



**UNITED STATES**  
**NUCLEAR WASTE TECHNICAL REVIEW BOARD**  
2300 Clarendon Boulevard, Suite 1300  
Arlington, VA 22201-3367

August 24, 2023

Dr. Kathryn Huff  
Assistant Secretary for Nuclear Energy  
U.S. Department of Energy  
1000 Independence Ave., SW  
Washington, DC 20585

Dear Dr. Huff:

The U.S. Nuclear Waste Technical Review Board (Board) is charged with evaluating the technical and scientific validity of activities undertaken by the U.S. Department of Energy (DOE) in implementing the Nuclear Waste Policy Act and with reporting its findings, conclusions, and recommendations related to the management and disposition of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) to Congress and the Secretary of Energy. In discharging these responsibilities, the Board holds public meetings two or three times each year and then, offers its feedback to DOE in writing. This letter provides the Board's feedback on the topics discussed during the Spring 2023 Board Meeting, which was held on March 28, 2023, in Orlando, Florida.

On behalf of the Board, I want to thank you and your staff, as well as the staff from the national laboratories, for supporting the Spring 2023 Board Meeting. The Board especially appreciated your participation from Idaho at an early hour. The purpose of the meeting was to review information regarding the DOE, Office of Nuclear Energy (DOE-NE) activities to evaluate the future removal of commercial SNF from nuclear power plant sites. Other topics included the activities of the DOE-NE Office of Integrated Waste Management (IWM) related to a consent-based siting (CBS) process supporting the development of one or more federal interim storage facilities, as well as updates on transportation research and development (R&D) including site infrastructure evaluations, systems analysis tools, and railcar development. The agenda, presentation materials, meeting transcript, and an archived recording of the webcast for the meeting are posted on the Board's website at <https://www.nwtrb.gov/meetings/past-meetings/winter-2022-board-meeting---march-28-2023>.

The Board also thanks the staff from DOE and the national laboratories for supporting a technical fact-finding meeting, which was held at the DOE offices in Washington, D.C., on February 9, 2023. This fact-finding meeting enabled the Board to better prepare for the Spring 2023 public meeting.

#### Background

Over the past several years, DOE has been conducting R&D to enable storage, transportation, and eventual disposal of SNF and HLW from existing and future nuclear fuel cycles and to support planning for an IWM system. The DOE Office of IWM has sponsored the development

of new railcars for transporting commercial SNF, and has implemented systems analysis tools, such as the Used Nuclear Fuel-Storage, Transportation & Disposal Analysis Resource and Data System (UNF-ST&DARDS) tool and the Next Generation Systems Analysis Model, which support evaluation of different alternatives for an IWM system. The Office of IWM has also proposed, but not yet received funding for, a full-sized rail cask test known as the Package Performance Study as a means of demonstrating to the public the robustness of such rail casks and gathering technical data related to validating package performance.

DOE recently re-initiated efforts to use a CBS approach to support the development of one or more federal interim storage facilities for commercial SNF. Part of this effort includes providing funding to states, Tribes, and local communities to facilitate information exchange and mutual learning between DOE and interested parties. Regarding Tribal outreach, DOE has actively sponsored and engaged Tribes through various working groups such as the National Transportation Stakeholders' Forum (NTSF), the Nuclear Energy Tribal Working Group (NETWG), and the Tribal Radioactive Materials Transportation Committee (TRMTC).

DOE's transportation R&D activities include conducting site infrastructure evaluations for operating nuclear power plant sites and shutdown nuclear power plant sites, as well as sponsoring initial de-inventory reports for selected sites.<sup>1</sup> The site infrastructure evaluations have been conducted by a team of researchers at Pacific Northwest National Laboratory (PNNL) since 2012. The initial site-specific de-inventory reports have been produced by contractor Areva, now Orano USA (and sometimes, in partnership with other contractors), since 2015. These reports build upon the information provided by the PNNL team and include a multi-attribute utility analysis (MUA) as the basis for evaluating transportation modes and routes for removal of SNF from each site. These reports are intended to present a contractor's first look at operational details and recommendations for SNF handling and transportation, but do not necessarily represent DOE agreement with the recommended operations.

### ***Summary of the Spring 2023 Board Meeting***

Prior to the Board's public meeting, members of the Board and staff along with some DOE staff and contractors, toured the SNF storage facility at the shutdown Crystal River Nuclear Plant site. DOE has already completed a site evaluation for the Crystal River site and released an initial de-inventory report this year.<sup>2</sup>

The first portion of the Board's meeting included an overview of the activities of the DOE Office of IWM. DOE updated the Board on the IWM system transportation R&D activities, including the proposal for a Package Performance Study. DOE staff members also described their efforts to use a CBS process for one or more federal interim storage facilities. Next, DOE described the activities to evaluate the future removal of commercial SNF from nuclear power plant sites.

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<sup>1</sup> Eleven initial site-specific de-inventory reports are available at: [Initial Site-Specific De-Inventory Reports | CURIE \(pnnl.gov\)](https://www.pnnl.gov/initial-site-specific-de-inventory-reports) (last accessed 8/24/2023).

<sup>2</sup> Orano Federal Services LLC, 2023. *Initial Site-Specific De-Inventory Report for Crystal River*, Report No: RPT-3022488-001.

During the second half of the meeting, representatives from three Tribal nations provided their perspectives on DOE's transportation and CBS efforts. They noted the support provided by DOE to maintain several Tribal working groups (described above) and they stated their appreciation for the opportunity to engage with DOE. Regarding the path forward on IWM, the Tribal representatives discussed what they perceive to be the key challenges for future transportation of commercial SNF, meaningful engagement during DOE's CBS activities, and developing adequate emergency preparedness and response programs.

National laboratory staff then presented DOE-sponsored analyses of as-loaded commercial SNF canisters using the UNF-ST&DARDS tool, including a comparison of the analysis results with the regulatory limits in the Certificate of Compliance (CoC) for transportation for different SNF canister systems. DOE also provided updates and the path forward for the Atlas and Fortis railcar projects. The Board appreciates the thorough presentations given by DOE as well as the detailed responses to questions throughout the public meeting.

The final presentation of the meeting was from a representative of the U.S. Nuclear Regulatory Commission (NRC), who presented key takeaways from NRC's 2021 transportation readiness review.<sup>3</sup> NRC's work focused on transportation of commercial SNF by commercial entities (i.e., not DOE) to one or more NRC-licensed consolidated interim storage facilities, which are not federal interim storage facilities. The NRC effort identified information needs and recommended enhancements for SNF transportation, provided roadmaps of the roles and responsibilities of various federal agencies for transportation of commercial SNF from existing to new storage facilities, and highlighted differences between commercial and DOE transportation of commercial SNF.<sup>4</sup>

### ***Board Conclusions, Findings, and Recommendations***

Based on the information presented at the public meeting, the fact-finding meeting, and in related technical reports, the Board developed several findings, conclusions, and recommendations on DOE's IWM program, transportation R&D activities, and CBS program. The Board also developed observations on topics that may be outside of DOE's control but impact how DOE implements its activities. The Board's findings, conclusions, and recommendations follow. The enclosure provides more background and details regarding the meeting topics, and again presents the Board's findings, conclusions, and recommendations.

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<sup>3</sup> U.S. Nuclear Regulatory Commission (NRC), 2021. "NRC's Regulatory Readiness for Oversight of Large-Scale Commercial Transportation of Spent Nuclear Fuel." October 22, available at: <https://www.nrc.gov/docs/ML2129/ML21298A164.pdf> (last accessed 8/24/2023).

<sup>4</sup> The Nuclear Waste Policy Act (NWPA) established requirements, in section 180, for DOE-directed shipments of SNF and HLW to a repository or a monitored retrievable storage facility (the federal facility equivalent to a commercial consolidated interim storage facility). This includes advance shipment notifications and financial support for training to the states and Tribes through whose jurisdictions DOE plans to transport SNF and HLW. Those NWPA conditions do not apply to commercial transportation of SNF to a commercial (privately-owned) consolidated interim storage facility.

## IWM Program Overview and Future Priorities

Finding 1a: The Board finds that DOE is making progress in its IWM program, particularly in three major cross-cutting areas: (i) transportation preparations, (ii) storage design and regulatory considerations, and (iii) systems analysis tools and integration. The Board recognizes that DOE activities related to CBS of a federal interim storage facility are in the early stages of a multi-year effort.

Finding 1b: The Board finds that incorporating public feedback in the early development of a Package Performance Study is important; the Board previously encouraged DOE to engage early with stakeholders in developing a plan.<sup>5</sup> To date, DOE has obtained limited feedback from a few groups, but has not yet received broad public feedback on its proposal for a Package Performance Study.

*Recommendation 1: If DOE pursues a Package Performance Study, the Board recommends that DOE first determine what the public's major safety concerns are, how public participants would like to be involved, and how meeting this goal can be integrated with regulatory testing goals. This will better enable DOE to identify the key issues to be addressed and to set clear outcomes for any demonstration. Further, planning for the demonstration should include a strategy for effective communication of test goals, expectations, and results to the public, and for a post-demonstration assessment of how well the test met its goals.*

## DOE's State and Tribal Engagement

The Board commends DOE for continuing to work closely with Tribes, and finds that the Office of IWM emphasis on making Tribal government engagement a priority is a positive step for CBS efforts. The Board also commends DOE for working to identify practical steps to enhance full participation, including efforts to engage with Tribes through its NTSF section 180(c) ad hoc working group, and with Tribal governments through NETWG and TRMTC.

The Board commends DOE for looking into developing metrics (i.e., ways to measure and evaluate Tribal engagement and progress) to assess or track the extent to which such efforts have been successful, as each Tribal government is independent and will be facing a variety of situations that are unique to its Tribe. The Board looks forward to seeing more detailed information about such metrics at future Board meetings.

The Board observes that some Tribes may lack adequate resources for emergency preparedness and response programs, which could hamper the Tribes' ability to support DOE activities to plan for future SNF transportation. However, as noted above, the Board recognizes DOE for its ongoing preparedness work with the Tribes, primarily through its renewed efforts relative to section 180(c) of the Nuclear Waste Policy Act. The Board believes that, through Tribal

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<sup>5</sup> Bahr, J.M. 2022. Board letter to Dr. Kathryn Huff with comments from March 2022 Board meeting (June 7, 2022), available at: <https://www.nwtrb.gov/docs/default-source/correspondence/jmb041.pdf?sfvrsn=4> (last accessed 8/24/2023).

engagement, DOE can help Tribes plan for the necessary emergency preparedness and response, technical expertise, and capabilities.

### DOE's Evaluation of the Future Removal of Commercial SNF from Nuclear Power Plant Sites

The Board observes that DOE has used the initial site-specific de-inventory reports (supported by the MUAs) during early engagement with Tribal, state, and local representatives on the possible modes and routes for SNF transportation from each site. These engagements appear to be a useful starting point for DOE's planning for future SNF transportation. As DOE's IWM system matures, the Board expects that DOE decision makers and external stakeholders will be involved in further, more detailed discussions about preferred modes and routes of SNF transportation from each site. The Board notes that these discussions can be enhanced by considering lessons from analogous situations (e.g., shipments of low-level radioactive waste), revisiting the weighting of attributes (potentially going beyond pairwise comparisons in some cases) in each MUA, and addressing uncertainties in the MUAs.

Finding 2: The Board finds that the DOE-sponsored site evaluations provide a good opportunity for DOE to meet with onsite staff and discuss technical details, including SNF condition, anomalies, and canister loading maps.

*Recommendation 2: During future site infrastructure evaluation visits, the Board recommends that DOE engage with site personnel and cask vendors regarding the NRC-approved transportation CoCs that apply to SNF in dry storage and assess whether the stored SNF will meet the requirements in the NRC-approved transportation CoCs. Site personnel and cask vendors who know the specific SNF contents for each storage canister and the approved contents for the transportation cask could potentially identify whether amendments or exemptions to the transportation CoCs will be needed prior to transportation.*

### As-Loaded Analyses to Determine Transportability of Commercial SNF Canisters

The Board commends DOE for sponsoring the as-loaded analyses needed to understand which commercial SNF canisters can meet the requirements of the corresponding transportation CoCs and which cannot, without an amendment or exemption to the NRC-approved CoC.

The Board observes that access to UNF-ST&DARDS would be valuable to the nuclear industry for analyses of SNF canisters for loading, storage, and transportation scenarios.

Finding 3: The Board finds that DOE can enhance its IWM system planning by engaging early with the NRC regarding the need for amendments or exemptions to the transportation CoCs for SNF canisters that do not currently meet the CoC requirements.

*Recommendation 3: The Board recommends that DOE work with the NRC to identify the number and scope (including potential technical challenges) of amendments or exemptions to transportation CoCs that will be needed to allow the transportation of the affected SNF canisters.*

Finding 4: The Board finds that there may be some technical difficulties with meeting the 10 CFR Part 72 requirements for SNF storage following the transportation of SNF, governed by 10 CFR Part 71. For example, 10 CFR Part 72 requires the licensee to demonstrate that the SNF cladding can meet its intended confinement function before placing the SNF into dry storage; but it is unclear how the licensee will demonstrate adherence to this requirement for SNF inside a welded canister.

*Recommendation 4: The Board recommends that DOE expand its engagement with the NRC to understand the technical difficulties with respect to meeting the 10 CFR Part 72 requirements for storage following the transport of commercial SNF, subject to 10 CFR Part 71 requirements. Recognizing that the issues could be different and unique for each specific SNF cask loading and for each cask or canister design, this action should commence well in advance of starting a large-scale transportation campaign, such as one that DOE may start in support of a new federal interim storage facility.*

Thank you again, on behalf of the Board, for the participation of DOE-NE staff and technical experts from the national laboratories at our February fact-finding meeting and our subsequent public meeting in March. In closing, the Board looks forward to hearing more about CBS and the CBS planning process in the upcoming Summer Board meeting. We look forward to continuing our ongoing review of DOE's activities related to managing and disposing of SNF and HLW.

Sincerely,

{signed by}

Nathan Siu  
Chair

Enclosure

cc: Dr. Kimberly Petry, DOE-NE  
Dr. Erica Bickford, DOE-NE

## Enclosure

### March 2023 Board Meeting Summary and Board Findings, Conclusions, and Recommendations

This enclosure summarizes the public meeting presentations, provides background and details regarding the meeting topics, and presents the Board's findings, conclusions, and recommendations. [Topics addressed have underlined text, **Board findings and conclusions are presented in bold text**, and *Board recommendations are presented in italicized text.*]

#### U.S. Department of Energy (DOE) Integrated Waste Management (IWM) Program Overview and Future Priorities

Regarding the IWM program, DOE presented information that shows progress is being made in several activities that support key future decision-making on transportation planning for removing commercial spent nuclear fuel (SNF) from nuclear power plant sites. DOE has completed several infrastructure evaluation reports, which help identify options for transporting SNF and greater-than-Class-C low-level waste from nuclear power plant sites. DOE has published initial site-specific de-inventory reports,<sup>6</sup> which provide information that may be useful for planning the future removal of SNF from specific sites. Also, DOE has completed the development of the 12-axle Atlas railcar, which will undergo multi-car testing with the buffer railcar and the rail escort vehicle this year. The 8-axle Fortis railcar has been designed and is being fabricated. DOE is also developing plans for a Package Performance Study, which, if funded, would involve a full-sized rail cask package test, with the goals of building public trust and confidence in the safety of SNF transportation casks and SNF transportation by rail and gathering data to validate computer models. In addition, DOE has made progress in developing design functions and requirements, as well as reference design concepts for a federal interim storage facility for commercial SNF. DOE has developed data management and systems analysis tools, including Stakeholder Tool for Assessing Radioactive Transportation, Next Generation Systems Analysis Model, Used Nuclear Fuel Storage, Transportation & Disposal Analysis Resource and Data Systems (UNF-ST&DARDS), and Performance Assessment of Strategy Options. These tools are being used to inform DOE's planning and decision-making related to an IWM system for SNF and high-level radioactive waste (HLW).

As a part of DOE's transportation-related efforts and based on the recommendations by the National Academy of Sciences (NAS)<sup>7</sup> and the Blue Ribbon Commission (BRC),<sup>8</sup> the Office of IWM is proposing to conduct a Package Performance Study. According to DOE, actual testing

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<sup>6</sup> Eleven initial site-specific de-inventory reports are available at: [Initial Site-Specific De-Inventory Reports | CURIE \(pnnl.gov\)](#) (last accessed 8/24/2023).

<sup>7</sup> *Going the Distance?: The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States*, 2006, available at: <https://nap.nationalacademies.org/catalog/11538/going-the-distance-the-safe-transport-of-spent-nuclear-fuel> (last accessed 8/24/2023).

<sup>8</sup> *Blue Ribbon Commission on America's Nuclear Future: Report to the Secretary of Energy*, 2012, available at: <https://www.osti.gov/servlets/purl/1133851> (last accessed 8/24/2023).



will depend on funding availability, which has been requested for fiscal year 2024. Also, DOE is planning to invite the U.S. Nuclear Regulatory Commission (NRC) to collaborate in this effort.

In 1999, the NRC began, but did not complete a project also referred to as the Package Performance Study. The NRC's study had an enhanced public participatory process that was used to collect public comment, including comments on the draft testing protocols.<sup>9</sup> One of the main purposes of the NRC project was to demonstrate the inherent safety of SNF package design with public outreach constituting a significant element. Work on the NRC Package Performance Study ceased because of the high cost and because the proposed Yucca Mountain repository project had been halted. DOE stated that the Package Performance Study it is considering would include non-regulatory tests (e.g., train collision, waterbody retrieval demonstration, etc.) in addition to regulatory tests (e.g., impact onto unyielding surfaces).

In the NAS report, the authors provided a critical assessment of package performance with respect to the information from the NRC's public outreach work related to NRC's Package Performance Study and the package performance standards developed by the International Atomic Energy Agency. The authors stated that "... package performance under severe accident conditions is a major concern for transportation safety among many members of the public, especially those who live and work along shipping routes. Finding a way to resolve this issue continues to be a challenge to regulators in the United States and may eventually become a challenge for DOE and the private sector in their commercial spent fuel transportation programs." The NAS report contains technical findings and recommendations on the type of full-scale testing that it endorsed, which involved both regulatory and credible "extraregulatory" conditions.<sup>10</sup> One of the report's principal findings and recommendations on package performance is reproduced below:

"[NAS] Finding: The committee strongly endorses the use of full-scale testing to determine how packages will perform under both regulatory and credible extraregulatory conditions. Package testing in the United States and many other countries is carried out using good engineering practices that combine state-of-the-art structural analyses and physical tests to demonstrate containment effectiveness. Full-scale testing is a very effective tool both for guiding and validating analytical engineering models of package performance and for demonstrating the compliance of package designs with performance requirements. However, deliberate full-scale testing of packages to destruction through the application of forces that substantially exceed credible accident conditions would be marginally informative and is not justified given the considerable costs for package acquisitions that such testing would require."

"[NAS] Recommendation: Full-scale package testing should continue to be used as part of integrated analytical, computer simulation, scale-model, and testing programs to

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<sup>9</sup> See *Package Performance Study: Developments Since PATRAM13*, available at: [https://inis.iaea.org/collection/NCLCollectionStore/\\_Public/37/088/37088721.pdf?r=1](https://inis.iaea.org/collection/NCLCollectionStore/_Public/37/088/37088721.pdf?r=1) (last accessed 8/24/2023) and *Full-Scale Accident Testing in Support of Used Nuclear Fuel Transportation*, 2014, SAND2014-17831, available at: <http://large.stanford.edu/courses/2017/ph241/watson2/docs/sand2014-17831r.pdf> (last accessed 8/24/2023).

<sup>10</sup> Extraregulatory conditions refer to accidents that impose thermal or mechanical loads on transportation packages that are different from those generated in the hypothetical accident conditions specified in 10 CFR Part 71.



validate package performance. Deliberate full-scale testing of packages to destruction should not be required as part of this integrated analysis or for compliance demonstrations.”

In the BRC’s report, one of the recommendations for transportation that specifically refers to a Package Performance Study is reproduced below:

[BRC Recommendation] “DOE and other federal agencies should reexamine and address those recommendations from the 2006 NAS *Going the Distance?* Study that have not yet been implemented. As part of this reexamination, the NRC should reassess its plans for the Package Performance Study without regard to the status of the Yucca Mountain project, and if it is found to have independent value, funding should be provided from the Nuclear Waste Fund so that the NRC can update these plans and proceed with those tests.”

A 2014 DOE-funded report,<sup>11</sup> which served as part of the re-examination recommended by the BRC and the reassessment requested by DOE, identified several important concepts. The authors noted that because full-scale testing is expensive, an evaluation of the added value of such testing on public perceptions and public acceptance is important. They stated that the first phase of a package performance study would need to determine the type of information and level of participation that the public desires in order for them to evaluate the safety of SNF transportation.

In 2018, the Western Interstate Energy Board, which represents eleven western states and two Canadian Provinces, published a Position Paper<sup>12</sup> encouraging DOE to conduct full-scale cask testing. The Position Paper recommends, among other things, that “[d]emonstration testing [i.e., extraregulatory testing] is acceptable only in conjunction with regulatory testing,” and “[s]takeholders should be involved in the testing program.”

The Board agrees with the views expressed in the 2014 report and the 2018 Position Paper. The Board notes that important aspects of a full-scale test that DOE will need to make clear in its early planning and in its communications with the public are 1) whether extraregulatory tests will be included and 2) the extent to which the results of testing of one package design apply to the performance of other package designs.

The Board is interested in hearing more about the updated CBS process and updated DOE strategy for managing nuclear waste, the IWM program plan, the status of DOE’s critical decision process, the DOE’s plans for interacting with awardees of the Funding Opportunity Announcement, and consideration of a Package Performance Study in the upcoming Summer 2023 Board meeting. For example, the Board is interested in understanding DOE’s underlying principles, approaches, and requirements for its CBS process, with evidence to support their validity, and how DOE has charted its path forward to meet the requirements. The Board is also interested in hearing how states and Tribes will be addressed in DOE’s CBS activities and

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<sup>11</sup> *Full-Scale Accident Testing in Support of Used Nuclear Fuel Transportation*. SAND2014-17831, available at: <http://large.stanford.edu/courses/2017/ph241/watson2/docs/sand2014-17831r.pdf> (last accessed 8/24/2023).

<sup>12</sup> Western Interstate Energy Board. 2018. “*High-Level Radioactive Waste Committee Position Paper, Full-Scale Cask Testing, Number 2018-2.*”

decision processes, including the relationship of the CBS activities to the requirements in the Nuclear Waste Policy Act (NWPA) for participation of states and Indian Tribes [see NWPA Section 141(h)]. How DOE will communicate the differences between the commercial and federal consolidated interim storage efforts for commercial SNF is another area the Board is interested in hearing about in the Summer 2023 Board meeting.

**Finding 1a: The Board finds that DOE is making progress in its IWM program, particularly in three major cross-cutting areas: (i) transportation preparations, (ii) storage design and regulatory considerations, and (iii) systems analysis tools and integration. The Board recognizes that DOE activities related to CBS of a federal interim storage facility are in the early stages of a multi-year effort.**

**Finding 1b: The Board finds that incorporating public feedback in the early development of a Package Performance Study is important; the Board previously encouraged DOE to engage early with stakeholders in developing a plan.<sup>13</sup> To date, DOE has obtained limited feedback from a few groups, but has not yet received broad public feedback on its early plans for a Package Performance Study.**

*Recommendation 1: If DOE pursues a Package Performance Study, the Board recommends that DOE first determine what the public’s major safety concerns are, how public participants would like to be involved, and how meeting this goal can be integrated with regulatory testing goals. This will better enable DOE to identify the key issues to be addressed and to set clear outcomes for any demonstration. Further, planning for the demonstration should include a strategy for effective communication of test goals, expectations, and results to the public, and for a post-demonstration assessment of how well the test met its goals.*

### DOE’s State and Tribal Engagement

In addition to the technical side of planning the CBS process, the Board heard about a parallel track for DOE’s CBS plans that involves re-invigorating public engagement. DOE described the expertise of new staff and how the Office of IWM has been reorganized. One staff team, the CBS team, will focus on socio-political and socio-technical issues associated with CBS and the other, the Cross-Cutting Initiatives team, will focus more on technical issues. One point that DOE emphasized in discussing its CBS process is the idea of creating a “level playing field” (in terms of knowledge, to allow for willing and informed decisions) for those communities that are interested in the CBS process.

Section 180(c) of the NWPA states “The Secretary [of Energy] shall provide technical assistance and funds to States for training for public safety officials of appropriate units of local government and Indian tribes through whose jurisdiction the Secretary plans to transport spent nuclear fuel or high-level radioactive waste [to a NWPA-authorized facility]. Training shall cover procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency response situations.” The Board notes that DOE has actively sponsored and engaged Tribes through various working groups such as the National

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<sup>13</sup> Bahr, J.M. 2022. Board letter to Dr. Kathryn Huff with comments from March 2022 Board meeting (June 7, 2022), available at: <https://www.nwtrb.gov/docs/default-source/correspondence/jmb041.pdf?sfvrsn=4> (last accessed 8/24/2023).

Transportation Stakeholders' Forum (NTSF), the Nuclear Energy Tribal Working Group (NETWG), and the Tribal Radioactive Materials Transportation Committee (TRMTC). DOE's efforts to engage states and Tribes on issues related to section 180(c) are relevant to efforts DOE may take with states, Tribes, and communities in its CBS effort. Understanding how DOE will implement a program that meets the requirements of section 180(c) is likely to be an important consideration for communities and Tribes that are participating, or contemplating participating, in the CBS process.

The Board looks forward to hearing more about how DOE will ensure greater Tribal and stakeholder engagement in its CBS process during the upcoming Summer 2023 Board meeting.

**The Board commends DOE for continuing to work closely with Tribes, and finds that the Office of IWM emphasis on making Tribal government engagement a priority is a positive step for CBS efforts. The Board also commends DOE for working to identify practical steps to enhance full participation, including efforts to engage with Tribes through its NTSF section 180(c) ad hoc working group, and with Tribal governments through NETWG and TRMTC.**

**The Board commends DOE for looking into developing metrics (i.e., ways to measure and evaluate Tribal engagement and progress) to assess or track the extent to which such efforts have been successful, as each Tribal government is independent and will be facing a variety of situations that are unique to its Tribe. The Board looks forward to seeing more detailed information about such metrics at future Board meetings.**

**The Board observes that some Tribes may lack adequate resources for emergency preparedness and response programs, which could hamper the Tribes' ability to support DOE activities to plan for future SNF transportation. However, as noted above, the Board recognizes DOE for its ongoing preparedness work with the Tribes, primarily through its renewed efforts relative to section 180(c) of the Nuclear Waste Policy Act. The Board believes that, through Tribal engagement, DOE can help Tribes plan for the necessary emergency preparedness and response, technical expertise, and capabilities.**

#### DOE's Evaluation of the Future Removal of Commercial SNF from Nuclear Power Plant Sites

DOE described its site infrastructure evaluations (sometimes called site evaluations), which have been conducted since 2012, and initial site-specific de-inventory reports, which have been conducted since 2015 at shutdown and operating nuclear power plants. For the site infrastructure evaluations, DOE contractors (led by PNNL) gathered data on site SNF inventories and the condition of on-site and nearby transportation infrastructure. The team identified information needs from each site (and continues to update the data) that could inform key future decisions for planning to remove commercial SNF from nuclear power plant sites. In many cases, it is envisioned that rail will be the primary mode of transportation for shipping commercial SNF. According to DOE, every site that has been evaluated so far has at least one option for mode of transportation (rail, heavy-haul truck, barge, etc.) for removing SNF. DOE noted that the infrastructure evaluations conducted by PNNL included input from site personnel, local Tribes/states, U.S. Department of Transportation, Federal Railroad Administration, and other stakeholders.

As part of the DOE-sponsored site evaluations, the PNNL team gathers available data on SNF types, SNF canister types and modifications, and other information that may affect the transportability of the SNF. Transportability can be determined by comparing the loaded SNF storage canister contents with the allowable contents listed in the corresponding transportation Certificate of Compliance (CoC). Learning from site personnel and cask vendors about which transportation cask CoCs may need to be amended or need an exemption to the NRC transportation regulation could enhance DOE's future planning and preparations for removing SNF from the sites.

DOE representatives explained how they are building on the information gathered during the site infrastructure evaluations by contracting with Orano USA to conduct more detailed assessments of needed infrastructure upgrades, equipment needs, time required, costs, etc. to remove commercial SNF from nuclear power plant sites. These assessments are documented in "initial site-specific de-inventory reports." The assessments are completed by experts in nuclear operations and SNF handling who make use of available documented information, without visiting the sites or consulting with site personnel or stakeholders. The intent of de-inventory reports is to obtain an expert opinion regarding "...the tasks, equipment, and interfaces necessary for the complete de-inventory of the [nuclear power plant site's] independent spent fuel storage installation (ISFSI)."<sup>14</sup> During the Board meeting, DOE noted that these reports are preliminary and represent the opinions of the contractor (not DOE), and that DOE expects to conduct new and updated assessments of the best approach for transporting SNF from nuclear power plant sites, when the timing for such transportation is closer at hand.

DOE also explained that Orano USA utilized multi-attribute utility analysis (MUA) as a key component of each de-inventory report. MUA is a well-established, general methodology for comparing different alternatives that may be considered in making a particular decision. The MUA process used by Orano USA employs an expert panel to identify attributes of each alternative, assign weighting factors to each attribute and then, compare the alternatives in a pairwise fashion. This was used to compare the pros and cons of the different modes and routes of SNF transportation away from each nuclear power plant site, culminating in Orano USA's recommendation for each site. For more details about how the MUA methodology was applied in support of the initial site-specific de-inventory reports, see Chapter 5 of any one of the reports (e.g., the report for Maine Yankee, listed in footnote 14).

**The Board observes that DOE has used the initial site-specific de-inventory reports (supported by the MUAs) during early engagement with Tribal, state, and local representatives on the possible modes and routes for SNF transportation from each site. These engagements appear to be a useful starting point for DOE's planning for future SNF transportation. As DOE's IWM system matures, the Board expects that DOE decision makers and external stakeholders will be involved in further, more detailed discussions about preferred modes and routes of SNF transportation from each site. The Board notes that these discussions can be enhanced by considering lessons from analogous situations (e.g., shipments of low-level radioactive waste), revisiting the weighting of attributes**

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<sup>14</sup> AREVA Federal Services LLC, 2017. *Initial Site-Specific De-Inventory Report for Maine Yankee*, Report No.: RPT-3016127-002.

(potentially going beyond pairwise comparisons in some cases) in each MUA, and addressing uncertainties in the MUAs.

**Finding 2: The Board finds that the DOE-sponsored site evaluations provide a good opportunity for DOE to meet with onsite staff and discuss technical details, including SNF condition, anomalies, and canister loading maps.**

*Recommendation 2: During future site infrastructure evaluation visits, the Board recommends that DOE engage with site personnel and cask vendors regarding the NRC-approved transportation CoCs that apply to SNF in dry storage and assess whether the stored SNF will meet the requirements in the NRC-approved transportation CoCs. Site personnel and cask vendors who know the specific SNF contents for each storage canister and the approved contents for the transportation cask could potentially identify whether amendments or exemptions to the transportation CoCs will be needed prior to transportation.*

#### As-Loaded Analyses to Determine Transportability of Commercial SNF Canisters using UNF-ST&DARDS

DOE, through its national laboratories, has been using UNF-ST&DARDS—which provides an SNF database and integrated analysis tools—for assessing dose limits and criticality safety for as-loaded commercial SNF canisters. These analyses differ from the analyses conducted to support NRC approvals of SNF storage and transportation in that the former analyses use realistic (as-loaded) SNF parameters (e.g., initial loading of uranium, burnup, cooling time, axial power distribution) while the latter analyses use bounding (conservative) values for parameters that affect doses and criticality.

DOE initiated these new analyses in an effort to find a solution to known dose rate and criticality safety challenges regarding currently loaded canisters holding commercial SNF. For example, while these SNF canisters are approved by the NRC for safe and secure storage, some of the canisters are known to contain types of SNF that will not allow the canister to meet the dose rate or criticality safety requirements for transportation, as documented in the corresponding CoC for transportation (Clarity et al., 2017).<sup>15</sup>

A staff member at PNNL explained how UNF-ST&DARDS is being used to determine the number of SNF canisters at storage sites that cannot meet the transportation CoC requirements (the so-called “cannot ship list”), pursuant to Title 10, Code of Federal Regulations, Part 71 (10 CFR 71), without NRC-approved amendments or exemptions to the CoCs. Particular CoC requirements that can be challenging for transportation are those for dose rates and criticality safety. Then, using realistic parameter values (rather than conservative bounding values) for commercial SNF as well as some assumptions about applying “burnup credit,” PNNL presented several analyses demonstrating that many (but not all) of the affected SNF canisters can meet the dose rate and criticality safety requirements for transportation. These analyses would have to be

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<sup>15</sup> Clarity, J.B., K. Banerjee, H.K. Liljenfeldt, W.J. Marshall. 2017. “As-Loaded Criticality Margin Assessment of Dual-Purpose Canisters Using UNF-ST&DARDS.” *Nuclear Technology*, 199:3, 245–275, September 1.

formalized, submitted to the NRC as part of new CoC amendments, and then reviewed and approved by the NRC to allow transportation of the affected SNF canisters.

DOE representatives also described plans to conduct validation and uncertainty quantification work, as well as the path for commercialization of UNF-ST&DARDS. An important issue is the accuracy of the UNF-ST&DARDS base data and the derived parameters. Remaining data limitations (e.g., characteristics of damaged fuel and reactor side information) and analysis assumptions may limit the fidelity of the calculations performed to date. The Board plans to follow up with DOE on its efforts to verify and validate UNF-ST&DARDS.

As discussed by NRC in a previous Board meeting in June 2018,<sup>16</sup> there may be some technical difficulties with meeting the 10 CFR Part 72 requirements for SNF storage following the transportation of SNF, governed by 10 CFR Part 71. For example, 10 CFR 72.122(h)(1) requires the licensee to demonstrate that the SNF cladding can meet its intended confinement function (i.e., protected against gross rupture) before storage, and if not, the SNF must otherwise be confined (e.g., be placed inside a can for damaged fuel). In practice, it is unclear how the licensee will demonstrate adherence to this requirement when the SNF arrives at a new storage site following transportation (inside a welded canister).

In a future fact-finding meeting or public meeting, the Board looks forward to hearing more in-depth information on how data and information is being updated in DOE's various systems analysis and data integration tools, and how DOE's analysis results and preferences for SNF management strategies address and could be impacted by conditions other than the best-case (or near-best case) assumptions DOE often uses.

**The Board commends DOE for sponsoring the as-loaded analyses needed to understand which commercial SNF canisters can meet the requirements of the corresponding transportation CoCs and which cannot, without an NRC-approved amendment or exemption to the CoC.**

**The Board observes that access to UNF-ST&DARDS would be valuable to the nuclear industry for analyses of SNF canisters for loading, storage, and transportation scenarios.**

**Finding 3: The Board finds that DOE can enhance its IWM system planning by engaging early with the NRC regarding the need for amendments or exemptions to the transportation CoCs for SNF canisters that do not currently meet the CoC requirements.**

*Recommendation 3: The Board recommends that DOE work with the NRC to identify the number and scope (including potential technical challenges) of amendments or exemptions to transportation CoCs that will be needed to allow the transportation of the affected SNF canisters.*

**Finding 4: The Board finds that there may be some technical difficulties with meeting the 10 CFR Part 72 requirements for SNF storage following the transportation of SNF,**

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<sup>16</sup> Darrell Dunn, NRC, presentation at June 13, 2018 public Board meeting, "NRC Perspective on a National Program to Transport Spent Nuclear Fuel and Radioactive Materials," available at: <https://www.nwtrb.gov/docs/default-source/meetings/2018/june/dunn.pdf?sfvrsn=4> (last accessed 8/24/2023).

**governed by 10 CFR Part 71. For example, 10 CFR Part 72 requires the licensee to demonstrate that the SNF cladding can meet its intended confinement function before placing the SNF into dry storage; but it is unclear how the licensee will demonstrate adherence to this requirement for SNF inside a welded canister.**

*Recommendation 4: The Board recommends that DOE expand its engagement with the NRC to understand the technical difficulties with respect to meeting the 10 CFR Part 72 requirements for storage following the transport of commercial SNF, subject to 10 CFR Part 71 requirements. Recognizing that the issues could be different and unique for each specific SNF cask loading and for each cask and canister design, this action should commence well in advance of starting a large-scale transportation campaign, such as one that DOE may start in support of a new federal interim storage facility.*