



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

March 30, 2001

Mr. Lake H. Barrett
Acting Director
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
1000 Independence Avenue, SW
RW-2/5A-085
Washington, DC 20585

Dear Mr. Barrett:

On behalf of the Nuclear Waste Technical Review Board, I would like to convey our reactions to the presentations made by the Department of Energy's (DOE) Yucca Mountain Project personnel at the Board's January meeting in Amargosa Valley.

Overall, the Board was pleased with the quality of the presentations. A wealth of information was conveyed succinctly. Difficult concepts and models were described clearly and in a manner that was easily understood by a broad range of listeners. In particular, the Board commends Gerald Gordon, Gudmundur Bodvarsson, Al Eddebbarh, Robert Andrews, and Paul Harrington, who responded directly and candidly to specific questions posed in advance by the Board. They were all instrumental in making the meeting a success. The Board anticipates using this new format at future meetings.

As you will recall, at the beginning of the meeting, I read into the record a statement of Board priorities. I noted that the Board

... has recommended that DOE focus significant attention on four priority areas dealing with managing uncertainty and coupled processes, which, in the Board's view, are essential elements of any DOE site recommendation.

- (1) Meaningful quantification of conservatisms and uncertainties in DOE's performance assessments
- (2) Progress in understanding the underlying fundamental processes involved in predicting the rate of waste package corrosion
- (3) An evaluation and comparison of the base-case repository design with a low-temperature design

(4) Development of multiple lines of evidence to support the safety case of the proposed repository. These lines of evidence should be derived independently of performance assessment and thus not be subject to the limitations of performance assessment.

In addition to these overarching priorities, the Board has made a number of suggestions about other investigations and studies that can support, complement, and supplement these four areas. Those investigations and studies include research on the unsaturated and saturated zones as well as work to make the performance assessments more transparent and informative. As the Board continues its review of DOE's technical activities, other elements essential to the site recommendation may be identified.

Although schedule considerations may preclude completing all work before the site recommendation decision, the Board believes it is reasonable to assume that the more those investigations have advanced, the more likely it is that the technical basis for the decision will be strengthened. In what follows, the Board comments on each area.

Meaningful Quantification of Uncertainties and Conservatism

The Board is pleased with the efforts made so far to quantify better the uncertainties and conservatism present in the performance assessments of the proposed Yucca Mountain repository. However, aside from the consideration of early failures of the waste packages, there seems to be no explicit consideration of possible differences that may evolve over time between performance of the engineered barrier systems as they have been designed and their performance as they actually may be built.

Progress in Increasing Fundamental Understanding of Corrosion Processes

The Board commends the project for developing a set of investigations that could lead to improved understanding of the fundamental processes relevant to waste package corrosion, especially the stability of the passive layer of Alloy 22. The Board is pleased that many of these investigations have started and encourages the project to begin the others as soon as possible and to expedite work in this area.

Evaluation and Comparison of Repository Designs

In its June 23, 2000, testimony before the House Subcommittee on Energy and Power, the Board observed: "Understanding the differences in estimated performance and associated uncertainties under different temperature conditions is an important component of our overall understanding of potential repository performance at the Yucca Mountain site." At its January 2001 meeting, the Board made its position more explicit when it called for an evaluation and a comparison of repository designs. We understand that work in this area has begun.

The Board is interested in obtaining an evaluation and a comparison of the base-case, high-temperature repository design with a low-temperature, ventilated design. Evaluating a possible low-temperature, ventilated design could clarify the advantages—and disadvantages—associated with keeping waste package temperatures below, say, 85° C. In particular, the Board believes that DOE should use performance assessment to evaluate a low-temperature, ventilated design concept. If necessary, performance assessment models should be modified to portray accurately the effects of temperature changes on performance. Associated levels of uncertainty in repository performance should be developed for both high- and low-temperature design concepts. The Board realizes that DOE also may want to examine other design-related considerations, including licensability, operations and logistics, flexibility, cost, etc. The more technically defensible and quantitative the evaluation and comparison, the more useful it will be for policy-makers.

Development of Multiple Lines of Evidence

The project's latest revision of its *Repository Safety Strategy* appears to be an improvement over the previous iteration. As was observed in the project's presentation, however, more work needs to be done to identify or develop multiple lines of evidence to supplement and support the safety strategy. The Board is encouraged that the project recognizes the importance of this work and is pleased that the Board and the project will be holding a public meeting on April 13, 2001, in Arlington, Virginia, to explore specifically what further steps might be taken.

Other Issues

The Board also has some specific reactions to several of the presentations (listed here generally in order of increasing specificity).

- The Board is concerned that project descriptions of short-term testing are not cast broadly enough. Testing plans mostly appear to be directed at developing better parameter estimates for performance assessment. Although better parameter estimates are necessary, the Board also would like to see testing of fundamental scientific concepts, particularly when such tests can challenge accepted models. Moreover, the project should specify better what it would do with the results of its tests.
- The project's development of a long-term, comprehensive "test and evaluation" plan is a step in the right direction. The plan, however, appears to be very general in nature. The Board believes that a much more detailed and well-integrated plan would significantly enhance the quality of the site recommendation decision. Such a plan, among other things, should detail how testing after repository closure would occur, including relevant monitoring activities.

- The project recognizes the importance of incrementally adjusting proposed repository design and operations in response to new technical information. Such a strategy makes sense, and indeed, the Board encourages the program to continue thinking along these lines. However, the implementation of such an incremental learning and adjustment process is neither easy nor straightforward. The Board looks forward to hearing more from the project about this issue in the future.
- The project needs to continue efforts to reconcile the conflicting chlorine-36 findings. Because DOE seems to believe that the conflict results from different sample-preparation methodologies, the project should develop a technically defensible strategy, implemented in a sound, peer-reviewed process, for deciding which methodology is more appropriate for the problem being investigated and for identifying which findings are more valid.
- The Board is pleased that the project will be undertaking a peer review of the performance assessment used in the site recommendation decision as well as a peer review of the project's material testing plans.
- There is still some confusion about "degraded" and "neutralized" barrier studies and about the consistent application of these terms to the different components of the repository system. The project should reexamine these studies and consider implementing an approach recommended in the Board's September 20, 2000, letter to Dr. Ivan Itkin. Under such an approach, the analysis would start off by estimating the dose, assuming that the radioactive waste is lying exposed at the earth's surface. Individual elements of the geologic and engineered systems then would be added, and resulting dose estimates would be calculated until the repository system reaches its completed form.
- Questions remain about the compositions and corrosion effects of electrolytes that may form on waste package surfaces. The Board urges the project to continue its investigations in this area and to ensure, in particular, that electrolytes chosen for future testing represent environments derived from repository pore water (as opposed to J-13 water) in its evolved state. That evolved state includes the effect of thermally driven processes caused by the decay heat from the waste and interactions with condensate, seepage, dust that may settle on waste packages during ventilation, and the engineered system materials themselves. The Board also reiterates its belief that long-term projections from performance testing in model solutions must be supported by sound mechanistic understanding, including theoretical development and experimental evaluation of theories.

In conclusion, the Board appreciates the project's responsiveness to its concerns, especially considering the importance of rapidly approaching project milestones. The Board looks forward in the next few months to commenting on specific project plans for additional technical studies and to interacting productively with project personnel.

Sincerely,

{Signed by}

Jared L. Cohon
Chairman