GREATER-THAN-CLASS-C LOW-LEVEL RADIOACTIVE WASTE MANAGEMENT CONCEPTS*

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ABSTRACT

In 1986, Public Law 99-240, the "Low-Level Radioactive Waste Policy Amendments Act of 1985" assigned to the Federal Government responsibility for the disposal of commercial greater-than-Class-C (GTCC) low-level radioactive waste (LLW). In 1987, DOE committed to Congress to accept GTCC LLW and provide storage and other waste management as necessary until disposal capacity is available. Current estimates are that about 6,000 m^3 of unpackaged GTCC LLW will be generated to the year 2020. Generators estimate that 110 m^3 of raw GTCC LLW might exceed planned storage capacity to the year 2020. This paper reports the activities of the National Low-Level Waste Program to manage GTCC low-level radioactive waste.

INTRODUCTION

On December 19, 1985, the Congress of the United States passed Public Law 99-240, the "Low-Level Radioactive Waste Policy Amendments Act of 1985: (the Amendments Act). The Amendments Act, signed into law on January 15, 1986, assigns to the Federal Government the responsibility for the disposal of non-DOE greater-than-Class-C (GTCC) low-level radioactive waste (LLW) as defined by 10 CFR Part 61. 55. The Amendments Act requires that GTCC LLW generated by NRC-licensed activities be disposed in an NRC-licensed facility. The Act also requires DOE to recommend actions to ensure the safe disposal of GTCC LLW. The recommendations were submitted to Congress in February 1987 (1).

As stated in the Report to Congress, until disposal capacity can be made available, DOE plans to accept GTCC LLW as necessary, after adoption of appropriate waste acceptance criteria, and to manage such waste until disposal options are available. Such management may include storage and any required treatment, packaging, and transportation prior to disposal. DOE will develop appropriate procedures and will assess appropriate fees for use of these services (1).

In 1989, DOE expects to have a program in place for accepting GTCC LLW for storage. In the interim, DOE will consider requests for acceptance of GTCC LLW on a case-by-case basis. Acceptance of GTCC LLW at any time will be contingent on the following (1):

1. The waste meets DOE acceptance criteria
2. Generator makes advance arrangements,to facilitate DOE planning
3. Adequate storage facilities are available or can be developed
4. Contractual and financial arrangements can be accomplished
5. All reasonable costs of storage, subsequent disposal, and associated waste management services such as treatment and transportation are borne by the beneficiaries of the activities resulting in the generation of this waste
6. Acceptance of the waste will not adversely affect other DOE waste management activities, and
7. Appropriate National Environmental Policy Act review is completed.

EG&G is assisting DOE in identifying existing DOE LLW storage capacity that could be made available for GTCC LLW storage in l989. Full evaluation and selection of a disposal technology and disposal site for GTCC LLW await Nuclear Regulatory Commission (NRC) rulemaking on the definition of high-level radioactive waste. The definition could determine if some of the wastes currently defined as GTCC LLW must be packaged and disposed as HLW in the planned HLW repository.

As stated in the Report to Congress, DOE will make every effort to involve interested persons in its program for acceptance and disposal of GTCC LLW and will publish guidelines for generators to use in requesting DOE acceptance of such waste. It will also assess the possibility of non-

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federal management and disposal options for GTCC LLW (*1*).

This paper describes the activities of the National Low-Level Waste Program to manage GTCC LLW. Schedules and plans for future efforts are also discussed.

WASTE CHARACTERIZATION AND VOLUME PROJECTIONS

A key step in developing disposal and storage capability for GTCC LLW is the realistic determination of the sources, quantities, and characteristics of GTCC low-level waste requiring disposal. With this information and a clear definition of the waste category, federal and/or nonfederal disposal options may be considered, and disposal facility design, general waste acceptance criteria, requirements for storage, treatment, packaging, transportation, and disposal, and costs can be developed more fully.

To assist in developing the required information, the Energy Information Administration (EIA) distributed a survey form, in the summer of 1986, to potential generators of GTCC LLW. With the assistance of the NRC and NRC agreement states, potential generators had been identified from NRC and agreement state lists of radioactive material licensees. The survey form, "NE-869 Greater-Than-Class-C Low-Level Radioactive Waste and Radium Waste Data Form," requested information about GTCC generators, GTCC LLW generating activities, current GTCC LLW inventories, future GTCC waste generation including facility decommissioning waste, characterization of the waste (radiological, chemical, and physical), and capabilities for storage of the waste at the generator sites.

In early 1987, EIA transferred the responses to the survey to the Low-Level Waste Program for analysis. Preliminary analysis of the survey data is nearly complete, and a final report on the results is expected to be issued to DOE in early 1989.

The survey results indicate that about 60 to 75% of GTCC LLW is expected to be remotely-handled waste, having radiation levels greater than 200 mR/h at the surface of a waste container. This type of waste includes activated metals and instruments from the core regions of nuclear reactors and miscellaneous wastes from reactor fuel testing facilities. Some of the instruments and miscellaneous wastes will also contain transuranic wastes.

The 25 to 40% of GTCC waste that is expected to be contact-handled includes transuranic sealed sources and transuranic wastes from sealed-source manufacturing and from development of mixed uranium--plutonium oxide nuclear fuels. Shielded containers of Cs-137 wastes may also be included. These would contain sealed-source manufacturing wastes and spent sealed sources. Solidified liquids from manufacture and use of materials tagged with C-14 as a tracer would be included in contact-handled wastes.

The raw waste volume of waste sealed sources that are not recyclable by the manufacturer is expected to be less than 1 m^3 to the year 2020. However, the number of sealed sources could be in the thousands, a considerable volume when appropriately packaged for storage or disposal. Pu-239 in sealed sources that contain at least 1 curie of Pu-239 will be considered for recycling via the DOE Central Scrap Management Office at its Savannah River Laboratory.

According to the survey, by the end of 1985 the commercial GTCC LLW inventory was about 130 m^3, equivalent to about 780 to 3250 55-gallon drums, for drum packing factors ranging from 80 to 20%. Generators project only about 300 m^3 of raw GTCC LLW from commercial reactor operations, manufacturing, institutional, and industrial uses of radioactive materials and products through the year 2020.

After the year 2005, decommissioning of nuclear power reactors could sharply increase the rate of production of waste materials that exceed the Class C limits. Based on survey results and projections by NRC and DOE, up to 5600 m^3 of packaged reactor decommissioning waste in the form of activated metal might be generated by the year 2020 if current schedules for decommissioning are adhered to (1-6). Extension of the operating lifetimes of reactors could push much of the decommissioning waste generation to well beyond the year 2020.

However, the volume of decommissioning GTCC LLW to be disposed will depend on the actual radionuclide concentrations in the waste, the waste packaging practices at the individual utilities, and the timing of decommissioning activities. Much of the GTCC activated metal waste projected to be generated from decommissioning has predicted radionuclide concentrations that fall close to the Class C limits. Because of the uncertainties in these predictions, and because waste is classified on the basis of the average radionuclide concentration over all pieces contained in a package, it is uncertain whether this waste would be Class C when finally characterized and packaged.

Until utility planning for decommissioning is sufficiently developed to include detailed waste packaging planning for activated metal waste, volume projections for GTCC LLW will remain uncertain, even disregarding uncertainties in the HLW definition and radionuclide concentration projections.

Based on the DOE survey and published predictions of GTCC decommissioning wastes, a computer model is being developed to project future volumes of commercial GTCC LLW for which DOE might need to develop disposal capacity. The model includes a median, high, and low

projection of waste volume to the year 2020. The model is expected to be submitted for peer review in late 1988.

POTENTIAL NEED FOR OFFSITE STORAGE OF GTCC LLW

In the absence of disposal capacity, most GTCC LLW could continue to be stored at the generator site; according to the survey, only 15 generators expected that they might exceed onsite storage capacity for GTCC LLW before the year 2020. Only eight generators, however, estimated the amounts of waste involved: a total of 110 m^3 to the year 2020.

It is difficult to project the schedules, volumes, and types of GTCC LLW to be tendered to DOE for storage, because the generator's decision to tender waste to DOE for storage in advance of disposal capability is voluntary. The generator's decision would usually be based on economic considerations. It is also possible that some generators would prefer DOE storage of their GTCC LLW to reduce their potential liability.

SELECTION OF STORAGE SITE AND MODE

As stated in the DOE report to Congress on GTCC LLW, DOE is currently committed to providing storage capacity in early 1989 (1). This optimistic schedule assumes that no major modifications will be needed for the selected existing DOE facility and its operations. It also assumes that all required basic safety, quality assurance, and environmental documentation in place for DOE waste currently being handled at the selected facility will also apply to GTCC waste that meets the facility waste acceptance criteria. If these assumptions require modification, waste acceptance capability will be delayed.

Because of the expected extended storage time for GTCC LLW accepted by DOE, the performance of the waste form and container must be demonstrated to be able to meet the DOE waste acceptance criteria over the assumed storage time. To this end, the role of quality assurance will be important in characterizing the waste.

Preliminary storage facility criteria and preliminary waste acceptance criteria for storage of the waste are currently being developed. DOE storage capability and cost estimates are being evaluated in preparation for selection of a DOE storage site, and a plan for storage of GTCC LLW is scheduled to be issued in early 1989. After a storage facility is selected, final storage facility criteria and waste acceptance criteria can be developed. The waste acceptance criteria will encompass requirements for documentation and quality assurance, the waste container, and the waste package, including waste form and characteristics.

DEVELOPMENT OF FEES AND FUNDING MECHANISM FOR DOE GTCC LLW MANAGEMENT

The Amendments Act requires DOE to identify options for ensuring that the beneficiaries of the activities resulting in the generation of GTCC LLW bear all reasonable costs of disposing of such wastes. Such costs could include all current and future reasonable costs incurred as a result of waste acceptance for disposal. Such costs are expected to include any required certification or verification of the waste characterization, initial packaging and shipping by the generator, receipt, recordkeeping, storage, handling, treatment, repackaging, transportation, disposal, and monitoring and surveillance.

Costs for offsite (away from the generator) GTCC LLW management, including storage, will remain highly uncertain until a GTCC LLW disposal facility and mode are identified that are shown by detailed calculational analysis to meet NRC and EPA regulations. Then the length of the storage period, the required treatment and repackaging to meet disposal site waste acceptance criteria and the costs of transportation and disposal can more accurately be determined. Until actual disposal costs can be estimated for GTCC LLW, such costs will likely be conservatively estimated to be the same as the costs of disposal of defense HLW in the HLW repository.

Identifying the specific dollar costs for disposal and DOE management of GTCC LLW is fraught with many more uncertainties than for commercially disposed LLW or for HLW. Costs for pre-disposal management of GTCC LLW will depend on the length of time the waste must be stored, the characteristics of the waste, and the total volume of each type of GTCC LLW that requires unique DOE management activities. For example, remote-handled waste will require different management than contact-handled waste. Ion-exchange resin to be stored for several decades could require different management practices than activated metals. Fissionable materials, such as some transuranics, could require different management than cesium sealed sources.

Costs of repackaging, treatment, and transportation for disposal cannot be accurately determined until a disposal technology has been selected, and disposal facility acceptance criteria for waste form and packaging are developed. Disposal technology and disposal facility waste acceptance criteria will depend on whether the forthcoming NRC definition of HLW puts any GTCC LLW in the HLW category. Any GTCC that became HLW would likely have to be packaged, transported, and disposed as HLW.

Development of a fee methodology will begin shortly and is planned to be complete in March 1989. The fee methodology will define the unit costs that should be represented in the fee, means to determine these unit costs, and the method of estimating actual total costs based on unit

costs. The methodology will determine how waste characteristics, packaging, and volume will be factored into the fee.

For development of payment methods, contractual negotiations between DOE and the generator will play a major role. The goal will be to minimize adverse financial impacts to the Federal Government and the generator. One method might be to require the generator to set up an escrow account that will contain sufficient funds to cover all estimated costs of waste management, including disposal. This escrow account would be billed yearly, but only for actual costs incurred. The estimated future costs of waste management would be reevaluated periodically, and the generator could be required to adjust the escrow account, if necessary, to cover the estimated future costs.

APPLICATION PROCEDURE FOR DOE ACCEPTANCE OF GTCC LLW

The generator/owner of the waste should apply in writing for DOE acceptance of non-DOE GTCC LLW for disposal. Interim application forms are expected to be available this spring from DOE. The purpose of the application form is to supply DOE with required information on the waste characteristics and packaging. This information is needed to allow DOE to determine whether the waste will meet DOE waste acceptance criteria for storage.

Before reaching a decision on an application, DOE will likely require certification or verification of the characterization of the waste and the projected performance of the waste package. The certification would likely involve review of the generator/owner's methods and associated quality assurance program for determining the characteristics of the waste and predicting the performance of the waste package. In the case of standard-model sealed sources that are not leaking and that will be repackaged at the storage site, this certification is envisioned to be a simple procedure, not involving much time or expense on the part of the generator/owner or DOE. Certification of other wastes would likely involve more extensive review and documentation.

When waste and performance certification is not possible, independent waste characterization, including waste sampling, analysis, and packaging, nondestructive testing of the waste container, and any required analyses of future performance of the waste package would likely be required. *Verification* could involve independent performance or oversight of the required efforts. Because of the potential extended storage time for GTCC LLW, certification/verification is viewed as an extremely important element in the program to ensure that the waste can be safely stored.

COORDINATION WITH THE PRIVATE SECTOR

DOE is required by the Act to evaluate nonfederal waste management capabilities, costs, and funding mechanisms for GTCC LLW management. These aspects of GTCC LLW management are expected to be coordinated with the private sector. One idea to facilitate coordination is to form a working group composed of representatives from the federal, state, and private sectors. The group would coordinate member activities to characterize the waste and define, develop, and evaluate waste management options, including disposal options. The group would also provide a ready means for dissemination of information concerning GTCC LLW and its management and ensure major interested parties have the same information readily available. Examples of the information considered important are identification of nonfederal waste management capabilities, fees, and potential risks, costs, and funding mechanisms for GTCC LLW management.

PLANNING FOR DISPOSAL

Presently, there is no disposal facility that will readily accept GTCC LLW and that meets the requirements of the Act. Because the GTCC LLW volumes projected to the year 2020 are relatively small, the development of a new, separate NRC-licensed disposal site dedicated to GTCC LLW could be prohibitively costly. Development of a program for disposal of GTCC LLW awaits regulatory guidance on the definition of HLW and on identification of acceptable disposal methods. A number of technical steps will then be required to develop the capability to dispose of GTCC LLW. The available and feasible treatment, packaging, transportation, and disposal technologies and options must be evaluated in light of the specific quantities and characteristics of GTCC LLW; health, safety, and environmental risks; and costs.

In late 1988, a preliminary assessment of the public and worker radiation doses that could potentially be associated with disposal of GTCC as LLW will begin. Conceptual designs for below ground vault and borehole disposal technologies will be used as the bases for the assessments. These technologies would be separately considered for the disposal of projected volumes of short-lived, long-lived, and combined short- and long-lived GTCC LLW.

CONCLUSIONS

Estimates of the amount of commercial GTCC LLW expected to be generated through the year 2020 remain small: 6000 m^3. Planning for disposal of this waste awaits at least two developments:

- Regulatory guidance on acceptable waste form, packaging, and disposal technology

- An NRC HLW definition, which could remove uncertainty in which GTCC LLW waste types may be disposed of as LLW.

In the interim, development is well underway for DOE acceptance of GTCC LLW that cannot be stored at a generator's facility. DOE plans to be able to accept limited quantities of GTCC LLW for storage at one of the DOE radioactive waste management sites in 1989. Such waste must meet DOE conditions for acceptance, including the applicable radioactive waste acceptance criteria for the specific DOE storage site.

Initiation of a GTCC LLW coordination working group will provide a ready means for DOE, the private sector, and interested regulatory agencies to coordinate activities and information needed for future storage and disposal of GTCC LLW.

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