



Department of Energy
Washington, DC 20585

September 7, 2001

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

Dear Dr. Cohon:

We appreciate the Nuclear Waste Technical Review Board's letter of July 17, 2001 providing comments on the information we presented at the Full Board Meeting on May 8 and 9, 2001. Our responses to the specific comments raised in your letter with regard to the Board's priority issues and observations on other aspects of our technical program are enclosed.

We continue to value the Board's feedback and look forward to the Board's detailed comments on the Supplemental Science and Performance Analyses Report. If you have any questions, please contact me at (202) 586-6842.

Sincerely,

A handwritten signature in black ink, appearing to read "L. Barrett", written over a horizontal line.

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

Enclosure:
Department of Energy Responses to the
July 17, 2001 letter from Jared L. Cohon



DOE Responses to Comments and Concerns Raised in the July 17, 2001 letter from the Nuclear Waste Technical Review Board

Meaningful Quantification of Uncertainties and Conservatisms-Inclusion/Exclusion of variables in performance assessment

The U. S. Department of Energy (DOE) agrees that the decision to include some variables, and not others, in the Total System Performance Assessment (TSPA) is important. Many of the subsystem level results described in Volume 1 of the Supplemental Science and Performance Analyses (SSPA) Report were abstracted and carried forward into the supplemental performance assessment model. Some new results were only evaluated through sensitivity analyses and were not included in the SSPA supplemental performance assessment model. Other results were only considered at the component model level. There are several reasons for not including a new parameter or model in the supplemental performance assessment model. These reasons include:

- low probability of occurrence
- no significant effect at the component model level
- no significant effect at the system level
- results are sufficiently uncertain so that inclusion would be non-conservative
- model is still conceptual

For example, the effects of coupled thermal-hydrologic-chemical (THC) processes on fracture porosity in the unsaturated zone were included in the subsystem model and described in the SSPA Report, Volume 1. However, the effects were not carried forward and evaluated in the supplemental performance assessment model, because the THC effects on fracture porosity were less than one percent for the higher-temperature operating mode and would be smaller for the lower-temperature operating mode. These changes are within the degree of uncertainty for this parameter and are thought to be insignificant. In addition, the effects of THC are relatively short-lived and local. Changes in the flow field at the mountain scale are influenced more by the boundary conditions, such as infiltration, rather than THC processes.

The DOE acknowledges that cumulative effects of uncertainties may have a non-negligible effect on performance. We will continue to re-evaluate the validity of the screening decisions as new data and refined models become available. We will also strengthen project reports to clearly articulate the rationale for including or excluding variables, related to features, events and processes, from evaluations of system-level performance.

Progress in Understanding the Underlying Fundamental Processes of Corrosion

The DOE agrees that it is important to develop an understanding of the underlying physical phenomena of corrosion processes. The DOE has implemented a detailed experimental program and development of a more advanced theoretical corrosion model to reduce uncertainties in the long-term performance of waste package and drip shield materials. Specific areas of study

include general corrosion, localized corrosion, waste package environmental conditions, and stability of passive films.

Long-term passive film stability is particularly important to long-term performance of the waste package. Additional theoretical and experimental work is ongoing to address specific processes that may affect the passive layer, including defect and debris accumulation in the passive layer and quasitranspassive dissolution.

The experimental program will provide data leading to a better understanding of the fundamental corrosion processes in passive materials such as Alloy 22 and confirm our ability to extrapolate short-term data to predict long term behaviors, which is important to postclosure performance. In addition, Alloy 22 samples that reflect heat lot variability are included in the test program to determine the effects of chemical compositional variations on alloy performance.

As noted by the Board, the DOE has also initiated a Peer Review of the technical basis for waste package performance. The Peer Review Panel (Panel) is reviewing the current technical basis for predictions of waste package and drip shield performance, and the long-term testing and modeling program. Several panelists attended and were able to benefit from discussions at the Board's recent International Workshop on long-term extrapolation of passive behavior of waste package materials. The Panel recently (July 24, 2001) held a public meeting at which experts from both the State of Nevada and the Nuclear Regulatory Commission's contractor, the Center for Nuclear Waste Regulatory Analyses, made detailed presentations to the Panel and attending public. The Panel will provide recommendations for augmenting planned tasks and underlying models in areas that will reduce uncertainties in predicting material performance. They will provide an interim report on their comments, conclusions, and recommendations in September 2001.

Evaluation and Comparison of Base-Case and Low-Temperature Repository Designs

The DOE has evaluated and compared the performance of a potential repository over a range of temperatures. For this evaluation, two specific examples (one higher- and one lower-temperature operating mode) were analyzed. These examples represent only two of many combinations of the design and operating parameters that can be used to achieve a range of thermal objectives. The primary purposes of this evaluation and comparison were to provide insights into the effects of thermal parameters on overall repository performance, including uncertainties, and to develop confidence in repository performance over a range of thermal conditions. The results of this comparison and evaluation are documented in the SSPA Report. The results were summarized at the Board's June 20 and 21, 2001 joint meeting of its Repository and Performance Assessment Panels. The SSPA report evaluated and compared subsystem as well as total system level repository performance during the post-closure period. The DOE is looking forward to the Board's comments on the Project's approach to the comparison and evaluation of performance over a range of temperatures.

We believe that the needs of the Nation may best be met by preserving the ability to select from a broad thermal range a design for repository licensing and initial operations. Preserving this

ability, however, may require testing and analytical efforts to support production of licensing documentation for the lower end of the thermal range. This documentation would supplement the analysis for the upper end of the thermal range and the technical and programmatic information developed would be used to further support the lower end of the thermal range in a potential license application. Accordingly, the Department has issued technical direction to Bechtel-SAIC Company, our Management and Operating Contractor, to begin evaluating this work in accordance with our project control processes so that the overall cost and schedule impacts of this effort can be fully understood. The Program's 2002 budget, which at this point is very uncertain, will strongly influence our ability to implement this work. We will evaluate these cost and schedule impacts in light of these broader program constraints and make appropriate management decisions regarding implementation of the technical work. We will keep the Board informed of our progress and decisions on this important topic.

Development of Multiple Lines of Evidence to Support the Proposed Repository Safety Case

The expanded consideration of multiple lines of evidence during the development of the recent Supplemental Science and Performance Analyses Report has improved the DOE's understanding of processes important to repository performance, independent of the results of the quantitative TSPA. As a consequence, the DOE intends to continue the expanded evaluation of multiple lines of evidence to provide additional confidence in the results of TSPA. Current plans include additional studies of various analogs, including work at Peña Blanca, Paiute Ridge, Yellowstone National Park, and examination of evaluation of analogs to man-made metals, such as Josephinite. We will consider both supporting and opposing lines of evidence to provide a balanced discussion of the available lines of evidence.

Ambiguities in interpreting the source of moisture in the bulk-headed drift and in determining if bomb-pulse chlorine-36 has migrated to the repository horizon.

The DOE has given high priority to studies investigating the source of moisture in the bulk-headed section of the cross drift and determining if bomb-pulse chlorine-36 has migrated to the repository horizon. Those studies are still underway. We will be providing the Board an update on the current progress in resolving these issues in the September 2001 Full Board meeting.

Investigations to connect the near-field natural environment with the engineered repository system

The DOE is aware of the Board's concern that studies to connect the near-field natural environment with the engineered barrier system are still under way. The Board's examples include studies of deliquescence of brines on the waste package and drip shield, colloid transport, and thermal conductivity of the lower lithophysal rock unit of the Topopah Spring. The DOE believes that there are sufficient data to bound the natural environment in the near field for evaluations of the effects of the near-field environment on the engineered barrier system.

Additional testing and analysis are ongoing to improve the defensibility of these bounds and possibly move toward more realistic bounds.

These studies include investigations of the potential occurrence of hygroscopic salts that could lead to concentrated brines such as sodium nitrate, sodium chloride, sodium sulfate, sodium carbonate, calcium sulfate, and possibly calcium or magnesium chloride. Corrosion test conditions include many of these constituents and provide a reasonable representation of water characteristics relative to the effects on corrosion. Along these lines, samples of dust are being collected in the Exploratory Studies Facility from horizontal or near-horizontal surfaces. These samples are being analyzed to determine the total organic components, major and minor ionic species, and particle analyses using petrographic and scanning-electron microscopes. To strengthen the colloid transport database, the DOE is continuing work at Busted Butte, the Alluvial Testing Complex, and in the laboratory. In addition, a study is ongoing to collect data on the thermal properties of the Topopah Spring Tuff lower lithophysal unit.

The repository layout described in the *Science and Engineering Report* extends over a new area that includes a part of the large hydraulic gradient, but the repository layout evaluated in the PA for site recommendation does not include this area. This inconsistency may have significant potential consequences.

The DOE's performance assessments are iterative. As new data become available and as the underlying processes are better understood, the models and inputs are refined. These models are then abstracted and analyzed in an updated TSPA model. Because this is an iterative process, the inputs, and therefore the simulation results, are a snapshot of the information available at the time the simulations are run. The Total System Performance Assessment-Site Recommendation (TSPA-SR) implemented the results of analyses in the Process Model Reports and supporting Analysis and Modeling Reports that were based on the modified Enhanced Design Alternative II. Since that time, the layout of potential repository development areas for site recommendation has continued to evolve. Therefore, the effects of the water table rise on the large hydraulic gradient beneath the northernmost emplacement drifts were not explicitly included in the TSPA-SR.

The SSPA (Volume 1, Section 3.3.4) does, however, include information on the performance implications of the expanded repository footprint to the north. The extensive zeolitization of the Calico Hills Formation in this area diverts water flow above the water table. Consequently, the values of total percolation flux at the water table are generally among the lowest in the area of the northernmost emplacement drifts. In addition, the fraction of the total number of radionuclide particles released from the repository and reaching the water table is generally lowest in this area for the medium infiltration case and the glacial transition climate case. This information suggests that any errors introduced by the simplified model of a uniform climate induced water table rise in the TSPA are likely to be small.

As noted in the *Science and Engineering Report*, the layout of potential repository development areas illustrates parts of the upper and lower blocks that could be used for emplacement of waste. If the site is designated, then as the design evolves to support a license application the performance implications of the northernmost drifts will be evaluated in TSPA analyses.