



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

November 22, 2002

Dr. Margaret S. Y. Chu
Director
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Dr. Chu:

On behalf of the Nuclear Waste Technical Review Board, I thank you for participating in the Board's meeting on September 10, 2002, in Las Vegas, Nevada. We appreciated your program overview and were pleased that you were able to stay for so much of the day's proceedings. Board members, especially the new members, found the technical presentations by individuals from the Department of Energy (DOE) and its contractors very useful. Members also feel that the field trip to Yucca Mountain was a valuable experience. The Board realizes that the high quality of the meeting and the site visit was due in great part to the effort put forth by your team.

The DOE is entering a new phase of its activities as it prepares an application to the U.S. Nuclear Regulatory Commission (NRC) for constructing a repository at Yucca Mountain. The Board's role, however, has not changed from what was envisioned by Congress in the 1987 Nuclear Waste Policy Amendments Act. It will continue to carry out a broad scientific and technical review of the DOE's work and will make recommendations on improving the technical defensibility of that work.

In that light, the Board presents in this letter its views on three areas covered at the meeting and, where appropriate, references your letter September 6, 2002, to the Board. The three areas are (1) the DOE's technical analyses of the potential repository's natural system, (2) the DOE's technical analyses of the potential repository's engineered system, and (3) the DOE's integration of the potential repository's natural and engineered systems.

Natural System

The Board believes that the interim report of the DOE-supported Yucca Mountain Igneous Consequences Peer Review Panel is a significant accomplishment and that the panel has made progress in defining the fundamental processes. This work is very important because on

the basis of the most recent performance assessment, volcanism appears to be the largest potential contributor to dose. For this reason, the Board waits with interest for the panel's final report.

The Board also is pleased that one of the priorities you have given the new Science and Technology unit is to determine whether the potential repository's natural system makes a greater contribution to isolating and containing waste than current performance assessments suggest. If a *strong technical case* can be made for such an increased contribution, it would provide additional defense-in-depth, thereby increasing confidence that public health, safety, and the environment would be protected over the longterm. For this reason, the Board believes that work in this area could have a major payoff and suggests that it be accelerated.

For nearly two years, the DOE has been trying to explain two conditions that have been observed at Yucca Mountain. The first involves two independent laboratory analyses that result in contradictory data with respect to the presence of bomb-pulse chlorine-36 at the repository horizon. The second condition involves moisture observed within the closed-off part of the cross-drift and whether this moisture is due to condensation or infiltration. To date, the DOE has not provided a persuasive explanation for either of these two conditions.

The Board strongly urges the DOE to continue its efforts in these two areas and looks forward to reviewing the work in the near future. The Board believes that it is essential that the DOE develop an understanding of key processes affecting repository performance, specifically seepage and the potential for waste package corrosion when packages are subjected to a range of conditions representative of the postclosure in-drift environment.

Engineered System, Including Repository Design

The Board has reviewed your letter of September 6, 2002, and the DOE presentations on repository design at the Board's May and September meetings. Still unclear to the Board are what decisions the DOE has made about repository design. However, in your September 6, letter and the DOE presentations, the DOE appears to have decided to seek a license for constructing a repository based on a design "*... that results in thermal conditions at the higher end of the expected range, provides a better balance of postclosure thermal conditions and preclosure advantages for construction and operations, flexibility and cost.*" We request that the DOE provide the Board with the criteria, analyses, and weighting factors that constitute the technical basis for the apparent selection of the repository design as stated in your September 6, letter.

According to the DOE presentation made at the September Board meeting, the DOE's design decision seems to be supported by the following two conclusions: (1) projected performance for the high-temperature design is comparable to a low-temperature design and, in any case, is well below the regulatory limit; and (2) *overall* uncertainty in the projected performance of the two designs is roughly equivalent. In response to the DOE's decision, the Board has several comments on the technical basis for these assertions.

The DOE's presentation on corrosion testing may call into question the first conclusion. The increase in corrosion potential due to the presence of nitrate leads to less of a margin at

temperatures above 140°C. Moreover, in back-up material from the presentation, the short-term weight-loss measurements based on linear polarization, when extrapolated to higher temperatures, show a significant increase in the rate of corrosion and indicate a definite thermal dependency that is not reflected in current models of performance assessment. The Board encourages continued corrosion testing and analysis supporting *basic understanding* of waste package corrosion and the in-drift environment.

Regarding the second conclusion, the DOE asserted at the meeting that performance assessment shows that the ranges of dose uncertainty for high- and low-temperature repository designs are similar. The Board notes that performance assessment is not capable of showing uncertainty unless the models appropriately incorporate uncertainty. Some parts of some key performance assessment models for the evolution of waste package environments and for corrosion at high temperatures are not based on data but on a number of *assumptions*. For example, TSPA assumes that there will be no liquid water above 120°C and no significant separation of chloride ions from beneficial anions and that low-temperature corrosion models are valid at high temperatures. To use these assumptions about high-temperature uncertainties as input into TSPA models and then say that performance assessment reveals that uncertainties are equivalent for high- and low-temperature operations constitute, in the Board's view, circular and therefore faulty reasoning.

The Board has noted for quite some time that the DOE's estimates of the total uncertainty in projected repository performance presume that the underlying conceptual models used to analyze both the low-temperature design and the high-temperature design are appropriate. For example, the models should capture relevant thermal sensitivities in a technically defensible manner. Many experiments, such as the drift-scale thermal test and additional high-temperature material investigations, have not been completed. Thus, the DOE's second conclusion may be premature.

Integrated Repository System

The Board understands that the DOE realizes that the repository safety case not only must rely on complex calculations of performance assessment but also must include multiple lines of evidence and argument, which could include natural and man-made analogues and traditional notions of defense-in-depth. The Board also supports the DOE's recognition that the safety case needs to address various audiences, including those not directly involved in the licensing process. International organizations, such as the Nuclear Energy Agency of the Organization for Economic Cooperation and Development, have assembled reports on this subject. The Board recommends that the DOE give serious consideration to the logic developed in those reports as well as the specific suggestions they contain.

Presentations at the meeting and the short roundtable discussion at the end of the meeting highlighted several points. The DOE's projections of repository performance, derived from performance assessment, have varied considerably over the last two years and differ in many important respects from those carried out by the Electric Power Research Institute and other groups. Many of these differences can be traced to the assumptions used and the influence of new data. However, confidence in these projections will depend in part on understanding and

explaining clearly why variations arise. The Board therefore urges the DOE to analyze the different estimates, assess their significance, and address any concerns that may arise about the overall uncertainty in estimating repository performance. The stability of these projections is an important element in building confidence.

The Board is pleased that the DOE has carried out the “one-on” barrier analysis. The roundtable discussion on this topic at the meeting suggested both the value and the potential limitations of such analyses. On balance, however, the Board believes that such analyses utilizing different approaches can provide important insights into the roles of the different natural and engineered barriers. For that reason, the Board urges the DOE to continue supporting this kind of work and to consider using it to better articulate its repository safety case.

The Board still has questions about the relative role and scope of the DOE’s proposed research and development, science and technology, and core science programs. As indicated in the DOE’s letter, the scope of performance confirmation (PC) is limited to a regulatory context. The Board believes that a PC program should focus on confirming the safety case by challenging the validity of estimates of long-term repository performance and their underlying assumptions. The Board would like to understand the key elements of the DOE’s PC plan; the specific tests and related analyses considered a priority for the PC plan for license application; the testing that will be undertaken during repository construction; and how PC information will be integrated and used by the project.

The Board believes that the DOE’s commitment to “jump-starting” transportation planning and activities is imperative, in particular the DOE’s recognition of the need to reactivate institutional activities to address the concerns of the State, Tribes, and affected counties.

Once again, I thank you, the DOE staff, and the DOE’s contractors for supporting the Board’s September meeting. The Board looks forward to continuing to review and comment on DOE activities.

Sincerely,

{Signed by}

Michael L. Corradini
Chairman