



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

June 30, 2003

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:

The Board thanks you and the rest of the Yucca Mountain Project team for participating in the Nuclear Waste Technical Review Board's May 2003 meeting in Washington, D.C. The meeting was extremely productive and informative. The first day's presentations were comprehensive, well integrated, and thought-provoking; the two large charts were especially useful integrating tools. The Board valued the extended question-and-answer periods, which allowed presenters to explain thoroughly the rationale for their conclusions. The extra effort that went into preparing these presentations was evident and, in the Board's view, worthwhile. The Board also found interesting the insights provided by you and your deputy director, John Arthur, particularly the comments related to the management challenges facing the civilian radioactive waste management program.

In this letter, the Board provides some initial reactions to the Project's technical presentations at the May meeting. The letter also conveys the Board's views on the *Final Report* of the Igneous Consequences Peer Review Panel. Last, the letter offers the Board's thoughts on the natural analogue studies being conducted by the DOE at Peña Blanca.

### **Initial Board Reactions to Presentations by the Project at the May Board Meeting**

The Board continues to believe that the concept of a "safety case," which is endorsed strongly by virtually all the major nuclear waste management programs abroad, has considerable merit. In fact, during the meeting, Project scientists were able to verbalize why they believe that a Yucca Mountain repository would isolate and contain waste effectively. An updated written narrative description similar to those oral comments would make the Project's approach to ensuring safety more transparent and understandable.

The first day of the meeting was structured to allow the Project to describe the thermal aspects of the current repository design and operating mode, how the thermal aspects have been analyzed, and the results of those analyses. In response, the Project delivered three major presentations related to in-drift thermohydrology, in-drift thermohydrochemistry, and Alloy-22

corrosion. The subjects presented are critical for predicting the potential repository's overall performance. Other factors relevant to performance, such as drift degradation and the thermal properties of the lower lithophysal unit, however, were not addressed fully. The Board's initial reaction is that potentially significant questions remain about the technical basis for the Project's thermal analyses. These questions include concerns about the initiation of localized corrosion and the technical basis underlying Project claims about capillary and vaporization barriers. The Board is in the process of carefully evaluating the DOE's presentations from the May Board meeting and will be preparing more detailed comments for the DOE on these subjects.

The Board is pleased that the Project is committed to sponsoring long-term research on "outside of the box" scientific and technical issues. It is not yet clear, however, how data and analyses from the Science and Technology Program will be integrated into the license application process or the performance confirmation effort mandated by the Nuclear Regulatory Commission.

### **Board Views on *Final Report of Igneous Consequences Peer Review Panel***

At the May meeting, a member of the Igneous Consequences Peer Review Panel (Panel) presented the Panel's findings from its *Final Report*. In the Board's view, the Panel has made an important contribution to the assessment of the consequences of igneous activity at Yucca Mountain. The DOE and its contractors deserve credit for initiating and supporting this effort. The Panel's *Final Report* shows evidence of both independence and high technical quality. Much original work was conducted. Detailed reviews of the Panel's work by Board consultants can be found on the Board's Web site: [www.nwtrb.gov](http://www.nwtrb.gov).

The Panel agreed with much of the DOE's approach (e.g., the overall conceptual model of a rising dike intersecting waste emplacement drifts and localizing into a volcanic conduit that reaches the surface), but the Panel also recommended improvements. Because of the significance of the igneous issues, the Board recommends that the DOE give the most emphasis to three areas.

- The first area is the use of upgraded modeling techniques that take into account conditions such as compressible inviscid flow that may be present at repository depth. Past models based on incompressible flow may not give a true picture of dike behavior and magma-drift interaction. Such modeling also would help evaluate the likelihood of the so-called "dog leg" scenario as proposed by Woods and others in their 2002 article, *Modeling magma-drift interaction at the proposed high-level radioactive waste repository at Yucca Mountain, Nevada*. The Board concurs with the Panel that the likelihood of the generation of strong shock waves, as proposed by Woods and others, is negligible.
- The second area is the need to study aeromagnetic anomalies in the vicinity of Yucca Mountain that could signify buried volcanoes. Such studies may involve additional aeromagnetic surveys (at appropriate altitudes); drilling; and dating, which could help determine the existence, age, and volume of the possible volcanoes.

- The third area is the need to address subjects that were not within the range of the Panel's expertise, i.e., waste package-magma interaction and waste entrainment in both the volcanic eruption scenario and the groundwater release scenario. The Panel confined itself to evaluating magma-drift interaction in the volcanic eruption scenario. These subjects are of great importance in any consequence analysis. The DOE should address them using the advice of outside reviewers. The DOE also should consider experimental studies for analyzing and verifying key phenomena and parameters (e.g., chemical and mechanical effects of magma on waste packages).

In all of these investigations, it is very important that the DOE maintain an integrated team of field experts, modelers, engineers, and performance assessment analysts. If, after considering the consequences and the risks posed to the public, the DOE decides to modify the repository design to mitigate the effects of igneous activity, such modifications would need to be evaluated in terms of their overall impact upon repository operations and performance.

### **Board Comments on Peña Blanca Natural Analogue**

At the meeting, two speakers touched on the Project's ongoing work at the possible analogue site at Peña Blanca in northern Mexico. Following the meeting, several Board and staff members visited Peña Blanca and observed the work first-hand. We are impressed with the progress being made.

The natural uranium deposits at Peña Blanca, particularly at the Nopal 1 site, form a unique natural analogue for many of the processes that would occur at the proposed Yucca Mountain repository. The uranium oxide deposit is in many ways similar to spent fuel. As at Yucca Mountain, it is located in oxidizing conditions in fractured, unsaturated welded tuff in a region of arid climate. There also are some important differences between Nopal 1 and Yucca Mountain, which Project scientists seem well aware of. The differences include the presence of some sulfates and iron in various forms at Nopal 1 and the relative lack of nonwelded-tuff layers. All in all, however, Peña Blanca offers the opportunity to test a number of the proposed models and assumptions underlying the DOE's analyses of Yucca Mountain and to examine alternatives to these models. They include, but are not limited to, models and assumptions related to waste form dissolution (the source term), unsaturated zone flow and transport, and the active fracture model.

The work at Peña Blanca can provide information for addressing important technical issues both in the short term and in the long term. The additional information that comes from studying this site could show that the repository system would perform better or not as well as current performance estimates now project. However, either way, these tests could increase understanding of the processes and their associated uncertainties. For this reason, the Board strongly recommends continued support for studies at this unique site.

Once again, the Board thanks you and the rest of the Yucca Mountain Project team for participating in the Board's May meeting. We look forward to continuing the Board's ongoing technical and scientific review and to commenting on Project activities in the future.

Sincerely,

A handwritten signature in black ink, reading "Michael Corradini". The signature is written in a cursive style with a large initial "M" and a long horizontal flourish at the end.

Michael L. Corradini  
Chairman