Chapter 1

Overview, Findings, and Policy Options

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OVERVIEW

What happens to commercial low-level radioactive waste (LLW)? Where do nuclear power plant workers discard their contaminated work uniforms, rags they used to clean instruments, and their old equipment? What happens to used organic solvents that are handled in radiopharmaceutical manufacturing? Where do hospital workers send obsolete instrumentation used to diagnose and treat cancer patients?

Since 1978, these and all other commercial LLW generated in the United States have been buried in three States—Washington, South Carolina, and Nevada. None of the other 47 States has an active disposal site. This situation prompted Congress to pass the Low-Level Radioactive Waste Policy Act of 1980[1], which requires every State to become responsible for disposing of the commercial LLW generated within its borders. Due to high disposal costs and small volumes of commercial LLW, States are encouraged to develop multi-State agreements in which one State hosts a disposal facility for all partners to the agreement. A partnership among States is called a compact. By December 31, 1985, these new facilities were to be operational, but the deadline was not met. The three States with sites threatened to shut the doors of their facilities to all States that were not members of their compacts. This prompted Congress to pass the Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) during the final days of 1985.2

The LLRWPAA establishes a new deadline—December 31, 1992—after which operating facilities will be closed to out-of-region waste. By this date, States will have to develop new disposal sites or otherwise be able to manage their own waste. To enforce this deadline the LLRWPAA set interim milestones, penalties for unmet milestones, and volume restrictions and surcharges on LLW shipped to the three operating disposal facilities. These mandates will remain in effect until the December 31, 1992 deadline.

Compliance With the Low-Level Radioactive Waste Policy Amendments Act of 1985

It is not clear whether every State will be able to comply with the LLRWPAA. About a dozen LLW disposal facilities are now slated for development (see figure 1-1), but it is questionable whether every State will belong to a compact or will be able to manage its own waste when it loses access to the three operating sites on January 1, 1993. A reduced number of facilities could easily handle the Nation's LLW.

States and compacts may try cooperative agreements to manage their LLW. Such an agreement could involve one State or compact paying another State or compact to take its waste or involve States and compacts trading waste types or waste services. It is hard to predict how successful such cooperative agreements will be.

Shrinking Volume Means Rising Disposal Costs

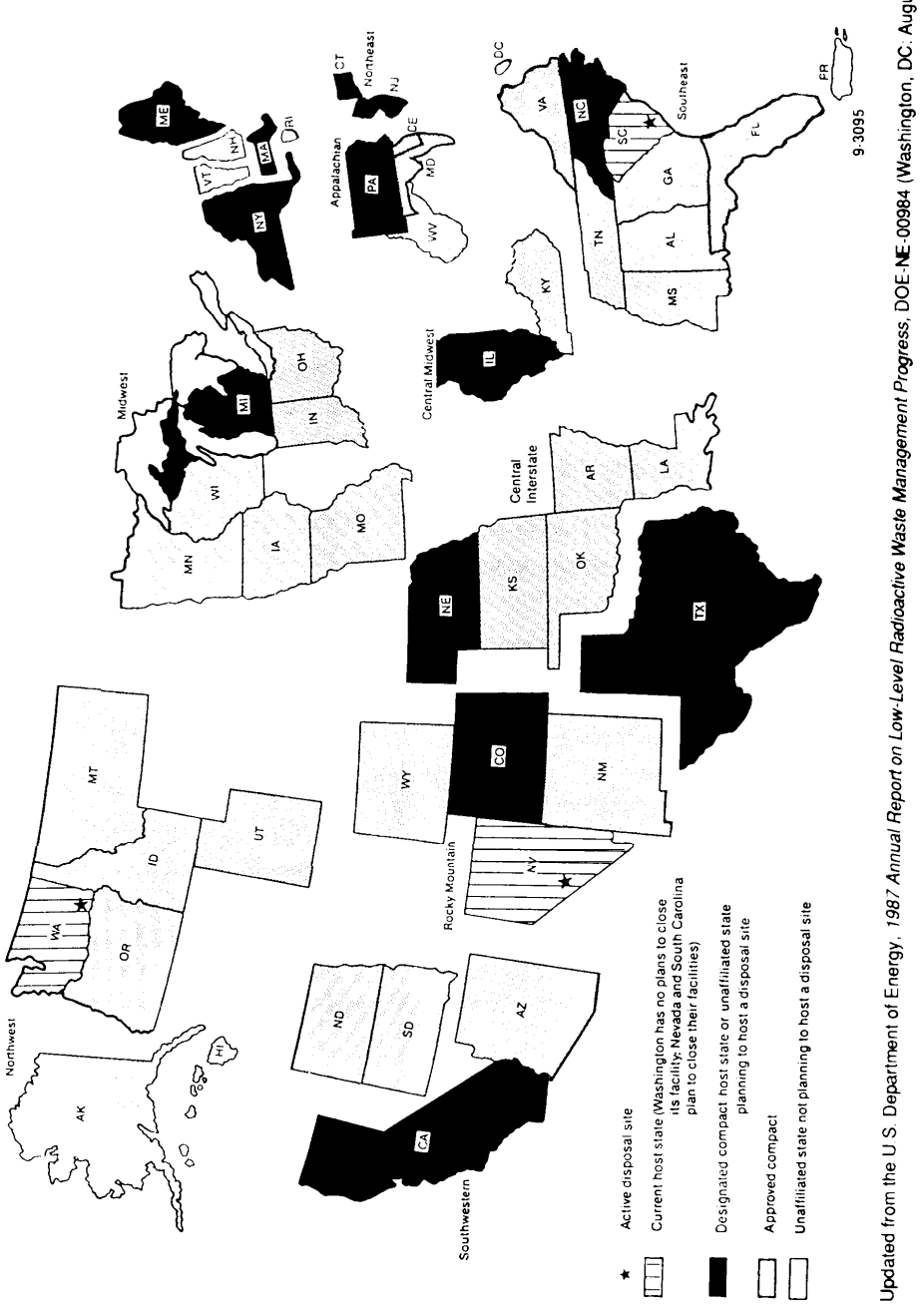
One factor that has made the development of multiple disposal sites difficult is the increase in unit disposal costs resulting from shrinking LLW volumes. Nationwide, LLW volumes have declined by about half in the last 9 years and could decline by another half again by 1993. The incentive for these reductions has been and will largely be surcharges added to disposal costs.

Volume is a major determinant of unit disposal cost. Smaller volumes mean higher costs per unit because many of the costs of developing and maintaining LLW disposal sites are fixed. With the Nation shifting from having three disposal sites to having a dozen or more, unit disposal costs will probably rise dramatically.

[1]Public Law 9(5-573, Dec. 22, 1980.

[2]Public Law 99-240, Jan. 15, 1986.

Figure 1-1—Status of Compact Regions and Unaffiliated States



SOURCE: Updated from the U.S. Department of Energy, *1987 Annual Report on Low-Level Radioactive Waste Management Progress*, DOE-NE-00984 (Washington, DC: August 1988).

Management Problems for Mixed Low-Level Radioactive Waste

An issue of immediate concern in managing LLW is the regulation of *mixed* LLW—waste that is both radioactive, as defined in the LLRWPAA, and hazardous, as defined by the Resource Conservation and Recovery Act (RCRA).[3] This waste is regulated by both the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA). Some specific regulations cannot be met, some regulations may be in conflict and inconsistent, and other regulations overlap and are duplicative.

Although mixed LLW comprises less than 10 percent of all LLW, it has been identified by States as their major concern in managing LLW. No disposal facility for mixed LLW has been available since 1985. Also, no offsite storage or treatment facility is available. Since mixed LLW is a subset of LLW, States will have to be able to manage their mixed LLW if they are to meet the milestones of the LLRWPAA. Most LLW generators are using all available management techniques to alter their practices in order to generate either exclusively radioactive waste or exclusively hazardous waste. By doing so, disposal of the waste is possible. Yet, the generation of some mixed LLWs is unavoidable.

Ad hoc surveys indicate that the cumulative onsite storage of mixed LLW is holding steady for the majority of generators, even though none is allowed to be disposed and new mixed LLW is being generated. This situation raises the question: where is mixed LLW going? Generators may be finding ways to treat some of their stored mixed LLW so that it is no longer a mixed LLW. However, it is also possible that some mixed LLW is slipping through waste brokers and processors, and is illegally entering nonqualified disposal facilities.

A primary problem is that some EPA regulations that apply to mixed LLW cannot be met (i.e., its land disposal restriction regulations). Many of the hazardous constituents in mixed LLW are banned from land disposal until they meet specific treatment standards. However, no offsite treatment facilities have been developed. Two examples of mixed LLWs for which no treatment capacity is available are organic chemicals and chlorofluorocarbon (CFC) solvents and sludges used in cleaning clothing, tools, and equipment. Furthermore, EPA developed its treatment standards based on hazardous waste only, not radioactive waste; therefore some of the standards are inadequate, inappropriate, or both. The NRC, EPA, and the Department of Energy (DOE) may wish to consider providing grant monies for researching treatment options and developing treatment facilities for these problem wastes.

A generator of mixed LLW for which no treatment capacity is available has no viable legal option for managing its waste. Even storage is illegal because of storage prohibitions. Generators, therefore, can stop producing the waste (which can mean going out of business); they can illegally store the waste; or they can illegally dispose of the waste.

EPA and NRC will have to decide how generators are to manage mixed LLW, given the absence of treatment facilities (in some cases the absence of an appropriate treatment technology), and the prohibition on storage. One option would be for EPA to relax its storage prohibition on wastes for which no treatment capacity and/or no disposal capacity is available. In turn, generators would have an intermediate ***legal*** option until treatment capacity and disposal capacity are developed and available. EPA could rescind this provision if a generator failed to demonstrate good faith effort in developing these capacities.

Goals for Congressional Consideration

To address the questions of whether States will comply with the LLRWPAA and how the problems pertaining to mixed LLW regulation

[3]Public Law 94-573, Oct. 21, 1976

can be resolved, Congress may want to consider two goals:

. to encourage States and compacts to cooperate among themselves so that all States can safely manage their LLW after December 31, 1992; and
. to resolve regulatory problems concerning mixed LLW.

There are several policy options that Congress may wish to consider to reach these goals.

Policy Options

Goal 1: Encourage Cooperation Among States and Compacts to Ensure Disposal Capacity Availability

1. Amend the LLRWPAA to force States and compacts to consolidate their disposal facility development efforts
   Pros: Economies of scale would be gained.
   Cons: It was never an intention of Congress to prescribe a certain number of facilities.
   Setting limits on the number of facilities would usurp State rights.
   Political climate within new host States would be damaged and their progress stalled.
2. Hold a congressional oversight hearing to encourage States to reduce the number of disposal sites
   Pros: It would provide a forum for encouraging cooperative agreements.
   Cons: Delicate negotiations amongst States and/or compacts would be disrupted and agreements in progress could be potentially killed.
3. Take no Federal action, but individual Members of Congress would track the progress of their States
   Pros: This option conforms with the original intent of Congress and the States. Members of Congress could discuss the issue with their governors and facilitate negotiations.
   Cons: There is no guarantee that agreements would be reached.

Goal 2: Resolve Regulatory Problems Concerning Mixed LLW

1. Give sole regulatory jurisdiction to one agency (legislation necessary)
   Pros: Facilities would be operated momeconomically and efficiently.
   Cons: One agency may not be able to carry out adequately the basic mission of the other agency's regulations—their regulatory approaches are very different (similar concerns at the State level). If the NRC is granted sole jurisdiction, EPA may lose regulatory authority over DOE defense sites.
2. Maintain current dual regulatory jurisdiction (joint guidance necessary)
   Pros: Each agency would be able to uphold its regulatory approach.
   Cons: Given the slow progress made by the two agencies thus far to resolve their differences, this option would not be timely.
3. Give one agency the regulatory lead with concurrence required by the other agency (joint rulemaking necessary)
   Pros: Facilities would be operated more economically and efficiently, but to a lesser degree than Option 1.
   Cons: The lead agency may not be able to carry out adequately the basic mission of the other agency's regulations, as under Option 1.
4. Establish an active interagency task force with congressional oversight
   (joint rulemaking/joint guidance necessary)
   Pros: Compromises between the two agencies could be resolved more quickly than under Option 2. Congress, in its oversight role, could forward a tight schedule for resolving the problem of unattainable regulations, the possible conflicts and inconsistencies, and the areas where the agencies' regulations overlap and are duplicative. If legislation is needed, Congress will be better informed after the task force has investigated these issues.

Cons: As with other options, the question remains whether the issues will be resolved fast enough.

UNDERSTANDING LOW-LEVEL RADIOACTIVE WASTE

What Is Low-Level Radioactive Waste?

Low-level radioactive waste (LLW) is defined in the LLRWPA of 1980 and its 1985 amendments by what it is ***not,*** rather than by what it is. LLW includes **all radioactive waste that is not classified as spent fuel from commercial nuclear power plants, defense high-level radioactive waste from producing weapons, or uranium mill tailings (see box 4-A in ch. 4).** About 97 percent of all commercial LLW produces relatively low levels of radiation and heat; it requires no radiation shielding to protect workers or the surrounding community; and the radiation decays within less than 100 years to levels that the NRC finds not to pose an unacceptable risk to public health (Class A LLW). The remaining 3 percent of LLW requires shielding and can remain harmful for 300 to 500 years (Class B and Class C LLW). A small percentage of LLW is Greater-Than-Class C (GTCC) waste and is the responsibility of the Federal Government to dispose. Isolation of GTCC waste needs to be for a few hundred to a few thousand years (8).

From 3 to 10 percent of all LLW is also considered mixed LLW because it contains both radioactive and hazardous constituents. Mixed LLW may be generated in several ways. For example, medical diagnostic procedures use scintillation fluids that contain small amounts of radioactivity in toxic organic solvents (e.g., xylene and toluene). These solvents generally pose a greater chemical hazard than radioactive hazard. Another example might be a rag containing a solvent used by a power plant worker to clean a radioactively contaminated water pump. If the solvent is listed by EPA as hazardous and the pump is slightly radioactive, the rag would be a mixed LLW.

The principal generators of commercial LLW, including mixed LLW, are nuclear power plants, industries, and academic and medical institutions. (See table 4-1.)

How *Much Waste Is Generated?*

No one knows how much commercial LLW, including mixed LLW, is generated in the United States; no comprehensive national survey has ever been conducted. Instead, records are kept of the LLW volumes shipped for disposal. Not all LLW generated, however, is disposed; extensive waste minimization practices and treatment practices result in a significant reduction in waste volumes. Table 1-1 lists the LLW volumes shipped by the nine compact regions and the seven unaffiliated States (plus the District of Columbia and Puerto Rico) in 1988; the total volume was about 1,440,000 cubic feet. Since no disposal sites exist for mixed LLW, these shipment figures include no mixed LLW. However, based on State and industry ad hoc surveys, it is estimated that mixed LLW would increase the national volume of nonmixed LLW by 3 to 10 percent.

The 1,440,000 cubic feet of commercial LLW shipped to disposal sites in 1988 would fill 390 tractor trailers, which if the trailers were lined up end-to-end would stretch over 3 miles.[4] For comparison, in 1988, hazardous waste, as regulated under RCRA and compacted (as is LLW) for disposal, would fill enough tractor trailers to stretch almost 1 l/z times around the globe at the Equator (32,000 miles).[5] In contrast, radioactive spent fuel from operating commercial reactors accumulated in 1988, all of which is in storage, would only fill about half of a trailer.[6]

[4]This analogy usin, tractor trailers demonstrates volumes only, not actual transportation scenarios, since tractor trailer weight limits would prohibit the transport of such heavy loads.

[5]As with the previous analogy, tractor trailers are used to demonstrate volume (not transportation scenarios) because of weight limitations. Unlike LLW, about% percent of RCRA hazardous waste is managed on site, with 4 percent shipped to commercial landfills.

[6]This analogy is also only used to demonstrate volume, not transportation scenarios, due to tractor trailer weight limitations. In addition, the heat associated with spent fuel would require much more space on a truck per unit of spent fuel.

Table I-l-Commercial LLW Volumes Shipped for Disposal in 1988[a]

	LLW volumes (cubic feet)
Compacts[b]	
Southeast (NC, GA, FL, TN, AL, SC, MS, VA)	522,000
Appalachian **(PA, WV,** MD, DE)	172,000
Northwest (WA, ID, OR, UT, AK, HI, MT)	129,000
Central Midwest (IL, KY)	128,000
Southwestern (CA, SD, ND, AZ)	102,000
Midwest (MI, WI, IN, 1A, OH, MN, MO)	*96,000*
Northeast (CT, NJ)	*78,000*
Central Interstate (NE, AR, LA, KS, OK)	*71,000*
Rocky Mountain (CO, NV, NM, WY)	*4,000*
Unaffiliated States[c]	
New York[c]	*65,000*
Massachusetts[c]	*47,000*
Texas[c]	*9,000*
Vermont	*7,000*
Maine[c]	*6,000*
Rhode Island	*1,000*
District of Columbia	*<1,000*
New Hampshire[d]	*<1,000*
Puerto Rico	<1,000
Total	1,440,000

[a]No mixed LLW is included, since none was shipped for disposal after 1985.
[b]Host States that are operating, or scheduled to operate, a disposal facility are listed first,
[c]Unaffiliated States that are planning to develop a disposal facility.
[d]LLW volumes will increase once the Seabrook power plant is Operational

SOURCE: Data taken from tables prepared by EG&G Idaho in May 1989 for the U.S. Department of Energy, *DRAFT Integrated Data Base for* 1989: Spent *Fuel and Radioactive Waste Inventories, Projections, and* Characteristics, DOE/RW-006, Rev 5, 1989.

A rough comparison by total weight indicates that in 1988 hazardous waste weighed 270 million tons, LLW weighed 36,000 tons, and spent fuel weighed 620 tons. Volume and weight figures are summarized in table 1-2, but it is important to note that they do not convey the relative health and environmental risks associated with each waste type.

Table 1-2—Waste Comparisons[a] for 1988

Waste type	Volume (cubic feet)	Weight (tons)
Hazardous waste[b]	13,000,000,000	270,000,000
LLW[c]	1,440,000	36,000
Spent fuel	1,800	620

[a]These comparisons do not Illustrate the relative risks associated with each waste type, only the volume and weight of each.
[b]About 96 percent of this waste is managed onsite, with 4 percent shipped to commercial landfills
[c]Commercial, nonmixed LLW. As with hazardous waste, a very high percentage of utility LLW is treated onsite, greatly reducing that shipped for disposal,

SOURCE: Office of Technology Assessment, 1989,

How Do the Risks of LLW Compare With Other Waste Types?

Regarding wastes (e.g., radioactive waste, hazardous waste) generated in our society, spent fuel from nuclear reactors and high-level waste from producing nuclear weapons most likely present the greatest risk to human health and the environment. EPA has determined that spent fuel and high-level waste must remain contained for at least 10,000 years.[7] The average concentration of spent fuel radioactivity is around 200,000 curies per cubic foot (8).

In contrast, the NRC has determined that LLW must remain contained for 100 to 500 years after site closure[8], while its average concentration of radioactivity is 0.1 curies per cubic foot (8). A containment period similar to the NRC periods does not exist for EPA-regulated hazardous waste packaging. The EPA does, however, require that no migration of hazardous constituents occur during the post-closure care period. This period is 30 years, but it can be shortened or extended depending on results from site monitoring. Unlike-radioactive

[7]This 10,000-year standard was part of a larger set of standards, some of which were remanded by the First Circuit Court of Appeals in Boston in July 1987. The 10,000-year standard was not specifically remanded, however, EPA decided to reanalyze it and plans to promulgate a new set of standards.

[8]NRC LLW regulations are based on the stability of the waste and on the stability of the disposal site to protect a disposal site inadvertent intruder from receiving excess radiation exposure. The regulations establish three classes of LLW: Class A waste (the least radioactive), Class B, and Class C (the most radioactive). Concentration limits for radionuclides are set for the different classes of LLW. These limits are based on the relationship between a few factors: the half-lives of the radionuclides in the waste, the types of radiation emitted, and potential pathways to human exposure. During an institutional control period that follows site closure and lasts up to 100 years, the site is monitored and maintained. The NRC sets the concentration of radionuclides in Class A waste so that during the institutional control period, the radionuclides will decay to levels that the NRC determines will not pose an unacceptable risk to public health and safety, therefore, will not harm a hypothetical intruder digging into the waste after this period. Class B and Class C waste must be packaged in containers that will retain their structural integrity for 300 years, due to the allowed concentration of radionuclides in them, In addition, Class C waste must be deeply buried or have an intruder barrier, such as a concrete cover, to divert intruders for up to 500 years (10 CFR Part 61; see ch. 3).

waste, however, the toxicity of some hazardous waste does not significantly decrease with time.

It is very difficult to compare the risks from LLW to risks from hazardous waste. In many cases these two wastes behave inconsistently in the environment and their health effects may be uncertain. Furthermore, research in risk analysis has been conducted by different experts and little has been done to compare the findings. Mixed LLW further complicates the issue. Both the hazardous constituent and the radioactive constituent in a mixed LLW can vary greatly in the level of toxicity. **Research has done little to analyze the potential synergistic effects of the constituents of mixed LLW on the environment and on humans (see** ch. 4).

Similarities can also be noted between these waste types. With spent fuel, LLW, mixed LLW, and hazardous waste, the focus is on isolating them to minimize migration of their radioactive and/or hazardous constituents, thereby minimizing the risk of environmental contamination and human exposure. Furthermore, the duration of hazard associated with spent fuel and with some LLW, including mixed LLW, and hazardous waste is high (e.g., Class C nonmixed LLW, hazardous waste such as synthetic organics and heavy metals, and r-nixed LLW that is a combination of these two wastes). Likewise, the duration of hazard can be low for both LLW, including mixed LLW, and hazardous waste (e.g., Class A nonmixed LLW, hazardous waste that is biodegradable, and mixed LLW that is a combination of these two wastes). **Health effects from LLW, including mixed LLW, and hazardous waste are all difficult to estimate for low exposures and absorbed doses.**

Who Regulates Commercial LLW?

The NRC, under the Atomic Energy Act (AEA) of 1954[9], as amended, regulates the management of all commercial LLW unless a State has obtained Agreement State status under Section 274 of the AEA.[10]

The EPA or an authorized State agency regulates mixed LLW in conjunction with the NRC or an Agreement State. NRC or an Agreement State would regulate a mixed LLW facility with respect to the radioactive constituents, while the EPA or a State agency with mixed waste authorization would regulate the facility with respect to the hazardous constituents.

The NRC and the Department of Transportation (DOT) have a Memorandum of Understanding (MOU) regarding the transportation of LLW. Under the MOU, the DOT is responsible for regulating safety in transporting all hazardous materials, including radioactive materials, and the NRC is responsible for regulating safety in receipt, possession, use, and transfer of these materials.[11] The NRC also reviews and approves or rejects package designs for high concentration low-level radioactive materials. The term radioactive materials is defined to include radioactive wastes.

[9]68 Stat. 919, 1954

[10]To become an Agreement State, a State must demonstrate to the NRC that the State regulations are compatible (In some cases, an Agreement State may establish regulations that are more restrictive than the NRC'S regulations.) If this is demonstrated, the State may regulate the use of radioactive materials, except those used in the operation of nuclear power plants, which are still licensed and inspected by the NRC. There are 29 States that have received Agreement State status, A State can also receive limited Agreement State status. For example, a State may choose to regulate LLW disposal facilities but not treatment facilities. In States that have Agreement State status for LLW disposal, the disposal facility would be regulated by that State's regulatory authority (e.g., the Department of Environmental Control, Department of Environmental Resources).

[11]Refer to 49 CFR Parts 100-199 and 10 CFR Part 71 for more detail on the MOU.

MAJOR FINDINGS

Management Trends

Increased Use of Waste Minimization and Treatment Techniques

To reduce waste volume, costs, and risks, LLW generators employ a wide range of techniques to minimize and treat waste. Since 1980, these techniques have been major factors responsible for cutting LLW volumes by 55 percent.

Waste minimization techniques include material substitution, i.e., the use, whenever possible, of nonradioactive material rather than radioactive material, and operational practices that prevent materials from becoming contaminated. One industry representative believes that these minimization techniques have been used to the fullest extent practicable and that they will not increase the decline in waste volumes significantly.[12]

Treatment techniques,[13] as discussed in this report, generally focus on: 1) reducing the volume of LLW that must be shipped for disposal (e.g., waste sorting practices, decontamination, storage for decay practices, compaction, shredding, or incineration); and on 2) stabilizing wastes.

Once a waste is generated, decontamination and incineration appear to offer the greatest potential for reducing waste volumes. A commercial incinerator is scheduled to open in Oak Ridge, Tennessee, in February 1990; it will bum dry activated LLW which accounts for 50 percent of the nuclear power industry's LLW.

In addition to reducing volumes and thereby disposal costs, **treatment techniques can improve the stability of the waste form and, thereby, the performance of a disposal facility.** Specifically, a well-compacted, stabilized waste form can greatly reduce the threat of waste packages settling, a disposal unit cap failing, water infiltrating the waste, and radionuclides migrating offsite.

Treatment is a critical step in managing mixed LLW. **Since *no* offsite treatment or storage *facilities are available* for mixed LLW, generators try to the extent practicable to alter their practices in order to generate either exclusively radioactive waste or exclusively hazardous waste, for which management options are available.** Despite their efforts, mixed LLW is still generated, containing hazardous constituents that EPA bans from disposal until a particular treatment standard is met. Since no commercial treatment facility exists for these mixed LLWs, generators store them onsite. However, storage prohibitions apply to these wastes. This quandry concerning mixed waste treatment and storage is more thoroughly discussed below under "What Additional Concerns Apply to Mixed LLW?"

Support for New Disposal Technologies

More stabilized waste forms and more elaborate disposal technologies at future disposal sites will likely avoid the disposal problems (e.g., water infiltration into buried waste) that occurred at the three former commercial disposal sites—Maxey Flats, KY; Sheffield, IL; and West Wiley, NY—all of which are now closed. At these sites waste packages were buried in excavated trenches—a technology called shallow-land burial. A variety of problems (see ch. 6), several of which related to poor operational practices rather than the disposal technology, resulted in radionuclides leaching from waste packages and migrating from the trench. According to NRC and State officials, the low concentration of radionuclides at each of the three sites' boundaries did not and does not pose an undue health risk to nearby

[12] John Hsu, DuPont NEN, made this comment at the OTA Review Panel meeting, Washington, DC, Aug. 18, 1989.

[13] This broad use of the term "Uea~ent" varies from EPA's definition. EPA does not support that the practices listed would necessarily be considered treatment for the hazardous constituents in mixed LLW but does contend that the practices may aid in the overall proper management of LLW, including mixed LLW.

residents. Dose models calculate the dose to be below NRC-permissible levels.

Several alternative disposal technologies (see ch1. 6) have been designed and are expected to be constructed in the next 3 to 5 years in several regions of the United States, particularly in humid regions. The main objectives of these new designs are to minimize water infiltration into buried LLW and to minimize subsequent migration of radionuclides via groundwater (10).

None of these new designs has been commercially built in the United States, but some have been demonstrated at DOE defense sites and some have been constructed and operated in Europe. Although there is limited U.S. data on the long-term performance of these technologies, it **appears that no significant technical advancements are necessary for these technologies to be developed commercially.**

Continuing long-term demonstration projects to test disposal facility caps may help in minimizing water infiltration, since the cap is the major barrier between the waste and precipitation. By including a monitoring point in the lower portion of the multilayered cap of the facility, site operators could detect water infiltration before the water comes in contact with the waste. A mechanism for collecting water and draining the water off of the cap could be included in the design.

Site-specific designs, appropriate construction, and comprehensive short- and long-term management of a LLW disposal facility are just as important as the particular disposal technology chosen. More elaborate designs, if poorly constructed or managed, may not provide more long-term waste isolation than a less elaborate facility that is well-constructed and well-managed. Quality control is critical to reducing human error and improving the short- and long-term performance of the site.

Increased Public Involvement

In most States designated to host a new LLW disposal facility, **local citizens and public interest groups have taken an active role in shaping the State's LLW disposal legislation and regulations; this role is likely to grow stronger in the future.**

An overriding concern of these individuals and groups is whether they can trust the disposal site operator. The public is frequently confronted with news stories of waste disposal problems, including water contamination at hazardous waste landfills, illegal dump sites, and Federal facilities (e.g., DOE weapons complexes). As a result, some citizens and public interest groups take a strong ''not-in-my-backyard' stance when it comes to siting a waste disposal facility.

Some citizens and public interest groups want more access to the decisionmaker (i.e., an official that will decide where the facility will be located and how it will be designed). Recognizing this desire, the host States that are far along in developing a disposal facility have extensive public participation programs (see ch. 2). The environmental groups and citizen advisory committees in these States have largely influenced the overall LLW disposal site development process.[14] For example, in some States these groups have helped to determine the weighting factors for screening prospective regions within the State.[15]

Some public interest groups and citizen advisory committees have also contributed to the States' analyses of disposal technologies and disposal site requirements. These groups' disposal requirements are generally more conservative and more prescriptive than the standard conceptual designs. Also, their requirements often go beyond disposal facility features to include components of a comprehensive disposal system. For example, some public interest groups in Pennsylvania have argued that

[14] Once a disposal site is chosen, new local public interest groups may become involved because they will then see themselves as stakeholders in the process.

[15] A State is screened to identify regions that will be excluded from further consideration as a disposal site because they do not meet certain criteria.

a facility should have ''a zero release capacity" goal, i.e., that if any radioactivity above background level is detected offsite, the disposal facility operator must take action to identify and abate the release. This goal is much more stringent than the NRC regulation that the annual dose to a member of the public not exceed 25 millirems[16] of radiation to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ (10 CFR Part 61). Furthermore, this requirement must be met during the operational and long-term care period. Long-term care is defined in Pennsylvania as the ''hazardous life' of the waste.[17] According to NRC regulations, the site operator must have its site secured and monitored after its operating period, but custodial institutional controls may not be relied on for more than 100 years (10 CFR Part 61).[18] However, due to the hazardous life of some radioactive waste and the hazardous life of mixed LLW, Pennsylvania is requiring as a precaution along-term care period that would extend much longer than 100 years.

Certain public interest groups in some States have required that the disposal facility operator be more aggressive in ensuring that the package manifest[19] accurately describes the contents of the package. States, in turn, are investigating methods of physically sampling and testing the waste without unacceptably exposing the worker.

Some host States are giving more control over their disposal facility to the host community. For example, the host community selects local inspectors to oversee the site. These inspectors have the power to shut down the facility if practices are out of compliance. In most States, the host community will also receive grants to conduct an independent assessment of the site.

Host States have created compensation packages for local host communities. These packages include assistance to local citizens, including financial incentives. Grants and scholarships are also available in some States to buy school equipment and to support science students. Finally, some host States guarantee local citizens' property values.

The role that public interest groups and citizen advisory committees have played to determine acceptable disposal designs, to develop a comprehensive disposal system, and to assure local control and compensation for local host communities could be precedent-setting with respect to other waste disposal facilities (e.g., those operated by DOE).

Major Issues

Will States Comply With the LLRWPAA?

About a dozen LLW disposal facilities are slated for development (see figure 1-1). It is impossible to know the exact number of sites that actually will be developed. While less than the dozen planned sites could easily handle the total volume of the Nation's LLW, **it is questionable whether all States and compacts that do *not* develop their own disposal facilities will be able to manage their own waste or reach an agreement with a sited State or compact when they lose access to the three operating sites on January 1, 1993.**[20]

States and compacts could reach agreements to cooperate in their management of LLW. **An**

[16] A rem is a standard unit of measurement of the radiation imparted to biological systems by radioactive material. Rem is an acronym for ''roentgen equivalent man.' ' Rem is the unit used to measure equivalent dose—the biological effect of an absorbed dose. For comparison, the average annual whole body dose in the United States is about 300 millirems, of which about 50 percent is from natural background (see ch. 4). A millirem is a one-thousandth of a rem (10^{-3}).

[17] '' Hazardous life" is defined in Pennsylvania as the maximum permissible concentration as defined in Federal regulation or as defiied by the State. Pennsylvania defines hazardous life as the time required before an area can be released for unrestricted use. An analysis would be conducted that calculates the effect all possible pathways of exposure to determine the total exposure at a given time. Pennsylvania will have to determine that this total exposure level is at background level before deciding that the hazardous life has expired.

[18] The NRC, however, has no prohibition on States choosing a longer institutional care period.

[19] The NRC, EPA, and DOT require that a manifest document describes in detail the contents of a waste package and is affixed to a package before it is transported to a waste processing facility or to a disposal site,

[20] Under the LLRWPAA, States and compacts hosting a facility are not obligated to cooperate with other States and compacts.

agreement could involve a State or compact paying another State or compact to take its waste or involve States and compacts trading waste types or waste services. For example, the Governors of Maine and Vermont are negotiating with the Governor of Texas to have Texas take their waste. Texas has always planned to develop its own site, and there has been some question as to the legality of a single State excluding other States from using its facility (7). If Texas accepts Maine's and Vermont's waste (which is low in volume—see table l-l) and forms a new compact, and if Congress consents to the compact, this question of exclusion rights would no longer be relevant.

A trade agreement could involve a compact deciding to trade its mixed LLW for another compact's Class C LLW.[21] A compact or State may also decide to develop a multiregional LLW treatment complex and trade these services for another State or compact to dispose of its waste. There may be great advantages for States and compacts to cooperate in such ways. Equity in sharing the responsibility for LLW could still be realized while treatment or disposal facility development costs could be saved. One disadvantage of this approach may be States' concern about the increase in liability associated with the increase in waste volumes. No State is currently planning to trade waste services with another State.

It is hard to predict whether States and compacts without access to a site will be successful at making these types of cooperative agreements or develop a way to manage their own LLW after the operating disposal sites close. States and compacts could have disposal facilities operational for their nonmixed radioactive LLW, but not for their mixed LLW, and eventually have to take title to and possession of the waste. If the State fails to take possession of the waste, it would eventually be liable for all damages incurred by the waste generator.

The next milestone for the States and compacts is to file a license application for a disposal facility by January 1, 1990, or to have their Governors certify to the NRC that they will have the capability to manage all their LLW by December 31, 1992, This 1990 milestone can be met and yet progress toward planning for post-1992 may be limited because earlier milestones are easier to meet than later ones.

How Will a Further Drop in Waste Volume Affect Disposal and Treatment Costs?

One factor that has made the development of multiple disposal sites difficult is shrinking LLW volumes. The nationwide LLW volumes have declined by about 55 percent in the last 9 years (see figure 4-4 in ch. 4) and could decline significantly more over the next few years. The past drop in volumes has been largely driven by costs related to implementing the 1982 LLW disposal regulations (10 CFR Part 61) and cost surcharges established in the LLRWPAA. A future drop in volumes will be driven by future LLRWPAA surcharges and costs associated with more elaborate disposal designs for facilities constructed to hold smaller waste volumes.

Many of the costs associated with developing a facility are fixed (e.g., State screening operations, site characterization, licensing, monitoring program, compensation packages to host community, and financial assurances). Therefore, costs per unit volume will increase with facilities designed to hold small waste volumes, While cost increases provide incentives for individual generators to reduce wastes, smaller volumes reduce economies of scale which drives up unit disposal costs. This scenario places more burden on small generators, e.g., medical and research facilities, than on large generators.

Some uncertainties make it difficult to predict how far future waste volumes will drop. First,

[21] In this example, a disposal provision would have to be made for Class C mixed LLW.

radioactivity (measured in curies[22]) is also a determinant of disposal cost. Site operators may decide to place even greater emphasis on radioactivity, than is currently done, in determining disposal cost at future sites. They may make this decision because treatment practices have reduced volumes far more than generators have reduced radioactivity. A possible negative outcome of this approach would be that waste generators would have lowered incentives to use volume reduction techniques, which often result in a more stabilized waste form that is less likely to collapse or leach once disposed. The drop in future waste volumes could also be greater depending on the impact of below-regulatory concern (BRC) limits for the radiological component of a waste.*[3] This impact may not happen depending on whether BRC waste is accepted at a municipal landfill or, in the case of mixed LLW, at a hazardous waste landfill.

The phenomenon of increasing ***unit*** disposal costs due to decreasing waste volumes heightens if the Nation shifts from having three disposal sites to having a dozen or so, in which case ***total*** disposal costs may go up. LLW generators are required to use the disposal facility in their compact unless their compact has made an agreement with another State or compact. Therefore, in each of the nine compacts, the disposal site operator has a guaranteed market for LLW disposal. Unit disposal costs will probably vary significantly from one disposal facility to another, depending on the waste volume requiring disposal, the disposal technology used, and other site-specific conditions such as land values, State regulations, and local community compensation programs. For example, disposal in a below-grade vault for a compact region generating only 10,000 cubic feet of waste a year could be between $450 and $590 per cubic foot (3), while in a compact region generating 230,000 cubic feet of waste a year the cost could ***be*** between ***$50*** and $56 per cubic foot for the same disposal design (3, 10). Yet generators in a particular State or compact cannot use a facility in another State or compact with a more economical disposal operation nor can a compact solicit out-of-State or out-of-compact customers to improve the economics of its facility unless the Board overseeing the compact approves of such an arrangement.

Until new LLW disposal facilities are operating and disposal costs stabilize, the trend of declining waste volumes will likely continue. By 1993, the trend in decreasing LLW volumes shipped for disposal should taper off, but by that time volume could drop 40 to 50 percent below 1988 levels. (See ch. 4 section on ‘‘Implications of Waste Minimization and Treatment Techniques on Future Waste Volumes. ’

The same phenomenon is true for waste treatment. Some compacts are moving towards controlling the export and import of waste for treatment (e.g., waste decontamination, recycling, and compaction). They may believe that their regulations are stricter and require that all waste be processed within the compact. A compact may also choose to restrict waste from being imported for processing. The compact may not want to accept waste from a State that it believes may lose disposal capacity access, because it fears that it will have to keep the State orphaned waste. By restricting the export and import of waste, however, competition to develop efficient treatment technologies will likely stall because of small waste volumes. **A decision by a compact to require its generators to use only its waste processing facility would run counter to the argument for State/compact cooperation. Likewise, closing compact treatment facilities to out-of-region States would oppose the argument for State/**

[22] A curie is a common unit of measure of radioactivity that is based on the rate of radioactive decay. One curie describes the amount of radiation from 1 gram of radium for 1 second, or about 37 billion disintegrations per second. The abbreviation for curie is Ci.

[23] When a waste is determined by Federal or State regulations to be radioactively BRC, the concentration or quantities of radionuclides in the waste are so low that the waste can be disposed of in a nonradioactive waste site (e.g., a landfill) without posing an undue risk to public health and safety. The NRC and EPA are both working on setting limits for BRC waste. As of November 1989, the two agencies' limits were inconsistent; this will have to be resolved eventually because NRC's regulations that arc set in a final rule must be consistent with EPA's final standard.

compact cooperation. The LLW Forum[24] passed a resolution on July 14, 1989 supporting the free movement of LLW and materials among regional compacts and unaffiliated States to treatment/processing facilities or to brokers.

What Additional Concerns Apply **to Mixed LLW?**

More immediate than any of the issues concerning nonmixed LLW management is the problem that no disposal facility or offsite storage or treatment facility for mixed LLW exists.

With respect to disposal, EPA regulations apply to hazardous waste landfills, while NRC regulations apply to LLW disposal facilities. A disposal facility for mixed LLW that incorporates both of these regulations, however, does not exist. Most generators, therefore, are using all available management techniques to alter their practices so that they generate either exclusively radioactive waste or exclusively hazardous waste. By doing so, disposal of the waste is possible. However, some practices that generate mixed LLW cannot be so altered and a LLW is generated that contains a hazardous constituent. As is discussed below, **the absence of treatment capacity, the absence of appropriate treatment technologies, storage prohibitions that cannot be met, and the absence of disposal capacity are serious problems that need to be addressed.**

Even without disposal facilities and offsite treatment and storage facilities, **ad hoc surveys indicate that the cumulative onsite storage volume of mixed LLW is holding steady for the majority of generators when it should be increasing (6). This situation raises the question: where is mixed LLW going?** Generators may be finding ways to treat some of their stored mixed LLW so that it is either exclusively radioactive or exclusively hazardous and, thereby, dispose of it legally. **However, it is also possible that mixed LLW is slipping through waste brokers and processors and illegally entering nonqualified disposal facilities.** Since waste packages are only visually spot-checked and scanned for radioactivity levels, it is possible that mixed LLW is entering the disposal sites ***undetected.*** Thus far, ad hoc State and industry surveys have neither supported nor refuted this speculation (6).

In passing the LLRWPAA, Congress did not give regulatory authority for mixed LLW to only the NRC or only EPA. Therefore, the NRC, under the Atomic Energy Act (AEA), and the EPA, under the Resource Conservation and Recovery Act (RCRA), have joint jurisdiction over mixed LLW. **Several States and compacts, particularly those in dry regions, believe that this dual regulatory system is technically unnecessary and burdensome.** NRC regulations are site-performance-based, meaning that the site as a whole has to meet certain objectives. NRC expects radionuclides to leach from the waste eventually, but at such a slow rate that no appreciable amount will ever reach the site boundary. EPA regulations are much more prescriptive in that they require certain features to be included in all disposal designs. For example, an EPA-permitted hazardous waste landfill must have double liners and a leachate collection system unless the permittee can demonstrate that ***no*** migration of any hazardous constituents into the groundwater or surface water will occur at any future time (40 CFR Part 264). It maybe quite difficult to prove that ***no*** migration will occur. States particularly in regions with little rainfall, deep groundwater, and long groundwater time-of-travel argue that the EPA-required design features are unnecessary. Nonetheless, one such State, Texas, has decided to design its mixed LLW disposal unit with these features in order to comply with EPA regulations.

Some other States and compacts, particularly those in humid regions, believe that the two agencies' regulations complement each other and, if used together, would provide for the most technically suitable mixed LLW disposal facili-

[24]The LLW Forum is an association of representatives of States and compacts with the goal to facilitate implementation of the LLRWPA and LLRWPAA.

ties. Their designs currently include EPA-required features and NRC site performance requirements. For example, double liners and a leachate collection system would be included while worker exposure would be limited and the site would be environmentally monitored and secured from human intrusion for 100 years.

Regulations That Are Currently Unattainable- As noted, many of the hazardous constituents in mixed LLW are banned from land disposal until they meet specific treatment standards. However, no offsite treatment facilities have been developed, aside from an energy recovery facility burning BRC[25] scintillation fluids in Florida. **Two examples of mixed LLWs for which no treatment capacity is available are organic chemicals and chlorofluorocarbon (CFC) solvents and sludges used in cleaning clothing, tools, and equipment (6). Waste oil may also become a problem.** (Some States have listed waste oil as a hazardous waste, however, it is not hazardous under Federal law. A lawsuit has required EPA to consider whether waste oil should be listed as a hazardous waste, and EPA expects to make this determination in late 1989. If waste oil is found to be hazardous, the volume estimates of mixed LLW will rise dramatically.)

If treatment capacity is to be developed commercially for these wastes, generators of "like" wastes will have to group together and pressure the waste treatment industry to develop the necessary treatment facilities. However, for at least five reasons, the industry is reluctant to develop mixed LLW facilities. First is lack of data. Without a national survey on mixed LLW volumes and types, industry will have difficulty meeting market needs. Second is the possibility that compacts could attempt to restrict the import and export of waste for treatment, thereby limiting waste volumes and making the development of a treatment facility economically unviable. Third is the long licensing period expected for receiving a permit to operate such a facility. Fourth is the reluctance of facility operators to contaminate the internal mechanisms of their machinery with radioactivity. Fifth, is the opposition of some public interest groups to siting such facilities.

Certain mixed LLW contains hazardous constituents for which EPA recommends incineration as the best demonstrated available technology. **Yet in developing hazardous waste standards, EPA did not consider possible radioactive constituents.** In the case of organic chemicals containing high concentrations of carbon-14 and tritium, no standard off-gas systems for incinerators would trap these radionuclides. To meet EPA's regulations, a generator of this waste would have to apply for a treatment standard variance. No **generator has found a technology in the research and development phase, much less available commercially, that can handle this type of mixed LLW. The NRC, EPA, and DOE may wish to consider providing grant monies for firms to research treatment options for these problem wastes.** In particular, monies within DOE's technical assistance program for States could be redirected to support this research.

A generator of mixed LLW for which no treatment capacity is available has two potential options for treating its waste. First, it can submit a' 'no migration' petition, for which a generator must demonstrate that disposal of this waste, without being treated first, will result in no migration. However, no such variance for mixed LLW has been granted to date. Second, a generator can apply for a case-by-case extension for 1 year, renewable for 1 year. To receive this extension, however, the generator must have a binding contract with a mixed LLW treatment facility operator ensuring that at the end of the extension period the waste will be treated to meet EPA's standards. Since no such treatment facility is operational or, to date, is even planned, this second option appears unfeasible.

[25] The BRC limits set for these fluids were established by the NRC in 1981 [(46 *Federal Register 16230,* Mar. 11, 1981) 10 CFR Part 20.3061. They are not the same limits as those over which the NRC and EPA are in conflict; the conflicting limits are for more generic types of LLW.

The result of considering these "options" forces generators into ceasing the practice that produces the mixed LLW or into simply storing their waste. Storage, however, is prohibited for any period longer than that needed to accumulate enough volume to 'facilitate proper recovery, treatment, and disposal" (40 CFR Part 268). Since no commercial treatment facility or disposal facility is available for these problem mixed LLWs, storage in all likelihood would not be allowed.[26] **Mixed LLW generators are, therefore, left with no options but to stop generating the waste or to ignore the storage prohibition.** Without a solution to this problem, States or EPA could prohibit generators from producing mixed LLW or to cease operation. Services provided by nuclear utilities, pharmaceutical manufacturers, and research and medical institutions could be crippled.

Possible Regulatory Conflicts and Inconsistencies—Most States and compacts agree that potential conflicts and inconsistencies may exist between the NRC and EPA in implementing both agencies' regulations on a site-specific basis. However, it is **unclear whether all of the conflicts and inconsistencies can be resolved within the existing regulatory framework.** One example of a possible conflict concerns worker exposure during waste sampling and testing to characterize a waste (e.g., to test its leachability) and to verify the contents of a waste package received by the disposal site operator. For characterization, EPA requires that a generator take a 100-gram sample to test a waste's leachability if the generator cannot verify that the waste is not hazardous based on his/her knowledge of the process that generated the waste. For this size sample for some mixed LLW, the NRC considers it dangerous to workers. To circumvent EPA's requirement, a generator has to apply for a waiver, which can take years to receive. EPA and NRC are working toward resolving this issue, but no final joint guidance has been established.[27]

With respect to waste verification, EPA requires that the treatment, storage, or disposal site operator verify the contents of a waste package by obtaining a detailed chemical and physical analysis of a representative sample of the waste (40 CFR Part 264). As is true for a generator, an operator need not verify the waste by sampling unless he/she is not certain of the contents based on a single process that generated the waste. In cases where several wastes are combined in one package (as is the case for routine waste from waste brokers and processors) or where the process that generated the waste has changed, the site operator may have to sample widely, conducting a detailed chemical and physical analysis on each sample. In contrast, the operator of a LLW disposal facility generally only visually checks packages and conducts no chemical assays on the waste. Once again, the issue is worker exposure; following NRC regulations, it has to be as low as is reasonably achievable. **If a disposal site operator verified all necessary packages as required by EPA, he/she could receive excessive exposure.**

Another possible inconsistency or conflict between the two agencies is in inspection and enforcement. For a storage site, EPA requires that the operator directly inspect containers on a weekly basis (40 CFR Part 264). Typically, the inspection is done visually to see if any containers are degrading. The NRC, in contrast, allows much of its storage inspection to be done remotely, using cameras and area radiation monitors. Again, **a** worker **could be subjected to excessive exposure if he/she visually moni-**

[26]Storage prohibitions do not apply in States that have base RCRA authorization but have not yet received mixed waste authorization. Mixed waste is a provision under RCRA, and EPA is not responsible for regulating a particular provision during the period whale the State is waiting to receive authorization for it. Therefore, during this interim period before a State is granted mixed waste authorization, the storage prohibition does not apply unless a State law establishes the prohibition. As of October 1989, nine States had mixed waste authorization: South Carolina, Washington, Tennessee, Colorado, Georgia, Kentucky, Utah, Ohio, and Minnesota.

[27]EPA and NRC have drafted a document entitled "Characterization Guidance' that addresses the sampling procedure.

tored stored mixed LLW on a weekly basis.[28] Furthermore, it is unclear how the agencies would procedurally arrange the inspection and enforcement of facilities, given their joint jurisdiction: Would a team of agency officials with representatives from both agencies inspect the facilities and enforce the requirements? Would enforcement actions against a generator be carried out by a joint-agency team?

Timing conflicts and inconsistencies between the development of EPA's regulations and the development of State/compact LLW disposal facilities are problematic for mixed LLW in some cases. For example, many States are planning to receive mixed waste authorization, which means that they, instead of EPA, will regulate mixed LLW. However, this authorization may not be granted in time for mixed LLW disposal units to be permitted consistent with State timetables for developing their LLW disposal facilities.

Regulatory Overlap and Duplication-The NRC and EPA may want to evaluate several areas where their regulations overlap and their efforts could be consolidated to regulate mixed LLW more effectively and efficiently. Overarching regulatory areas include generic procedures for determining inconsistencies between the AEA and RCRA and below-regulatory concern limits for specific wastes (e.g., waste oi1[29] and CFC solvents and sludges). For waste package manifests, the two agencies could establish one set of requirements. For documentation of facility activities, the two agencies could streamline the licensing and permitting procedures so that only one set of procedures would have to be followed. Recordkeeping, in general, could also be conducted in a format that would meet both agencies' needs. The two agencies could also agree on a single set of financial assurance requirements. Finally, several areas concerning practices at the site could be simplified; these include design variance procedures, facility monitoring requirements, emergency preparedness and prevention requirements, post-closure failure scenarios, and remediation requirements.

Conclusion

The generation of some mixed LLW is unavoidable, even if generation practices are changed to the extent practicable. Of primary concern is the management of organic chemicals and CFCs.[30] EPA and NRC will have to decide how generators are to manage these wastes, given the absence of treatment facilities, in some cases the absence of an appropriate treatment technology, and the prohibitions on storage.

With these roadblocks, generators are left with three options. They can stop producing the waste; they can illegally store the waste; or they can illegally dispose of the waste. None of these ''options' are ideal and two of them (to illegally store or illegally dispose of the waste) could lead to adverse environmental and/or adverse health effects.

POLICY OPTIONS

What can Congress do to make sure commercial low-level radioactive waste, including mixed LLW, is disposed of equitably among States, in an environmentally sound manner, and with administrative efficiency? To grapple with these questions and the specific problems reviewed above, Congress may want to consider two major goals. They are: 1) to encourage States and compacts to cooperate among themselves so that all States can safely manage their LLW after December 31, 1992, and 2) to resolve regulatory problems concerning mixed LLW. There are several options that Congress may wish to consider to reach these goals.

[28] It is unclear whether EPA would allow all of this inspection to be conducted remotely. The NRC and EPA are developing guidance on this issue.

[29] BRC limits for the radioactivity in waste oil would only be relevant to national mixed LLW management if EPA determines that waste oil is hazardous, Even if EPA does not make this determination, the BRC limits would apply to States in which waste oil is listed as hazardous.

[30] As noted, if EPA finds waste oil t. be a hazardous waste, mixed LLW volumes will rise dramatically because the available treatment practices for waste oil will result in a residue that will still be found to be a mixed LLW.

Goal 1: Encourage Cooperation Among States and Compacts To Ensure Disposal Capacity Availability

***Option A: Amend the LLRWPAA** To Force States and Compacts To Consolidate Their Disposal Facility Development Efforts*

Some States (e.g., Michigan) favor Congress amending the LLRWPAA to limit the total number of disposal facilities to gain economies of scale. These States believe that with fewer facilities, more revenue could be collected at each facility to support a more rigorous regulatory oversight program and a financially sound liability fund.

For three main reasons, amending the LLRWPAA does not seem very viable. First, neither the LLRWPA of 1980 nor the 1985 amendments of LLRWPA intended to prescribe a certain number of disposal facilities for the Nation. States felt that they should have the latitude to negotiate among themselves and form workable compacts. Congress made this a central theme to both the LLRWPA and the LLRWPAA. In some cases a compact of two States resulted and in others a compact of eight States resulted. Some States decided to develop a facility for waste generated only within their borders. Not surprisingly, political factors, rather than economic ones, were generally the driving force in compact membership. Also, for some compacts, economy was not as critical as ensuring that the facility could be built to accommodate public concerns.

Second, setting limits on the number of LLW facilities would take away State rights—the very rights that the States, via the National Governors Association, asked Congress to include in drafting the LLRWPA of 1980 and the LLRWPAA of 1985. As is, the LLRWPAA neither discourages nor encourages States to change the terms of their compacts. States are free to negotiate, if they so desire, and to cooperate among themselves to manage and dispose of LLW. The balancing of political factors and economic factors is left to the States.

Third, by limiting the number of LLW disposal facilities now, the supportive political climate under which new facilities are being developed could be damaged. Some States and compacts have made great progress in developing these facilities (e.g., Texas, the Central Midwest Compact, and the Southwestern Compact), and this progress could halt abruptly. The communities that have agreed to host a disposal facility may fear that they would be forced to take a much greater volume of LLW from elsewhere. They may feel that the equity built into the LLRWPA and LLRWPAA was being challenged. If the States and compacts that have made the most progress in developing new disposal facilities were to stop their development, the Nation would be little closer than it was in 1980, when the LLRWPA passed, to having new LLW disposal facilities.

As of November 1989, the most vocal State, Michigan, that lobbied Congress to consider amending the LLRWPAA to limit the number of LLW disposal facilities, had dropped its case. Michigan received no endorsement from the States and compacts that are making good progress in developing disposal facilities. Nonetheless, as tougher LLRWPAA milestones approach, which States and compacts must meet, the amendment argument could be raised again.

Option B: Hold a Congressional Oversight Hearing To Encourage States To Reduce the Number of Disposal Sites

Through an oversight hearing, a congressional committee with jurisdiction would encourage States and compacts to cooperate among themselves to ensure that every State can safely manage its waste after December 31, 1992. States in favor of Option A would likely support this option.

A potential downside of such congressional action is that many States and compacts may not be in a position to discuss the delicate negotiations they are undertaking. The Governor of a host State that plans to build a disposal site for nonmixed LLW may be quietly negotiating with the Governor of a host State that plans

to develop a disposal unit for mixed LLW. These Governors may be negotiating a trade—nonmixed LLW for mixed LLW and vice versa. **An oversight hearing may only agitate these negotiations. Furthermore, a hearing could panic potential host communities into rejecting their role.** All States that have made significant progress toward developing disposal capacity would likely be opposed to this option.

Option C: Take No Federal Action, But Individual Members of Congress Would Track the Progress of Their States

Alternatively, Congress would take no public action to reduce the number of disposal sites. Instead, individual Members of Congress could keep abreast of the progress their States are making to ensure that disposal capacity will be available. Members of Congress could discuss the issue with the Governors of their particular States, determine whether negotiations are proceeding, and determine how they can be quietly facilitated.

Goal 2: *Resolve Regulatory Problems Concerning Mixed LLW*

There is a range of policy options that could meet this goal. Four main options are presented here. As shown in figure 1-2, at one end of a spectrum, either the NRC or EPA may receive sole regulatory jurisdiction. At the other end, dual NRC-EPA jurisdiction as it now stands can continue. Between these two extremes are two other possibilities. All four options, with scenarios for implementation, are discussed below.

How any option would be implemented depends on whether the State in question has Agreement State status under the AEA or mixed waste authorization under RCRA, or both. Furthermore, to implement one option would require legislation, while for others only rulemaking and/or guidance would likely be required.

Option A: Give Sole Regulatory Jurisdiction to One Agency

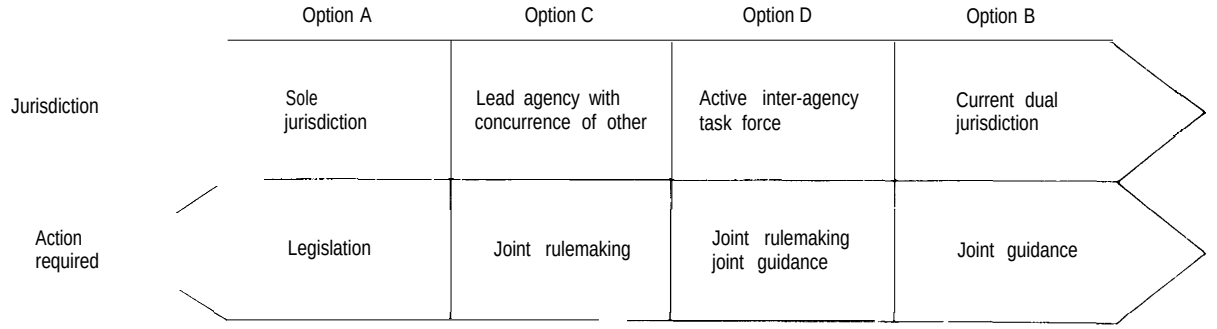
Either NRC or EPA would be given sole jurisdiction for regulating mixed LLW. Sole jurisdiction would require legislation. Several groups (e.g., Edison Electric Institute, Utility Nuclear Waste and Transportation Program, Nuclear Management and Resources Council, Utility Solid Waste Activities Group, and some user groups of radioactive materials) have lobbied Congress to give the role to the NRC. They argue that the current dual regulatory system is duplicative, burdensome, and inconsistent (1, 2,4). They believe that the regulations EPA applies to mixed LLW that are not included in NRC's regulatory framework could be added to the NRC framework and enforced by NRC.

Sole jurisdiction could also be given to EPA. Regulations that NRC applies to mixed LLW could be added to EPA's regulations and enforced by EPA. No group has supported this approach to date, however.[31] One reason is that mixed LLW was buried at LLW sites, until burial was no longer allowed, and the radioactive waste community became more familiar with NRC regulations than with EPA regulations. Furthermore, it was assumed that by regulating the radioactive portion of the waste, the hazardous portion would be regulated as well.

An advantage of sole regulatory jurisdiction is that from an administrative perspective mixed LLW disposal facilities, or special mixed LLW units at a larger facility for mainly nonmixed radioactive LLW, could be developed and operated more economically and efficiently. The disposal site developer/operator would have only one agency (whether at the State or Federal level) with whom it would have to coordinate. Furthermore, a waste generator, processor, and a disposal site developer/operator would no longer need two sets of manifest documents or two sets of reporting forms.

[31] If the environmental community (e.g., the Natural Resources Defense Council) had to choose between the NRC or the EPA for sole jurisdiction, it would favor the EPA, The environmental community, however, favors both agencies regulating mixed LLW.

Figure 1-2—A Spectrum of Policy Options for Mixed LLW Regulation



SOURCE: **Off Ice** of Technology Assessment, 1989

If the NRC is granted sole jurisdiction, mixed LLW generators and processors would need only a license from the NRC or, if located in an Agreement State, from the designated State agency to treat and store their waste. Generators would not have to receive a permit from EPA or, if the State is mixed waste authorized, the State designated agency. If a State had Agreement State status, the State agency with jurisdiction (e.g., Department of Nuclear Safety, Department of Health Services) by itself would regulate all mixed LLW management activities. If the EPA were to be granted sole jurisdiction, the designated agency in a State with mixed waste authorization would assume much of the regulatory role.[32]

A major disadvantage of shifting all Federal regulatory responsibility y to one agency is that the one agency may not be able to carry out adequately the basic mission of the other agency's regulations. For example, if the NRC is granted sole regulatory responsibility, it may have trouble assuming EPA's regulatory philosophy of treating waste to the extent practicable and making waste as nonhazardous as possible before disposing of it. EPA holds this philosophy because many of the hazardous constituents EPA regulates can become very mobile in a disposal site and can migrate offsite via groundwater; organic chemicals are good examples. EPA has a long history of regulating these types of wastes and this expertise may not readily transfer to the NRC. The reverse would be true if EPA is granted sole regulatory responsibility. EPA may not be able to appropriately reflect the AEA's and NRC's philosophy. For example, it is unclear whether EPA would adopt NRC's concern about worker exposure being kept as low as is reasonably achievable and about the institutional control period at a mixed LLW disposal facility lasting up to 100 years.

Similar problems with respect to one State agency regulating mixed LLW could result. For example, assume that NRC is given sole regulatory authority and a particular State has Agreement State status; the authorized agency within that State may have no working knowledge of hazardous waste and be unable to effectively regulate mixed LLW from a hazardous waste perspective. Likewise, assume that EPA is given sole regulatory authority and a particular State has mixed waste authorization; the authorized State agency may have no working knowledge of radioactive waste and be unable to effectively regulate that part of the waste.

Another disadvantage of transferring all regulatory responsibility to the NRC would

[32]EPA, as well, would have a role in regulating mixed LLW on issues that the State had not yet received jurisdiction. For example, a State could have mixed waste authorization and yet not have received responsibility for enforcing new standards that had recently been issued by EPA that deal with some aspect of mixed LLW. EPA is constantly issuing new regulations, and RCRA-authorized States have some time to become responsible for them.

be the potential loss of EPA's regulation of hazardous waste at DOE defense sites. To date, DOE sites are independently regulated only for their hazardous materials and subsequent wastes that are produced. A large constituency, including several public interest groups (e.g., the Natural Resources Defense Council), feels strongly that EPA regulatory oversight of waste management activities is necessary for adequate environmental protection, including the restoration of contaminated areas at DOE sites. **Removing EPA from regulating commercial mixed LLW would raise the question of whether EPA should be removed from regulating defense mixed waste as well.**

For the above reasons, it appears likely that the expertise of both agencies will be needed to continue regulating mixed waste. Environmental organizations (e.g., the Natural Resources Defense Council) oppose either agency being given sole regulatory jurisdiction.

Option B: Maintain Current Dual Regulatory Jurisdiction

The present dual jurisdiction of NRC and EPA can continue, along with the schedule on which the two agencies are working to resolve implementation issues relating to the dual regulation of mixed LLW. Legislation would not be required to implement this option. Most likely only joint guidance would be needed.

Under this option, in a State with only Agreement State status, a State agency would regulate the radioactive portion of the mixed LLW while the EPA would regulate the hazardous portion. In a State with only mixed waste authorization, a State agency would regulate the hazardous portion of the waste while the NRC would regulate the radioactive portion. In a State with both of these State authorities, the State agencies would regulate both the radioactive and hazardous components of the waste. As described in Option A, the range of regulatory possibilities, considering both Federal and State jurisdiction, are numerous and can greatly complicate policy decisions.

Since the passage of the LLRWPAA in 1985, the EPA and the NRC have only developed three guidances/guidelines. There are several areas of potential regulatory conflict and inconsistency, areas where regulations are unattainable, and areas where the regulations are duplicative. **It is imperative for safely managing mixed LLW that the current schedule of resolution between the two agencies be greatly accelerated.** Timely action is particularly needed for mixed organic chemicals and CFCs that may be being illegally stored for lack of treatment and disposal capacity. No constituencies, including public interest groups or industry, have supported Option B.

Option C: Give One Agency the Regulatory Lead With Concurrence Required by the Other Agency

One option between the two extremes is for one agency to take the regulatory lead, but only with the other agency's concurrence on regulatory issues. Joint rulemaking would most likely be required to implement this option.

An advantage of this option, as with the option of one agency having sole regulatory jurisdiction, is that mixed LLW would be more economically and efficiently regulated. Coordinating with the lead responsible State or Federal regulatory agency would be easier for all waste management activities than coordinating with two agencies at all times.

As with the sole regulatory jurisdiction option, **the major disadvantage of Option C, but to a lesser degree, would be the question of whether the lead agency could appropriately carry out the tenor of the other agency's regulations.** Even with concurrence by the supporting agency, it is difficult to ensure that its regulations would be implemented thoroughly. Furthermore, as with sole jurisdiction, if a State agency must take the lead to regulate mixed LLW, the agency may be ill-equipped to carry out dual roles with equal expertise. Another disadvantage is that the concurrence requirement could greatly impede resolution of the

various regulatory problems concerning mixed LLW.

Option C has been neither supported nor dismissed by public interest groups and various industries. However, environmental organizations are against designating the NRC as the lead agency.

Option D: Establish an Active Interagency Task Force With Congressional Oversight

Another option between Option A and Option B is for an active interagency task force to resolve problems concerning regulation of mixed LLW. The current NRC-EPA Interface Council, which was formed to address mutual concerns, would be expanded, or a new task force would be formed with members from both agencies. **Congress, in its agency oversight capacity, would request such a task force to develop joint rulemaking or joint guidance on mixed LLW issues where compromises between the two agencies are needed.**

Task forces have been used effectively in other cases of overlapping Federal regulatory jurisdiction. For example, the Mine Safety and Health Administration has overlapping jurisdiction with the Occupational, Safety, and Health Administration in developing health and safety standards for employees in the mining industry. The two agencies formed an interagency agreement, including a provision to develop joint rulemaking and cooperative training.[33] Likewise, the Food and Drug Administration, within the U.S. Department of Agriculture, and EPA have an overlap on regulating biotechnology products. A Biotechnology Science Coordinating Committee was established, consisting of members from both agencies, to regulate these products (7).

Congress could forward a tight schedule, containing milestones for resolving possible conflicts and inconsistencies, to the task force. Joint rulemaking or joint guidance, in fact, could be established for all of the following issues:

- regulations that are currently unattainable:
  —certain treatment standards,
  —storage prohibitions;
- possible regulatory conflicts and inconsistencies:
  —waste sampling and testing,
  —facility inspection and enforcement,
  —timing conflict between EPA location standards and LLW disposal siting efforts,
  —timing conflict between States being granted mixed waste authorization and States' schedules in developing LLW disposal facilities;
- regulatory overlap and duplication:
  —procedures for determining inconsistencies between AEA and RCRA,
  —BRC limits for specific wastes,
  —facility design variance procedures,
  —waste package manifest requirements,
  —licensing and permitting procedures,
  —recordkeeping,
  —financial assurance requirements,
  —facility monitoring requirements,
  -emergency preparedness and prevention requirements,
  —post-closure failure scenarios,
  —remediation.

In addition to developing rulemaking and guidances on the issues above, **Congress could request that the task force report on additional areas where rulemaking or guidance is needed.** This task force could decide that all the issues are resolvable through joint rulemaking or joint guidance, or it could decide that legislation is needed. **If legislation is needed, Congress will be better informed after the task force makes its recommendations than it is now to determine which issues need to be resolved by law.**

Some compacts (e.g., Central Interstate) and public interest groups support this option as a practical approach to regulating mixed LLW. Opposing this option are the electric utility industry and some user groups of radioactive

[33] 44 Federal Register 22827 (Apr. 17, 1979).

materials. These opposition groups are more familiar with NRC regulations than with EPA regulations and would prefer reporting to one agency—the NRC. However, because of the disadvantages discussed under Option A (e.g., the difficulty of ***one*** agency enforcing *both* sets of regulations and the precedent that would be set for DOE defense waste regulation if the NRC were granted sole jurisdiction over mixed waste), it appears that the expertise of both agencies is needed. Chairman Carr of the NRC has had discussions with EPA Administrator, William Reilly, on the problems concerning mixed waste regulation. The agencies have made little progress, however, in resolving these problems. No legal impediment is keeping the NRC and EPA from expanding their Interface Council or from creating a new task force. There is, however, no evidence that the agencies plan such action.

Issue Requiring Prompt Resolution

It is imperative that mixed waste regulations that are currently unattainable be addressed immediately so that waste generators are left with an option for managing their mixed LLW. Today these generators face the choice of going out of business (if they have to stop producing the waste), illegally storing the waste, or illegally disposing of it.

To **address this problem, Congress could encourage EPA to allow generators/operators to store a particular waste if no treatment capacity and/or no disposal capacity is available.** In other words, storage would be allowed only if it is not being used in lieu of disposal. **This action would give mixed LLW generators an intermediate option until treatment capacity and disposal capacity are developed and available.**

EPA could require that generators demonstrate their diligence to ensure that these facilities are developed as a condition for permitting mixed LLW storage. EPA would have authority to stop waste storage if a generator fails to demonstrate progress, An advantage of this approach is that by generators applying for a storage permit, EPA would have a record as to what types and volumes of mixed LLW are being generated. EPA could use the data to better ensure that wastes are not being illegally disposed. The waste treatment industry could use the data as a marketing tool to develop necessary waste treatment facilities.

Monies could be allocated within EPA, NRC, and DOE budgets to support entities (e.g., universities, national laboratories, and private companies) that are interested in researching and developing treatment technologies for mixed LLW. For example, monies could be redirected from the DOE technical assistance program established to support States' site development efforts. Particular attention could be given to treatment technologies for organic chemicals containing high concentrations of carbon-14 and tritium.

With congressional support, there may be a way for EPA to allow such intermediate storage when it issues its rule for treatment standards, established in the final third of listed hazardous wastes (due to be issued in May 1990).

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