

CHAPTER 4

U.S. PROGRAMS FOR THE MANAGEMENT AND DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE AND THE EVALUATION OF YUCCA MOUNTAIN

4.1 INTRODUCTION

The Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Environmental Protection Agency (EPA) each have legislatively defined roles in management and disposal of spent nuclear fuel and high-level radioactive wastes (HLW) at the proposed Yucca Mountain disposal site. As stated in the Nuclear Waste Policy Act of 1982 (NWP83), DOE is responsible for developing, constructing, and operating repositories for disposal of these wastes. The NRC has responsibility to license the repository and related facilities, and the EPA is to promulgate radiation protection standards which the NRC is to adopt as basis for their licensing actions. The Nuclear Waste Policy Amendments Act of 1987 (NWP87) designated the Yucca Mountain site in Nevada as the only site to be evaluated by DOE as a potential location for disposal of spent fuel and HLW. The Energy Policy Act of 1992 (EnPA92) directed EPA to promulgate site-specific radiation protection standards for the Yucca Mountain site.

The legislative framework also prescribes roles for state governments, local governments, and Indian tribes in the waste management and disposal program, and establishes the Nuclear Waste Technical Review Board which provides oversight of the DOE program. This chapter presents an overview of the responsibilities and program activities of the DOE, NRC, and these groups. Responsibilities and activities of the EPA are described in Chapter 1 of this BID.

4.2 THE DEPARTMENT OF ENERGY

As noted above, DOE is responsible for the management and disposal of high-level radioactive waste, which includes spent nuclear fuel and other waste generated by nuclear reactors and reprocessing plants.¹⁴ Disposal of these wastes would occur at the Yucca Mountain site if it is found suitable and approved for this function. Other radioactive waste categories defined by

¹⁴ DOE typically separates spent nuclear fuel from other high-level waste by definition, although NRC includes spent fuel as part of its high-level radioactive waste category.

DOE are transuranic (TRU) and low-level waste (LLW). TRU, consisting of material with atomic numbers greater than 92, is generated as a result of defense production operations. DOE began disposal of TRU wastes at the Waste Isolation Pilot Plant (WIPP), in New Mexico, in 1999. LLW is buried at DOE sites where it is generated or, if commercially generated, at sites operated by private firms in several locations.

Fulfillment of its responsibility for radioactive waste management and disposal involves four principal program activities in DOE: (1) receipt, transport, interim storage, and disposal of spent nuclear fuel from commercial nuclear power operations, (2) management and disposal of DOE spent nuclear fuel, which originates from DOE production and research operations and from naval propulsion reactors, (3) solidification and disposal of high-level waste generated by reprocessing operations for spent nuclear fuel from DOE's production reactors at Hanford and Savannah River, (4) storage and disposition of fissile materials from dismantled nuclear weapons, and (5) disposal of high-level waste from a former commercial waste processing facilities at West Valley, NY now managed by DOE. Materials generated by the dismantling of weapons may be treated and disposed of like high-level radioactive waste or they may be used as reactor fuel. In either case, such materials will eventually become part of the disposal inventory.

In addition to commercial and DOE spent nuclear fuel, and high-level waste from DOE and commercial processing operations, other radioactive wastes that have been considered for disposal in a repository at Yucca Mountain include fissile materials from dismantled nuclear weapons, and low-level radioactive wastes known as Greater-Than-Class-C (GTCC). The radioactivity levels of wastes in this latter category exceed the NRC's limits for Class C wastes as established in the 10 CFR Part 61 regulations. Decisions concerning disposition of these radioactive materials have not been made. The NWPA limits the contents of a repository at Yucca Mountain to "...70,000 metric tons of heavy metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent nuclear fuel until such time as a second repository is in operation" (NWPA, Section 114(d)). As detailed in Chapter 7 of this BID, DOE currently plans that a repository at Yucca Mountain would contain approximately 63,000 metric tons of spent commercial reactor fuel. Defense high-level wastes, DOE spent nuclear fuel, and Navy spent fuel would contribute the equivalent of 7,000 metric tons of heavy metal.

4.2.1 DOE'S Office of Civilian Radioactive Waste Management (OCRWM)

The DOE's Office of Civilian Radioactive Waste Management (OCRWM) was established by Congress specifically to provide management and disposal of spent nuclear fuel from commercial nuclear power reactors. Under a 1985 Presidential Executive Order, the repository established by OCRWM is also to be used for disposal of high-level waste from DOE operations. The OCRWM charter includes responsibility for receipt of spent nuclear fuel from commercial reactors at the reactor sites and from storage at DOE sites, interim storage of spent nuclear fuel as necessary prior to disposal, transport of spent nuclear fuel to the site for interim storage and disposal. The Navy program, which manages a small portion of DOE spent nuclear fuel, will transport their own spent fuel to the repository. DOE has developed alternative designs for a central interim storage facility (known historically as a Monitored Retrievable Storage (MRS) facility), but, as of March 2000, the Department has not established a site for such a facility.

Since passage of the Nuclear Waste Policy Amendments Act in 1987, OCRWM activities have been focused on evaluating Yucca Mountain as the disposal site for spent nuclear fuel and high-level waste. In accordance with the Site Characterization Plan (DOE88a), characterization of the Yucca Mountain site is proceeding with surface-based and sub-surface activities. Recently, DOE has focused on the "Viability Assessment" (VA), which is intended to allow a greatly improved appraisal of the prospects for geologic disposal at the Yucca Mountain site. The VA consists of:

- A reference engineered design for the repository and the waste package
- A total system performance assessment describing the probable behavior of the repository based on available data and the reference engineered design
- A plan and cost estimate for completing a License Application (LA)
- Cost estimates for constructing and operating the repository

The VA was published in December 1998. It was the basis for continued evolution of the engineered design for the repository and for future data acquisition activities. DOE has issued a Draft Environmental Impact Statement (EIS) and is in the public comment phase to issue a final EIS. The Total System Performance Assessment for Site Recommendation (TSPA-SR) was published in late 2000. The Site Recommendation is planned to be submitted to the President in 2001 if the site is found suitable, and the License Application (LA) is planned to be submitted to

the NRC in about 2002 (depending resources) if the site is approved for disposal. To date, principal program accomplishments include:

- Completion of excavation of the north-south Exploratory Studies Facility (ESF) tunnel at Yucca Mountain and the Enhanced Characterization Repository Block Cross-Drift; both excavations have been mapped and will be used as sources of in-situ data at the repository horizon
- Initiation of various types of testing in alcoves and niches in the ESF and the Cross-Drift
- Development of a market-driven plan for to storage and transportation of commercial spent nuclear fuel
- Completion of the TSPA-SR, which included an analysis of enhanced design alternatives aimed at resolving some of the issues identified in the VA.
- Publication of the Draft Environmental Impact Statement

The OCRWM program has produced thousands of technical documents concerning its mission and activities. Future technical documents are expected to support the Environmental Impact Statement, the Site Recommendation, and the License Application if the site is approved for disposal.

4.2.2 DOE Management and Disposal of Defense Wastes

The DOE's defense programs have produced significant amounts of high-level waste that may eventually be disposed of in a repository at Yucca Mountain (see Chapter 5). Other wastes produced by these defense programs (e.g., TRU waste) will be managed and disposed of separately.

During the last 40 years, DOE and its predecessor agencies generated, transported, received, stored, and reprocessed spent nuclear fuel at facilities throughout its nationwide complex. Spent nuclear fuel was generated by nuclear weapons production reactors; U.S. Navy nuclear propulsion program power reactors; government, university, and test reactors; special-case commercial reactors; and research reactors. The DOE operated production reactors at the Hanford and Savannah River Sites to provide special nuclear materials and other isotopes. These

production reactors are no longer operating. However, the Naval Nuclear Propulsion Program and some test and research reactors are still in operation.

The DOE has reprocessed more than 100,000 metric tons of heavy metal (MTHM) of spent nuclear fuel at the Idaho National Engineering and Environmental Laboratory (INEEL), the Hanford Site, and the Savannah River Site to recover fissile material (uranium-235 and plutonium-239) and other nuclides needed for national defense or research and development programs. These reprocessing operations generated large quantities of high-level radioactive waste. This waste exists as liquid, sludge, solids, and calcine and is stored primarily at its reprocessing sites.

In April 1992, the DOE began to phase out defense spent nuclear fuel reprocessing. As a result, approximately 2,500 MTHM of unprocessed spent nuclear fuel exist today in the DOE inventory. This spent nuclear fuel is in a wide range of enrichments and physical conditions and is stored at several locations throughout the United States. The majority of this spent fuel and high-level waste is stored at three major sites in Idaho, South Carolina, and Washington. In addition to this inventory, the DOE estimates that over the next 40 years it will generate another 100 MTHM from defueling DOE and naval reactors.

4.3 THE NUCLEAR REGULATORY COMMISSION

The NRC is responsible for licensing and regulating the receipt and possession of high-level waste, including spent fuel, at privately owned facilities and at certain facilities managed by DOE. This responsibility will extend to a repository at Yucca Mountain. The NRC currently licenses temporary storage facilities at reactor sites, as well as commercial spent nuclear fuel storage facilities at West Valley, New York, and Morris, Illinois.

4.3.1 Legislative Requirements and Regulatory Framework

The NWPA specifies that licensing of a geologic repository will occur in three phases. In the first phase, which follows site characterization and approval of the site for disposal, DOE will submit a License Application (LA) for the repository to NRC. After the LA is submitted, NRC will have three years to perform its review, conduct a public hearing, and reach a construction authorization decision by an independent licensing board. To comply with this schedule, NRC is already reviewing DOE's site characterization, repository design, and performance assessment

activities to identify and resolve potential licensing issues. However, during the licensing proceeding itself, all issues, including those previously resolved, can potentially be re-opened by the licensing board.

In the second phase, as construction of the repository nears completion, DOE will request a license to receive high-level waste and spent nuclear fuel. Only after that license is granted will DOE begin placing waste into the repository. In the third phase, when all waste is in place, DOE will apply for a license amendment to decommission and permanently close the disposal facility.

The NWPA directed both EPA and NRC to publish standards and criteria for the storage and disposal of high-level waste. In response to the NWPA, NRC developed a generic regulation for geologic disposal at 10 CFR Part 60. Although the regulation has been amended several times, the technical criteria date to 1983. As previously noted, the Energy Policy Act of 1992 directed EPA to develop new individual dose standards for the Yucca Mountain site and for NRC to conform its standards to the new EPA standards. In light of the requirements of the EnPA, NRC has elected to develop additional regulations specific to Yucca Mountain. To that end the Commission has proposed a new rule at 10 CFR Part 63 entitled “Disposal of High-Level Radioactive Waste in a Proposed Geologic Repository at Yucca Mountain Nevada”. Additional discussion of the proposed rule is included in Chapter 2 of this BID.

The proposed NRC 10 CFR Part 63 regulation does not contain prescriptive criteria, but does require DOE to demonstrate defense in depth. Under its own 10 CFR Part 960 regulations, if DOE identifies potentially adverse conditions, the Department must demonstrate that the conditions can be compensated for by the repository design or favorable site conditions. DOE has proposed revision of the 10 CFR Part 960 siting guidelines to 10 CFR Part 963, which would base site-suitability evaluation on total system performance assessment.

4.3.2 Status of NRC’s Program

The NRC’s Prelicensing High-Level Waste Repository Program is currently part of the NRC’s Office of Nuclear Material Safety and Safeguards (ONMSS). This program was refocused in FY 1996 based on three events: (1) a reduction in congressional funding, (2) a reorganization of DOE’s high-level waste program, and (3) the publication of the National Academy of Sciences’ report, Technical Bases for Yucca Mountain Standards (NRC97).

The NRC program is now focused on the following ten issues which the Commission believes are most important to repository performance:

- Igneous activity
- Structural deformation and seismicity
- Evolution of the near-field environment
- Container life and source term
- Thermal effects on flow
- Repository design and thermal-mechanical effects
- Total system performance assessment and integration
- Activities related to the development of the NRC high-level waste regulations
- Unsaturated and saturated flow under isothermal conditions
- Radionuclide transport

The status of resolution of these Key Technical Issues (KTIs) will be periodically re-evaluated based on new information, performance assessments, and technical interactions with DOE.

4.4 NUCLEAR WASTE TECHNICAL REVIEW BOARD

The NWPAA established the Nuclear Waste Technical Review Board comprising 11 members recommended by the National Academy of Sciences and appointed by the President. These individuals are experts in the fields of science, engineering, or environmental sciences and represent a broad range of scientific and engineering disciplines, including hydrology, underground construction, hydrogeology, and physical metallurgy. No member of the Board may be employed by DOE, its contractors, or the National Laboratories. The current Board is composed of individuals with academic and public and private sector experience.

As defined in Section 503 of the NWPAA,

The Board shall evaluate the technical and scientific validity of activities undertaken by the Secretary [of Energy]..., including-

(1) site characterization activities, and

(2) activities related to the packaging or transportation of high-level radioactive waste or spent nuclear fuel.

The NWTRB meets four times a year in open public meetings. Two of these meetings are held in Nevada. In addition, the Board reports to Congress and to the Secretary of Energy at least twice a year on scientific issues associated with the high-level waste and spent fuel disposal program. The Board also publishes a periodic newsletter and other information about its views and activities. Information concerning the Board's membership, activities, and links to NRC and DOE activities can be found at the Board's website, www.nwtrb.gov.

4.5 STATE AND LOCAL AGENCIES

Congress provided for active State participation in both the NWPA and the NWPAA. The NWPAA provides for financial assistance to the State of Nevada and any affected unit of local government to allow for participation in activities related to the establishment of a repository at Yucca Mountain. Specific activities include:

- Reviewing all work done at the Yucca Mountain site to determine any potential economic, social, public health and safety, and environmental impacts of a repository on a State or local government and its residents
- Developing an impact assistance request
- Monitoring, testing, or evaluating site characterization programs
- Providing information to State residents
- Requesting information from and making comments or recommendations to the Secretary of Energy

The State of Nevada and any affected unit of local government may also request assistance to mitigate any economic, social, public health and safety, and environmental impacts that are likely to result from site characterization activities at Yucca Mountain. The NWPAA specifies that this financial assistance shall continue until "such time as all such activities, development, and operation are terminated at such site."

The Nevada legislature created the State's Nuclear Projects/Nuclear Waste Project Office (NWPO) in 1985 to oversee Federal high-level nuclear waste activities in the State. Since then, the NWPO has dealt primarily with the technical and institutional issues associated with DOE's efforts to characterize the Yucca Mountain site.

Yucca Mountain lies in Nye County, Nevada. This county and nine others that are contiguous have been designated “affected” and are therefore eligible to receive financial assistance under the NWPAA. Nye County sponsors a year-round on-site representative. The nine other counties include: Churchill County, Clark County, Esmeralda County, Eureka County, Lander County, Lincoln County, Mineral County, and White Pine County, all in Nevada; and Inyo County, California.

4.6 NATIVE AMERICAN TRIBES

Native American tribes have a unique sovereign status in U.S. law which was recognized by the NWPA and the NWPAA. This government-to-government relationship between the Federal Government and the tribes obligates the Federal Government to interact directly and specifically with tribes in areas where repository or MRS siting activities will occur. The NWPA, as amended, under Section 2(2), defines an affected tribe as any tribe:

- *(A) within whose reservation boundaries monitored retrievable storage facility, test and evaluation facility, or a repository for high-level waste or spent nuclear fuel is proposed to be located; or (B) whose federally defined possessory or usage rights to other lands outside of the reservation's boundaries arising out of congressionally ratified treaties may be substantially and adversely affected by the locating of such a facility. Provided, That the Secretary of the Interior finds, upon the petition of the appropriate governmental officials of the tribe, that such effects are both substantial and adverse to the tribe... (NWP83)*

As noted above, specific provisions of the NWPA, as amended, that delineate the participation activities and rights of affected States in repository and MRS siting decisions also apply to affected tribes. The means for an affected tribe to disapprove of the site selection and designation process is given in Section 118(a). An affected tribe is also eligible to receive the same grants, financial and technical assistance, and payments equal to taxes for which a State is eligible under Section 116(c). Since the passage of the NWPAA, no tribes have been designated as affected tribes. However, to ensure compliance with the American Indian Religious Freedom Act (AIRFA), the National Historic Preservation Act (NHPA) and related statutes, the Native American Graves Protection and Repatriation Act (NAG90) and the National Environmental Policy Act (NEPA), the DOE is cooperating with Indian tribes that have current or traditional religious or cultural ties to the Yucca Mountain site or that may be located near the transportation routes to or around the site (DOE88b).

In 1985 and in keeping with the NHPA, the Advisory Council on Historic Preservation (ACHP) issued guidelines for discussing which tribes should be involved in the Yucca Mountain cultural resource study (STO90). The guidelines contributed to the Yucca Mountain Project's Programmatic Agreement (PPA), which was jointly produced by DOE and the ACHP. The PPA requires that DOE consult with tribal groups having traditional cultural ties to the Yucca Mountain area prior to land-disturbing activities to assure that cultural or religious values are preserved to the extent practicable. The PPA further stipulates that when such activities are thought to have a negative effect that cannot be avoided, the DOE will consult further with the tribal groups and others to identify ways to mitigate those effects.

DOE has established the Yucca Mountain Site Characterization Project, which led to the Cultural Resources Program to meet resource preservation requirements set forth in the PPA. The preliminary site characterization (DOE87) identified the ethnic and tribal affiliations of the tribal groups most likely to have traditional ties to cultural resources located in the Yucca Mountain region. These groups consist of Southern Paiute, Western Shoshone, and Owens Valley Paiute/Shoshone people from Nevada, Utah, Arizona and California. Extensive ethnographic research led to the identification of 15 tribes and one Native American organization. In the mid-1990s, an additional tribe was included. The following 17 tribal entities are commonly involved in the Yucca Mountain Cultural Resources Program:

1. Benton Paiute Indian Tribe, California
2. Timbisha Shoshone Tribe, California
3. Bishop Paiute Indian Tribe, California
4. Big Pine Indian Tribe, California
5. Fort Independence Indian Tribe, California
6. Lone Pine Indian Tribe, California
7. Yomba Shoshone Tribe, Nevada
8. Duckwater Shoshone Tribe, Nevada
9. Pahrump Paiute Indian Tribe, Nevada
10. Las Vegas Paiute Indian Tribe, Nevada
11. Las Vegas Indian Center, Nevada
12. Chemehuevi Tribe, California
13. Colorado River Indian Tribes, Arizona
14. Moapa Paiute Tribe, Nevada
15. Paiute Indian Tribes of Utah
16. Kaibab Paiute Tribe, Arizona
17. Ely Shoshone Tribe, Nevada

All groups requested that they be included in the project. The DOE informs tribes of the status of the project through a cooperative agreement with the National Congress of American Indians. Through this group, DOE and the tribal governments have established a consulting relationship through which the concerns of the tribal peoples can be expressed.

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