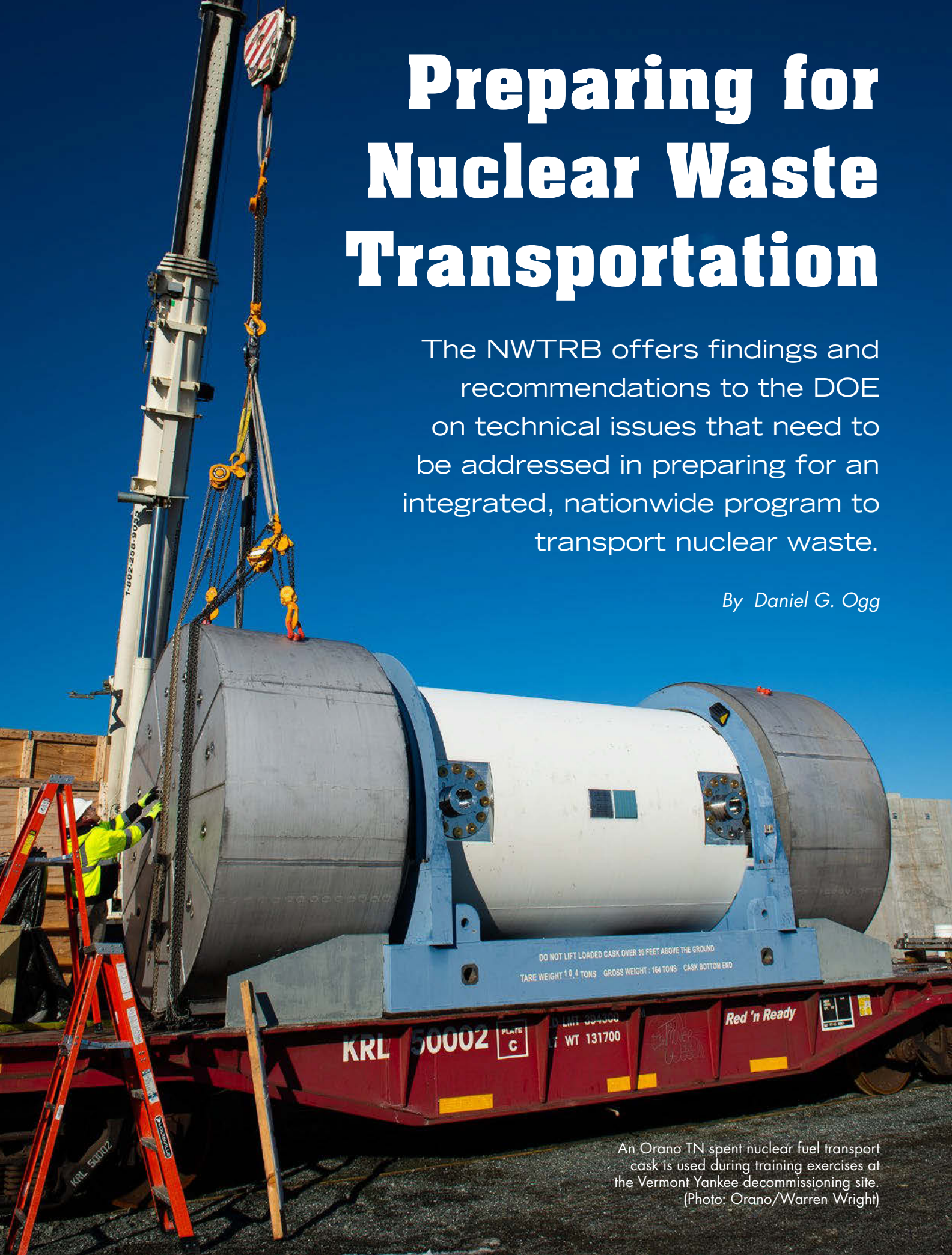


Preparing for Nuclear Waste Transportation

The NWTRB offers findings and recommendations to the DOE on technical issues that need to be addressed in preparing for an integrated, nationwide program to transport nuclear waste.

By Daniel G. Ogg



An Orano TN spent nuclear fuel transport cask is used during training exercises at the Vermont Yankee decommissioning site. (Photo: Orano/Warren Wright)

The U.S. Nuclear Waste Technical Review Board (NWTRB or Board) recently completed an evaluation of Department of Energy activities related to transporting spent nuclear fuel (SNF) and high-level radioactive waste. These topics have been the subject of several Board meetings and associated reports, and in September 2019, the Board issued a report, *Preparing for Nuclear Waste Transportation—Technical Issues That Need to Be Addressed in Preparing for a Nationwide Effort to Transport Spent Nuclear Fuel and High-Level Radioactive Waste* [1], which focuses on the issues DOE will need to address to plan and implement an integrated transportation program. In its report, the Board describes 30 broad technical issues that DOE needs to address and offers three sets of findings and recommendations.

Background

Congress created the NWTRB in the 1987 Nuclear Waste Policy Amendments Act (Public Law 100-203) to evaluate the technical and scientific validity of activities undertaken by the secretary of energy to implement the Nuclear Waste Policy Act and to advise Congress and the secretary on technical issues related to nuclear waste management. Among the topics specifically identified for Board evaluation is the transportation of SNF and HLW.

In 2010, the Board published a report evaluating the technical basis for the extended storage and transportation of SNF [2]. Other groups have also evaluated the issues associated with transporting SNF and HLW. For example, the National Academy of Sciences Committee on Transportation of Radioactive Wastes issued a report in 2006 examining the technical and societal aspects of transporting radioactive wastes [3].

More recently, the Board held public meetings in 2014, 2015, 2016, and 2018, on DOE SNF and HLW management activities. The meetings addressed research and analyses of nuclear waste streams, waste packaging, waste transportation, and integration. These meetings not only helped the Board but also the public to identify and discuss technical and integration issues that will need to be addressed in preparing to transport SNF and HLW.

In September 2019, the Board completed its evaluation of DOE activities and issued its report on technical issues that need to be addressed in preparing for a nationwide effort to transport SNF and HLW [1]. The report tabulates the Board-identified technical issues that DOE will need to address and includes the Board's findings and recommendations to DOE. It is important to note that the Board's evaluation, findings, and recommendations are focused on DOE activities leading to an integrated, nationwide transportation campaign for commercial SNF and DOE-managed SNF and HLW. Therefore, the Board's findings and recommendations are not meant to be applied to commercial or local shipments of SNF that are limited to only certain SNF types or only interim storage of SNF.

Board review and evaluation

Staff-to-staff meetings and fact-finding meetings.

When the DOE Office of Civilian Radioactive Waste Management ceased operations in 2010, responsibility for directing and implementing DOE's Nuclear Waste Policy Act activities related to nuclear waste transportation and disposal was transferred to the DOE Office of Nuclear Energy (DOE-NE). The Board staff meets with representatives of DOE-NE on a periodic basis to understand the scope and nature of these DOE activities.

DOE-NE is funding the development of several computer-based system analysis tools that can be used to help design and assess a nationwide waste management system, including nuclear waste transportation. The Board conducted fact-finding meetings during its evaluation of these DOE-NE-sponsored system analysis tools.

In December 2017, a team of Board members and staff members visited Argonne National Laboratory to discuss the development of the Next Generation System Analysis Model (NGSAM). In May 2018, the same Board team visited Oak Ridge National Laboratory to review the status of the Used Nuclear Fuel Storage, Transportation & Disposal Analysis Resource and Data System (UNF-ST&DARDS) tool. The Board found the NGSAM and UNF-ST&DARDS tools to be mature and useful for conducting integrated systems analyses. However, to date, the tools are being used to analyze alternative waste management systems that include only commercial SNF. The Board notes that, to be fully applicable to a nationwide waste management system, the system analysis tools will have to include information about DOE-managed SNF and HLW.

The DOE Office of Environmental Management (DOE-EM) is responsible for packaging, storing, and planning for disposal of DOE-managed SNF and HLW, and the Board interacts with DOE-EM on a periodic basis to remain informed about DOE-EM activities related to these wastes. DOE-EM funds its contractor at the Idaho National Laboratory to maintain a database for DOE-managed SNF but has not developed system analysis tools like those being developed within DOE-NE.

Summer 2018 Board meeting.

Building on the information gathered in its fact-finding meetings and its public meetings conducted in 2014, 2015, and 2016, the Board planned its summer 2018 public meeting to discuss technical and integration issues that DOE will need to address in developing a nationwide effort to transport SNF and HLW. The Board heard presentations from past and present transportation system managers at DOE and staff members involved in current activities related to transportation planning. The Board also heard from representatives of the U.S. nuclear industry, stakeholder groups, the Nuclear Regulatory Commission, and one utility in Switzerland. A key Board observation from the

meeting was that the combined time needed for the design, testing, licensing, fabrication, and implementation of a new-design SNF cask or canister can be 10 years or longer. However, the Board recognizes that modifications to existing cask or canister designs can be developed and implemented in shorter time periods.

Technical issues to be addressed

The Board notes that DOE will have to address technical issues as well as nontechnical issues (such as policy, cost, and public perception issues) before a nationwide transportation effort can begin. However, consistent with the scope of its jurisdiction, the Board focuses only on the technical issues. For the purposes of this effort, the Board defines technical issues to be questions or problems that require scientific analysis, laboratory or field testing, engineering or manufacturing design work, computer model development and use, specialized technological knowledge or skills, or completion of engineering calculations for resolution.

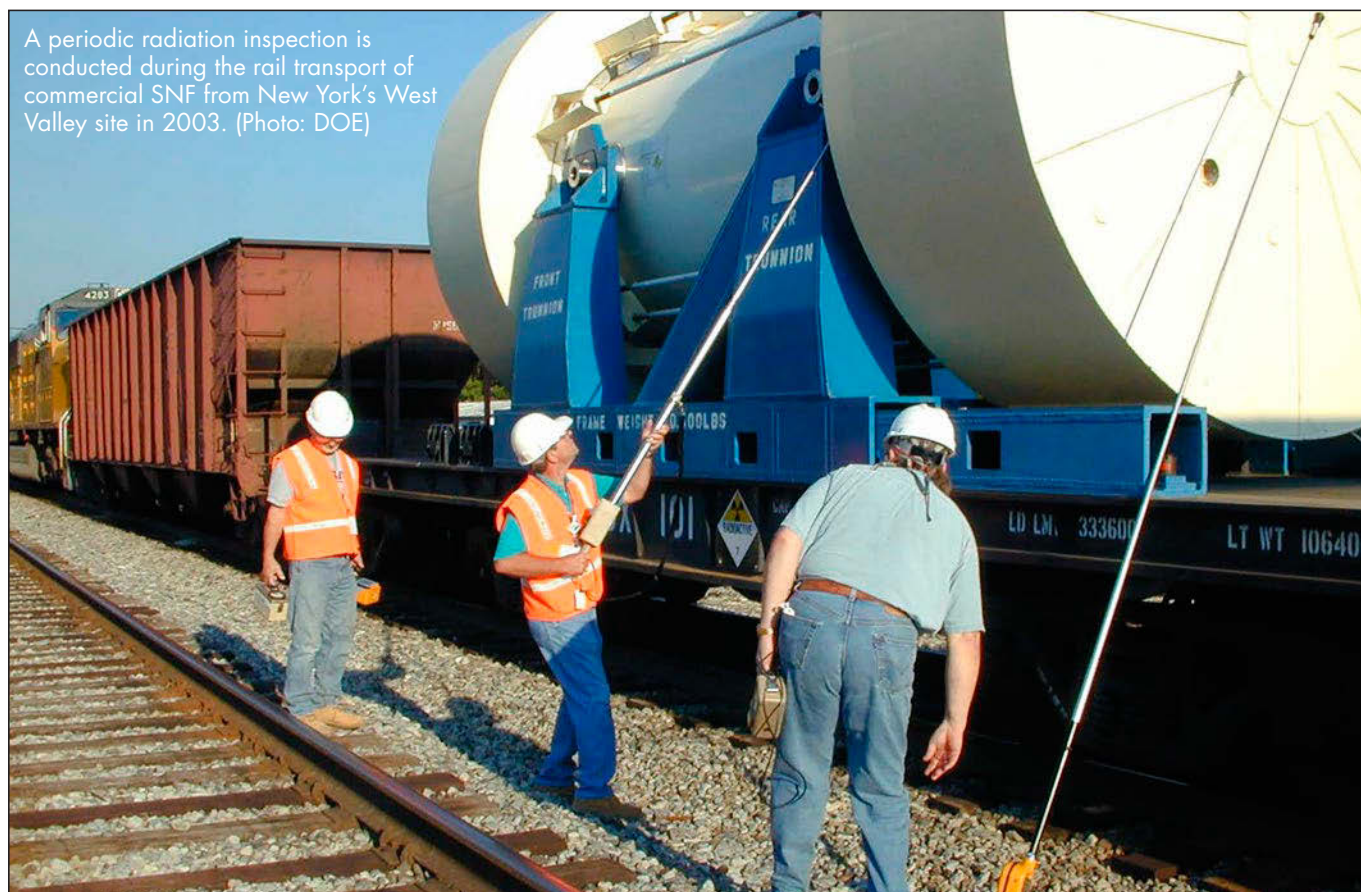
The technical issues to be addressed in preparing for a large transportation effort span a broad range of topics. The technical issues include uncertainties or questions about the condition of some wastes, including, for example, DOE-managed SNF. In some cases of commercial SNF, the condition of the SNF is known, but the characteristics of the SNF are such that the SNF does not currently meet the requirements for transportation set by the NRC. For example, certain SNF that has a relatively high enrichment of uranium-235 (the “initial enrichment” of uranium-235), but a relatively low burnup (i.e., used in the reactor for a relatively short period of time), may require special packaging or other measures in order to meet the NRC’s transportation requirements.

Other uncertainties are associated with the containers that store SNF. For commercial SNF, some of the welded stainless steel canisters used for SNF storage at commercial nuclear power plant sites were not designed for transportation and are not

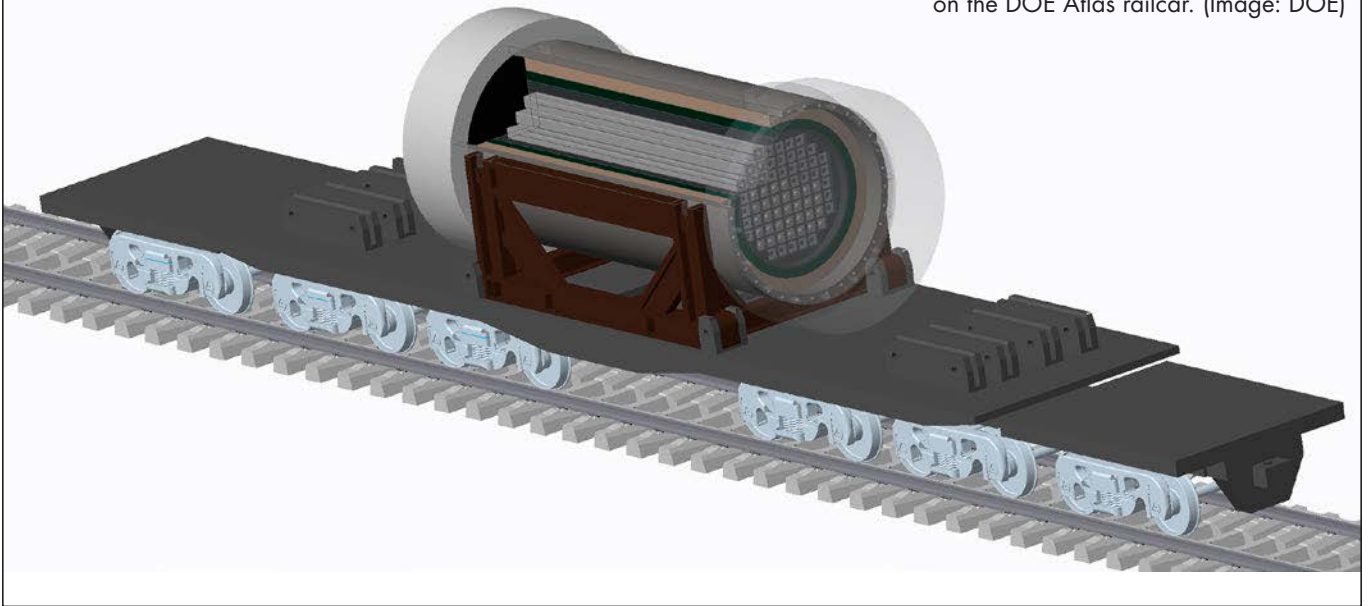
approved for that purpose by the NRC. Similarly, more than 80 percent (by mass) of DOE-managed SNF has been packaged into storage containers at DOE’s Hanford site in Washington State, and these containers will require further structural analyses before the NRC can approve them for off-site transportation. DOE also must develop a new transportation overpack for the Hanford SNF containers, unless an existing overpack is chosen. Still other types of DOE-managed SNF and HLW have not yet been packaged for transportation. A detailed evaluation of the inventory of DOE-managed SNF and the expected DOE path forward for managing this SNF was published by the Board in 2017 [4].

Addressing these and other uncertainties in how to transport the various SNF and HLW types will be necessary as DOE prepares these materials for transportation. DOE will have to ensure that all SNF and HLW is packaged in a manner that meets the requirements set by the NRC for transporting these wastes. Furthermore, developing an integrated transportation program that meets the regulatory requirements of the NRC and other federal agencies, such as the Department of Transportation, will require DOE to conduct significant advance planning and coordination. DOE’s coordination will also have to include private entities such as the nuclear utilities, rail carriers, and local jurisdictions that will be involved in implementing the program.

Well in advance of the start of transportation of commercial SNF, DOE will have to reach agreement with the nuclear utilities about how it will receive the SNF, in other words, whether DOE will accept unpackaged, bare SNF assemblies (Scenario 1 in the Board’s report [1]), SNF packaged in dry-storage casks or canisters (Scenario 2 in the Board’s report [1]), or both. This decision by DOE will have a direct impact on the technical issues to be resolved before a transportation campaign can begin. Most notably, if DOE accepts only unpackaged, bare SNF assemblies, then fuel sealed in dry-storage casks or canisters will have to be repackaged into new casks or canisters provided by DOE and, at some locations, this approach would require that a new repackaging facility be designed, approved, and built.



A diagram of a commercial SNF transport cask on the DOE Atlas railcar. (Image: DOE)



Findings and recommendations

Based on presentations at Board public meetings, other interactions with DOE, and the Board's evaluation of DOE activities and reports, the following findings and recommendations are made:

1. *Technical issues should be addressed in an integrated and comprehensive manner.*

The complexity and scale of the nation's SNF and HLW man-

agement program make resolving technical and integration issues a challenge. SNF and HLW inventories in the United States include a diverse collection of waste forms, waste storage containers, storage locations and conditions, waste transportation containers, and licensing requirements. The Board listed the 30 broad technical issues that need to be addressed in Table 2-1 of its report [1]. Some technical issues apply to only certain waste types.

Therefore, not all the issues must be resolved before the first

of the waste can be transported, but all technical issues must be resolved before the nation's entire inventory of waste can eventually be transported. As DOE continues its research and analysis of transporting SNF and HLW, it may find additional technical issues to address. Careful prioritization of the issues will be needed, including the development of prioritization criteria and agreement from affected government agencies, such as the NRC, and affected local, state, and tribal organizations.

Finding 1. The Board finds that many interrelated technical and integration issues must be addressed in preparing for a nationwide effort to transport SNF and HLW to their eventual destination. The technical issues must be prioritized and their resolution properly sequenced to ensure that the overall program will be operationally feasible and unhindered by delays.

Recommendation 1. As DOE continues analyses and research for a nationwide waste management and transportation system, the Board recommends that DOE ensure the issues in Table 2-1 of [the Board's report] [1] are addressed. The Board also recommends that the issues in Table 2-1 and any other issues identified by DOE be prioritized and carefully sequenced to support the integrated operation of a nationwide transportation program.

2. DOE evaluations of storage sites for nuclear waste should continue.

The Board commends DOE for proactive efforts to inspect and evaluate the readiness to remove commercial SNF from nuclear power plant sites where all reactors have been shut down but where commercial SNF remains in dry storage. To support the full integration of a transportation program for SNF and HLW, similar evaluations will need to be conducted at all nuclear power plant sites as well as DOE sites storing DOE-managed SNF and HLW.

Finding 2. The Board finds that DOE's effort to evaluate the readiness to move commercial SNF from shutdown nuclear power plant sites has gathered important information that will be needed to support the removal of commercial SNF from these sites for transportation. However, not all shutdown sites have been fully evaluated. Furthermore, DOE has not conducted similar reviews at DOE facilities that store DOE-managed SNF and HLW.¹

Recommendation 2. The Board recommends that DOE give higher priority to evaluating the removal of commercial SNF from shutdown nuclear power plant sites and to evaluating DOE sites that store DOE-managed SNF and HLW. DOE should also share the results of the evaluations with operators of waste storage sites, so they can apply lessons learned, retain critical site transportation infrastructure, and be better prepared for the eventual transportation of the wastes.²

3. Advance planning for the development of casks and canisters for SNF and HLW is needed. [Note that in this context, "develop" means to complete design, safety documentation, testing, NRC approval, fabrication, and implementation.]

To implement an integrated, nationwide waste management program, DOE will need to complete the testing, licensing, and fabrication of existing canister designs (e.g., the DOE standardized canister) and develop new canister designs for some

¹ In Finding No. 2 and Recommendation No. 2, the Board is addressing DOE effort to evaluate waste storage sites to gain valuable information about the condition of the wastes and the condition of transportation infrastructure. It is not intended, nor should it be implied, that the Board is commenting on the preferred shipping queue for removing SNF or HLW from the waste storage sites.

² It should be noted that the Board's recommendations are directed to DOE for action. It is not intended, nor should it be implied, that the Board's recommendations are directed to commercial nuclear utilities for action.