A MANAGEMENT APPROACH FOR GREATER-THAN-CLASS C LLRW

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ABSTRACT

The several thousand generators of the most dangerous class of commercial low-level radioactive waste (LLW), greater-than-Class C (GTCC) LLW, have no off-site storage or disposal facility available to them. GTCC waste is produced by the full range of typical LLW generators: universities, hospitals, nuclear utilities, and industries. Most of these generators are small, such as academic laboratories and small pharmaceutical companies. Several generators argue that their on-site storage capacity is shrinking and that over the next decade or so they will have no capacity remaining. The relatively high levels of radioactivity associated with GTCC waste demand that management options be made available to ensure that public health and safety are protected.

Sealed sources pose a particular concern. Several thousand GTCC sealed sources are now being used in the United States in a wide variety of tools and machines. The theft, loss, and mishandling of such tools and machines have been responsible for 14 deaths in foreign countries and serious radiation burns in the United States. Although it is impossible to predict whether a GTCC waste accident might occur in this country, the political repercussions of such an accident for the Federal Government could be especially significant if the accident were linked to the Government's inability to accept GTCC waste for storage or disposal. To help manage sealed sources, manufacturers could be required to recycle all sealed sources. A deposit could be placed on each sealed source as an incentive to users to return them to the manufacturer.

Congress directed the Federal Government, presumably the Department of Energy (DOE), to develop a disposal plan for GTCC waste. No such plan, however, has been developed. It appears that no matter how DOE finally decides to dispose of the waste, no disposal facility could become available for at least 2 decades and potentially much longer.

A three-step integrated management approach could include: first, DOE granting limited access to one of its existing storage facilities while an extended-storage facility is being developed. Second, DOE could transfer GTCC waste from its limited-access facility to its extended-storage facility once it is operational. Third, DOE could provide a disposal facility for GTCC waste. Based on existing analysis, the conservative approach would be to dispose of GTCC waste in the high-level radioactive waste repository. It appears that environmental, institutional, and probably economic benefits would be gained. Nonetheless, DOE must still determine the impact of this disposal option on the repository's overall operation and performance. This 3-step integrated management approach would help ensure that accidents (such as those that have already occurred) do not reoccur, and that GTCC waste is safely managed over the short and long term.

INTRODUCTION

Most commercial low-level radioactive waste (LLW) in the United States is classified as A, B, or C, with Class C being the most radioactive. A small amount of LLW is generated that is more radioactive than Class C waste -- greater-than-Class-C (GTCC) waste. The current volume of this waste is equivalent to about 6 tractor trailers. Nonetheless, there are several thousand generators of it, most of which are small. They are currently forced to store all GTCC waste on site because no options are available for storing or disposing of it off site. Furthermore, some generators' on-site storage capacity is becoming limited.

In the Low-Level Radioactive Waste Policy Amendments Act of 1985, Congress mandated that the Federal Government develop a disposal plan of GTCC waste. In response, the Department of Energy (DOE) issued a report in 1987 focusing on GTCC waste (1). This report primarily evaluates GTCC waste characteristics, as well as the present and projected volumes, but defers analyzing disposal options.

Without knowing when a disposal option will be available, generators of GTCC waste can neither estimate their storage needs nor design waste packages for such storage. Congress therefore asked OTA to analyze different management options, and to develop a comprehensive management approach for GTCC waste. Before presenting this analysis, some background information on GTCC waste is presented.

BACKGROUND

The volume of GTCC waste currently being stored and projected to be generated is small. As of the end of 1985, about 14,000 cubic feet, which is equivalent to 6 tractor trailers, had been generated (2). For comparison, about 1.8 million cubic feet of Class A, B, and C LLW was shipped for disposal in 1987 alone. By 2020, it is projected that a total 170,000 cubic feet of packaged GTCC waste will be generated (2). This is equivalent to about 65 tractor trailers. Sixty percent of this projected volume is expected to result

TABLE I
Relative Risks From Different Types of Radioactive Waste.

Waste type	Average Concentration[a] (Ci/cubic foot) End of 1985	2020	Relative longevity of risk
Spent fuel	200,000 (1)	100,000 (1)	Ten thousand years[b]
High-level waste (defense)	100 (1)	100 (1)	Hundreds to few thousand years[b]
Transuranic waste (defense)	0.2 (1)	1 (1)	Few to several thousand years[c]
Greater-than-ClassC Waste*	300 (2)	2,500 (2)	Hundreds to few thousand years
Low-level waste			
Total commercial	0.1 (1)	0.1 (1)	
Class C	7 (1&3)		Few 100 years[d]
Class B	2 (1&3)		Few 100 years[d]
Class A	0.1 (1&3)		Less than 100 years[d]

* Much of the initial radioactivity associated wth GTCC waste is due to short-lived radioBy 2020, more than half of its radioactivity will be contributed by long-lived radionuclides (e.g., nickel-63).

[a] Average concentrations for waste in storage or shipped for disposal.

[b] Semi- quantitative approximation of longevity of risk based on the half-life of the radionuclides in the waste, and EPA standards for radioactive waste disposal.

[c] Semi-quantitative approximation of longevity of risk based on the half-life of radionuclides in the waste relative to EPA standards for radioactive waste disposal.

[d] Semi-qualitative approximation of longevity of risk based on NRC 10 CFR 61 regulations for LLW.

Sources:

1. U.S. Department of Energy, "Integrated Data Base for 1987: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics, "DOE/RW-0006, Rev. 3 (Washington, D.C.: September 1987).

2. Knecht, M., EG&G (DOE contractor), personal communication, September 1988.

3. U.S. Department of Energy, "The 1986 State-by-State Assessment of the Low-Level Radioactive Waste Received at Commercial Disposal Sites," National Low-Level Radioactive Waste Management Program, DOE/LLW 66T, December 1987.

from decommissioning and refurbishing nuclear power plants (2).

Even though the volume of GTCC waste is small, its radioactivity is very high relative to other classes of LLW. By the end of 1985, the radioactivity of all GTCC waste in storage was 2.5 million curies (2). For comparison, this is more than three times the radioactivity of all other commercial LLW that had been disposed of by the end of 1985. The cumulative radioactivity of all GTCC waste generated by 2020 is projected to rise to 80 million curies (2). Much of GTCC waste radioactivity is contributed by cobalt-60, which has a short half-life. The overall radioactivity of GTCC waste will decay substantially in about 50-60 years.

To evaluate the management of GTCC waste, as compared to other types of radioactive waste, two primary factors were used: 1) the concentration of radioactivity in the waste and 2) the length of time that the waste poses a significant risk to humans, or the longevity of risk. Table I illustrates that the average concentration of radioactivity in GTCC waste is closest to that of defense high-level waste (HLW) and higher than any type of commercial radioactive waste except spent fuel. As of 1985, the average concentration of radioactivity in GTCC waste was 300 curies per cubic foot. If the activity from all short-lived radionuclides (e.g., cobalt-60) were ignored, this concentration would drop to about 50 curies per cubic foot. By 2020, GTCC waste's average concentration is projected to increase significantly to about 2500 curies per cubic foot. If all short-lived radionuclides were again ignored, this concentration would drop to about 1500 curies, an order of magnitude higher than the projected concentration of defense HLW.

AN INTEGRATED MANAGEMENT APPROACH FOR GTCC WASTE

Since some GTCC waste remains potentially dangerous for a few thousand years, it must be safely disposed of in a manner that protects future populations and the environment. Regardless of the technology used, it appears that an appropriate disposal facility for GTCC waste will not be available for at least 15 to 20 years. Furthermore, GTCC waste generators cannot prepare their waste for disposal because no disposal technology has been chosen. Instead, they must prepare their waste for storage, and may have to repackage it later for disposal. Until a disposal facility is available, GTCC waste must be safely stored to avoid unnecessary worker exposure and handling accidents that could subsequently contaminate the environment and harm the general population.

The controls required for radiation protection and accident prevention tend to increase as the intended storage periods increase. Storage regulations and packaging guidance now used for most GTCC waste may have to be revised to accommodate the long storage period before a disposal facility is made available.

Even with these regulatory revisions, some GTCC waste generators may not be able to continue to store their waste on site. An off-site storage facility may be needed to handle this waste. The following 3-step integrated management approach was developed for handling GTCC waste during the short and long term. This approach is depicted in Fig. 1.

Limited-Access Storage

Some generators of GTCC waste may need access to a small amount of storage capacity (e.g., a few thousand cubic feet -- equivalent to one or so tractor trailers) over the next decade while an extended-storage facility is being constructed. This capacity could be at one of DOE's existing, unlicensed storage facilities.

Of particular concern is the fate of the several thousand sealed sources now being used in a wide variety of tools and machines throughout the United States. Some portion of these will become obsolete before an extended-storage facility would become available. Manufacturers of these tools and machines will generally only accept them back from their users if it is economical. For example, it may be economical to repackage a sealed source into a different tool or machine. Institutional controls tend to diminish with such transfers. It may also be uneconomical to recycle an obsolete sealed source, in which case, the user may have no option for getting rid of the tool or machine.

The General Accounting Office (GAO) reports that tools and instruments containing sealed sources and radioactive material are poorly regulated (3). For example, GAO found that during 1986 NRC licensees reported 68 cases of lost, abandoned, or stolen material and 21 cases of leaking sources (3). In foreign countries, the theft and improper handling of sealed sources have been responsible for four major accidents and 14 deaths. The International Atomic Energy Agency held a meeting in June 1988 on the problems associated with regulating sealed sources and

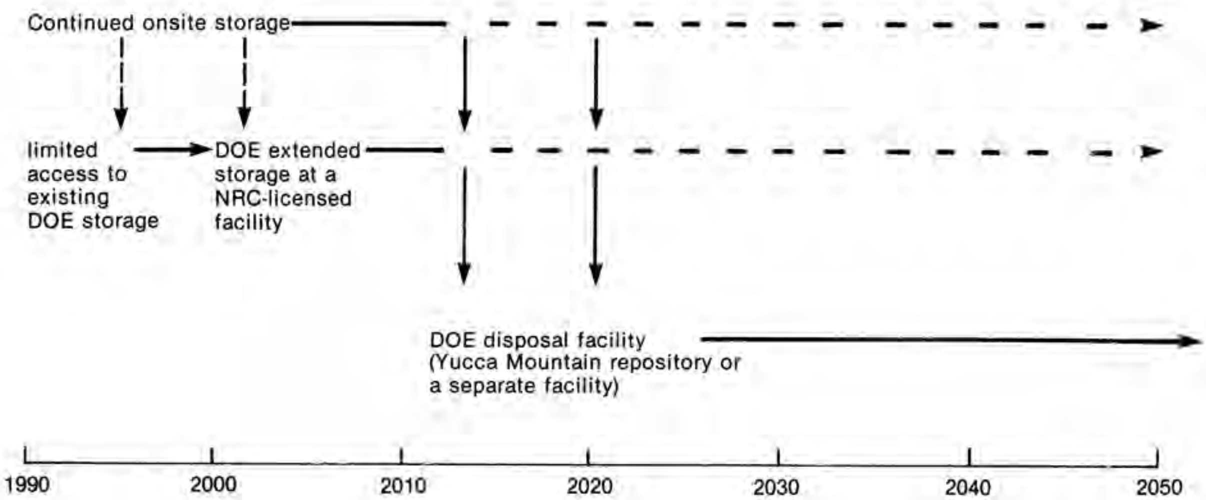

Fig. 1. A Management Approach for GTCC Waste.

acknowledges the potential for accidents to occur if sealed sources are poorly controlled (4).

Although fatal accidents involving sealed sources have not been recorded in the United States, they would be more likely to occur if tight regulatory control of licensed material and sealed sources is not maintained, especially when on-site storage is unfeasible. Even though the amount of radioactive material in many sealed sources is small, some are highly radioactive. Moreover, there are several thousands in use or in storage. In response to recent accidents involving sealed sources and mishandling of radioactive materials, the Nuclear Regulatory Commission (NRC) issued a Notice in March 1988 to material licensees, alerting them of the need to control the handling and transfer of their licensed material to reduce the risk of an accident or its loss (5). Specifically, licensees are to periodically inventory and test for leaks in their sealed sources. Furthermore, the NRC encourages licensees to avoid long-term storage of surplus radioactive material. Even with these cautions expressed, it does not change the fact that no off-site storage facility is available for GTCC waste. The political repercussions for the Federal Government if a GTCC waste accident were to occur could be especially significant if the accident were linked to the Government's inability to accept the waste for storage or disposal.

Providing limited access to a DOE storage facility could greatly reduce the risk of having a GTCC waste accident occur. To further reduce this risk and to minimize the amount of GTCC waste that would require limited-access storage, manufacturers of tools and machines containing new sealed sources could be required to recycle these sealed sources. A deposit could be placed on each sealed source as an incentive to users to return them to the manufacturer.

An initial fee for limited-access storage could be collected when GTCC waste is accepted for storage. Unreasonably high costs would discourage the use of a limited-access facility, while some waste generators may need to use it to protect public health and safety. Once a disposal option is chosen and the costs of extended storage and disposal are better known, a second fee could be calculated. This second fee could be collected when GTCC waste in limited-access storage is transferred to the extended-storage facility.

Extended Storage

Since a disposal facility for GTCC waste will likely require at least two decades to develop, most GTCC waste will have to remain in storage until at least 2010 and potentially much longer. The Federal Government (presumably DOE) will likely need to provide some storage capacity, especially for small and/or financially unstable GTCC waste generators. It is estimated that during the next three decades, about 10,000 to 20,000 cubic feet of packaged GTCC waste -- a volume equivalent to four to eight tractor trailers -- will need off-site storage. This storage capacity could presumably be made at one facility.

In its 1987 report, DOE tentatively committed the Federal Government to accepting GTCC waste for storage by 1989, presumably at an existing DOE facility. There are questions, however, about the propriety of storing commercial GTCC waste at an unlicensed DOE facility used primarily for defense waste. With few exceptions, commercial radioactive waste has been stored at facilities that are licensed by the NRC or Agreement States. Furthermore, the Low-Level Radioactive Waste Policy Amendments Act of 1985 requires licensing of any disposal facility for GTCC waste. Congress may also decide that any Federal extended-storage facility for commercial GTCC waste must be licensed by the NRC.

To ease potential problems associated with developing a licensed storage facility, DOE could parcel off a site adjacent to or within one of its national laboratories, such that the activities occurring at the licensed facility would not interfere with unlicensed defense-related activities. Two of the three commercial LLW disposal facilities are located in such a fashion. Even if this made siting easier, it would still require probably several years to select a site, to conduct the required environmental assessments, and to construct a licensed storage facility for GTCC waste. Considering the probable uncertainties in waste volumes that will require off-site storage, a modular storage facility could be incrementally developed as storage needs become more apparent.

Disposal

The longevity of risk and the radioactivity associated with most GTCC waste is similar to that of defense HLW. Also, about half of all GTCC waste is composed of transuranic radionuclides, and more than half of its activity is contributed by long-lived radionuclides (primarily nickle-63). The Federal Government is currently planning to use deep-geologic repositories for the disposal of both defense HLW and defense long-lived transuranic waste.

If a decision about the disposal of GTCC waste were required today, the conservative approach would be to permanently isolate the waste in a deep-geologic repository. It is possible, however, that further research and analysis could demonstrate that other disposal alternatives would be acceptable (e.g., deep-augered holes or an intermediate-depth repository). Near-surface disposal alternatives, such as buried concrete vaults, would probably provide waste isolation for periods of a few hundred years, but probably not for the few thousand years needed for the majority of GTCC waste.

The volume of GTCC waste is probably not large enough to justify the economic or institutional costs associated with developing a separate disposal facility, regardless of the technology used. The projected volume of GTCC waste that will be generated through the year 2020, including the waste from decommissioning nuclear power plants, would probably occupy about 0.1 percent of the volume of the proposed repository for commercial spent fuel and defense HLW (6). Preliminary calculations also indicate that the costs associated with using this large repository would be comparable to, or perhaps less than, costs associated with developing a small, less conservative disposal facility dedicated solely to GTCC waste (6).

The proposed repository for commercial spent fuel and defense HLW could be operational in about two decades if the site now being investigated at Yucca Mountain, Nevada, is found suitable and no unforeseen legal or procedural delays are encountered. This time estimate could be extended by another two decades if the Yucca Mountain site is found unsuitable and another repository site must be located. Even if another technology were chosen for GTCC waste disposal, history indicates that it would still require about five years to select that technology, and another ten to fifteen years to design, site, and license a separate facility.

In evaluating GTCC waste disposal options, DOE could concentrate its efforts on the Yucca Mountain repository. After one or two years, DOE could determine whether any unacceptable impacts would result in using the repository for GTCC waste. If such impacts were detected, DOE could then evaluate other disposal options for GTCC waste. In weighing the advantages and disadvantages associated with using the Yucca Mountain repository, it is important to consider the institutional and political difficulties associated with siting a separate GTCC waste disposal facility, regardless of its size or type.

REFERENCES

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