



Department of Energy

Washington, DC 20585

October 19, 1998

Dr. Jared L. Cohon
Chairman
Nuclear Waste Technical Review Board
2300 Clarendon Boulevard
Arlington, Virginia 22201-3367

Dear Dr. Cohon:

The Department of Energy has received and reviewed the Nuclear Waste Technical Review Board's letter of July 30, 1998, transmitting comments on its June 1998 meeting. We appreciate your compliments on the high level of technical content in the Department's presentations and on the coordination for the field trip. In an effort to address important issues in a timely manner, the Department would like to respond to the Board's comments. Our responses are provided in the attachment.

We continue to value the Board's feedback as we complete the viability assessment and work toward site recommendation. If you have any questions, please contact me at (202) 586-6842.

Sincerely,

Lake H. Barrett
Lake H. Barrett, Acting Director
Office of Civilian Radioactive
Waste Management

Attachment



**Department of Energy Responses to the
July 30,1998, Letter of the
Nuclear Waste Technical Review Board**

Total System Performance Assessment

The Department agrees with the Board that any set of calculations, including those presented on the status of the TSPA calculations for the VA, are only as valid as the underlying assumptions, models, and data. Time constraints at the June 1998 Board meeting did not permit a thorough presentation of the science underlying the calculations. More exhaustive presentations were made to the Board's Performance Assessment Panel in April 1998. The most complete documentation of the analyses is contained within Volume 3 (TSPA) of the VA and in the accompanying TSPA-VA Technical Basis Document.

The Board questioned how parameter uncertainties were assigned and whether parameters were appropriately correlated. The Department agrees that the parameter uncertainty analyses are dependent on the assigned uncertainty distributions. To address this concern, we also conducted a suite of sensitivity analyses, which provide additional insight into the range of possible behaviors. On the correlation question, the parameters cited in the Board's example, infiltration and seepage fraction, are fully correlated, and this correlation has been included in all analyses. Uncertainty analyses and correlations are presented in Volume 3 of the VA in summary level and in the TSPA-VA Technical Basis Document in detail. We recognize that additional uncertainty analyses and correlations will be required for the site recommendation and license application.

The TSPA team has consistently used comments made by the Board to improve the quality of our analyses. The Board's previous comments on making TSPA technically persuasive, transparent, and traceable, on paying proper attention to uncertainties, on coordinating with the repository safety strategy, on demonstrating validity with natural and engineering analogues, and on using simplified calculations, peer review, and outside expertise are all leading to improvements. We will continue to combine these suggestions with the comments we have received from the Nuclear Regulatory Commission (NRC) and the TSPA Peer Review Panel as we move forward to the TSPA for site recommendation and license application.

License Application Plan

We appreciate the Board's suggestion that the decision methodology be made more transparent and that the key measures of importance be defined more rigorously. The License Application Plan (Volume 4 of the VA) describes the additional technical work needed before the Department's decisions regarding site recommendation and license application can be made. That work includes evaluation of design alternatives and features that might enhance confidence in system performance. The Plan also identifies the work needed to address the remaining issues for postclosure performance and preclosure safety.

The Department's approach to determining the relative importance of the principal factors affecting these issues and the prioritization of the information needed to address them was outlined in the presentation to the Board. A more detailed description of the importance of the various principal factors and the prioritization of those factors are presented in Volume 4 of the VA. This discussion will provide additional information on work done subsequent to the June 1998 meeting that is responsive to the Board's comments on making the methodology more transparent and rigorous. However, uncertainties in characteristics of the system will continue to make the judgements about necessary work somewhat subjective. A completely rigorous assessment of the information needs in the face of these uncertainties is not practicable. Nevertheless, we hope the additional information provided in the VA will help illuminate the judgements that have been made.

Determination of Importance Evaluation on the East-West Crossing

The Board wrote that it "believes that the OCRWM has not addressed adequately mountain-scale coupled thermal, hydrologic and mechanical (THM) processes. The Board has not seen any rigorous THM analysis of whether the east-west crossing will affect long-term repository performance or will foreclose repository design alternatives."

Part of the Department's basis for excavating of the east-west cross-drift was our conclusion that the Determination of Importance Evaluation (DIE), Revision 2, adequately bounds the impact of the cross-drift on repository performance. This conclusion was based in part on these findings:

- An in-depth analysis of coupled thermal-hydraulic processes in the near-field environment demonstrates that the effects of the drift are small, even at the scale of the near-field model, and dampen out over time.
- Lateral gas-phase connectivity within the repository area would not change significantly due to the cross-drift, given the massive connections represented by waste emplacement drifts.
- The cross-drift may participate in thermal convection cells; however, this potential mechanism also exists in undisturbed rock due to natural fractures.
- Although the cross-drift effective conductivity is significantly larger than for fractures, any gas-phase process that connects the waste emplacement drifts with the cross-drift must also pass through fractured rock. Therefore, fracture conductivity will dominate the serially connected pathway.
- The cross-drift overlies only a very small number of waste packages; hence any adverse effects due to condensate drainage from the cross-drift onto waste packages would have a very limited effect.
- Operational controls (such as waste package selection to accommodate thermal mixing) will

preclude asymmetric thermal loads.

- Any flux (beyond the nominal fracture connectivity) that could occur between hot and cold drifts in a repository as a result of the presence of the cross-drift could be mitigated by backfilling the drift.
- There is no available technology to perform a rigorous mountain-scale coupled THM analysis. If such analysis is deemed necessary, the methodology could be developed and validated. Mountain-scale models currently in use do not yet take into account the effects of drifts; for example, ventilation models such as the one George Danko, University of Nevada - Reno, presented to the Board are based on drift-scale calculations. While the mountain-scale models do provide boundary and initial conditions for the near-field models (a “nested” approach), they do not provide sufficient resolution to assess the effects of the cross-drift.

The Department maintains that the practical, qualitative approach used for the mountain-scale analysis in the DIE is in accordance with standard geoenvironmental practice and conforms to the Department’s DIE procedure. Standard practice performs appropriate analyses prior to design and construction, but is fully prepared to implement remedial measures, if necessary.

The possible effects on repository design alternatives were an important consideration in the decision where to site the cross-drift. A formal analysis was not included in the DIE, Rev. 2, as it was not required by the DIE procedure.

Revision 3 of the DIE was released on September 4, 1998. This revision includes consideration of expanded infiltration rates, operational controls to preclude asymmetric thermal loads, impacts of temporary storage of the Tunnel Boring Machine at Station 28+23, expanded Quality Assurance controls, and several other features.

The Department has concluded that the DIE is technically adequate, based on available technology; however, we would appreciate your specific suggestions that would improve our THM processes. We look forward to further discussions with the Board on this matter.

Observations from the Field Trip

The Board complimented the Project for the rapid progress on the Busted Butte experiment and suggested examining related colloid transport work done at Hanford. In Fiscal Year 1999, we will collect and evaluate the field colloid information from Busted Butte and the Nevada Test Site. Additional laboratory information will be collected to determine forward and backward sorption/desorption rates based on drip test colloids.

The technical cross-fertilization now in progress with other sites will aid the Project in addressing issues of observed or projected radionuclide migration. The Department has opened a data and knowledge-sharing dialogue with the investigators responsible for characterizing and

understanding the migration of radionuclides observed at Hanford, the Idaho National Environmental and Engineering Laboratory, the Los Alamos National Laboratory, and the Nevada Test Site. Preliminary indications are that where migration of actinides has been observed, there was a direct link to the chemistry of the solutions involved, which were typically designed to keep actinides in solution or suspension. It is not appropriate to apply results from these sites directly to Yucca Mountain; however, anthropogenic analogue work will examine the colloid information at Hanford for potential use by the Project.

The Board also suggested that tunnels elsewhere on the Nevada Test Site (NTS) could provide information relevant to percolation during wetter climates at Yucca Mountain. The N-tunnel system was previously examined as part of a scoping exercise to select candidate sites for analogue studies. The tunnel is considered "wet" and has been sealed with a temporary bulkhead. Data are currently being collected for NTS through the bulkhead with remote monitoring equipment. A white paper was prepared several years ago that summarized what is known about the N-tunnel and further work was proposed; however, due to budget constraints the proposed work was not funded.

Environmental Impact Statement

The Board requested additional information on how the thermal load options bracket the environmental impacts from potential repository designs beyond what was presented during the June 24, 1998, meeting. The Department presented the logic for initially selecting a range of thermal loads as the underlying basis for the thermal load options to be evaluated in the Environmental Impact Statement (EIS). The intent of the EIS presentation was to put into context how the Project developed and is using the thermal load options. A report documenting the technical analyses and decisions on the range of potential repository designs is being prepared as an EIS reference, and we will provide you with the additional information.

Departmental staff and National Environmental Policy Act (NEPA) experts made the initial selection of thermal load options in informal planning sessions. That selection, in concert with the transportation options and spent nuclear fuel packaging options, was made in early to mid-1995 for purposes of developing the EIS Notice of Intent, which is the start of the NEPA process. Evaluating a range of thermal loads was considered to be reasonable for purposes of eliciting public input on the potential scope of the EIS during the scoping period for the EIS. This construct was believed to bound the potential environmental impacts of the design alternatives and features that were then being studied by the Project.

We are also conducting additional studies to ensure that the thermal load options adequately bound the environmental impacts of potential repository designs. This work is being conducted in close coordination with the reference design activities presented at the Board meeting. Because the environmental impact analysis is closely integrated with the analysis to determine the reference design to carry forward to site recommendation and license application, it will not be finalized until mid-1999. As the work proceeds, if environmental impacts are potentially not bounded by

the current EIS construct, additional analyses will be done and the draft EIS will be revised.

We look forward to sharing the results of our ongoing evaluations with the Board and specifically understanding what potentially significant types of environmental impacts that the Board thinks may not be bounded by the current construct of the EIS thermal load options.

Alternative Repository Designs

The Board was pleased with the Department's commitment to examine design alternatives before selecting a design for site recommendation and license application but questioned whether the examination would be as comprehensive as the Board desires. The scope of the Department's alternative repository design evaluations has been established with the goal of considering any repository design concepts that appear to have potential merit. Potential merit includes pre- and post-closure safety, operating and maintenance characteristics, cost, schedule, licensability, and risk considerations. The VA Reference Design and TSPA-VA will be used for evaluation purposes since there is substantial scientific and technical information available for them and they can be useful as a benchmark in comparing other design concepts. All concepts will receive an equitable consideration.

The Board also suggested that the Program examine relevant work done at the Basalt Waste Isolation Project (BWIP). The Program is taking advantage of experience such as BWIP in conducting its evaluations. Technical exchange visits to BWIP have been conducted. Technical documentation produced for BWIP and other programs is being captured during the compilation and evaluation of previous work that is relevant to our alternate designs and design features.

The work to evaluate alternative designs and design features is planned to be comprehensive and includes examples cited by the Board (i.e., restricted peak temperature, long term ventilation and waste package material layering options) as well as many others. Information on the budget for the alternatives work may not adequately reflect the extent of the effort. There is substantial work in the Fiscal Year 1999 planning, which will benefit the alternative effort although not coded as such (e.g., engineering on facility elements which are building blocks for alternatives). Also, substantial advantage will be taken of previous, well-documented work which has heretofore been presented as topical information, but which can now be applied in integrated design alternatives and design feature evaluations. Previous work will be updated as necessary.

The planning for the alternatives evaluation work has been geared towards meeting the May 1999 design decision. The schedule is challenging and has been identified as one of the top priority items by Project management, both in terms of management attention and support of resources to accomplish the work.