

ACCEPTANCE OF WASTE FOR DISPOSAL IN THE POTENTIAL UNITED STATES REPOSITORY AT YUCCA MOUNTAIN, NEVADA

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ABSTRACT

This paper addresses the process for the acceptance of waste into the waste management system (WMS) with a focus on the detailed requirements identified from the Waste Acceptance System Requirements Document. Also described is the recent dialogue between OCRWM and the Office of Environmental Management to resolve issues, including the appropriate interpretation and application of regulatory and system requirements to DOE-owned spent nuclear fuel. Some information is provided on the design of the repository system to aid the reader in understanding how waste that is accepted into the WMS is received and emplaced in the repository.

INTRODUCTION

The Nuclear Waste Policy Act (NWPA) of 1982 (Public Law 97-425) established a national plan to develop a repository for the permanent disposal of high-level radioactive waste. The U.S. Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) has the responsibility of developing the nation's first high-level waste (HLW) repository. HLW includes wastes -- from defense and commercial reprocessing operations -- that are encapsulated in borosilicate glass as well as spent nuclear fuel (SNF) from commercial power reactors. As described in the following

paragraphs, the mix of fuel may be amended to include other DOE SNF. The U.S. Nuclear Regulatory Commission has the responsibility for promulgating the technical requirements necessary to license all phases of repository operation. The development of the repository has been delegated to the DOE's Yucca Mountain Site Characterization Project Office. Framatome Cogema Fuels (formerly B&W Fuel Company), as part of the Civilian Radioactive Waste Management System Management & Operating Contractor, is responsible for designing both the waste package and the engineered barrier system.

The goal of the DOE's Yucca Mountain Site Characterization Project is to characterize the Yucca Mountain site and design a potential geologic repository for the safe disposal of SNF and solidified HLW. Yucca Mountain is about 160 km northwest of Las Vegas, Nevada and consists mainly of compacted layers of volcanic ash flows (tuff). The repository horizon lies in the densely welded Topopah Spring member.

Safe disposal of waste will rely on: the unsaturated nature of the Yucca Mountain site in which the flow of groundwater into the repository will be slow; a robust multi-barrier waste package that will remain intact for thousands of years; the slow mobilization of radionuclides from the waste forms; the retardation of radionuclides within the engineered barrier system; and the dispersion

and mixing of radionuclides in the groundwater system below the repository.

As part of the site characterization effort, the DOE is developing an Exploratory Studies Facility (ESF). The ESF provides underground laboratories to support site characterization. It includes a tunnel that will provide access for the repository if one is built at Yucca Mountain. Tunnel excavation with a tunnel boring machine began in August 1994 and is about half-way along the planned 7.9 km (4.9 mile) route. The tunnel has been mapped to study the geology. Several alcoves have been developed to study faulting and the effects of heat and water, and water-vapor transport in the rock.

WASTE RECEIPT AND EMPLACEMENT

HLW and SNF will be shipped to the repository in transportation casks, some of which are currently available. Others casks are being developed. The waste may or may not be canistered prior to shipment. For SNF, the canisters and casks will vary in size from small models that can hold one or two assemblies to large models accommodating 24 pressurized water reactor assemblies or 68 boiling water reactor assemblies. The loaded casks will be transported on special carriers via truck or rail. The repository will accommodate both modes of receipt. At the repository, the casks will be unloaded and the contents inserted in waste packages for emplacement in the underground facility. The waste packages are composed of inner and outer containers made of corrosion-resistant and corrosion-allowance materials, respectively. The current reference design for the inner container is a 20 mm-thick high-nickel alloy (Alloy 825). The outer container is a 100 mm-thick carbon steel (A 516). The HLW glass containers may use an alternate outer container made of a copper-nickel alloy.

After the waste packages are seal-welded and inspected, they will be transported underground. The underground facility is made up of a series of drifts. The spacing of the waste packages will be adjusted to keep within the thermal limits placed on the packages and the host rock.

WASTE ACCEPTANCE

The NWPA of 1982 limits the content of the first U.S. repository to 70 000 metric tons of heavy metal (MTHM) until a second repository is in operation. The DOE Mission Plan and Mission Plan Amendment (MPA) describe the implementation of the provisions of the NWPA for the waste management system. In the Draft 1988 MPA, the repository inventory was further broken down into about 63 000 MTHM of spent fuel and 7,000 MTHM of HLW glass. The current inventory of spent fuel located in storage at the reactor sites is about 30,000 MTHM and is expected to reach 40,000 MTHM by the year 2000. The HLW is currently anticipated to be borosilicate glass logs like those to be produced by Savannah River and West Valley. In response to a recent request from the Office of Environmental Management, OCRWM has agreed to revise its waste acceptance planning baseline to accommodate the potential substitution of DOE-owned spent fuel for some portion of the HLW glass, 7 000 MTHM defense-waste allocation. DOE-owned spent fuel proposed for geologic disposal includes types such as production reactor, research reactor, and U.S. navy.

The acceptance of waste into the WMS is constrained by technical baseline requirements such as those delineated in the Waste Acceptance System Requirements Document (WA-SRD), DOE/RW-0351P Revision 1, March 1994. The requirements for the DOE-owned SNF have been collected in the Preliminary Requirements for the Disposition

of DOE Spent Nuclear Fuel in a Deep Geologic Repository (December 1995). Future revisions to the waste acceptance requirements documentation will incorporate those requirements for the other waste forms. The WA-SRD currently picks up regulatory requirements from Title 10 of the Code of Federal Regulations. These include Part 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories, Part 71, Packaging and Transportation of Radioactive Material, and Part 961, Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste. Other Title 10 regulations, DOE Executive Orders and other requirements are also included, the latter drawn from upper-tier system requirements documents or derived as a result of practice or analysis.

Particular Part 60 requirements of interest to waste acceptance include 60.135 that defines specific design criteria for the waste package and its components. These criteria include constraints on the general performance of the package, its chemical reactivity, and provisions for its handling and labeling, as well as design criteria for the waste form.

Of relevance is the limitation of explosive, pyrophoric or chemically reactive materials that could compromise the ability of the waste packages to meet their containment and waste isolation requirements (identified in 60.112 and 60.113). In addition, 60.21(c)(1)(ii)(D) requires the comparative evaluation of alternative designs that would provide longer radionuclide containment and isolation. Another requirement of concern, defined in 60.131(b)(7), is the assurance that criticality control is maintained during the period of waste isolation in the repository.

For commercial light-water reactor fuels and borosilicate glass HLW, waste form contribution to repository performance has

been assessed through the use of computer models (total system performance assessment) and physical testing of spent fuel. To accommodate the acceptance and disposal of DOE-owned spent fuel, similar performance and compliance issues must be addressed through modeling and testing programs specifically oriented towards these materials.

To this end, the DOE Offices of Environmental Management and Civilian Radioactive Waste Management have established technical coordinating groups for both HLW and DOE-owned SNF which meet on a quarterly basis to monitor interface issues between these programs. The objectives of this coordination are to provide reasonable assurance that the disposal system will be able to accommodate the waste forms as designed and to craft resolution strategies for emerging technical issues.

SUMMARY

The process for the acceptance of waste into the waste management system is discussed, with detailed requirements identified from the Waste Acceptance System Requirements Document. Also described is the recently initiated issue resolution dialogue between OCRWM and the Office of Environmental Management, including the appropriate interpretation and application of regulatory and system requirements to DOE-owned spent nuclear fuel.

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