UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD
2300 Clarendon Boulevard, Suite 1300
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October 10, 2014

Mr. Mark Whitney
Acting Assistant Secretary for Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Mr. Whitney:

The U.S. Nuclear Waste Technical Review Board held a public meeting in Idaho Falls, Idaho, on August 6, 2014. The principal focus of the meeting was the management and ultimate disposition of the spent nuclear fuel (SNF) and high-level radioactive wastes (HLW) that are the responsibility of the U.S. Department of Energy (DOE) Office of Environmental Management (DOE-EM) and Office of Nuclear Energy (DOE-NE). The Board also toured a number of Idaho National Laboratory facilities on August 5, 2014.

The Board thanks the DOE employees who prepared material for the eleven DOE-EM presentations at the public meeting and the representatives of the DOE Idaho Operations Office and its contractors who led an excellent tour of the facilities. The Board especially appreciates the considerable effort made by Barbara Beller in organizing and leading portions of the tour and for her four presentations at the meeting. The Board notes that the DOE-EM presentations were responsive to the questions the Board had provided to DOE in advance of the meeting. The Board notes and appreciates that some of the presenters provided additional information to the Board questions after the meeting.

As the Board nears completion of its report on management and disposal of DOE SNF, the information gathered at the meeting and the facilities tour will be of great value. The Board's report will review DOE SNF and SNF storage facilities at Hanford, Idaho National Laboratory, Savannah River Site, and Fort St. Vrain, and will identify technical issues that the Board believes that DOE needs to address as DOE continues to store SNF and plan for the disposal of DOE SNF.

The purpose of this letter is to provide observations and recommendations based on the Board's analysis of material presented at the meeting. These observations and recommendations are organized into two sections: (1) issues that cut across DOE-EM and DOE-NE responsibilities and (2) issues that the Board identified from presentations made by the DOE Office of Environmental Management.

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Cross-cutting Issues

The Board recognizes that DOE-EM and DOE-NE have different responsibilities; however, both offices manage SNF and HLW that will need to be disposed of in a geologic repository. Consequently, the issues of integration, transportation, and knowledge management and retention apply to both DOE-EM and DOE-NE and affect the ability of DOE to dispose of DOE SNF and HLW.

Integration

The closure of the Office of Civilian Radioactive Waste Management (OCRWM) and the subsequent suspension of most of the activities of the National Spent Nuclear Fuel Program have led to a lack of integration of activities related to SNF and HLW management. OCRWM had many responsibilities and functions (for example, transportation and disposal studies) that served to integrate both the defense and commercial SNF and HLW programs. However, it appears that some of OCRWM's responsibilities have not been explicitly reassigned within the management structure of DOE. For example, no DOE organization is explicitly responsible for research and development related to long-term disposition of DOE SNF and HLW. As compared with commercial SNF, DOE SNF is more damaged, includes many more types of fuel and cladding, and contains highly enriched uranium, all of which are important considerations when designing and implementing an integrated SNF management and disposal program. Also, DOE will need to dispose of three other solid HLW forms in addition to the vitrified HLW that has been created from commercially generated SNF and is being produced at the Defense Waste Processing Facility at the Savannah River Site. As an example, the calcined HLW at Idaho National Laboratory will be processed for geologic disposal. *The Board recommends that DOE review OCWRM's past responsibilities and functions and explicitly assign the responsibilities, that have not been already been reassigned, to specific DOE organizations to facilitate the management and disposal of DOE SNF and HLW.*

The National Spent Nuclear Fuel Program previously enabled interactions among the technical staff responsible for managing SNF at the DOE sites. The program also addressed SNF management issues that cut across the whole DOE complex. For example, until 2011 the National Spent Nuclear Fuel Program maintained the Spent Fuel Database that served as the single source of data for DOE SNF. *The Board recommends that DOE revitalize the National Spent Nuclear Fuel Program to integrate approaches at the staff-level, in order to address issues affecting the DOE SNF program, and update and maintain the Spent Fuel Database.*

Mr. Gary DeLeon, Director of the Office of Nuclear Materials Disposition (DOE-EM), provided an overview of the current and future inventory of SNF stored or planned to be stored by DOE at the Idaho National Laboratory and at other DOE sites. He noted that in order to address the challenges of managing the wide range of DOE fuel types and facilities, DOE-EM will charter a new Spent Nuclear Fuel Corporate Board. This organization will include representatives from DOE-EM, DOE-NE, DOE's Office of Science, and the National Nuclear Security Administration. Mr. DeLeon noted that one purpose of the SNF Corporate Board will be to better utilize the resources and technical capabilities for SNF management across the DOE. The Board notes that a "Corporate Board" usually establishes policy and makes budget decisions

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in order to implement policy. Both Mr. DeLeon's description of the SNF Corporate Board and the charters of other DOE Corporate Boards (for example, the High-Level Waste Corporate Board and the Tank Waste Corporate Board) suggest that the responsibility of the DOE Spent Nuclear Fuel Corporate Board will focus on coordination and cooperation on SNF management and disposition activities, and will only make recommendations to the Assistant Secretary for Environmental Management. The Board looks forward to learning more about the Corporate Board, its functions and authorities, its members, the issues it will address, and what role the Corporate Board will play in addressing the integration of SNF and HLW management and disposal activities across the DOE.

Transportation

A number of DOE-EM presentations addressed transportation of DOE SNF and HLW to a geologic repository. However, the issue of SNF and HLW transportation is a good example of how the closure of OCRWM has led to a loss of the crucial linkage between the different waste types and transportation strategies. Prior to its closure, OCRWM was responsible for designing, obtaining U.S. Nuclear Regulatory Commission (NRC) certification for, and fabrication of the transportation cask system for DOE-EM SNF and HLW. OCRWM was also responsible for the transport of DOE-EM and commercial SNF and DOE-EM and commercial vitrified HLW to a repository. Now there appears to be no clear, central coordination of transportation issues related to commercial and DOE SNF and HLW, and several presenters noted that no organization is currently charged with the responsibility of transporting DOE SNF and HLW. *The Board recommends that DOE explicitly assign responsibility for the coordination of all transportation activities for SNF and HLW.*

Knowledge Management and Retention

In an August 2013 Board report, *Review of U.S. Department of Energy Activities to Preserve Records Created by the Yucca Mountain Project*, the Board provided observations and recommendations on one part of DOE's knowledge management activities. As part of its review, the Board conducted spot checks to assess the preservation and retrievability of OCRWM's records of the Yucca Mountain Project. The report focused on records created by OCRWM in support of the Yucca Mountain project, but did not explicitly address records created by the DOE field offices responsible for the management of SNF and HLW. Under the Yucca Mountain program, these field offices would have eventually supplied the SNF and HLW *and records associated with the wastes* (for example, information on the radionuclide contents and details on packaging) to OCRWM. However, several of the DOE-EM presentations at the meeting required retrieval of information on past DOE operations and, according to the DOE-EM presenters, this proved to be difficult. *The Board recommends that DOE assess the level of record preservation and retrieval capability of DOE field office site organizations and ensure that all records related to the past management of SNF and HLW are preserved and retrievable, in order to support future waste management activities.*

Based on presentations at the meeting, it appears likely that portions of DOE's knowledge base related to past SNF handling operations and other management activities have been lost in recent years. For example, in trying to respond to a Board question on the dry cask

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storage characterization program conducted at Idaho National Laboratory during the late 1990s, no DOE employee or DOE contractor present was able to provide the details of the program. However, a member of the audience, who is no longer affiliated with DOE or its contractors, provided details on the dry cask storage characterization program during a public comment session at the meeting. Many of the key personnel who were involved in the Yucca Mountain Project and in the National Spent Nuclear Fuel Program have retired or left DOE, and very few are still available to pass on their knowledge and experience to others. This knowledge will be invaluable when determining requirements for SNF and HLW packaging, transportation, and disposal. As time passes and experienced personnel retire, there is a high likelihood that this very valuable and necessary information will be lost. *The Board recommends that DOE take early action to capture this critical knowledge so that it can be used to support later DOE efforts related to handling of the wastes, certification of transportation and storage packages, and interim storage and final disposal.*

DOE Office of Environmental Management

DOE Standard Canister and Multi-Canister Overpack

Mr. Brett Carlsen (Idaho National Laboratory) gave very informative presentations on the DOE SNF standard canister and on an analysis of the probability for mechanical failure from dropping the multi-canister overpacks used for SNF storage at the Hanford site. Mr. Carlsen provided a detailed history of DOE's efforts to develop a standard canister and clearly laid out the steps remaining and outstanding issues that would need to be resolved in order to complete the development of a standard canister. Specifically, he noted: (1) the challenges in designing a standard canister that could accommodate the large number of DOE SNF types; (2) the inconsistency between the assumption used for assessing criticality safety taken by DOE and the one specified by NRC regulations for SNF transportation; (3) the need to complete the development of remote canister welding technology; and (4) the need to complete the development of advanced neutron absorbers for criticality control in the geologic repository after permanent closure.

Mr. Roger McCormack of Hanford's contractor, CH2M Hill Plateau Remediation Company, described the multi-canister overpack, the process used to load the overpacks with SNF, and the scoping analyses conducted to determine potential viability for offsite shipments of the multi-canister overpacks. Mr. McCormack identified issues that would need to be resolved in order to ensure that the multi-canister overpacks could be transported offsite. Specifically, he noted: (1) the need to complete criticality analyses for multi-canister overpacks loaded with scrap baskets; (2) the need to ensure the availability of a specific commercial, NRC-certified, transportation cask in which to transport the multi-canister overpack; (3) the need to finalize the design, including a determination of the number of multi-canister overpacks within the cask and the need for impact limiters within the cask; and (4) the need to amend the certification of the commercial transportation cask to allow for transport of the multi-canister overpacks.

The Board recommends that DOE resume efforts on the DOE standard canister and multi-canister overpacks. These efforts should:

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- *Resolve criticality issues related to the transportation and disposal of the DOE standard canister. These efforts should include the submission of a topical report to NRC in order to confirm that the standard canister would be acceptable to the NRC staff as part of a transportation package based on the canister's ability to prevent intrusion of water under hypothetical transportation accident conditions.*
- *To the extent that DOE continues its generic disposal research, it should assess the viability of, and implications for, disposal of the DOE standard canister and multi-canister overpacks in different geologic settings with their associated disposal concepts (e.g., copper outer layer for a waste package in a reducing environment).*
- *Identify those issues that could impact future shipment of the multi-canister overpacks from Hanford to a geologic repository.*

Future Packaging Facility

Ms. Barbara Beller, DOE Idaho Operations Office, gave four informative presentations on the management and storage of DOE-EM-owned SNF at the Idaho National Laboratory, fuel drying experience at the Idaho National Laboratory, programs for managing aging of SNF and related facilities, and examination and transportation of damaged fuel. Many of DOE's activities related to SNF at the Idaho National Laboratory are driven by the commitments and milestones documented in the 1995 Settlement Agreement between DOE, the U.S. Navy, and the State of Idaho. It requires DOE to remove all SNF from wet storage by December 31, 2023, and from the State of Idaho by January 1, 2035, with some exceptions for SNF being maintained for purposes of testing. A 2008 addendum to the 1995 Settlement Agreement, related only to the receipt and storage of naval SNF at Idaho National Laboratory, provided additional exceptions to the 2023 and 2035 SNF deadlines. The 1995 Settlement Agreement also requires HLW that existed at the time of the agreement to be treated so that it is ready to be transported out of Idaho for disposal by 2035. Ms. Beller described DOE's approach for a future facility that would have the capability to prepare SNF for transfer from Idaho by the January 1, 2035, deadline.

Because the requirements and schedules for a consolidated interim storage facility or geologic repository for SNF are not known, it was noted by DOE personnel that plans and designs for a facility to package DOE SNF for offsite transportation, storage, and disposal cannot be finalized. Previously, DOE had considered the Idaho Spent Fuel Facility, which is licensed by the NRC but has not been constructed, as the potential packaging facility. That facility would have relied on the waste acceptance system requirements for Yucca Mountain, which included the DOE standard canister as the basis for the packaging of DOE SNF. *Regarding the plans for the management of SNF at Idaho, the Board recommends that DOE review and update the scope of the proposed packaging facility, taking into account the possibility that some SNF could be stored at the site beyond 2035, and examine how this extended period of storage could impact the capabilities needed and the timing for packaging the SNF.*

Management of Aging Facilities and SNF

Roger McCormack continued the discussion of the management of aging facilities and described the SNF management programs being undertaken at Hanford. Mr. McCormack also

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presented an overview of the SNF inventory at Hanford, including the large quantity of defense-related SNF stored in multi-canister overpacks. The Board noted significant differences in the number and scope of activities for managing aging SNF and SNF facilities at the Idaho National Laboratory and the Hanford site. For example, within the last 15 years, almost all SNF at Hanford was cleaned, dried, sealed in new multi-canister overpacks containing inert gas, and stored in a new facility. DOE monitors the gas chemistry of some of the stored multi-canister overpacks to assess degradation of the stored SNF. In contrast, most of the SNF storage facilities at Idaho National Laboratory are more than 30 years old. Some of the SNF in dry storage at the Idaho National Laboratory is not stored in an inert environment, and degradation of that SNF is not monitored. The programs for managing aging of SNF and the SNF storage facilities, at a single site and DOE-wide, do not appear to be well-coordinated or well-supported by a research and development program. As an example, the DOE research and development activities for managing aging of SNF and the SNF storage facilities at Idaho National Laboratory are focused on addressing issues associated with one DOE SNF storage facility: the NRC-licensed Three Mile Island Unit 2 Independent Spent Fuel Storage Installation. In addition, the timeline for some aging management programs appears to be linked to the duration of the current operations contract rather than the expected period of operation of the facilities. Ms. Beller stated that the Idaho National Laboratory maintains a Risk Management Plan to address challenges related to the management of Idaho's SNF. However, she noted that there are limited resources available to implement the plan.

The NRC generic aging lessons learned report for reactors [NRC 2010, Generic Aging Lessons Learned (GALL) Report — Final Report (NUREG-1801, Revision 2)] and presentations on potential generic aging management programs for dry storage systems (NRC 2014, July 14-15, 2014 meeting) provide insights for aging management programs for both wet and dry SNF storage facilities by identifying the materials subject to aging, methods for assessing the extent of aging of the different materials, and potential aging management programs (for example, for fuel performance and cask internals, concrete performance, and stress corrosion cracking). *The Board recommends that DOE develop a comprehensive system-wide strategy for managing aging SNF and SNF storage facilities and individual aging management plans for all types of SNF and SNF facilities that is based on their expected period of storage and takes advantage of the experience of the NRC's aging management programs.*

Technical Basis for Drying SNF

Both Ms. Beller and Mr. McCormack discussed experiences in drying SNF for storage at Idaho National Laboratory and Hanford. Idaho National Laboratory developed its drying process for Three Mile Island Unit 2 SNF that would be stored in unsealed storage units using extensive mock-up testing of the drying unit. Hanford relied more heavily on modelled results for the determination of the drying requirements for SNF stored in sealed multi-canister overpacks; however, at Hanford they did not focus on collecting data to understand the degradation processes that can affect stored SNF that is incompletely dried. The NRC recognizes, given that longer periods of dry storage of SNF prior to disposal will occur, that an enhanced understanding of drying of SNF storage containers is needed. For example, the NRC-funded Vacuum Drying Test Plan (Miller et al. 2013) describes experimental parameters related to vacuum drying procedures, fuel assembly and canister design features, and fuel assembly heat

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load that could be evaluated to better understand the drying process and assess how much residual water remains in a "dry" storage container. These data will be important in developing the future requirements for drying SNF for storage, transportation, and disposal. *The Board recommends that DOE collect additional empirical data in order to develop an understanding of the important processes that can occur during drying and afterwards in a sealed container with SNF that may not have been effectively dried.*

Calcined HLW Waste

Mr. Mark Shaw, DOE Idaho Operations Office, gave a presentation on the Calcine Disposition Project, including the background and path forward for calcined HLW stored at the Idaho National Laboratory. DOE created the calcined waste by converting liquid HLW from the reprocessing of SNF into a granular solid using a thermal process. DOE's preferred method for the treatment of the calcined waste is a hot isostatic pressing process. Mr. Shaw noted that some uncertainties still remain about the hot isostatic pressing facility's design and that hot isostatic pressed waste is not the U.S. Environmental Protection Agency (EPA) "Best Demonstrated Available Technology" for radioactive waste generated during the reprocessing of SNF. The EPA's "Best Demonstrated Available Technology" standard for this waste is vitrification and use of a "Best Demonstrated Available Technology" is a requirement contained in EPA's Land Disposal Restrictions. The Board understands that DOE will need to submit a petition to the EPA requesting that the hot isostatic pressing process be accepted as a "Best Demonstrated Available Technology". The Board remains interested in the disposition of calcined HLW waste and will follow future developments in this area.

The Board commends DOE-EM for providing the Board with the requested information, and the Board looks forward to hearing, at its next meeting, about DOE-EM SNF and HLW management activities at the Savannah River Site. The Board will continue its ongoing technical and scientific review of DOE efforts to manage and ultimately dispose of its SNF and HLW.

Sincerely,

Rodney C. Ewing
Chairman

cc: Dr. Peter Lyons
Mr. Richard Provencher

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