



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

September 4, 2008

Mr. Edward F. Sproat III  
Director  
Office of Civilian Radioactive Waste Management  
U.S. Department of Energy  
1000 Independence Avenue SW  
Washington, DC 20585

Dear Mr. Sproat:

The U.S. Nuclear Waste Technical Review Board appreciates the participation of the U.S. Department of Energy (DOE) in the Board's meeting in Las Vegas, Nevada, on May 29, 2008. The central focus of the meeting was the Total System Performance Assessment for the License Application (TSPA-LA). Consistent with its statutory mandate, the Board has continuously evaluated the technical validity of DOE activities related to developing TSPA-LA and related analyses, which are the basis for DOE estimates of repository performance at Yucca Mountain.

The Board considered this an excellent meeting. The presentations conveyed the expertise of the analysts and the challenges of estimating repository performance for one million years after waste emplacement and repository closure. The Board's observations and comments on the material presented at the meeting are summarized below.

***TSPA-LA Assumptions, Methods, and Results***

TSPA-LA may be the most complex and ambitious probabilistic risk assessment ever undertaken. Clear from presentations at the meeting is that the dedicated work of numerous highly capable scientists and engineers over many years has significantly advanced the understanding and representation of the natural and engineered systems at Yucca Mountain. As discussed below, however, there are notable uncertainties related to TSPA-LA calculations.

*DOE analyses show that the engineered barrier system (EBS) contributes very significantly to overall repository performance.* The drip shield is intended to prevent water and rocks from falling on the waste package, thus extending waste package lifetime. The drip shield therefore plays a significant role in predictions of repository performance. According to DOE analyses, in the nominal scenario, none of the drip shields fail before 265,000 years and, on average, more than 99 percent of waste packages containing civilian spent nuclear fuel remain sealed at least 500,000 years after repository closure. The extent to which the drip shield reduces calculated doses by extending waste package lifetime is uncertain because it has not been analyzed.

*DOE sometimes uses what it considers conservative assumptions about the features or processes being modeled while taking an opposite approach in other instances.* Because the system modeled by TSPA-LA is highly complex, simplification and abstraction of features, events, and processes are necessary. As a result, some of the simplifications and underlying assumptions in TSPA-LA may overestimate radioactive dose. For example, rather than trying to predict the location and extent of an igneous intrusion, DOE assumes that such an intrusion will damage all 11,629 waste packages in the repository. This seems to be a very (unrealistically) conservative

assumption. On the other hand, an important waste package failure mechanism that does not seem to be treated conservatively in TSPA-LA is the potential for damage of the Alloy-22 waste package by deliquescence-induced localized corrosion, which has been eliminated from performance estimates through a screening process. Deliquescence-induced localized corrosion, if it were to cause penetration of the waste packages, would have potentially significant performance implications. The Board reiterates its view that DOE should strengthen the technical basis for screening out deliquescence-induced localized corrosion. Because DOE's assumptions are not always conservative, the overall degree of conservatism of the assumptions in TSPA-LA is difficult to assess.

*Assumptions and methods in TSPA-LA are not consistently well-supported.* For example, estimates of the character of mountain-scale water flow in the unsaturated zone are consistent with scientific understanding. On the other hand, results of infiltration model calculations were adjusted to make them more consistent with field measurements. The Board has stated that the statistical modification of infiltration model results does not have a strong technical basis.

### ***Enhancing Confidence in TSPA-LA Assumptions, Methods, and Results***

The Board believes that some of the aforementioned uncertainties can be addressed by undertaking some or all of the specific actions described below. Addressing the uncertainties could enhance confidence in TSPA-LA methods and results.

*Improve the technical basis for screening out deliquescence-induced localized corrosion.* The Board believes that an appropriate experimental program could be performed to address the potential occurrence of this phenomenon and has recommended such a program in previous letters to DOE. Alternatively, the Board's opinion is that maintaining surface temperatures of the waste packages below approximately 150°C could eliminate the possibility that deliquescence-induced localized corrosion would initiate. If the technical basis for screening out deliquescence-induced localized corrosion cannot be improved, then that could have significant implications for repository design and loading.

*Develop prototypes of novel engineered systems.* You and I testified on July 15 at a hearing before the House Subcommittee on Energy and Air Quality, Committee on Energy and Commerce. In my testimony, I stated that in the Board's view, DOE's assumptions about drift degradation and repository tunnel tolerances may make installation of the drip shields, as currently designed, problematic. Prototyping of drip-shield fabrication and emplacement can help reduce uncertainties associated with this critical engineered component of the repository.

*Continue to enhance fundamental understanding of the geologic environment.* A sound fundamental understanding of the geologic environment is important for predicting both the environmental controls on EBS degradation and subsequent radionuclide transport. The Board believes that DOE should continue to develop such understanding. Although the possibility of very-long-term sequestration of radionuclides in secondary mineral phases suggested by analogue observations has not been supported so far by laboratory investigations, this process and others investigated in the Science and Technology Program of OCRWM's Office of Science and Technology and International (OSTI) are likely to be important for increasing confidence in the plan for the proposed Yucca Mountain repository. Consequently, in the Board's view many of the study areas previously supported by OSTI merit renewed support.

Thank you again for DOE's participation in the Board's May meeting. The Board looks forward to continuing its technical review of DOE activities.

Sincerely,

{Signed By}

B. John Garrick  
Chairman