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

December 19, 2005

Mr. Paul M. Golan
Acting Director
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Mr. Golan:

On behalf of the Nuclear Waste Technical Review Board, I thank the Department of Energy (DOE) staff and contractors who participated in the Board's fall meeting on November 8-9, 2005, in Las Vegas, Nevada. The Board welcomed the opportunity to review technical and scientific issues currently important to the Yucca Mountain program. Furthermore, the members were pleased with the increased technical content of the presentations, which allowed the Board to explore many important issues more fully. The Board has organized the following comments in the order that the issues were discussed at the meeting.

Program Overview

The DOE has announced significant changes in the Yucca Mountain program that are intended to emphasize safety and reliability and to reduce the complexity of the surface facility design and waste handling operations. The most notable change is the decision to evaluate the development of the transportation, aging, and disposal (TAD) canister system. The Board believes that this system has the potential to address the Board's previously stated concerns related to excessive fuel handling (Board letter to Theodore Garrish, April 19, 2005). However, because nuclear utilities would be responsible for loading spent fuel into the TAD canisters at their power plants, selecting the "right" standard canisters for the TAD will require close cooperation and coordination between the DOE and the utilities. To ensure total system integration, the DOE should determine first-hand the compatibility of possible TAD designs with the capabilities for storage, handling, and transportation available at each reactor site.

The success of the TAD canister system also will depend on integration of the TAD concept into a waste management system that effectively balances preclosure safety and long-term repository performance and that is based on a viable and clearly defined thermal-management strategy. Such a strategy should establish the technical basis for waste acceptance, transportation, waste handling, and emplacement of waste. Thermal criteria should result in waste handling and facility operations that are safe, flexible, reliable, and simple. In addition, key goals of a thermal-management strategy should be to enhance understanding of post-closure near-field and in-drift conditions and to ensure that these conditions do not affect adversely the long-term performance of both the natural- and engineered-barrier systems. Because of the importance of the thermal-management strategy for the entire waste management system, a

group of outside experts should review the strategy periodically during its development, just as experts have reviewed the DOE's Total System Performance Assessment (TSPA).

Science Update

As usual, the Board found the science update particularly helpful; it is apparent that progress has been made since our last meeting. It seemed clear from the presentation that many large-scale, long-term tests are about to be concluded. The Board believes that much can be learned from post-test characterization, including a better understanding of some of the anomalies that have occurred and refinement in the current interpretation of test results. For example, data from the Drift-Scale Test should be used to evaluate near-field thermal-chemical-hydrologic effects. Similarly, other tests conducted behind the bulkheads in the Enhanced Characterization of the Repository Block drift and in infiltration-testing alcoves also have the potential to provide important supplemental information. It is important to complete and fully assess post-test characterization.

The Board continues to support testing in the unsaturated and saturated zones at Yucca Mountain to understand better the contribution of the natural system to repository performance. Understanding of the natural barriers at Yucca Mountain, especially over geologic time, can be increased with studies of natural analogs. For example, the Peña Blanca analog site continues to provide highly relevant data related to radionuclide migration and retention processes at Yucca Mountain. The Board encourages the DOE to continue the studies at the Peña Blanca site.

Thermal conductivity of the rock at Yucca Mountain is of fundamental importance in predicting thermohydrologic conditions in the proposed repository and the tunnel conditions that waste packages will encounter. Uncertainty in thermohydrologic conditions, especially during the thermal pulse, arises in part from the scarcity of *in situ* measurements of thermal conductivity over the range of predicted repository temperatures in the lower lithophysal rocks of the repository horizon. More thermal conductivity data collected in the repository rocks under predicted repository conditions can help reduce thermohydrologic uncertainty and thus improve predictions of long-term repository performance.

Fundamental understanding of the nature of the source term—including spent fuel oxidation, dissolution, and transport—is very important for predicting repository performance. The DOE presented experimental data on spent fuel alteration where Np-U co-precipitation did not occur. Those data suggest that Np transport may not be significantly delayed by co-precipitation. Furthermore, drip-test data show Np concentrations that are not necessarily at Np solubility limits, and thus do not strongly support the assertion that the Np solubility curves used in TSPA are conservative. Continued efforts to achieve greater understanding of the source term are important, and the Board is gratified to see this area emphasized in the portfolio of studies sponsored by the Office of Science & Technology and International.

Conspicuous by its absence was a status report on DOE efforts to determine the source of discrepancies among Cl-36 studies. Inconsistencies in past DOE studies of Cl-36 in Yucca Mountain create questions about the technical basis of model predictions of water flow and radionuclide transport. The Board looks forward to an update on DOE efforts to address these discrepancies and the possible presence of fast flow paths in the unsaturated zone.

Drip-Shield Design

The DOE provided a comprehensive briefing in response to Board questions about the metals selected for drip-shield fabrication and the potential degradation of the drip shield as a result of corrosion. The Board will evaluate the substantial volume of information on drip-shield configuration, drip-shield emplacement, possible deformation—due to creep—of the drip-shield material under load, and environmental and mechanical degradation. The Board notes that a subsequent presentation by the State of Nevada raised issues about restrictive in-drift operational envelopes and installation tolerances that could potentially increase the difficulty of installing the drip shields remotely.

Because drip shields will not be installed until just before repository closure, which will be many years after waste emplacement, the DOE should evaluate now what factors will affect the final design of the drip shield and explain how, when, and by whom decisions about drip shield emplacement will be made.

Localized Corrosion of the Waste Package

The Board has continuing concerns about the DOE's technical basis for screening out deliquescence-based localized corrosion of the waste package's Alloy 22 outer barrier from Total System Performance Assessment for License Application (TSPA-LA). The Board is especially concerned about the potential for localized corrosion in deliquescent brines formed between 160ºC - 220ºC from airborne dust that will be deposited on the surface of the waste packages. Although the most recent corrosion data at these temperatures were alluded to, they were not presented or discussed at the meeting. The Board wants to evaluate the significance of the new data and looks forward to receiving them from the DOE as soon as possible.

The Board believes that evidence presented at the meeting supporting the screening out of deliquescence-based localized corrosion from TSPA-LA was not compelling, primarily for two reasons: First, no corrosion data were presented for temperatures above 150ºC. Second, data showing stifling of localized corrosion at considerably lower temperatures may or may not be relevant to all conditions under which localized corrosion could occur in the proposed repository. The Board is assessing further the significance of the information presented by the DOE and expects to hold a corrosion workshop to discuss these important issues.

Total System Model (TSM)

The Board believes that the TSM has significant potential as a tool for understanding better the performance of the waste management system. However, it is very important to the success of the model that it incorporates the most up-to-date information (e.g., the availability of spent fuel and on-site waste handling equipment) and that the quality of all input data and assumptions is confirmed. For this reason, the Board recommended earlier in this letter that the DOE determine first-hand the compatibility of possible TAD canister designs with the storage, handling, and transportation capabilities available at the power plants. The Board also

recognizes the potential of the TSM as a valuable tool in preparing the preclosure safety analysis and in addressing important issues related to movement of spent fuel through the waste management system.

The Board would like to understand fully the capabilities and limitations of the TSM in conducting probabilistic assessments, optimizing the waste management system, and analyzing "what if" operational scenarios (e.g., how the waste management system would operate under normal, marginally normal, and off-normal conditions). In addition, the Board would like to know the role that the TSM played in the decision to pursue the TAD canister concept, in particular, the implications of the TAD system for dose, thermal management, and waste handling. We look forward to hearing from the DOE about insights that have been gained as a result of TAD-related studies and analyses.

Conservatism in TSPA-LA

The DOE believes that uncertainties related to TSPA-LA have been addressed using multiple conservatisms and a "cautious but reasonable" approach. However, the DOE does not seem to know the extent to which TSPA-LA is conservative overall. The Board believes that levels of conservatism associated with different components of TSPA-LA vary significantly and that TSPA-LA is, in general, unrealistic. The use of multiple conservatisms (and some non-conservatisms) may mask effects and obscure fundamental understanding of how the engineered and natural barriers would work together as a system to isolate waste. As a result, important constituencies (i.e., the public, the scientific community, and policy-makers) are deprived of meaningful information on which to base their opinions and judgments. The DOE's contention that conducting sensitivity analyses of TSPA-LA would enhance system understanding has limited validity, in the Board's view, because the effects of parameter and model changes related to one component of the system or subsystem may be masked by assumptions about other components of the system or subsystem.

The Board believes that in addition to its compliance case, the DOE should develop in parallel a realistic analysis of repository performance based on the assessments by project scientists of how the repository would behave. Such an analysis would be invaluable for fundamental understanding, for informing key constituencies, and for building confidence in the DOE's estimates of repository performance.

Thank you again for the DOE's support of this meeting.

Sincerely,

{Signed By}

B. John Garrick
Chairman