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Report to the Chairman, Committee on Governmental Affairs, U.S. Senate

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NUCLEAR WASTE

Slow Progress Developing Low-Level Radioactive Waste Disposal Facilities

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GAO

United States
General Accounting Office
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Resources, Community, and
Economic Development Division

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January 10, 1992

The Honorable John Glenn
Chairman, Committee on
Governmental Affairs
United States Senate

Dear Mr. Chairman:

This report responds to your February 21, 1990, request that we review the states' efforts to implement the Low-Level Radioactive Waste Policy Act, as amended, and the status of state and federal efforts to resolve issues pertaining to special categories of low-level waste.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to appropriate congressional committees; the Chairman, Nuclear Regulatory Commission; the Secretary of Energy; the Administrator, Environmental Protection Agency; the Director, Office of Management and Budget; and state officials interested in the disposal of low-level waste. We will also make copies available to others on request.

Should you have any questions or need additional information, please contact me at (202) 275-1441. Major contributors to this report are listed in appendix II.

Sincerely yours,

Victor S. Rezendes
Director, Energy Issues

Executive Summary

Purpose

Each year 110 nuclear power plants and thousands of businesses, hospitals, and universities generate over 1 million cubic feet of hardware, rags, paper, liquid waste, and protective clothing that have been contaminated with low levels of radioactivity. For more than 10 years, this waste has been disposed of at facilities in Nevada, South Carolina, and the state of Washington. The Low-Level Radioactive Waste Policy Act of 1980, as amended in 1985, made the states responsible, either individually or through groups of states called compacts, for developing new disposal facilities. The act also authorized states with existing facilities to deny other states access to these facilities after 1992.

The Chairman, Senate Committee on Governmental Affairs, asked GAO to determine (1) the states' progress and problems in meeting facility-development milestones contained in the 1985 legislation, (2) the status of federal and state efforts to resolve issues related to mixed waste (low-level waste that also contains hazardous chemicals) and wastes with very low levels of radioactivity, and (3) the Department of Energy's (DOE) progress in discharging the federal government's responsibility under the 1985 act to manage the most hazardous low-level waste.

Background

By 1980 the three states operating disposal facilities had expressed objections to bearing the national disposal burden. The Low-Level Radioactive Waste Policy Act of 1980 encouraged states, either separately or in compacts, to develop new disposal facilities by 1986. Because progress was slow, the act was amended in 1985 to stimulate the states' facility-development efforts. Six milestones were established to mark the states' and compacts' progress. The most critical milestone is January 1, 1993, when the three states currently operating facilities can deny waste generators in other states access to their facilities. States that do not have new facilities by then will have to assume ownership and possession of the wastes generated within their borders or assume liability for any damages from wastes left in the hands of waste generators. Beginning January 1, 1996, the states must, at the waste generators' requests, take ownership and possession of the wastes.

Forty-two states have formed nine compacts. Seven compacts (31 states) plan to develop eight disposal facilities, and two compacts (11 states) will be served by the existing facility in Richland, Washington. The other two existing facilities are to be closed at the end of 1992. In addition, five states not affiliated with compacts intend to develop their own disposal facilities. Three states, the District of Columbia, and Puerto

Rico are not planning to develop disposal facilities and will be seeking storage and disposal arrangements with other states.

Three federal agencies are also involved in the disposal of low-level waste. The Nuclear Regulatory Commission (NRC) sets basic standards for the storage and disposal of commercially generated low-level waste, regulates the disposal of wastes in some states, and has agreed to allow other states to regulate the storage and disposal of these wastes. Also, the 1985 act directed NRC to establish standards and procedures for exempting wastes that have very low concentrations of radioactivity from standard disposal requirements. The Environmental Protection Agency (EPA) regulates the hazardous chemical constituents that are contained in some low-level waste, called mixed waste. The three existing disposal facilities are not authorized to accept mixed waste; therefore, these wastes are now being stored pending development of new facilities. Finally, the 1985 act made DOE responsible for, among other things, disposing of the most hazardous commercially generated low-level wastes.

Results in Brief

Although most states and compacts have made some progress in developing their disposal facilities, only one compact expects to complete a new facility by 1993 and only two other compacts expect to complete their facilities by 1996. The slow pace of facility development results from the numerous and complex legislative and administrative tasks, such as selecting potential sites, that must be accomplished. These tasks have often been performed in the face of public opposition, legal challenges, and uncertainty over issues such as liability protection for new disposal facilities. As a result, most states are preparing for storage of wastes by waste generators from January 1, 1993, until new disposal facilities are operational.

The disposal of mixed waste and waste having very low levels of radioactivity are unresolved issues. Regulation by both NRC and EPA of the small volume of mixed waste is expected to make the unit cost of disposing of this waste much higher than the cost of disposing of other low-level wastes. Primarily for this reason, states and others have suggested either that DOE, which generates much larger quantities of mixed waste, dispose of commercially generated mixed waste or that a lead regulatory agency be designated to regulate disposal of the waste. In addition, negative public reaction to NRC's policy statement on the approach it would follow to exempt waste with very low levels of radioactivity from

normal disposal requirements has caused the agency to defer implementing the policy pending further review.

Finally, although DOE said in 1987 that it would begin managing the most hazardous low-level waste in 1989, it has not completed preparations to store this waste and does not expect to dispose of the waste until 2010.

Principal Findings

Delays in Developing Facilities Will Require Waste Storage

Only California, Illinois, and Nebraska, which represent three compacts covering 11 states, have applied for licenses to construct and operate disposal facilities before the end of 1992, 1993, and 1995, respectively. Waste generators in these 11 states produce about 21 percent of commercially generated low-level waste. Five unaffiliated states and 5 states representing four compacts covering 20 states do not expect to complete their facilities until 1996 or later. These 25 states account for about two-thirds of all commercially generated low-level waste.

The process of enacting legislation; conducting programs to screen, select, and investigate potential sites; and providing opportunities for public involvement in facility development has been more complex and time-consuming than states originally anticipated. Furthermore, the process has often been carried out in the face of public opposition and legal challenges. Finally, states have had to develop methods to provide financial protection against damages to public health and property from the operation of new disposal facilities. As a result of the delays, after January 1, 1993, states without disposal facilities will manage their wastes through on-site storage at waste generators until new disposal facilities are ready. NRC has provided states and waste generators with guidance on interim waste storage.

Issues of Mixed and Very-Low-Level Waste Are Unresolved

The states, industry, and EPA estimate that mixed wastes comprise 3 to 10 percent of commercially generated low-level waste and an even smaller portion of hazardous wastes. The cost per cubic foot of disposing of this waste, however, could be much higher than for other low-level waste —$15,000 compared with $800 or less—in part because it is subject to the regulatory requirements of two agencies. For this reason,

states and others have questioned the merits of regulation of commercial mixed low-level waste by both NRC and EPA. Proposed alternatives include that DOE dispose of the waste or that one agency, not both, take the lead in regulating its disposal. DOE has expressed interest in exploring with states a role in the disposal of commercial mixed waste. Furthermore, NRC has stated that no serious impediments exist to DOE's accepting this waste from NRC licensees and that DOE's acceptance of the waste might resolve this issue.

In 1986 NRC announced a policy on procedures and standards for exempting consumer products, wastes, or other materials with very low levels of radioactivity from regulatory control. Many states, however, have resisted the disposal of any radioactive waste in other than licensed disposal facilities, and several states have expressed their resistance through legislation. Because of the negative reaction to its policy statement, in July 1991 NRC announced a moratorium on the implementation of its exemption policy pending completion of a consensus-building process. The process has not yet been completed.

Disposal of the Most Hazardous Low-Level Waste Is 20 Years Away

In 1987 DOE said that a program would be in place within 2 years to manage the most hazardous commercially generated low-level waste. However, in June 1991 DOE said it intended to begin accepting limited amounts of these wastes from generators for interim storage. DOE has tentatively identified its Oak Ridge, Tennessee, facility as an interim storage site. In addition to selecting a site and developing a storage facility, over the next several years, according to agency officials, DOE needs to better identify and characterize these wastes, develop criteria and fees for accepting the wastes, and develop the ability to dispose of this waste by about 2010.

Recommendations

GAO is making no recommendations in this report.

Agency Comments

GAO discussed the factual information in this report with officials of DOE and NRC. These officials generally agreed with the facts, and their comments have been included where appropriate. As requested, GAO did not obtain written comments.

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Abbreviations

DOE	Department of Energy
EPA	Environmental Protection Agency
GAO	General Accounting Office
NRC	Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act

Introduction

Each year 110 nuclear power plants as well as numerous businesses, hospitals, and universities generate and must dispose of various types of radioactively contaminated waste. This waste is designated as low-level radioactive waste because its levels of radioactivity are relatively lower than those of high-level waste, which is predominantly spent (used) fuel from commercial nuclear power plants and certain radioactive waste from nuclear weapons production. Over 1 million cubic feet of low-level radioactive waste is generated annually. For more than 10 years, these wastes have been disposed of at three commercially operated disposal facilities for civilian low-level radioactive waste in the states of Nevada, South Carolina, and Washington.

Following the March 1979 accident at the Three Mile Island nuclear power plant near Harrisburg, Pennsylvania, large quantities of low-level waste were shipped from that plant to existing disposal facilities. The governors of those states objected to bearing the national burden of disposing of low-level waste. In part to provide for more equitable disposal of low-level waste, the Congress passed the Low-Level Radioactive Waste Policy Act of 1980. That act made the states responsible for the disposal of commercially generated low-level radioactive waste and certain federally generated low-level wastes. The latter category includes wastes generated by federal agencies, such as the Department of the Army and the National Institutes of Health, authorized by licenses issued by the Nuclear Regulatory Commission (NRC) to possess and use radioactive materials.

The 1980 act encouraged states to form compacts—groups of two or more states—to dispose of low-level radioactive waste on a regional basis. This approach would minimize the number of new disposal facilities required to meet the nation's needs. The 1985 act reaffirmed this policy and stimulated facility development by establishing specific development milestones for the states and financial penalties for waste generators if the states do not meet the milestones established in the act.

Low-Level Radioactive Waste

Low-level radioactive waste is a general term for a wide variety of radioactively contaminated waste generated in many physical and chemical forms and at many levels of contamination. These wastes include protective clothing, machinery and related hardware, compacted solids, and other substances that have been contaminated with or contain certain levels of radioactivity. About 97 percent of this low-level waste decays to safe levels within less than 100 years, while the rest remains harmful for 300 to 500 years or more.

According to data assembled by the Department of Energy (DOE), commercial nuclear power plants and related industrial facilities generate about 90 percent of all the commercial low-level radioactive waste and about 95 percent of the radioactivity associated with such waste. The rest is produced by thousands of hospitals, medical and educational research institutions, private and government laboratories, and other commercial activities that use radioactive materials as part of their normal operations.

Low-level radioactive waste has generally been grouped into four classifications according to the level of radioactivity of the waste. These classifications, in ascending order of potential hazard, are Class-A, Class-B, Class-C, and Greater-Than-Class-C wastes. In recent years the greatest volume of low-level waste has been Class-A waste, which has made up about 97 percent of the waste but represents only about 10 percent of the radioactivity. In contrast, Class-C and Greater-Than-Class-C low-level wastes have comprised the lowest volume of waste generated—less than 1 percent—but have made up 86 percent of the radioactivity. Also, some low-level waste, regardless of its classification, is referred to as "mixed" waste because it contains both radioactive and hazardous constituents. Under the Resource Conservation and Recovery Act (RCRA), the hazardous substances in mixed waste are regulated by the Environmental Protection Agency (EPA) and states authorized by EPA. According to state and industry information used by the Office of Technology Assessment in 1989, mixed waste may comprise from 3 to 10 percent of all low-level waste.

Over the past 10 years, the volume of low-level radioactive waste generated each year has decreased from about 3.7 million cubic feet in 1980 to about 1.1 million cubic feet in 1990. This reduction has been attributed in large part to the application of various waste-reduction techniques employed by the waste generators. According to DOE, further reductions in volume may be possible but the techniques may be more expensive, with less potential for volume reduction than that experienced over the last 10 years. Low-level waste volumes resulting from nuclear power plant operations and from industrial and institutional activities are projected to remain essentially constant through 2020.

Direction of the Low-Level Radioactive Waste Policy Act

The Low-Level Radioactive Waste Policy Act of 1980 (P.L. 96-573) established the policy that the disposal of commercially generated and certain federally generated low-level radioactive waste was the responsibility of the states, preferably to be managed on a regional basis.To help minimize the number of new disposal sites developed, the act authorized states to enter into compacts of two or more states to establish regional disposal facilities. The act also designated January 1, 1986, as the date after which compacts could restrict the use of their disposal facilities to waste generated within the compact region. The Congress expected states to have new disposal facilities capable of handling their own low-level waste by that date.

Although nearly 40 states had formed seven regional compacts by the end of 1983, it had become clear that no new disposal facilities would be ready for at least another 5 years. As a result, on January 15, 1986, the Congress passed the Low-Level Radioactive Waste Policy Amendments Act of 1985 (P.L. 99-240). The act provided impetus and direction for states to develop new facilities for the disposal of low-level waste. The act extended the January 1, 1986, deadline by 7 years to January 1, 1993. By that date, new disposal facilities were expected to be operational and the rights of waste generators to dispose of their low-level wastes at the three existing facilities would end.

To help ensure the states' progress during the 7-year extension period, the act established four milestones and two deadlines by which states should make decisions and commit to certain actions towards developing new disposal facilities. The act also established financial penalties, called surcharges, on the waste disposed of in existing facilities if certain milestones were not met. In addition to basic disposal charges, surcharges were to be paid by waste generators based on the volume of wastes disposed of at the three operating disposal facilities. The surcharges are a multiple of the base penalty charge established in the act for not meeting certain milestones, applied during a specific period of time.[1] The three states currently operating disposal facilities were also authorized to deny access to any state that failed to comply with specific milestone requirements of 1986, 1988, and 1990. The six milestones and deadlines were as follows:

- July 1, 1986, when a state must have either joined a compact with other states or certified its intention to develop its own disposal facility.

[1] The 1985 act established a base cubic foot surcharge penalty of $10 for 1986 and 1987, $20 for 1988 and 1989, and $40 for 1990, 1991, and 1992.

- January 1, 1988, when each compact was to have identified either a host state where its disposal facility would be located or a facility developer, and developed a siting plan.
- January 1, 1990, when a state must have submitted either a facility license application to NRC (or the appropriate state agency) or, in lieu of an application, a governor's certification to NRC on how the state would manage its low-level waste after December 31, 1992.
- January 1, 1992, when a state must have submitted a facility license application.
- January 1, 1993, when each state's disposal facility is expected to be operational and disposal rights at the three existing disposal facilities will end. If a state's facility is not ready, the state and other members of the state's compact must either begin taking title to and possession of the waste generated in the states or assume liability for any damages that might result from the waste. Also, the state or states will have to forfeit rights to rebates of previous surcharge payments made by waste generators because of the state's failure to meet earlier milestones in accordance with the 1985 act.
- January 1, 1996, when, if a state's disposal facility is not operational, the state and other states in the compact must, if they have not already done so, begin taking title to and possession of their generators' waste at the request of the generators.

The 1985 act also assigned DOE and NRC responsibilities for implementing the act. DOE is responsible for disposing of Greater-Than-Class-C waste, managing collection and disbursement of surcharges, providing specific financial and technical assistance to compacts and states, and generating required reports. NRC is responsible for reviewing disposal facility license applications, providing regulatory and technical assistance and guidance to states that have been given authority by NRC to license and regulate low-level radioactive waste disposal facilities, developing standards and procedures for exempting certain low-level wastes from disposal in licensed facilities, and determining procedures for granting emergency access to low-level waste facilities for waste generated in other regions.

Current Arrangements of Compacts and Unaffiliated States

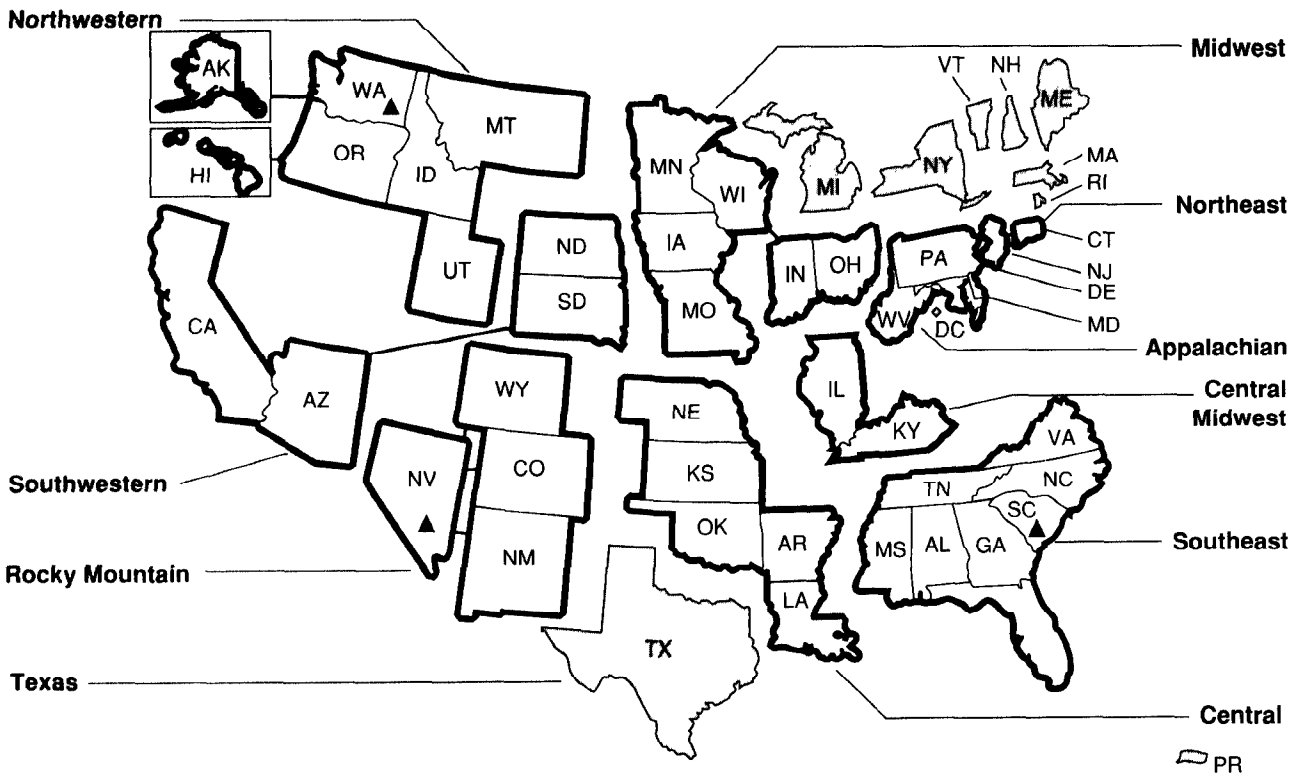
At present, nine compacts of states represent 42 states. Seven of these compacts (31 states) are planning to build eight new disposal facilities.[2] In addition, the existing disposal facility located near Richland, Washington, will remain open to serve waste generators located within the 11 states that are members of the Northwest compact and the Rocky Mountain compact. The other two existing disposal facilities, in Nevada and South Carolina, are scheduled to be shut down at the end of 1992. Five states not affiliated with compacts are also in various stages of developing their own low-level waste disposal facilities. If all these proposed facilities are eventually developed, 14 disposal facilities will exist to handle commercially generated low-level nuclear waste.

Two states—New Hampshire and Rhode Island—and the District of Columbia and Puerto Rico are not planning facilities and are at various stages of securing access for storage and/or disposal of their waste. The remaining state—Michigan—was expelled from the Midwest compact on July 24, 1991, and has not announced plans to manage and dispose of low-level waste generated within the state.

Figure 1.1 shows the current arrangements of compacts and unaffiliated states. As shown, the compacts are generally organized regionally with the exception of the Southwestern compact, which includes North and South Dakota in addition to California and Arizona. With the exception of Texas, unaffiliated states are concentrated in the Northeast. The largest compact is the Southeast compact, which represents eight states and about 30 percent of commercially generated low-level waste.

[2] Except for the Northeast compact, composed of Connecticut and New Jersey, each compact plans to build one disposal facility. Both Connecticut and New Jersey intend to develop their own facility.

Figure 1.1: Low-Level Radioactive Waste Compacts and Unaffiliated States, as of October 1991



Northwest
- WA is host state
- 8% national LLW

Southwestern
- CA is host state
- 7% national LLW

Rocky Mountain
- NV current host state
- Northwest compact eligible to accept LLW from Rocky Mountain compact after 1992
- <1% national LLW

Midwest
- OH selected as host state
- 7.6% national LLW

Central
- NE selected as host state
- 5% national LLW

Central Midwest
- IL is host state
- 9% national LLW

Northeast
- Both NJ and CT will be host states
- 8% national LLW
- Disposal technology to be determined by host states

Appalachian
- PA is host state
- 11% national LLW

Southeast
- SC current host state
- NC selected as next host state
- 29% national LLW

Unaffiliated states
- 14.2% national LLW (10 states)
- NY to host site - 6% national LLW
- MA to host site - 4% national LLW
- ME to host site - <1% national LLW
- MI undecided on hosting site - 3.2% national LLW
- TX to host site - 1% national LLW
- VT to host site - <1% national LLW
- NH, RI, DC, PR each less than 1% national LLW

Unaffiliated states
▲ Operating LLW Disposal Sites

Note: LLW = low-level waste.
Source: GAO illustration based on NRC original.

Objectives, Scope, and Methodology

On February 21, 1990, the Chairman, Senate Committee on Governmental Affairs, requested that we review the progress being made by the states in implementing the Low-Level Radioactive Waste Policy Amendments Act of 1985. Following subsequent discussions with the Chairman's office, we agreed to review the states' progress and problems in meeting the facility-development milestones and deadlines contained in the 1985 amendments to the low-level waste act. In addition, we agreed to review the status of federal and state efforts to resolve issues pertaining to disposal of mixed waste and waste that may be "below regulatory concern." Finally, we agreed to assess DOE's progress in discharging its responsibility to dispose of Greater-Than-Class-C low-level waste.

We reviewed reports and other documentation from NRC, DOE, EPA, and the Low-Level Waste Forum;[3] individual compacts and unaffiliated states; and various private organizations involved in the low-level waste disposal issue. We also interviewed officials of these organizations to obtain additional information and perspectives on the status of the states' efforts to implement the 1985 act and to clarify information contained in the reports and other materials reviewed.

We discussed the factual content of pertinent sections of this report with officials of NRC and DOE. These officials generally agreed with the facts and their comments were included where appropriate. Our work was conducted between April 1990 and September 1991 in accordance with generally accepted government auditing standards. As requested, we did not obtain written comments on a draft of this report.

[3] The Low-level Waste Forum is an independent association of states and regional compact representatives working to facilitate implementation of the Low-Level Radioactive Waste Policy Act, as amended, and to promote the objectives of the low-level radioactive waste regional compacts.

States' Efforts to Develop New Disposal Facilities Affected by Legislative, Administrative, and Other Requirements

Of the 13 states planning to develop new low-level radioactive waste disposal facilities, most have made progress but only one expects to have its facility operating when states with existing disposal facilities can deny access to their facilities to waste generators in other states. Furthermore, most of the other 12 states will not have their facilities ready until 1996 or later. Because of the number of activities involved, facility development has been a complex and time-consuming process that will take longer than the states originally envisioned. For example, efforts to involve the public and public opposition have affected the time needed to accomplish key tasks, especially during the selection of potential disposal sites. As a result of the delays in developing new disposal facilities, after January 1, 1993, most states expect to manage the low-level wastes generated within their areas by having waste generators store the wastes until new disposal facilities are ready.

Progress and Problems in Achieving the 1985 Act's Milestones

The majority of the states met the requirements of the three milestone dates of the 1985 act that had passed by January 1990, but most states will not meet the last three milestones. For example, most states planning to develop new disposal facilities will not be able to submit their license applications by January 1, 1992, and do not expect to have their disposal facilities operational by the final deadline of January 1, 1996. These states, however, say they will continue their development processes until new facilities have been completed. The states point to numerous legislative, administrative, programmatic, and technical matters that must be addressed as their reasons for not meeting the milestones.

Current Status and Plans of the States

Only California, host state for the Southwestern compact, submitted a license application by the January 1, 1990, milestone. Although the majority of compact host and unaffiliated states met this milestone, they did so only by submitting a governor's certification describing how they intend to pursue development of a disposal facility and provide for the management of low-level waste generated in their respective areas beginning on January 1, 1993. Table 2.1 shows the dates by which compact host states and unaffiliated states accomplished, or expect to accomplish, key steps in developing new disposal facilities.

Table 2.1: Actual and Estimated Dates for Completing Steps in Facility Development

Compact/ host state	Select site	Submit license application	Receive license approval	Operate facility
Appalachian/ Pennsylvania	Feb. 1994	Feb. 1994	Aug. 1995	Aug. 1996
Central/Nebraska	Dec. 1989	July 1990	Oct. 1992	May 1995
Central Midwest/ Illinois	Jan. 1991	May 1991	May 1992	May 1993
Midwest/Ohio[a]	[b]	[b]	[b]	[b]
Northeast/ Connecticut	Apr. 1992	May 1993	Jan. 1995	Mar. 1996
New Jersey	July 1994	Oct. 1994	Jan. 1996	Oct. 1997
Southeast/ North Carolina	May 1993	[b]	[b]	Feb. 1996
Southwestern/ California	Mar. 1988	Dec. 1989	Dec. 1991	Aug. 1992
Unaffiliated states				
Maine	June 1992	Feb. 1993	Jan. 1996	Dec. 1998
Massachusetts	June 1994	Nov. 1994	Nov. 1995	Dec. 1996
New York[c]	[b]	[b]	[b]	[b]
Texas	Nov. 1991	Jan. 1992	Jan. 1996	Jan. 1997
Vermont	Oct. 1995	Oct. 1997	Dec. 1998	Aug. 1999

[a]On July 24, 1991, the Midwest compact revoked Michigan's membership and designated Ohio as the new host state. Ohio will not announce target dates until the enabling legislation is passed by the Ohio legislature in 1992.

[b]Target date not stated.

[c]New York has withdrawn its estimates for the completion of these tasks. No date has been set for announcing new target dates.

To date, only California, Illinois, and Nebraska have submitted license applications. Collectively, these states represent 11 states in three compacts that account for about 21 percent of commercially generated low-level waste. These three states are the only states expected to meet the milestone for accomplishing this task. Waste generators in states that do not meet this milestone, as well as generators in other states that are affiliated with these states through compacts, will be subject to surcharges on the wastes they dispose of during 1992 until the states submit applications for disposal facility license applications to appropriate regulatory agencies. Furthermore, only California, Illinois, and Nebraska expect to have their disposal facilities operational by January 1, 1996. The remaining four host states for compacts and the five unaffiliated states that are planning 10 new disposal facilities are expected to continue developing their respective facilities after that deadline until the facilities are operational. Collectively, these 10 facilities would serve waste generators in 25 states that generate about two-thirds of all commercially generated low-level waste.

The seven states of the Northwest compact, which generate about 8 percent of low-level waste, will continue to use the existing disposal facility near Richland, Washington. In addition, the compact is contracting to receive the small amount of waste generated by the four states of the Rocky Mountain compact after the disposal facility in Nevada closes on December 31, 1992.

The existing disposal facility in South Carolina is also scheduled to close on December 31, 1992. However, on October 25, 1991, the Southeast compact, which includes South Carolina, passed a resolution requesting the South Carolina legislature and the state's Board of Health and Environmental Control to keep the facility open to the eight members of the compact until the new host state—North Carolina—completes development of its planned facility. Because North Carolina does not expect to complete its facility until 1996, an affirmative decision by South Carolina would eliminate the need for temporary storage arrangements by members of the compact beginning in 1993. The region covered by the compact accounts for about 30 percent of commercially generated low-level waste. At the completion of our review, South Carolina had not acted upon this request.

Facility Development Is Complex and Time-Consuming

Facility development has proved more complex and time-consuming than the states originally anticipated. The process has involved the states in many legislative, administrative, programmatic, and technical matters. These have included the development of implementing legislation; the selection of a facility developer; the development and implementation of site-selection and facility-development programs, including initiatives to involve the public; and the need to address public opposition and legal challenges to the development process. Other issues the states have had to address have included liability protection for parties responsible for disposal facilities and, as discussed in chapter 3, the disposal of mixed waste and the effects of NRC's proposed policy to permit exemption of wastes with very low levels of radioactive materials from disposal requirements.

The steps required to develop a low-level waste disposal facility have proven to be time-consuming and complex. States' efforts to accomplish these steps have required the extensive involvement of state and local governments, utilities, facility developers, and the public. Among the primary phases in the facility-development process are

- a state's decision either to form a compact with other states, join an existing compact, or remain unaffiliated;
- the selection by compact members of a state to host the compact's disposal facility and subsequent enactment of the necessary implementing legislation by the host and member states;
- development and implementation of a site-selection plan, including the identification and scientific investigation of candidate sites and selection of the preferred site;
- selection of the disposal facility design;
- completion of environmental assessments;
- preparation and submission of a license application to the appropriate regulatory agency—either the NRC or the state regulatory agency responsible for low-level radioactive waste disposal;
- review and approval of the license application; and
- construction and operation of the disposal facility.

The time needed to accomplish these steps has been difficult to predict. Virtually all target dates originally set by the states have been changed several times since January 1, 1988, when states were to have developed siting plans. In addition, compacts and states differ in their arrangements for conducting the steps required to find sites for, license, and construct new disposal facilities. Also, the direction provided by state legislatures can affect the development process and the time required to accomplish specific tasks. To show how selected states have pursued facility development, appendix I describes the experiences of the compact host state of California, the unaffiliated state of New York, and the state of Michigan which, until July 1991, was the designated host state for the Midwest compact. Also, we discussed Nebraska's experience in finding a site for a low-level waste disposal facility in an earlier report.[1]

As noted above, almost all states met the July 1, 1986, milestone for joining compacts or certifying their unaffiliated status and intent to develop their own facilities. In addition, most prospective host states met the January 1, 1988, milestone for establishing a plan to identify a facility site. However, states' estimates of the time it would take to select disposal sites have fallen far short of the time actually needed. All but a few states originally expected to have selected a disposal site for licensing before 1991, but most states have adjusted this date forward from 1 to 3 years or more. For example, Michigan had expected to select

[1] Nuclear Waste: Extensive Process to Site Low-Level Waste Disposal Facility in Nebraska (GAO/RCED-91-149, July 5, 1991).

a site by December 1989. However, because of the state's relatively restrictive site-selection criteria, the state could not identify a qualified site. For this and other reasons, in July 1991 the Midwest compact revoked Michigan's membership in the compact. The Midwest compact's new host state, Ohio, must now start a site-selection process and is not expected to make any announcements about its schedule until 1992.

Public Involvement in the Disposal Facility Process

Initiatives to involve the public in the facility-development process and public opposition to the process have been of interest and concern to most compact host and unaffiliated states. States have engaged in considerable discussion among themselves about the need for programs and processes that provide for open and clear communication between state governments, facility developers, the public, and various interest groups. These programs have contributed to the time needed to complete steps in facility development. Public opposition has also affected the time taken to move through the process, especially during the site-selection phase. Some opposition efforts have also resulted in legal actions that have slowed or stopped the process. Among these efforts have been challenges to the act and continuing debate over the number of sites necessary to meet national requirements for disposal capacity.

States have used various forms in their public participation programs or initiatives, recognizing the need for statewide, county, and local participation and interaction. Public meetings, hearings and workshops on the various facets of the low-level waste issue and the facility-development process have been common activities. Statewide advisory committees and local advisory or monitoring committees have also been used to communicate with the public and provide a mechanism for direct public input during various phases of the development process. Nebraska used an innovative, statewide, 12-location video conference, and North Carolina undertook a similar effort. Some states have also used scale models, displays, exhibits, and site tours to communicate the issues and details of facility development.

However, states further along in the process have recognized that, despite their public communication plans and activities, public opposition will continue. Public opposition can make the facility-development process complicated and time-consuming during both the site-selection phase and subsequent phases. Both New York and Nebraska have experienced public protests during site-selection activities and legal actions challenging state and federal law and efforts to site a disposal facility.

In April 1990 public opposition and protests in New York led to an incident involving personal injury. As a result, the governor suspended plans to conduct preliminary investigative work at candidate sites and obtained legislation changing state law on the process. Although a state agency continues to review data on candidate sites from available records, the lack of access to sites has delayed the overall facility-development process. New York has not announced any new target dates for completing site selection or subsequent steps in facility development.

Public disagreement and opposition in Nebraska during the screening and investigation of sites included organized protests and disruptions of meetings. Furthermore, a lawsuit was filed by a local opposition group challenging the constitutionality of the Low-Level Radioactive Waste Policy Act, among other claims against the Central compact, the state of Nebraska, the facility developer, and NRC. Other states, including Illinois, Colorado, Michigan, North Carolina, and Texas have experienced similar situations, including legal challenges, at both the state and local level.

According to information assembled by DOE, most states have reported that gaining public acceptance of the facility-development process was a significant factor affecting their progress. States have noted that misunderstanding about low-level waste and the facility-development process has caused delays. According to information conveyed by state representatives at Low-Level Waste Forum meetings, comprehensive and well-planned public involvement programs do not necessarily preclude strong public opposition, which must be addressed if the process is to move forward.

Although the National Governors Association and other state government associations supported the original and amended low-level waste act, some states have challenged the 1985 act on the basis that it represents an unconstitutional infringement on the states' sovereignty. Both New York and Michigan, challenged the constitutionality of the 1985 act and raised other issues. Court rulings to date have rebuffed these constitutional challenges.

Finally, since the 1980 act was passed, decisions on the number of sites that would be built to dispose of commercially generated low-level waste have rested with the states. Although neither the original nor the amended acts mentioned the need for an economical network of regional disposal facilities, the legislation authorized the states to form compacts,

subject to congressional approval, in whatever manner they decided. Some public officials, however, have challenged the amended act on the basis that it would result in the development of too many new disposal facilities. A common concern has been the cost of developing waste disposal facilities, the estimates of unit disposal costs, and the waste volumes spread over multiple facilities around the country. Several federal and state legislators and officials and others have questioned the need for as many as 14 facilities. In their view, the current approach is uneconomical and will unnecessarily cost the nation hundreds of millions of dollars during a time of budget constraints.

Arguments contrary to this view note that the act clearly encouraged the states to form compacts with the intent of minimizing the number of facilities developed and achieving potential economies. Various state and compact officials have expressed the view that the potential economies may have already been realized in the current structure of compacts and unaffiliated states and that further consolidation may be difficult. Concerns have also been expressed that further federal intervention could adversely affect the progress that has been made. For example, in a March 1990 letter to the Secretary of Energy, the Governor of the state of Washington stated

> I am an ardent supporter of the national compact system. My offer to contract with the Rocky Mountain states is an effort to protect and nurture the compact process, through site consolidation. At the same time, I will not permit Hanford [the state's disposal facility site near Richland] to become a disposal facility for states outside of our region. . . . We in Washington State have learned that, when compelled to find solutions to nuclear waste issues, political leaders adopt responsible positions.

A similar view was expressed in July 1991 as a result of a proposed amendment to the National Governors Association's nuclear policy. The governors of Nebraska and Michigan had submitted a proposed amendment calling for a reexamination of the low-level waste facility-development process, including costs and the number of sites. The amendment was rejected by the association's staff advisory council and has been given no further consideration.

Efforts to Provide Liability Protection Against Third-Party Claims

Providing liability protection for citizens and property from potential releases of radioactivity from a disposal sites has been a concern of the states that are developing facilities and has been the subject of considerable discussion within and between the compacts and states. While this type of protection is not specifically required or addressed by federal

law or regulation, states and developers have made or will be making arrangements for this type of protection.

The parties responsible for the construction, operation, and closure of low-level radioactive waste disposal facilities are required to show in their license application that they have certain financial capabilities to manage all license activities over the planned life of the facility. However, neither the act nor NRC's regulations require protection against third-party claims. In addition, the Price-Anderson Act, which limits the liability of utilities and others involved with nuclear power plant operations, does not apply to low-level waste disposal sites. As a result, some states have passed legislation to clarify this issue by establishing strict liability for all property damage and bodily injury resulting from the operation of the disposal facility and/or have provided the state and/or the developer with other direction on their responsibilities.

The states have been examining various arrangements to provide protection for such third-party claims, including self-insurance, special reserve funds, and letters of credit, among other methods. Thus, two of the compacts that have submitted license applications appear to have the potential to use several mechanisms to meet the financial assurance requirements as well as the potential for third-party claims against the facility operators and other responsible parties. For example, Nebraska, in its Low-Level Radioactive Waste Disposal Act, made disposal facility operations subject to strict liability for all property damage, bodily injury, or death resulting from such disposal.[2]

While there are no provisions in California state law for liability protection, as host state for the Southwestern compact's facility, California intends to impose a surcharge on disposal fees to build a third-party liability fund for injury to people and property during the facility's operation or after closure.

Waste Storage After January 1, 1993

Because most states will not have a new disposal facility operational by the January 1, 1993, deadline, the states will have to make arrangements to ensure that low-level wastes generated within their borders are properly managed and stored until new disposal facilities are operational. In governor's certifications submitted to DOE and the three states

[2] GAO's report Nuclear Waste: Extensive Process to Site Low-Level Waste Disposal Facility in Nebraska (GAO/RCED-91-149, July 5, 1991), addressed Nebraska's efforts to ensure that appropriate liability protection was obtained by the disposal facility operator.

with existing disposal facilities, most states reported that on-site storage by waste generators will be the primary arrangement for managing the low-level waste after access to the three existing facilities is terminated on January 1, 1993. For some states the storage period may be less than a year. For others it is likely to be longer, possibly 5 years or more, until their disposal facilities are operational. This approach may require that some generators, including utilities that operate nuclear power plants, either use existing space approved for storage or expand storage capacity through license amendments.

Under NRC's basic policy on the storage of low-level waste, storage is not considered a substitute for disposal. Waste is to be stored only when disposal capacity is not available and then no longer than necessary. NRC has issued several policy and informational documents on low-level waste storage over the past several years because of the importance of the topic to states and generators that will be involved in planning for and implementing temporary storage of low-level wastes in lieu of current disposal operations. NRC has also used the Low-Level Waste Forum to inform states about this subject and has had direct communications with many individual states, compacts, and waste generators. According to NRC policy and guidance, the agency's fundamental position on storage of low-level waste is that strict compliance with regulations is required to ensure protection of public health, safety, and the environment. NRC officials have also said that the agency recognizes that temporary storage of low-level radioactive waste is the primary option the states have until the new facilities are completed. NRC believes that on-site storage may require some generators to prepare and submit license amendments to NRC or their state regulators for review and approval to ensure compliance with federal and state regulatory requirements.

In September 1991 NRC's staff prepared a paper for the NRC Chairman on the provisions of the 1985 act related to transfer of title and possession of low-level waste from waste generators to states. According to the agency's staff, the paper discusses a number of legal, policy, and technical issues and potential actions the Commission could take to address these provisions. Although prepared for the Commission's use in deciding what actions it could take, this paper will also provide additional guidance to states and generators on these provisions of the 1985 act.

Observations

All prospective compact host and unaffiliated states planning a disposal facility are behind in their original development schedules. The states

recognize that the facility-development process has been more complex and time-consuming than they originally estimated. Furthermore, these complexities and the related adjustments of target dates made by the states over the past several years indicate that further delays are not unlikely. Currently, 25 states, which collectively account for about two-thirds of commercially generated low-level waste, do not expect to have access to a disposal facility until after January 1, 1996. However, the five compact-affiliated and five unaffiliated states plan to continue developing their facilities.

Until the states' facilities are operational, most states intend to arrange for on-site storage by waste generators as the primary method for managing low-level wastes. Also, the Southeast compact has requested that South Carolina keep its existing facility open to the eight members of the compact until North Carolina has developed a new facility. South Carolina has not acted on this request. NRC has developed waste storage policies and guidance for the states and the generators to follow. Thus, it appears that the states, the waste generators, and NRC (1) have recognized that most states will not have new disposal facilities in operation by the time the states with existing disposal facilities begin denying access to their facilities and (2) are taking steps to prepare for temporary storage of waste at waste generators' facilities pending completion of planned disposal facilities.

Efforts to Resolve Issues Related to Special Categories of Low-Level Waste

In addition to the factors affecting facility development discussed in chapter 2, states and affected federal agencies have been addressing questions associated with the disposal of special categories of low-level waste. These categories are mixed waste, which contains both radioactive and hazardous constituents; wastes that have very low levels of radioactivity; and those low-level wastes having the highest level of radioactivity.

Commercial entities generate a relatively small volume of mixed waste that is subject to regulation by both NRC (or agreement states) and EPA. Joint regulation is expected to make the unit cost of disposing of mixed waste much higher than the cost of disposing of other low-level wastes. For this reason, states and others have been concerned about the management and disposal of mixed waste and have suggested either that DOE, which generates much larger quantities of mixed waste, assume responsibility for disposing of commercially generated mixed waste or that a lead agency be designated to regulate low-level radioactive waste.

Also, the 1985 act directed NRC to establish standards and procedures for responding to petitions to exempt low-level waste having very low concentrations of radioactivity—estimated to be about 20 percent of all commercially generated low-level waste—from its requirements for disposal of low-level wastes in regulated disposal facilities. However, negative public reactions to NRC's policy statement on the approach it would follow to exempt waste that is "below regulatory concern" from disposal requirements has caused the agency to reexamine the policy before preparing regulations to implement it.

Finally, the 1985 act made the federal government responsible for disposing of the most hazardous low-level waste. Although DOE has taken some steps to address this issue, it does not expect to have a disposal facility ready until 2010. In the interim period, DOE had planned to begin accepting this waste by October 1990 for storage at a facility to be developed for that purpose; however, it now does not expect the facility to be ready until sometime in 1992.

Disposal Arrangements for Mixed Waste Are Under Review

Mixed waste represents a relatively small portion of commercially generated low-level waste and an even smaller portion of the hazardous waste produced in the United States. However, one estimate of the unit cost of disposing of this waste in new low-level waste disposal facilities is much higher than the unit cost of disposing of other low-level waste in part because disposal of mixed waste is subject to regulatory requirements of both NRC and EPA. For this reason, most states, several industry groups, and an NRC advisory committee have questioned the merits of joint regulation of mixed waste. Proposed alternatives to joint regulation include disposal of commercially generated mixed waste by DOE or disposal in facilities for commercially generated waste regulated either by NRC or EPA but not both agencies.

Cost-Effectiveness of Joint Regulation Questioned

Mixed low-level radioactive waste is a waste mixture that contains both radioactively and chemically contaminated constituents. The radioactive component of the waste is subject to regulation by NRC under the Atomic Energy Act, and the hazardous constituents are regulated by EPA under RCRA. NRC and EPA staff and management have worked together to address aspects of the joint regulation of mixed waste. According to representatives of the agencies, each agency has been committed to making joint regulation of mixed waste work. In this regard, the two agencies generated three joint documents in 1987 that provided information on definitions and guidance on disposal sites and facility designs. Additional guidance documents are being developed to address the agencies' separate requirements in the areas of waste storage characterization sampling, joint licensing, and facility inspection.

However, most states, several industry groups, and NRC's Advisory Committee on Nuclear Waste have questioned the merits of joint regulation of mixed waste. These questions center on whether, considering the relatively small volume of mixed waste that is involved, the benefits in protection to public health, safety, and the environment are worth the expected cost of disposal of mixed waste under joint regulation.

Mixed waste is estimated to be a small portion of the total amount of both commercially generated low-level waste and hazardous waste subject to RCRA requirements. For example, various state and industry surveys have estimated that mixed waste comprises between 3 and 10 percent of all commercially generated low-level waste, or between 45

thousand and 150 thousand cubic feet annually.[1] Furthermore, EPA regulates an estimated 200 million to 500 million cubic feet of hazardous waste generated each year.[2] Of this amount, according to an official from EPA's Office of Solid Waste, EPA annually exempts between 10 million and 25 million cubic feet, or 5 percent, of this hazardous waste from certain regulatory requirements. According to EPA, these exemptions minimize the regulatory burden on small generators of hazardous wastes and make better use of EPA's limited resources. Thus, estimates of mixed low-level wastes are very small when compared with estimates of the total amounts of commercially generated low-level waste and hazardous wastes produced each year in the United States.

Although relatively little mixed waste is produced by commercial low-level waste generators, the estimated unit cost of disposing of mixed waste under the current joint-regulation approach is relatively high. According to information presented by officials of several states to the Low-Level Waste Forum in July 1991, preliminary cost estimates for disposal of low-level radioactive waste ranged from $121 to $800 per cubic foot of waste, excluding mixed waste. In contrast, US Ecology, the developer of a disposal facility for the Central compact, estimated that it would cost about $15,000 per cubic foot to dispose of mixed waste. This estimate was attributed to the small volume of mixed waste, the high costs of developing and constructing dedicated portions of disposal facilities for mixed waste, and the effects of joint regulation by both NRC and EPA.

Proposed Options for Mixed-Waste Disposal

Through the Low-Level Radioactive Waste Forum, compact host states, unaffiliated states, and industry have been exploring possible alternatives to disposal of mixed wastes in accordance with NRC's and EPA's regulations. One suggested alternative is transferring to DOE the responsibility for disposing of commercially generated mixed low-level waste. In view of the higher volume of mixed waste that DOE generates, many states believe that DOE could more practically and economically dispose of commercially generated mixed waste.

[1] NRC and EPA are jointly conducting a national survey to better identify and characterize the amount of commercial mixed low-level mixed waste generated and its treatability. They expect to complete this survey in 1992.

[2] EPA has had difficulty estimating the amount of hazardous waste generated for which it has regulatory responsibility. GAO reviewed this issue in a report entitled Hazardous Waste: EPA Has Made Limited Progress in Determining the Waste to Be Regulated (GAO/RCED-87-27, Dec. 23, 1986).

In October 1990 the Low-Level Waste Forum requested that DOE explore the possibility of an agreement with the states under which DOE would accept commercial mixed low-level waste at DOE's own treatment and disposal facilities. Later, at a December 1990 and January 1991 workshop on low-level waste disposal, NRC's Advisory Committee on Nuclear Waste also suggested that DOE could manage the disposal of mixed waste, similar to DOE's responsibility to manage and dispose of commercially generated Greater-Than-Class-C waste, if the Congress passed appropriate legislation. In this regard, the advisory committee noted that the vast majority of mixed low-level waste generated in the United States is federal waste, largely resulting from DOE activities.

Forum and DOE officials have subsequently discussed the issue on several occasions, and DOE has indicated its interest in exploring with the states its possible role in commercial mixed waste disposal. Furthermore, on August 2, 1991, the Chairman of NRC wrote to the Secretary of Energy expressing the Chairman's interest in resolving the commercial mixed-waste disposal issue in a way that is consistent with NRC's responsibility to protect the public health and environment and indicating that DOE's acceptance of the waste may be the solution. The Chairman's letter stated that NRC believes that no serious impediments exist to DOE's taking possession of this waste from NRC licensees. According to the Chairman, through the joint efforts of NRC, DOE, EPA, the states, and the regulated community, the increasingly urgent problems surrounding the management and disposal of this waste can be successfully resolved. On September 5, 1991, the Secretary of Energy responded to NRC's Chairman by acknowledging the need for the involved agencies and the states to address this issue. On October 16, 1991, senior NRC and DOE managers met to discuss the issue further. DOE managers expressed a need for further discussion and information for DOE's consideration of accepting commercially generated mixed waste.

A second alternative to continued joint regulation is regulation only by NRC, based on an interpretation that EPA's regulations are inconsistent with NRC's regulations. In the December 1990 and January 1991 workshop of NRC's Advisory Committee on Nuclear Waste, the committee reviewed the issues associated with the disposal of commercial mixed low-level waste. Representatives from NRC and EPA staff as well as representatives from the states and industry provided information to the committee. In its February 28, 1991, report to NRC's Chairman, the committee discussed several problems related to joint regulation of mixed low-level waste. It noted that differences in the regulatory requirements

of EPA and NRC complicate the regulatory effort of each agency. Among the differences the committee pointed out were

- differences regarding the need for liners and leachate collection systems for mixed waste disposal facilities,
- differences in regulations on the nature and location of the treatment and packaging of mixed waste,
- EPA's unique requirements for periodic sampling analysis and inspection of mixed wastes, and
- differences in the periods established for waste containment and isolation for hazardous and low-level radioactive wastes.

The advisory committee also commented on NRC's and EPA's efforts to manage and improve the joint regulatory system, including efforts to improve the guidance on joint regulation. The advisory committee noted the agencies' further efforts to issue additional guidance on the periodic sampling and analysis of waste, to administer licensing procedures, and to review and approve a conceptual design for proposed facilities. However, the committee also noted the high estimated costs for disposing of this waste under the current arrangements. The advisory committee's report to NRC's Chairman stated that

> Dual jurisdiction of the regulatory process for mixed wastes appears to be wasteful of resources and lacks justification on the basis of benefit to the public. Some groups have strongly urged that the responsibility for regulating mixed wastes be assigned to a single agency.

One suggestion offered at the workshop to achieve this result was for NRC to exercise the option provided under section 1006(a) of the RCRA, which allows the Atomic Energy Act to "take precedence in the event provisions or requirements of the two acts are found to be inconsistent."

Resistance to Exempting Least Hazardous Materials From Disposal Requirements

Under the 1985 act, NRC was directed to establish standards and procedures, under existing authority, for dealing with petitions to exempt specific radioactive waste from regulation by NRC because of the presence of radionuclides in sufficiently low concentrations or quantities as to be below regulatory concern. In response to the 1985 act, NRC initially made revisions to 10 C.F.R. part 2 (app. B) related to exemptions of specific waste streams from disposal in licensed facilities, and subsequently prepared a policy statement known as the below-regulatory-concern policy. This policy statement has met with considerable opposition

within the states, including legislation in some states that would prohibit exemptions from normal disposal requirements. As a result, NRC has suspended further efforts to implement the policy pending reexamination of the policy.

NRC Developed Below-Regulatory-Concern Policy

The Atomic Energy Act of 1954, as amended, authorized the exemption of certain classes, quantities, or uses of radioactive material from regulation when NRC finds that such exemptions will not constitute an unreasonable risk to public health and safety. NRC's regulations identified the radioactive materials and radioactive limits authorized for exemption and, for many years, NRC has exempted low-level radioactive waste and other materials determined to be below regulatory concern from disposal in NRC-licensed facilities. According to an NRC representative involved with the below-regulatory-concern exemption policy, NRC does not have a data base on the specific substances and amounts of radioactive materials and waste that licensees have been permitted to dispose of since the Atomic Energy Act of 1954. However, over the years licensees have disposed of these radioactive wastes in other than licensed low-level waste disposal facilities.

Section 10 of the 1985 act required NRC to establish standards and procedures, as well as the technical capability, to expedite actions on petitions to exempt specific wastes streams from regulation. As a result, in August 1986 NRC made revisions to 10 C.F.R. part 2 (app. B) that provided standards and procedures for the Commission to make practical and timely decisions to determine when wastes need not go to a licensed low-level waste disposal facility and announced the development of a below-regulatory-concern policy statement. In announcing the approval of the policy statement in June 1990, NRC's Chairman emphasized that the policy statement did not constitute a decision to exempt any specific consumer product, waste, or other material from regulatory control. Instead, the statement was a general guideline for the development of such exemptions and provided a uniform and consistent health and safety risk framework for later consideration of regulatory exemption decisions. The policy covers activities or products such as (1) cleanup of decommissioned and decontaminated facilities, (2) consumer products containing small amounts of radioactive material, (3) very low-level radioactive waste, and (4) recycled equipment and materials with slight amounts of radioactivity.

The 1990 below-regulatory-concern policy statement identified criteria, in the form of maximum allowable doses of radiation to individuals and

populations, that NRC would use to help make exemption decisions. NRC established an individual dose criterion of 10 millirems per year.[3] Table 3.1 shows NRC's comparison of below-regulatory-concern radiation dose criteria with doses from other radiation sources. As shown in the table, NRC's dose criterion for individuals is one-thirtieth of an individual's estimated annual exposure to radiation from natural sources. For added conservatism, NRC set an interim individual dose criterion of 1 millirem per year for materials and products involving widespread distribution of radioactive materials, such as consumer products. To ensure that the total potential effects of exemptions on society is appropriately minimized, NRC also established a collective (population) dose criterion. According to NRC, this criterion is equivalent to 100,000 individuals receiving 10 millirems per year or 1 million individuals receiving 1 millirem per year, which has a calculated annual number of health effects for an exempted practice of less than one person.

Table 3.1: Comparison of Below-Regulatory-Concern Criteria With Other Sources of Radiation

Source of radiation	Annual radiation dose (millirems)
All natural background radiation	300
Natural radioactive materials in the body	40
One chest X-ray	6
Living in Denver, Colorado, versus Washington, D.C.	70
Living in a brick versus a wood home	10
All medical exams	50
Round-trip cross country flight	5
Below-regulatory-concern practice affecting a limited number of people	10
Below-regulatory-concern practice affecting a large number of people	1

Source: NRC.

Opposition to NRC Efforts to Implement the Below-Regulatory-Concern Policy

There is resistance in many states to the disposal of any radioactive waste in other than licensed low-level waste disposal facilities. Several states, including Iowa, Maine, Minnesota, and Wisconsin have passed legislation banning the disposal of very low levels of radioactive wastes in other than a licensed low-level radioactive waste disposal facility. Several other states are considering similar legislation. Also, bills have been introduced in the Congress to rescind NRC's policy on the basis that

[3] A millirem is a unit of radiation dose that is one-thousandth of a rem.

implementation of the policy would endanger public health and create environmental problems.

Several other groups, including the National Association of Attorneys General, the Western Governors Association, and the National Conference of State Legislatures, have also opposed NRC's policy. In addition, a group of over 25 environmental organizations filed a petition with the U.S. Court of Appeals for the District of Columbia for a review of NRC's policy statement. On August 2, 1991, the Court of Appeals denied the petition.

In response to opposition to its policy statement, NRC announced in July 1991 that it was imposing a moratorium on efforts to implement the policy and that it would implement a two-phase consensus-building process for the below-regulatory-concern policy. In the first phase, leaders representing parties that have a direct interest in the policy would be assembled. This group would consist of a high-level representative from each state, a utility, the medical community, an environmental or public interest group that has demonstrated interest in the policy, and NRC. NRC believes that before the second phase—the functioning of the working group—of the consensus-building process starts, all the parties to the process should agree to defer actions on other avenues of relief, such as legislative or judicial alternatives. By the conclusion of our work, the first phase of the consensus-building process had not been completed, and NRC management was considering alternatives to this process, including building consensus during specific rulemakings on below-regulatory-concern wastes.

DOE's Efforts to Dispose of the Most Hazardous Low-Level Waste

The Low-Level Radioactive Waste Policy Amendments Act made the federal government responsible for disposing of the most highly radioactive low-level waste, called Greater-Than-Class-C waste, and directed DOE to report to the Congress its recommendations for ensuring the safe management and disposal of this waste. According to NRC, commercial firms may possess about 100,000 devices or sealed sources containing this type of low-level waste.

In February 1987 DOE issued a report on its recommendations for managing Greater-Than-Class-C low-level radioactive waste. In this report, DOE stated that it planned to have a program to manage these wastes in place within 2 years. Then, in April 1990, DOE issued a three-phase strategic plan for managing and disposing of these wastes that involved interim storage of the wastes, followed in sequence by dedicated storage

and the eventual treatment and disposal of the wastes beginning about 2010. DOE stated that a program to provide for interim storage capability at a DOE facility would be in effect by October 1990.

During 1990 DOE surveyed its facilities to identify a potential location for interim storage of Greater-Than-Class-C waste and identified its Oak Ridge, Tennessee, facility as a potential storage site pending further discussions within DOE and with state officials. For planning purposes, DOE projected that it will be asked to accept several hundred sealed sources of this waste over the next 5 years.

In June 1991 DOE drafted a revised strategic plan, stating that DOE intends to have a program in 1992 to accept for interim storage from generators limited amounts of sealed sources of Greater-Than-Class-C waste that present a significant threat to public health and safety. However, according to the program manager for DOE's low-level waste program, when potential threats to public health and safety are involved, DOE has and will continue to accept sealed sources of Greater-Than-Class-C waste at certain of its facilities.

DOE's program manager also stated that, in addition to finalizing the decision on the location of the interim storage facility, DOE has several fundamental tasks to perform over the next several years. These include the need to better identify and characterize Greater-Than-Class-C waste now held at DOE facilities and commercial generators and users, and the need to develop waste acceptance criteria and fee schedules for receiving this type of waste at the dedicated storage facility that DOE plans to provide by 1997.

Selected States' Experiences in Developing Low-Level Radioactive Waste Disposal Facilities

California, the host state for the Southwestern compact, has made the most progress towards developing a disposal facility for low-level radioactive waste. In contrast, Michigan, which was the host state for the Midwest compact until July 1991, was unable to identify candidate sites for a facility that would be expected to meet the state's technical siting criteria. After early efforts to form a compact with other states, New York decided to develop its own low-level waste disposal facility. Strong public opposition to selected candidate sites, however, caused the state to revise its facility-development process. The experiences of each of these states in attempting to develop a low-level waste disposal facility is summarized below. Also, a discussion of Nebraska's experience through mid-1991 in developing a low-level waste disposal facility for the Central compact is contained in our July 5, 1991, report on that subject.[1]

California

The state of California took legislative steps in 1982 to address the Low-Level Radioactive Waste Policy Act of 1980. In 1987 the state's legislature approved a compact with Arizona, known as the Western compact. Subsequently, North Dakota and South Dakota joined and the compact was renamed the Southwestern compact. With California as host state, the Southwestern compact was ratified by the Congress in 1988.

California's Department of Health Services—the state regulatory agency[2] —developed siting criteria, established regulations for the designation and licensing of a private low-level waste facility developer, and identified regions of the state likely to meet the criteria that had been developed. The regional screening was based on NRC guidance and additional criteria established by the department.

California's legislation required public involvement in the site-selection process and the establishment of a statewide advisory committee to advise the Department of Health Services on siting criteria, disposal technologies, waste classification, and environmental impacts. California selected a private company—US Ecology—to site, construct, operate, and close the proposed disposal facility. The company established, through the League of Women Voters, a 12-member Citizens' Advisory

[1] Nuclear Waste: Extensive Process to Site Low-level Waste Disposal Facility in Nebraska (GAO/RCED-91-149, July 5, 1991).

[2] The Nuclear Regulatory Commission (NRC) is authorized to enter into agreements with states permitting them to assume authority for licensing and regulating low-level waste disposal facilities, among other activities.

Committee to participate with the company in developing and weighing criteria, evaluating sites, and recommending areas for study. Through periodic meetings with the advisory committee, US Ecology identified areas of public concern about the site-selection process and criteria, and participated in exercises to rate candidate sites.

By 1986 US Ecology had focused on 16 areas of the state comprising more than 1,000 square miles. On the basis of field visits, Citizens' Advisory Committee involvement, public meetings, and input from local officials and other citizen interest groups, the contractor selected areas for detailed site characterization.[3] In February 1987 US Ecology identified three potential areas—two areas in San Bernardino County (Ward Valley and Silurian) and Panamint Valley in Inyo County. US Ecology then established a local advisory committee at each candidate site. These committees, whose members were nominated by local organizations, served as objective, fact-finding organizations, made information available to their respective communities, and provided US Ecology with the communities' views on the issues important to site selection.

Seismic profiles for the Panamint Valley site in Inyo County indicated the potential presence of earthquake faults underlying the site; therefore, drilling to obtain soil and rock samples was deferred at that site but continued at the other two sites. In September 1987 comprehensive descriptions of the three sites were provided to the Citizens' Advisory Committee for its review. The committee recommended that the Panamint Valley site be removed from consideration but was undecided about which of the other two sites should be designated as the preferred site. US Ecology viewed both sites as technically excellent, but on March 11, 1988, the company designated the Ward Valley site as the proposed site for the disposal facility. The major environmental issue associated with this site during the site-selection process was the habitat of the desert tortoise. When construction begins, measures are to be taken to accommodate the species.

California state law did not designate or prohibit any specific disposal technology and the state accepted US Ecology's proposal for an enhanced shallow land burial arrangement. However, the Environmental Protection Agency (EPA) raised concerns about the proposed

[3] Site characterization refers to those assessments of a parcel of land to determine its geologic and hydrologic characteristics, among other features.

design for the disposal facility because the design did not include a special liner and leachate collection system. To address this issue, California arranged for a meeting of experts to review the situation. As a result, the proposed monitoring system for the facility was revised but the design of the facility was only slightly modified.

US Ecology prepared and submitted a license application to the Department of Health Services late in 1989. The department found the application to be complete, except for information on the disposal of mixed waste, and began a detailed review of the application in early December 1989. The department was assisted in its review by a team consisting of representatives of state regulatory and executive agencies. The license review process also included a quality assurance and control audit by a contractor for the department.

Public hearings on the license application were held in July 1991. Public concerns centered on the design of the disposal facility, the potential liability of state taxpayers for damages resulting from the facility, and the emergency access provision of the 1985 act. The Department of Health Services now estimates that a licensing decision should be made by the end of 1991 and, in the absence of unanticipated delays, that the facility should be operational by August 1992. California has estimated that the total cost of the development effort will be about $36 million, of which about half was spent during the licensing application phase.

Michigan

The Midwest compact, consisting of seven states, was ratified by the Congress in 1986, and in 1987 Michigan was selected as its host state on the basis of waste generation and transportation factors. The same year, Michigan passed the Low-Level Radioactive Waste Authority Act. It also established the Low-Level Radioactive Waste Authority as an independent government entity responsible for selecting a site for a low-level waste disposal facility; preparing a license application; and designing, constructing, operating, and closing the facility. The authority was to make a preliminary designation of the disposal site, but the state legislature would be involved in making the actual selection. To accomplish these tasks the authority was to contract for technical services to assist in all of its responsibilities.

The authority developed siting criteria and, using these criteria, began screening the state for candidate areas for further study. In this initial screening phase, the authority eliminated about 97 percent of the state from further consideration. By October 1989 Michigan had identified

three large candidate areas in three counties—Lenawee, Ontonagon, and St. Clair. Upon further review of these areas, with assistance from its public advisory committee, the authority eliminated each area from further consideration. St. Clair and Ontonagon counties were eliminated in October 1989 because of new data on wetlands and Lenawee county was eliminated for similar reasons in February 1990. Michigan has stated that since then it has been examining other potential siting areas that may meet the state's criteria.

Michigan had been successful in meeting the milestones contained in the 1985 act through January 1, 1990, because the state submitted a governor's certificate on its plans to manage its own waste after December 1992. However, because the state was unable to find suitable candidate sites to investigate, the Midwest Compact Commission—the operating arm of the compact of states—became concerned about Michigan's siting criteria. In March 1990 the Midwest compact issued a resolution noting that any request of a host state to be relieved of siting responsibilities because it lacked a suitable site must be based on siting criteria contained in NRC's regulations.

The compact also arranged for a detailed independent review of Michigan's siting criteria. The review report stated that the criteria used to screen the state were very restrictive and that it was highly unlikely that any site could be found in the state that could meet the criteria. The report offered recommendations for amending the criteria to make them more compatible with NRC's requirements and guidance.

In June and July 1990, the three states that have existing disposal facilities notified the governor of Michigan that unless problems related to Michigan's efforts to find a site for a low-level waste disposal facility were rectified, access to the existing disposal facilities would be denied. In October 1990 Michigan responded that, as it interprets the Low-Level Radioactive Waste Policy Act, as amended, the states with existing disposal facilities may only deny waste generators in other states access to their facilities if a state or compact fails to meet a milestone date. Michigan also stated that it had met each milestone through January 1, 1990.

Because of their dissatisfaction with Michigan's progress and response to their letters, the three states denied Michigan access to their disposal facilities, effective November 10, 1990. In response, waste generators in Michigan—the Michigan Coalition of Radioactive Material Users, Inc.—sued the three states on November 13, 1990, asserting that Michigan has complied with the milestones of the 1985 act and that access to existing

disposal facilities should be provided at least until December 31, 1992. On June 18, 1991, the United States District Court for the Western District of Michigan entered a partial summary judgement in favor of the waste generators. The court said that the milestones in the 1985 act are not continuing obligations to be monitored by the three states with existing disposal facilities on a continuing basis. The court declared that the three states are required to make their facilities available to Michigan generators for waste generated in the state before January 1, 1993, when disposal rights can be denied in accordance with the 1985 act. The three states appealed the decision and on September 24, 1991, the United States Court of Appeals granted the three states a motion for a stay of the judgment.

At a special meeting in July 1991, the Midwest compact considered Michigan's expulsion from the compact. The compact noted several reasons for considering the expulsion, including Michigan's failure to amend the siting criteria, essentially precluding it from finding a suitable site, and the state's legal actions and legislative proposals expressing opposition to the federal framework for low-level waste disposal.

At the meeting, Michigan's views were conveyed through a statement on behalf of the governor that characterized the Low-Level Radioactive Waste Policy Act as a failure on a national scale and said that the Midwest compact was destined to self-destruction unless it changed course. Michigan also presented several conditions that it required of the compact; otherwise the state would curtail the activities of the Michigan Authority. Among these conditions were that the compact agree that if no suitable site can be found in Michigan under Michigan law, then Michigan will be released from its host state authority.

On July 24, 1991, the Midwest compact voted to expel Michigan from the compact for not acting in good faith to honor a binding contractual obligation to find a site in Michigan for the compact. Compact member states are also considering legal actions against Michigan for damages resulting from its failure to choose a site for a facility.

New York

Although New York made an effort to form a compact with several other states in the early 1980s, the state eventually decided to remain unaffiliated and to develop a state-owned and -operated disposal facility for its own low-level radioactive waste. As an unaffiliated state, New York has been moving through a site-selection process. State legislation passed in 1986 established the framework for the site-selection and

facility-development process. The legislation included establishment of a siting commission to select one or more sites and a disposal technology. An advisory committee, consisting of 13 members appointed by the governor, was also established to provide advice to the siting commission on site selection and the disposal method(s) being considered. When the proposed sites and disposal technologies have been identified, the state's Department of Environmental Conservation is to review and certify the selections.[4] The state's Energy Research and Development Authority will then prepare the license application and submit it to the Department of Environmental Conservation, which will review the application and determine if the proposed facility should be licensed.

A multiphased siting process essentially began in June 1988 with the application of screening criteria, resulting in the identification of 30,000 square miles to be considered for further screening and consideration. Subsequent steps included the continued application of more specific site-selection criteria covering geology and hydrology, climate, population, public water supplies, transportation, and socioeconomic factors. In September 1989 the siting commission announced that it had identified five potential sites for the disposal facility—two in Cortland County in the south central part of the state and three in Allegheny County, in the southwestern part of the state.

On-site survey teams were then to perform preliminary investigations of these sites. However, survey teams were blocked from performing these investigations by strong public opposition and protests at the potential siting areas. In April 1990, following an incident at which some minor injuries occurred during confrontations between police and protestors, the governor suspended efforts to conduct work at the sites. The siting commission continued to review existing data without gaining access to the sites and has continued other siting activities.

During the same period, New York was also developing new legislation to redirect state efforts to develop a facility. The legislation, signed into law in July 1990, required a number of changes in the facility-development process, including expanding the membership on the siting commission, establishing a process for selecting a disposal method, and establishing requirements for a number of special reports and review efforts on siting activities.

[4] New York is an agreement state with responsibility to regulate the management of certain radioactive materials, including low-level waste.

New York complied with each milestone in the 1985 act through January 1, 1990, when it submitted a governor's certification on how it would handle its waste after January 1, 1993. The governor's certification was challenged by the three states with existing disposal facilities on October 1, 1990, because, the states said, New York had not provided persuasive evidence that its low-level waste would not become a burden on other states. About 6 percent of commercially generated low-level waste is produced in New York. However, after further communication with New York, the three states found New York in compliance with the January 1, 1990, milestone. New York provided a special report detailing its efforts to date and its plans for managing its waste before and beyond the January 1, 1993, milestone.

In February 1990 the state of New York and Allegheny and Cortland counties filed a lawsuit claiming that the Low-Level Radioactive Waste Policy Act, as amended, was unconstitutional. The suit focused on (1) the act's provision requiring states to take possession of their waste in 1996, if they do not have disposal capacity, and (2) the provision on the states' responsibility to dispose of Class-C waste. On December 7, 1990, the district court dismissed the suit. On January 31, 1991, New York appealed the case. On August 8, 1991, the U.S. Court of Appeals for the Second Circuit affirmed the decision of the district court and dismissed the lawsuit.

At the conclusion of our review in June 1991, New York was developing new legislation to designate a benefits package for the community that hosts the facility. In July 1991 the town of Ashford in Cattaraugus County, near the former low-level waste site in West Valley, in western New York, voted to be a potential host for the low-level waste disposal facility if an appropriate benefits package was provided. While the county legislature subsequently voted against a resolution to support the town's decision, the benefits package bill now in the state legislature reflects that the state would be guided by the community's decision, not the county's decision.

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Nuclear Regulation: The Military Would Benefit From a Comprehensive Waste Disposal Program (GAO/RCED-90-96, Mar. 23, 1990).

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