



Department of Energy

Washington, DC 20585

June 15, 1999

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

Dear Dr. Cohon:

The Department of Energy appreciates the Nuclear Waste Technical Review Board's letter of March 3, 1999, regarding your observations and comments on the Department's presentations at the panel meeting on January 25 and Full Board meeting on January 26-27. In particular, we are pleased that the testing and research plans in the viability assessment (VA) are generally consistent with those identified by the Board. The Department's responses to your specific comments on repository design and site investigations are enclosed.

As discussed at the panel meeting, the Department is evaluating repository and waste package design alternatives beyond the design options considered in the VA. This evaluation furthers the evolution of our repository and waste package design and will provide the basis for selecting an appropriate design for site recommendation (SR) and license application (LA). Our early conceptual waste package design, with thin-walled canisters, changed to larger, more robust waste packages. The reference design then evolved to a high temperature design, as used in the VA, intended to keep water away from the waste packages for long periods of time. However, higher water flux through the repository than previously thought, together with the desirability of reducing uncertainty in repository performance, now makes re-evaluation of the design appropriate.

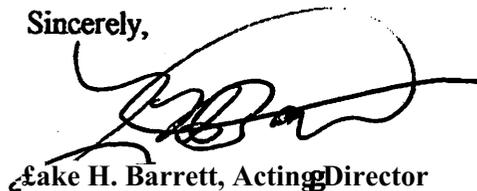
This evaluation has covered a wide variety of repository and waste package designs, including designs suggested by the Board. The evaluation followed a consensus decision process, which is appropriate for an ongoing design process in which the alternatives are continually being refined. The Department is pleased that the Board has chosen to closely follow the design selection process.

The Program's Management and Operating contractor completed its evaluation process and recommended a repository design with a lower thermal impact than the reference design for the VA. This design is flexible and permits modification toward higher or lower temperatures. It also reduces uncertainty in repository performance estimates. The recommended waste package design also includes an outer corrosion-resistant barrier, as suggested by the Board. The Department plans to make a design decision subsequent to the Board's meeting on June 29-30, during which the alternative design evaluation will be discussed.

Regarding your concern on cutbacks in science and engineering, we intend to prioritize in our planning the activities most important to site recommendation. The periodic re-evaluation of the priorities of Project activities has special significance because of the likely change in the reference repository and waste package designs.

We continue to value the Board's feedback on our program as we work toward a decision on site recommendation. If you have any questions, please contact me at (202) 586-6842.

Sincerely,

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

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

Enclosure

**Department of Energy Responses to the
March 3, 1999, Letter of the
Nuclear Waste Technical Review Board**

Repository Design

The Board believes that the selection criteria and weighting must be clearly defined and that transparency of the process should be improved. We look forward to receiving a list of the selection criteria as soon as they are finalized.

Response:

The Department agrees that the selection process and criteria should be clearly defined and that the implementation of the process used to evaluate design alternatives should be transparent, structured and defensible. The design selection process includes an independent review panel to help ensure that the process is transparent and defensible. The goal of the design selection process is to select a conceptual design for the initiation of the site recommendation (SR) and license application (LA) process.

The set of criteria used in phase I of the process and presented at the January meeting was revised for the evaluation of the enhanced design alternatives (EDA) in phase II. The revised set included a screening criterion reflective of possible release standards and four general criteria for the alternatives were ranked in paired comparisons: licensing probability, construction/operation/maintenance issues, flexibility to accommodate design changes, and cost/schedule.

Rather than giving each criterion a specific weight in the selection process, the participants followed a consensus decision process. We believe that this consensus process was most appropriate for an ongoing design process in which the alternatives were continually, being refined. The participants looked for designs that appeared to rank well across multiple criteria while having no low ranking for any criterion. The participants considered qualitatively their individual evaluations of the relative significance of the criteria in selecting a design, although no quantitative weights were explicitly assigned to the criteria.

The Board believes that the DOE should give serious consideration to true alternatives to the reference design, including changing from a high-temperature to a ventilated low-temperature design.

Response:

The Department is giving serious consideration to true alternatives to the viability assessment (VA) reference design in the license application design selection (LADS) process, including diversity in waste package design, engineered barrier system (EBS) features, and thermal management features. These alternatives are all ventilated and include two concepts that have

time-temperature profiles that are significantly lower than that for VA, two concepts that have time-temperature profiles that are comparable to VA, and one concept that has a time-temperature profile that is significantly higher than that for VA.

The Board believes that a repository design based on lower waste package surface temperatures could significantly reduce uncertainty, enhance licensability, and simplify the analytical bases required for site recommendation. Combined with improved shielding, such a design could also simplify preclosure performance confirmation by enhancing access to the tunnels, thus reducing or eliminating the need for separate performance confirmation drifts and permitting direct access to performance confirmation instrumentation near the waste packages.

Factors that have influenced the Board's thinking on repository design include:

- *Corrosion severity would be significantly reduced by lowering waste package temperatures.*
- *There would be degradation of tunnel stability because of the thermal pulse.*
- *There would be significant reduction of coupled thermal-hydrologic and thermal-geochemical processes at lower temperatures.*

Response:

The lower temperature concepts are being considered for precisely the reasons identified in the Board's letter. Furthermore, the Department recognizes that the lower temperature concepts carry the potential to decrease the complexity of the performance confirmation system.

The objectives of the LADS activity are to select a reference design that satisfies the appropriate regulatory performance objectives for the preclosure and postclosure time frames, limits cost, limits licensing risk, and limits management risk (e.g., increases confidence and flexibility). Alternatives under consideration have included self-shielded waste packages that allow human accessibility for off-normal events.

The potential for providing shielded waste packages and continuous ventilation to allow unrestricted access to emplacement drifts has been evaluated. This evaluation identified serious concerns with respect to the increased thermal resistance of the waste package (thereby increasing the fuel temperature and potentially degrading the fuel cladding), the operational impacts of handling heavier, shielded packages, and the increased cost of the waste packages. Additionally, the increased size of the waste packages could require larger emplacement drifts. Finally, the current concept of not allowing routine personnel access should allow the facility to operate with lower overall personnel exposures than a concept involving such access.

Upon evaluation of the benefits and impacts, self-shielded waste packages were not carried forward as part of any of the alternatives. In the event that human access would be required to evaluate and respond to an off-normal event, cooling and radiation shielding requirements could be met by blast cooling a normally ventilated drift and by using portable shielding. Recognizing that repeated blast cooling could lead to instabilities in the drift walls, the need to do this would

be thoroughly evaluated before action was taken. These concepts are included in all of the EDAs being considered.

The Board recommends that a more complete quantitative analysis of a low-temperature repository design be undertaken before the completion of the LADS process. For example, preliminary calculations could be performed in the next several months to quantify the removal of heat and water from continuously ventilated repository tunnels. Such an evaluation also should include an analysis of the long-term stability of the tunnels.

Response:

Before selecting a design for SR and LA, the Department will develop a sufficient technical basis to support this decision. A number of 2- and 3-dimensional models have been developed and used to depict temperature and humidity variations in the emplacement drifts with various waste package loadings. The Department believes that this work and existing analyses and evaluations will provide a sufficient basis for a selection between a high and low temperature repository.

Site Investigations

The Board is concerned about the deferral, at best, of critically important geologic, geochemical, and hydrologic studies in the east-west cross-drift that are aimed at understanding the magnitude and distribution of seepage into the repository under present ambient conditions, as well as under conditions existing in the past, when climates were very different. Technically defensible arguments about the repository's hydrologic environment, which is the single most important natural feature affecting repository performance, will be difficult to make without this information. These studies include:

- *Systematic analysis of the rock samples being collected, in particular with respect to chlorine-36 and other indicator isotopes.*
- *Flow and seepage tests at different locations along the drift, perhaps even closing off part of the drift for these studies.*
- *Tests in lithophysal zones, where the majority of waste packages may be emplaced*
- *Studies of the Solitario Canyon fault.*

Response:

Although the scientific studies cited by the Board will not be completed in time for all the results to be incorporated in the initial versions of the License Application Design and Total System Performance Assessment-Site Recommendation (TSPA-SR), some results will be available for incorporation in later revisions of SR or as confirmatory data either before or during the licensing process. In particular, the iterative nature of the TSPA for SR and LA will allow test results to be used in support of suitability and licensing decisions. As was indicated in Volume 4 of the VA, a

substantive change in the design will necessitate a re-assessment of scientific and engineering work priorities. The Department is in the process of such a re-assessment based on proposed changes to both the design and the set of documents that will support the TSPA. Planned activities in the following discussion that will not produce results in a time frame that can support SR may be delayed or changed. The Department acknowledges that these activities are important to reducing uncertainties in the natural system.

Current plans include a systematic sampling program for hydrologic, hydrochemical, and mineralogic-petrologic-geochronologic studies. For the chlorine-36 analyses in the cross-drift, we have sampled every 50 meters from boreholes, collected feature-based samples, concentrating on faults and highly fractured zones, and collected systematic samples utilizing a modified sampling strategy based on comments of the Chlorine-36 Peer Review Panel. Some of these samples are being analyzed in Fiscal Year 1999, with more analyses planned in Fiscal Year 2000.

The Department is currently prioritizing the testing in the Cross-drift and working to bring the most important testing forward in the schedule. The revised Fiscal Year 1999 plan includes: a) excavation and drilling at the Crossover Alcove, with testing to follow in Fiscal Year 2000 to address flow and transport processes in repository horizon rocks (Middle Nonlithophysal Subunit); b) excavation and start of drilling at Niche 5, with testing to follow in Fiscal Year 2000 to address flow and seepage processes in the repository horizon (Lower Lithophysal Subunit); and c) sealing the back half of the cross-drift with bulkheads for as long as a year to address flow and seepage processes under the relatively high infiltration areas and the Solitario Canyon Faults Zone (SCFZ).

Testing in the cross-drift in Fiscal Year 2000 will include the Cross-Drift Thermal Test in the repository horizon (Lower Lithophysal Subunit). Flow and seepage testing at Niche 6 (Lower Nonlithophysal Subunit); hydrologic testing underneath the high infiltration area (Crest Alcove); and borehole testing of the SCFZ may not provide data in time for the SR and, consequently, will probably be deferred to later years.

With respect to the SCFZ, the tunnel boring machine cut through the main splay of the fault, but stopped short of the west splay of the fault. We have completed detailed mapping of the main splay. We also plan to drill long boreholes to explore the undisturbed west splay and the main splay and conduct studies similar to those completed in Alcove 6 for the Ghost Dance fault.

The Board also is concerned about the apparent premature cessation of surfaced-based drilling at WT-24, the borehole that was meant to shed light on the origin of the large hydraulic gradient located just north of the proposed repository.

Response:

At its present depth, WT-24 is in a relatively tight section of the aquifer, and we are not able to conduct a pump test. The borehole would likely have to be deepened another 500 to 700 feet to get an acceptable aquifer pump test, and, even then, testing may not be feasible. Consequently,

we have demobilized the drilling rig. However, we have not precluded deepening the borehole at a later date based on needs generated from future results of the TSP A process or the LADS effort.

The Board will be very interested in the substantiation and interpretation of initial results from the EWDP indicating the existence of warm water at depth in some locations.

Response:

The Department is very pleased with the cooperation between Nye County and the Yucca Mountain Project on the first phase of the Early Warning Drilling Program (EWDP) and looks forward to similar successes in the planned follow-on EWDP efforts. We will continue to provide information to the Board on the interpretation of the results from the EWDP as they become available.

The Board is concerned that if cutbacks in science and engineering occur during the next two years, then the chances of accomplishing these needed activities also will decrease.

Response:

Our periodic re-evaluation of the priorities of ongoing and newly proposed Project activities in science, design and performance assessment has special significance because of the likely change in the reference repository and waste package design. We intend to emphasize in the current and near-term future work plans, which are likely to be revised as a result of the re-evaluation, the activities most important to site recommendation. We will issue only a site recommendation that has adequate scientific, engineering, performance assessment and environmental bases.