



UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD
2300 Clarendon Boulevard, Suite 1300
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March 20, 2000

Dr. Ivan Itkin
Director
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
1000 Independence Avenue, SW, RW-2/5A-085
Washington, DC 20585

Dear Dr. Itkin:

On behalf of the Nuclear Waste Technical Review Board, please let me thank you and your staff and contractors for participating in the Board's January 2000 meeting, which all members felt was productive and stimulating. We were particularly pleased that you were able to attend and participate in the meeting.

In your remarks to the Board, we noted your intention to maintain the DOE's current schedule for evaluating the suitability of the Yucca Mountain site. According to that schedule, the Secretary of Energy will decide in less than 18 months whether to recommend the site to the President. The DOE's scientific program has amassed a considerable body of knowledge to date, and additional efforts in the scientific program during the next year and a half will augment that body of knowledge. Despite the large amount of work, however, significant technical uncertainties will still be present at the time of the Secretary's decision. A central theme of the January meeting was the challenge of describing uncertainties in ways that will be meaningful in the decision-making process. This letter gives the Board's views on four aspects of uncertainty relating to: repository safety strategy, repository design, scientific studies, and communication.

Repository Safety Strategy. The repository safety strategy presented to the Board recognizes the importance of describing uncertainties as part of the postclosure safety case. The strategy proposes five ways of addressing uncertainty:

1. Quantification of repository performance in a performance assessment (PA).
2. Mitigation of uncertainties through safety margin and defense-in-depth.
3. Consideration of potentially disruptive processes and events.
4. Insights from studying natural analogues.
5. Long-term reduction of uncertainties through a continuing program of testing and performance confirmation until permanent closure.

In a separate letter on the DOE's Part 963 rulemaking (dated March 20, 2000), we note that the Board continues to endorse the use of PA, along with other supporting lines of evidence and reasoning, for making a site-suitability determination. At the same time, the Board believes

that addressing PA's uncertainties and the sources of these uncertainties as clearly as possible is essential for technical credibility and sound decision-making. Therefore, the Board recommends that the DOE include in its representation of performance uncertainty a description of critical assumptions, an explanation of why particular parameter ranges were chosen, a discussion of possible data limitations, an explanation of the basis and justification for using expert judgments (whether or not they are elicited formally), and an assessment of confidence in the conceptual models used. In addition, the Board recommends that the uncertainties associated with the performance estimates be identified and quantified well enough so that their implications for the performance estimates can be understood. This analysis also would help the DOE demonstrate the safety-margin component of the postclosure safety case described in the latest revision of *Repository Safety Strategy*.

The Board believes that PA should not be used as the sole source of guidance about the features, events, and processes that might affect long-term repository system performance. Multiple lines of argument and evidence—combined with a clear and complete description of uncertainty—will present a much more technically defensible demonstration of repository safety than will any individual component of the safety case. The Board urges the DOE to keep this perspective in mind as the program moves forward.

In developing the repository safety strategy, sensitivity analyses were among the considerations used by the DOE to identify the seven “principal factors” that most strongly affect the postclosure safety case. As indicated above, performance assessment is only one element of the safety case. We urge the DOE to ensure consideration of all elements of the safety case, including defense-in-depth, in defining principal factors.

The principal factors apparently will be the focus of much of the DOE's scientific studies in the future. The Board's understanding is that current performance assessment models may not adequately describe the interactions of heat, water flow, chemical reactions, and mechanical disturbances within the rocks near heated emplacement drifts. If this is the case, then sensitivity analyses could fail to identify coupled processes as principal factors. The Board recommends that the DOE reexamine its evaluation of the importance of coupled processes in its identification of principal factors.

The Board urges the DOE to pursue studies of natural analogues. The Board is concerned that there continues to be little evident progress in this area. Presentations at the January Board meeting described modest plans for studying analogues, but there seems to be no serious commitment to funding such studies. In addition to those analogues discussed at the meeting (e.g., Peña Blanca, Rainier Mesa), the Board urges the DOE to consider studies of josephinite, a naturally occurring alloy of nickel and iron that may provide insights into the long-term corrosion resistance of waste packages in a Yucca Mountain repository.

To maintain its site recommendation and licensing schedules, the program may choose to rely more heavily on performance confirmation rather than on site characterization for the information needed to determine whether the Yucca Mountain site can safely isolate wastes. If this is the case, the Board believes that the DOE should develop and communicate a carefully

thought-out plan for its performance confirmation and site monitoring program as an integral part of its site recommendation.

Repository Design. One way to address uncertainties is to reduce them through modifications of repository design, although uncertainties can never be entirely eliminated. In a recent letter,¹ the Board stated that it “. . . does not believe that a strong-enough technical basis exists at this time to support adequately any above-boiling repository design.” (In that letter, “above-boiling” referred to the temperatures of the drift walls after closure.) The Board suggested that many of the above-boiling designs studied by the management and operating (M&O) contractor could be modified to achieve below-boiling conditions by aging the spent fuel or by increasing the rate or the duration of ventilation before repository closure.

In its response to the Board’s letter,² the DOE committed to examining uncertainties associated with coupled thermally driven processes, to refine models that are the basis for evaluating thermal conditions, and to evaluate design options for increasing the efficiency of heat removal prior to repository closure. We look forward to reviewing the results of these very important efforts and discussing them with you as soon as they become available.

We noted above the possibility that existing models may not have captured adequately the effects of coupled processes when identifying principal factors. Similarly, the evaluation of repository design alternatives (including above-boiling and below-boiling design options) using performance assessment models may cause above-boiling designs to appear to have greater certainty about performance than they really have. Adoption of a below-boiling design could substantially reduce most concerns about coupled processes.

Scientific Studies. Another way to address uncertainties is to attempt to reduce them through additional scientific and engineering studies. Presentations on scientific studies at the January Board meeting indicated that significant new information continues to be generated and plans for important future work are being developed. Expert judgment and careful interpretation of data will be needed to accurately characterize and quantify the uncertainties associated with data and their use in predicting repository performance.

The Board heard at the meeting that moisture conditions within the bulkheaded part of the cross-drift appear to be approaching equilibrium conditions and active dripping does not appear evident. We look forward to additional observations from within that part of the cross-drift, including evaluation of the apparent condensation of moisture in some locations. Regarding seepage modeling efforts, there is a need either to incorporate U.S. Geological Survey calcite deposition data and concepts into seepage models or to explain why it would be inappropriate to do so.

¹ July 9, 1999, letter from Jared L. Cohon, Chairman, Nuclear Waste Technical Review Board, to Lake H. Barrett, Acting Director, Office of Civilian Radioactive Waste Management, U.S. Department of Energy.

² September 10, 1999, letter from Lake H. Barrett, Acting Director, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, to Jared L. Cohon, Chairman, Nuclear Waste Technical Review Board.

We were impressed with the careful planning and attention to detail for the fluid inclusion studies. We look forward to completion of that work and hope that it will help resolve remaining questions about the hydrothermal history of the Yucca Mountain site. The Board also looks forward to reviewing plans and schedules for other new tests to be carried out in support of site characterization and, potentially, repository licensing. We noted that coordination of Yucca Mountain participants with the Nye County Early Warning Drilling Program appears to be productive. However, we were disappointed in continuing delays in the chlorine-36 validation studies. At this, and previous, Board meetings, presentations on this important topic were canceled due to insufficient progress. We look forward to hearing about the results of these studies at our next meeting.

Communication. Accurately portraying the nature of uncertainties about the performance of a complex system like a Yucca Mountain repository is a formidable challenge. As you are aware, the DOE will need to communicate effectively to a wide variety of audiences as the project moves forward. The DOE's initiative to develop a simplified performance-assessment capability is a commendable effort to make the "black box" of performance assessment more transparent to nonspecialists. While it remains to be seen how successful this will be, we urge the DOE to make this tool available to the public well in advance of the release of the site recommendation consideration report. We also urge the DOE to seek other innovative ways of improving communication with all stakeholders.

Again, the Board thanks you for your efforts in supporting the Board's January meeting. We that hope you find these comments timely and helpful.

Sincerely,

Jared L. Cohon
Chairman