UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD
2300 Clarendon Boulevard, Suite 1300
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Dr. Monica Regalbuto
Deputy Assistant Secretary
Fuel Cycle Technologies
Office of Nuclear Energy
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585-0620

Dear Dr. Regalbuto:

On behalf of the U.S. Nuclear Waste Technical Review Board, I am pleased to provide comments on the draft report, *Gap Analysis to Support Extended Storage of Used Nuclear Fuel*, which was prepared by National Laboratory staff for the Used Fuel Disposition Campaign of the U.S. Department of Energy (DOE) Office of Nuclear Energy and issued on June 30, 2011.

As you know, the Board issued its report, *Evaluation of the Technical Basis for Extended Dry Storage and Transportation of Used Nuclear Fuel*, in December 2010. In it, the Board recommended that a number of topics related to the safety of spent nuclear fuel (SNF) after extended dry-cask storage and subsequent transportation of the SNF be addressed in future research. The lack of data related to the storage and transportation of high-burnup SNF was noted in particular. The Board believes that the draft *Gap Analysis* report identifies issues that should be addressed in establishing a technical basis for safe extended dry-cask storage and retrieval of SNF and, in general, sets appropriate research priorities for resolving the issues. More-detailed comments and Board recommendations are presented in the following paragraphs.

The Board understands the utility of the approach used in the draft *Gap Analysis* report for assigning research-priority designations of low, medium, or high to identify the essential and urgent data gaps. However, the Board considers it important that the methodology, including the priority-setting process, be applied to the important technical questions. The Board notes that the transportation element of SNF management was not included in this gap analysis; thus we look forward to a similar assessment of research needs for transportation of SNF in an integrated research program covering both storage and transportation.

Our review of the draft *Gap Analysis* report indicates that the significant research priorities identified in the Board report relating to degradation mechanisms and "cross-cutting" research needs[1] were designated in the draft *Gap Analysis* report as medium or high research

[1] For example, the "cross-cutting" needs for determining fuel-temperature profiles over time, better quantifying the amount of residual water present after drying, carrying out additional cask-demonstration and fuel-inspection projects with representative dry-stored fuel, developing concepts for fuel-transfer options, and developing advanced monitoring and instrumentation of casks.

priorities. The Board is interested in learning more about why the delayed hydride cracking degradation mechanism was set as a medium and not a high research priority.

The Board agrees with the high priority assigned in the draft *Gap Analysis* report to developing the technical basis for taking burnup credit.[2] This crosscutting issue plays a very important role in all aspects of SNF management, including storage, transportation, and disposal.

The U.S. Nuclear Regulatory Commission and cask vendors currently depend on results from the CASTOR V/21 Dry Cask Storage Characterization Project[3] at Idaho National Laboratory for technical support in considering license extensions for dry-cask storage. The draft *Gap Analysis* report states that the CASTOR V/21 cask and fuel conditions differ in significant ways from those typical for fuel in dry storage. In particular: the fuel was loaded into the demonstration cask dry (and not in a SNF pool as is typical). Consequently, the cask did not require drying and did not have the large temperature swings that occur during vacuum drying; the retention of residual water after drying; and the loaded SNF had assembly average burnups of approximately 36 GWd/MTU, which is lower than is typical. The Board thus supports the caution stated in the draft *Gap Analysis* report that the CASTOR V/21 demonstration results may not represent the cask and fuel conditions of all the commercial fuel currently in dry-cask storage in the United States.

This situation underscores the need to carry out additional cask-demonstration and fuel-inspection projects. The Board supports the recommendation to reexamine the CASTOR V/21 cask and contents along with the REA-2023 cask system stored at Idaho National Laboratory. The Board also recommends examining other representative dry-storage cask systems or developing a cask-demonstration project where a number of representative fuel assemblies of interest (including various burnups) are placed in dry storage under typical storage conditions, followed by periodic inspection to monitor changes in the state of the fuel and the storage system's components.

The Board would like to make several related recommendations. The Board report points out the importance of characterizing SNF before dry storage to establish a baseline against which to monitor changes in fuel condition during drying and extended storage. The Board recommends that a sample of representative fuel assemblies of various burnups be characterized to the extent possible before they are loaded in different casks. The casks then should be opened and inspected periodically during the storage period at a facility capable of such inspections to identify changes from the baseline conditions.

The Board report also discusses the possibility of degradation mechanisms that interact or mechanisms that may occur simultaneously. Because coupled effects are difficult to model or fully anticipate this is another reason for opening and examining representative dry-storage systems periodically. In addition to investigating the work on storage gap analysis being done in other countries, the Board encourages DOE to collect international data on SNF that has been stored in casks or canisters and examined after periods of storage to develop a more complete

[2] Burnup credit was beyond the scope of the Board Report.
[3] After more than 14 years of dry storage, when the CASTOR V/21 cask was opened, almost no degradation of PWR fuel rods, cask, or internal cask parts was observed.

centralized database of the condition of stored SNF and storage systems. The collection of the international database might affect the research needs and priorities.

The Board notes that the draft *Gap Analysis* report identifies a degradation mechanism involving cladding oxidation that occurs during high-humidity conditions in the cask. The draft *Gap Analysis* report indicates that a high-humidity condition could be caused by insufficient drying before cask sealing, the loss of helium cover gas and subsequent replacement with humid air, or mistaken filling with humid air. Not clear from the discussion in the draft *Gap Analysis* report is which scenarios are considered likely to lead to the potential fuel-side cladding degradation in storage systems. In its report, the Board emphasizes the importance of ensuring the presence of the helium cover gas to limit degradation mechanisms and recommends the development of technologies for monitoring the presence of helium in the canisters or casks over time. Accordingly, the Board supports research by DOE to quantify the amount of residual water that remains in casks after drying and to develop and implement new monitoring instrumentation. When monitoring instruments become available, they could be installed and tested as a part of the new characterization program for dry-cask storage.

The draft *Gap Analysis* report cites a number of references to the Board report and indicates that the Board report does not discuss degradation mechanisms for several named components located within welded casks or bolted containers. Although the Board report does not specifically address these mechanisms as individually applied to specific components, it does consider them in the discussion of general categories of metal and nonmetal internal components of a dry-storage system. The Board notes and endorses the need to investigate these degradation mechanisms separately for distinct types of internal cask components as is done in the draft *Gap Analysis* report.

Finally, the Board understands that a revision of the draft *Gap Analysis* report is planned for FY 2012 that will include identification of research priorities related to transportation of SNF following extended storage. The FY 2012 revision also will include a more comprehensive evaluation of technical issues raised in gap-analysis reports issued by the NRC, EPRI, the Board, and other organizations. The Board looks forward to the opportunity to review those future revisions to the draft *Gap Analysis* report and supports DOE in identifying the research and priorities necessary to develop an improved safety case for extended dry-cask storage, retrieval, and transportation of SNF.

Sincerely,

{Signed by}

B. John Garrick
Chairman

cc:
Dr. Peter Lyons, Acting Assistant Secretary for Nuclear Energy
Dr. William Boyle, Director, Office of Used Nuclear Fuel Disposition, Research and Development