



UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD
2300 Clarendon Boulevard, Suite 1300
Arlington, VA 22201

January 22, 2015

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 Augusta, Georgia, on October 29, 2014, that focused on the management and plans for disposal of the spent nuclear fuel (SNF) and high-level radioactive wastes (HLW) at the U.S. Department of Energy's (DOE) Savannah River Site (SRS). These materials are the responsibility of the DOE Office of Environmental Management (DOE-EM). The Board also toured a number of facilities at SRS on October 28, 2014.

The Board thanks DOE for the participation of the many representatives of DOE Headquarters and of the DOE Savannah River Operations Office and its contractors who gave the Board an excellent tour of SRS and those who made presentations at the Board's public meeting. In advance of the meeting, the Board provided DOE with questions on several topics, indicating the Board's key areas of interest. The questions are recorded in the meeting agenda, which is posted, together with the presentation materials from the meeting, on the Board's website: www.nwtrb.gov. At the public meeting, there were 13 presentations covering the full range of topics requested, and the Board commends the presenters for explicitly addressing each of the Board's questions. The DOE and contractor representatives also provided excellent descriptions of the facilities and activities during the site tour and gave thorough answers to the additional questions asked by Board members and staff both on the site tour and during the meeting.

The information presented at the public meeting and discussed during the site tour will be particularly useful to the Board as it continues to "...evaluate the technical and scientific validity of activities undertaken by the Secretary [of Energy] ... including ... activities relating to the packaging or transportation of high-level radioactive waste or spent nuclear fuel" in accordance with its mandate as established in the Nuclear Waste Policy Amendments Act of 1987. The Board will also consider the information provided at the meeting in finalizing the report it is preparing on the management and disposal of DOE SNF.

The Board was impressed with the way DOE and its contractors at SRS have been successful in integrating operations at the facilities on site, including the handling, storage, and

processing of SNF; removal and vitrification of HLW from underground tanks; and storage of the vitrified HLW in preparation for offsite disposal in a geologic repository. One example of this integration is that contractor personnel who are involved in the processing of SNF in H-Canyon provide detailed projections, in advance, of the volumes of radioactive waste to be sent to the HLW tanks for storage and subsequent processing. This allows the contractor personnel involved in HLW management to better coordinate the receipt of waste from H-Canyon with other HLW facility operations. Also, on several occasions, both during the site visit and the public meeting, DOE and contractor staff demonstrated a high level of awareness of how the operations they manage must be coordinated with operations at other facilities on site and with the overall site mission.

DOE Headquarters

DOE Corporate Boards

Mr. Jay Rhoderick, DOE-EM Associate Deputy Assistant Secretary for Tank Waste and Nuclear Material Management, gave a presentation on DOE-EM activities related to managing SNF and HLW at SRS, including an update on the establishment of the DOE SNF Corporate Board and the re-establishment of the Tank Waste Corporate Board. From his presentation, the Board understands that the term “Corporate Board” refers to an internal DOE group that has limited authority and is advisory in nature, and, is thus, different from a Board of Directors in the commercial sector, which has more extensive management and financial responsibilities.

Mr. Rhoderick described the role of DOE’s Corporate Boards as providing the opportunity for sharing information and transferring lessons learned among DOE’s Program Offices (e.g., DOE-EM and the Office of Nuclear Energy (DOE-NE)) and the DOE site offices. He indicated that the SNF Corporate Board will be co-chaired by representatives from DOE-EM and DOE-NE and will include representatives from the DOE Office of Science, the Naval Reactors program, the Global Threat Reduction Initiative program, and the DOE offices at the sites that manage SNF.

Integration of Programs to Manage and Dispose of HLW and SNF

Several of the presenters at the meeting addressed questions from the Board regarding the integration of the HLW activities at SRS with similar activities at the Hanford Site and the Idaho National Laboratory (INL). Based on the discussion of these presentations at the meeting and information gathered during visits to the Hanford Site in April 2013, and to the Idaho National Laboratory in August 2014, the Board concludes that the coordination of HLW-related activities at these sites, and the transfer of lessons learned between them, could be improved. While this has been noted in previous Board letters to DOE-EM and DOE-NE, it may be appropriate to record it again here, in the context of the reestablishment of the Tank Waste Corporate Board reported by Mr. Rhoderick. *Regarding the management of HLW and coordination between the DOE sites, the Board recommends that DOE place more emphasis on the exchange of lessons learned, and the transfer of new technology, such as improvements in HLW melter performance and advances in melter designs. The Board suggests that this may be an appropriate role for the Tank Waste Corporate Board.*

As has also been recorded in previous correspondence with DOE, the Board is keenly interested in DOE's efforts to improve integration across the nuclear complex and notes that responsibility for coordination of tank waste management and disposition activities is included in the charter of the Tank Waste Corporate Board. In developing the charter of the SNF Corporate Board, the Board encourages DOE to include a similar focus on leading improvements in coordinating the management of SNF across the DOE complex and to also take account of the need to eventually dispose of DOE SNF as part of a program that will include disposal of commercial SNF, whether or not in the same repository. The Board suggests that these complex and interrelated programs are best managed by applying a systems engineering approach. In the context of DOE's SNF and HLW systems, such an approach would include a comprehensive scientific and engineering review of the functional requirements of the SNF and HLW system components, and their design, fabrication, and operation as an integrated system. This approach would also account for end-of-life considerations applicable to each of the system components and the system as a whole.

One important example of where these two Corporate Boards could together be instrumental in improving integration is in coordinating the designs of SNF and HLW containers, transportation casks, cask-handling equipment, dry storage facilities, and waste packages for emplacement in a geologic repository. The ultimate disposal of DOE SNF and HLW, as well as of commercial SNF, will require transportation in casks certified by the U.S. Nuclear Regulatory Commission (NRC). Consequently, DOE has envisioned packaging its own SNF and HLW in containers that would allow the use of commercially available transportation casks, as this would avoid having to design its own transportation casks. If DOE pursues this option, its programs for storage, transport, and disposal of SNF and HLW will need to take into account decisions, requirements, and limitations pertaining to design and licensing that originate outside of the DOE complex. *Following consideration of these issues, the Board recommends that DOE task the SNF Corporate Board and the Tank Waste Corporate Board with:*

- *employing a systems engineering approach in developing and implementing SNF and HLW management programs;*
- *obtaining design and regulatory input from outside organizations whose activities will impact the technical management of DOE SNF and HLW within the DOE complex and its preparation for off-site transportation (e.g. NRC, state regulators, local government organizations in the vicinity of the DOE sites, and commercial cask vendors);*
- *ensuring that DOE's efforts to transport and dispose of HLW, defense SNF and commercial SNF are integrated both at the management level and at the staff level, and;*
- *making DOE's efforts to integrate these activities more transparent.*

DOE Savannah River Operations Office

SNF Storage at the L Basin Facility

Ms. Maxcine Maxted of the DOE Savannah River Operations Office and Mr. David Rose of Savannah River Nuclear Solutions presented information regarding the storage of SNF at the

L Basin facility. They discussed the SNF inventory, expected receipts and condition of the SNF, and extended storage of SNF. Limited storage capacity is available in L Basin to receive additional SNF. However, following recent processing campaigns at H-Canyon, sufficient space exists now in L Basin to store the SNF expected to be received for at least the next three years, depending on the actual rate of SNF receipt and the rate of processing at H-Canyon.

Mr. Rose described the existing surveillance and maintenance programs that monitor water chemistry and support continued storage of SNF in L Basin. He also described the newer Augmented Monitoring and Condition Assessment Program, which includes additional surveillance of the SNF and the basin structures. This program will provide data to support the justification of the long-term use of L Basin to store SNF.

Implementation of a robust program for SNF surveillance and basin water chemistry control is very important in order to avoid the problems that were encountered during long-term storage of SNF at the K Basins at Hanford, where basin conditions were not well controlled and the SNF degraded. At Hanford, the degraded SNF proved to be very difficult to handle, dry, and package in preparation for transportation and disposal in a geologic repository. Some of the SNF in L Basin was received as cut fuel pieces that had been used in laboratory studies and other SNF arrived with damage to the cladding and/or the fuel. By maintaining a non-corrosive environment in L Basin, further degradation of the SNF can be limited. Consequently, assessing and controlling degradation of the SNF are important, especially given the possibility that not all of the SNF stored at SRS will be processed in H-Canyon, and any fuel that is not processed will have to be handled, dried, and packaged for on-site storage prior to eventual transportation to a geologic repository.

The Board notes that the existing programs for basin water chemistry control, corrosion surveillance, and monitoring of microbial growths are receiving significant management attention and are important activities to be maintained. These programs apply to both aluminum- and non-aluminum-based fuels that are stored in a variety of bundled and overpacked configurations.

DOE also has implemented many of the activities in the Augmented Monitoring and Condition Assessment Program (AMCAP), including periodic re-examination of certain SNF with techniques sensitive to detecting degradation of both the fuel material and its cladding. For example, cladding breaches and fuel corrosion can be detected by sampling water inside fuel bundle tubes, and the results from periodic reexaminations will allow DOE to better understand changes in the condition of the SNF over time. However, another planned AMCAP activity that DOE has not yet started is performance of baseline visual inspections of selected fuel, the results of which are to be recorded in photographs and videos. The Board suggests that fully implementing the remaining AMCAP activities on an early timescale is essential, as the results will provide a basis for determining what action can be taken to reduce SNF degradation and prepare some of the SNF for processing at H-Canyon or for drying and packaging in preparation for offsite transportation and disposal. *The Board recommends acceleration of the Augmented Monitoring and Condition Assessment Program to substantiate the condition of the fuel and facilitate future SNF handling, drying and packaging operations.*

Regarding the L Basin structure, Mr. Rose described the analyses completed to assess the structural integrity of L Basin and reported that the results were documented by the Savannah River National Laboratory in the L Basin Life Expectancy Report. That report concluded that the condition of the L Basin would allow storage of SNF there for another 50 years. Mr. Rose also described the elements of the L Basin structural integrity program and presented results of the recent characterization of concrete from the retired C Basin, which is similar to L Basin in age and operating history. In this context, the Board is also encouraged to learn from Mr. Rose's presentation that SRS will complete an evaluation of the newest seismic hazards analysis at SRS and perform additional work on ground-motion models applicable to the safety analysis of the L Basin structure.

Although DOE has concluded that these activities indicate the L Basin concrete is structurally sound, it is the Board's opinion that more data should be gathered to support the technical basis for continuing operation of the facility for an additional 50 years. SRS will need to store SNF for an indeterminate length of time, and, as L Basin is the only SNF storage facility on the site, it will need to be maintained as an operational facility both for storage of SNF and to support treatment and packaging in preparation for transport and disposal. *The Board recommends that DOE consider further actions to validate the structural integrity of L Basin, including:*

- *obtaining and analyzing core samples of the L Basin structural concrete, including samples containing rebar;*
- *expanding the visual examination of the interior and exterior surfaces of the basin walls, including those areas of the exterior surface in contact with soils;*
- *obtaining and analyzing core samples of older (possibly on the order of 100 years old) representative concrete from other sources to gather data that can improve the understanding of the long-term performance of the concrete; and*
- *ensuring coordination with other efforts to study concrete aging, such as those being conducted by the DOE Light Water Reactor Sustainability Program, the Concrete Sustainability Hub at the Massachusetts Institute of Technology, and the DOE-EM Cementitious Barriers Partnership at Vanderbilt University.*

Processing of SNF at the H-Canyon Facility

Mr. Allen Gunter of the DOE Savannah River Operations Office described the design and operation of the H-Canyon facility. He also discussed recent campaigns at H-Canyon to process damaged and degraded SNF and recover highly-enriched uranium, which is being down blended to low-enriched uranium for use in fabricating fuel for commercial power reactors. This capability to process damaged SNF that may be problematic during handling and packaging for repository disposal provides DOE with options and flexibility for the management of a broad range of difficult-to-handle SNF and other nuclear materials. However, the Board notes that, as currently configured, the H-Canyon facility cannot process the stainless steel and Zircaloy-clad SNF stored in the L Basin. If this SNF is not going to be processed or shipped to INL, it will have to be dried and packaged at SRS for shipment offsite and disposal at a geologic repository.

Alternatives for SNF Management

Ms. Maxcine Maxted described alternatives that DOE is considering for the future management of SNF at SRS. Although DOE has made no firm decisions, three primary options are available, each of which assumes the receipt of additional foreign and domestic research reactor fuel at the L Basin through 2019. The three primary options are the following:

- continued pool storage of the SNF at the L Basin facility, combined with processing of some SNF at H-Canyon
- processing of all aluminum-clad fuel at H-Canyon and transfer of non-aluminum-clad fuel to INL
- drying, packaging, and on-site dry storage of all SRS SNF until it can be transported off-site to a consolidated interim storage facility or a geologic repository

If DOE does not modify H-Canyon to enable the processing of non-aluminum-clad SNF, that fuel will have to be prepared for onsite storage or transportation offsite. This preparation includes drying and packaging, and, as there is no facility currently available at SRS that could be used for these operations, DOE would need to modify an existing facility or construct a new facility to provide this capability. In discussing the potential requirement for drying and on-site storage of SNF, Ms. Maxted stated that one option DOE has is to resume work on developing the L Area Basin Isolation System that was developed as a concept in preparation for packaging this fuel for transportation to INL. However, Ms. Maxted stated that work on this system is not currently funded by DOE, and she does not expect funding for it to be provided in the near future.

If SNF at SRS is to be packaged for off-site transportation and disposal, DOE plans to use commercially available SNF drying processes and container designs where possible, and plans to ensure that the packaged SNF is “road ready,” *i.e.*, that the containers are licensed for transportation. Ms. Maxted stated that SRS may use the multi-canister overpack design employed at the Hanford Site for packaging SNF. However, as the Board noted in its October 10, 2014, letter, the multi-canister overpack design is not yet licensed for transportation, and technical questions remain regarding whether it can be licensed for transportation. It is not clear to the Board whether SRS has considered using the DOE standard canister that was intended as a common design for storage, transportation, and disposal of all DOE-owned SNF other than the Hanford SNF that is already stored in multi-canister overpacks.

Based on the presentations regarding the management of SNF at SRS, the Board observes that there is significant uncertainty associated with DOE’s plans for the ultimate treatment and disposal of the SNF. Although DOE decided, in 2013, to process approximately 3.3 metric tons of a projected 22 metric tons of SNF through H-Canyon, there are no firm plans regarding processing of the remaining SNF. In considering the options for processing or disposal of the remaining SNF, DOE should take into account the difference in the projected release of radionuclides according to the physical form and the chemical composition of the alternative waste forms in different geologic environments.

Although the impacts of the defense wastes in a combined defense/commercial waste repository would be overshadowed by the impacts of the large quantity of commercial SNF, the waste form will be especially important if DOE decides to pursue a defense-waste-only repository. *The Board recommends that DOE perform a study to compare the performance of DOE SNF and vitrified HLW in different geologic environments. The results of this work should then be used to inform plans for processing SNF in H-Canyon.*

Processing of HLW and Integration of Activities Across the DOE Complex

Eight of the presentations at the meeting were related to the management of radioactive wastes at SRS, including processing of HLW at the Defense Waste Processing Facility, plans for processing waste streams from the new Salt Waste Processing Facility, storing the resulting canisters of vitrified HLW, integration of all associated activities, and lessons learned. The presenters were Jean Ridley of the DOE Savannah River Operations Office; Jonathan Bricker, Peter Hill, Dan Iverson, Vijay Jain, and Brenda Green of Savannah River Remediation; and David Peeler and Sharon Marra of the Savannah River National Laboratory. The Board appreciated the detailed presentations provided by these speakers and the commendable approach that they used to display clearly the integrated system of all SRS HLW management facilities and operations. Each speaker identified where the subject of their presentation fit into the integrated system. The Board also observed a notable practice at the Salt Waste Processing Facility where the plant operations staff is working with the construction and testing staff during construction to ensure that the requirements of the operations staff are incorporated into the design and construction of the facility. The project managers at the facility indicated that they expected this input would play a major role in avoiding problems during the startup and operation of the facility.

Ms. Ridley's presentation on the storage of vitrified HLW canisters highlighted that DOE continues to follow the requirements of the Waste Acceptance System Requirements Document (DOE/RW-0351, Rev. 5) and the Quality Assurance Requirements and Description document (DOE/RW-0333P, Rev. 21). The Board notes that although these documents were developed as part of the Yucca Mountain Project, they form a solid foundation for development of the technical information needed to support a license application and safety analysis for any future geologic repository for the final disposal of DOE's SNF and HLW.

Finally, the Board observes that DOE and its contractors at SRS have been successful in coordinating a broad range of nuclear facilities on site that together represent most of the back-end of the nuclear fuel cycle: storage and processing of SNF, vitrifying HLW and storage of the vitrified product, and disposing of low-activity radioactive waste. A particular practice at SRS that could serve as a useful example for other DOE sites is the issuance of a periodic Liquid Waste System Plan that clearly explains the interrelationships between, and the coordination of, all the HLW facilities. The Board is therefore encouraged to learn that DOE intends to utilize contractor technical exchanges and the availability of the DOE Corporate Boards to improve communication among all the sites and to encourage the transfer of lessons learned, including lessons learned at SRS.

On behalf of the Board, thank you again for the participation and cooperation of the representatives of DOE-EM, the Savannah River Operations Office, and DOE's contractor organizations. We look forward to continuing our ongoing review of DOE's technical activities related to managing and disposing of SNF and HLW.

Sincerely,

{Signed by}

Rodney C. Ewing
Chairman

cc: Dr. Peter B. Lyons
Dr. David C. Moody, III