions dampening any impetus to developing new disposal facilities for class A, B and C wastes have not changed since 1999. These conditions include a combination of factors: significant decreases in commercial LLRW generation, available capacity at the three existing facilities to meet national disposal needs, and rising costs of developing disposal facilities. Developing new LLRW disposal facilities also encountered public and political resistance in states designated to host these facilities.

DOE Has Not Provided a Disposal Facility for Greater-Than-Class-C Waste but Is Collecting This Material

In our April 2003 report, we provided information on DOE's efforts to recover and dispose of greater-than-class-C sealed radioactive sources. As you know, since September 11, 2001, there has been a great deal of concern about the control of sealed sources containing radioactive material that are used in medicine, agriculture, research, and industry throughout the United States. The radioactive material in these sources is encapsulated, or sealed, in metal—such as stainless steel, titanium, or platinum—to prevent its dispersal. The small size and portability of the sealed sources make them susceptible to misuse, improper disposal, and theft. If these sealed sources fell into the hands of terrorists, they could be used as simple and crude but potentially dangerous radiological weapons, commonly called dirty bombs.

Certain sealed sources are considered particularly attractive for potential use in dirty bombs because, among other things, they contain more concentrated amounts of radioactive material such as americium-241, cesium-137, plutonium-238, plutonium-239, and strontium-90. Applications of greater-than-class-C sealed sources include portable and fixed gauges used by the construction industry for testing the moisture content of soil, medical pacemakers, medical diagnostics and treatments, gauges used for petroleum exploration, and government and private research and development. While a

study by the Idaho National Engineering Laboratory estimates that there currently could be about 250,000 to 500,000 greater-than-class-C sealed sources in the United States, the actual number of greater-than-class-C sealed sources that are no longer wanted is not known because no one kept track of this information.

The Low-Level Radioactive Waste Policy Amendments Act of 1985⁸ requires DOE to provide a facility for disposing of all greater-than-class-C radioactive waste, including greater-than-class-C sealed sources that are no longer wanted by their owners. A permanent disposal facility has not yet been developed, but in the interim, DOE created the Off-Site Source Recovery Project that, since fiscal year 1999, has been recovering unwanted greater-than-class-C sealed sources from their owners and temporarily storing them at the Los Alamos National Laboratory in New Mexico. NNSA officials told us that, to date, the project has recovered over 10,000 sealed sources.

In April 2003, we reported that DOE's Off-Site Source Recovery Project faced three problems that could hinder future recovery efforts. First, we reported that DOE's Office of Environmental Management, which was responsible for the Off-Site Source Recovery Project at the time of our report, had a questionable long-term commitment to the project. The project did not receive full funding because of other higher-priority projects, and officials from the Office of Environmental Management told us that they would have liked responsibility for the project to be placed in another DOE office because of inconsistencies between the mission of the project and the main mission of the Office of Environmental Management to accelerate the cleanup and closure of contaminated DOE weapons development facilities.

Second, we reported that the Off-Site Source Recovery Project was unable to recover any additional sealed sources containing plutonium-239 (which, in sufficient quantity, could be used to fabricate a crude nuclear weapon) because there was no more space at the Los Alamos National Laboratory that met DOE's security standards for storing these sources. As a result, about 150 holders (mostly universities) of over 400 unwanted

⁸ Pub. L. No. 99-240.

sources containing plutonium-239 were forced to retain them and keep them properly secured until space became available. In some instances, sealed sources at these facilities were stored in unlocked and open rooms, and most holders expressed their desire to dispose of the sources as quickly as possible. In addition to plutonium-239, at the time of our report, DOE had not approved a means for temporarily storing sources containing strontium-90 and cesium-137.

Finally, we reported that, as of February 2003, DOE's Office of Environmental Management had not made progress toward providing for the permanent disposal of greater-than-class-C radioactive waste, and it was unlikely to provide such a facility by fiscal year 2007 as it had planned because it is not a priority within the office. Specifically, the office had not begun the first step in developing a disposal facility—completing an appropriate analysis as required by the National Environmental Policy Act of 1969 and its implementing regulations. Such an analysis would likely take the form of an Environmental Impact Statement. Officials from DOE's Office of Environmental Management told us that funding had been provided in fiscal years 2002 and 2003 to conduct an environmental analysis, but these funds had been reallocated to other priorities.

Our April 2003 report recommended that DOE determine whether the priority given to the Off-Site Source Recovery Project was commensurate with the threat posed by greater-than-class-C sealed sources and ensure that adequate resources are devoted to the project to cover the costs of recovering and storing these sealed sources as quickly as possible. In addition, we recommended that DOE take immediate action to provide secure storage space for unwanted sealed sources containing plutonium-239, strontium-90, and cesium-137. Furthermore, we recommended that DOE initiate the process to develop a permanent disposal facility for greater-than-class-C radioactive waste as required by the LLRW Policy Amendments Act and develop a plan to ensure the continued recovery and storage of greater-than-class-C sealed sources until such a disposal facility is available.

DOE has made progress addressing the problems we identified. Specifically, to address the problem of the low priority given to the Off-Site Source Recovery Project within the Office of Environmental Management, DOE transferred the project to NNSA in October 2003. Now renamed the U.S. Radiological Threat Reduction Program, the project is managed by NNSA's Office of Global Radiological Threat Reduction and is part of NNSA's larger efforts to secure potential dirty bomb material worldwide. The project has also experienced funding increases following the transfer. According to NNSA officials, the project was appropriated nearly \$2 million in fiscal year 2004 and received an additional \$3.5 million that was transferred by the Secretary of Energy from the Office of Environmental Management. In addition, the project completed spending from an additional \$10 million that the Congress appropriated in August 2002 as part of the 2002 Supplemental Appropriations Act for Further Recovery from and Response to Terrorist Attacks on the United States.⁹ In total, the project spent about \$8 million in fiscal year 2004. In our view, funding for this effort must be sustained for the foreseeable future to continue progress in the recovery of material that potentially could be fabricated into dirty bombs.

With regard to the continued recovery of sealed sources containing plutonium-239, NNSA completed the security requirements for accepting additional plutonium-239 at Los Alamos National Laboratory. NNSA officials also told us that additional storage capacity has become available at the Nevada Test Site for additional plutonium-239 storage. The project began recovering plutonium-239 sources in November 2003. As of September 2004, the project has recovered over 260 sources containing plutonium-239. Although the project estimated at the time of our report that there were over 400 unwanted plutonium-239 sources, NNSA officials told us that about 400 additional excess sources have been identified that will be recovered. Recovered sources are stored at Los Alamos National Laboratory and the Nevada Test Site until they are eventually shipped to the Waste Isolation Pilot Plant in Carlsbad, New Mexico, for permanent disposal. According to an NNSA official, these shipments are due to begin in April 2005.

⁹ Pub. L. No. 107-206.

According to NNSA officials, the project started recovery of large strontium-90 sources in February 2004 and has recovered four of the six known large strontium-90 sources in the United States. The project plans to recover the remaining two large strontium-90 sources in fiscal year 2005. For cesium-137 sources, NNSA officials told us that they are currently working to find commercial partners to leverage existing disposal and recycling options for this material and to securely store cesium-137 sources in the interim.

Finally, in response to our recommendation that DOE initiate the process to develop a permanent disposal facility for greater-than-class-C radioactive waste, DOE transferred the responsibility for developing the environmental analysis from the Office of Environmental Management to DOE's Office of Environment, Safety, and Health. DOE plans to publish an Advance Notice of Intent to prepare an Environmental Impact Statement. This Environmental Impact Statement will evaluate disposal options and other considerations. However, DOE has been unable to tell us when the Advance Notice of Intent will be published or when DOE expects to complete the Environmental Impact Statement.

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

Contacts and Acknowledgements

For further information about this testimony, please contact me at (202) 512-3841. Gene Aloise, Ryan T. Coles, Daniel Feehan, Doreen Feldman, Richard Kasden, Thomas Laetz, Ilene Pollack, Leslie Pollock, Carol Herrnstadt Shulman, and Kevin Tarmann made key contributions to this testimony.

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