



UNITED STATES  
NUCLEAR WASTE TECHNICAL REVIEW BOARD

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

Dear Dr. Itkin:

On behalf of the Board, I would like to extend our appreciation for the presentations made by your staff and contractors at the Board's meeting held last month in Pahrump, Nevada. We were especially pleased that you were able to attend and participate in the gathering.

Although the meeting covered a wide range of topics, the presentations raised among Board members an interrelated set of impressions and observations. In particular, the Board notes that the Department of Energy (DOE) is still in the process of addressing key uncertainties and that new uncertainties continue to arise. The existence of these uncertainties, coupled with some of your own comments, suggests that the DOE is beginning to explore ways of systematically tying important milestones to the acquisition of critical information. For such an approach to be credible and effective, preserving flexibility and ensuring that the bases for decision-making are transparent will be important.

**Addressing Old and New Uncertainties.** We appreciated Jean Younker's presentation on thermally driven uncertainties. The presentation demonstrated that DOE scientists have a good grasp of the types of uncertainties that currently are present. The next step, important for the fast-approaching site recommendation by the Secretary of Energy, is to analyze and explain quantitatively the size and significance of those uncertainties for performance and how they vary with repository temperature. For example, the variations with temperature of uncertainties in generalized and localized aqueous corrosion rates of waste-package and drip-shield materials must be determined over the temperature range from ambient to at least the boiling point of water that contains highly concentrated dissolved salts. Similarly, quantifying uncertainties in variables and processes that pertain to fluid flow and transport in the repository rock over the temperature range from ambient to the maximum predicted temperature in the rock is very important.

Other uncertainties that had not been discussed previously with the Board also became evident during the meeting. One involves potential interactions between repository materials. An employee of the management and operating contractor (M&O), commenting from the floor, indicated that closely placed steel sets (ring beams) would be used throughout the emplacement

drifts for rock support. We are concerned about the adequacy of the corrosion database on the interaction of steel and its corrosion products with Alloy 22. We realize that steel sets rather than concrete drift liners were chosen for rock support because concrete might have deleterious effects on waste package performance. However, we have not seen the analysis indicating that steel would be less deleterious than concrete. Additional corrosion studies may be needed to determine whether current waste package designs are compatible with the environmental conditions that might result from the use of steel for rock support.

The Board also appreciated the information in the presentations by Bill Boyle of the DOE and Marc Caffee of Lawrence Livermore National Laboratory (LLNL). We were pleased as well by the candor of the subsequent discussions among the two presenters, June Fabryka-Martin of Los Alamos National Laboratory (LANL), and Board members. The Board realizes that much of the data discussed were obtained very recently and that the analysis of the data is just beginning. LLNL and LANL investigators appear to disagree about the presence of bomb-pulse chlorine-36 in a faulted and fractured area of the Exploratory Studies Facility and about the background ratio of the chlorine-36 to chlorine in that area. Because the presence of bomb-pulse chlorine-36 at specified locations within the ESF has been interpreted as evidence of fast paths for the infiltration of water to the repository level and the background ratio of chlorine-36 to chlorine has been used to estimate the age of the water in the rock, validating the chlorine-36 measurements is important. Perhaps of even greater importance is how this dispute could affect the credibility of the scientific program. Although differences in interpretation are quite normal and expected in science in general and in geology in particular, the standing of the program is not enhanced if these differences appear, as is presently the case, to be due to differences in sampling and processing techniques. In the Board's view, resolving the apparent disagreement should be a very high priority.

Predictions of performance that will be developed to support the Secretary's site recommendation will depend on the assumptions that the waste packages and drip shields can be manufactured with high reliability and will function as intended. Showing that these assumptions are true may take many years of research, development, and demonstration. Although complex designs may be justified under some circumstances, they often are the source of increased uncertainty. For example, the designs of the final closure end of the waste package and the connections between drip shields have become very complex over the last year or so. As a result, current performance assessment models do not capture well how water might elude the drip shields and cause stress corrosion cracking. Thus, the Board urges DOE to explore the possibility of simplifying the current designs for the repository, the waste package, and the drip shield.

Another significant area of uncertainty is the saturated zone flow-and-transport model. It may be possible to improve this model using geochemical information being collected by Nye County. In fact, Don Shettel's presentation included a substantial amount of geochemical data. The Board is looking forward to the interpretation of those data in the larger context of the geochemical and hydrological investigations of the regional groundwater system.

Of course, there are many other sources of uncertainty that will affect estimates of repository performance. As the Board has communicated to you before, meaningful quantification of the uncertainties associated with performance, clearly and understandably presented, is an essential element of performance characterization.

**Interpreting New Data Acquired Over Time.** In your prepared remarks to the Board and in the discussion that followed, you made reference to the reality that the Yucca Mountain project is unique in its long duration, its high degree of complexity, and the persistence of significant technical and institutional uncertainties. You alluded to the possibility of using a modular approach to design and proceeding in stages to develop a repository at Yucca Mountain. Although you did not specifically use the term, the process you seemed to outline appears to be an “evolutionary” one as opposed to one that tries to foresee and address in advance all potential contingencies.

The Board can appreciate why the DOE may think that this kind of evolutionary process may offer important advantages, especially given many of the singular characteristics of the Yucca Mountain project. The Board observes, however, that for such an approach to be technically credible and effective, the DOE would likely want to consider several prerequisites. For example, broad agreement would have to be reached on how to quantify and rank uncertainties that significantly affect performance, a program would have to be created to gather data designed to address key uncertainties, clearly stated benchmarks and criteria would have to be developed to evaluate uncertainty reduction, and a clear protocol for technical decision-making, including a bona fide exit strategy from the site if a fatal flaw were found, would have to be established.

Ric Craun's presentation suggested that the current repository design contains sufficient flexibility to allow for changes in repository design as new data are acquired. The chart he presented, which related ventilation time, "staging" time, and distance between waste packages to repository temperature, was very helpful. We agree that there is a great deal of operational latitude in the current design. In particular, the chart clearly shows that broad flexibility exists to implement the design as either a below-boiling or an above-boiling repository. The Board notes, however, that even more flexibility might be available if certain factors now held constant (e.g., spacing between drifts, age of fuel when received at the repository, ventilation efficiency) were allowed to vary.

On several occasions, the Board has commented to the DOE on the importance of carrying out technical analyses and making critical decisions in a manner that is highly transparent to the broad range of interested and affected parties involved in developing a potential repository at Yucca Mountain. The remarks made at the Board meeting by the representatives from the municipality of Oskarshamn, Sweden, suggest that the complicated development process can be carried out in a transparent fashion. Although it is unclear which, if any, lessons from Sweden might be applied in this country, it is clear that transparency has been and will continue to be an important requirement for this program.

Sincerely,

Jared L. Cohon  
Chairman