Department of Energy
Washington, DC 20585
May 11, 1998

MAY 14 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 appreciates the Nuclear Waste Technical Review Board's new initiative in providing preliminary comments following its meetings. This timely feedback will help the Department manage the ongoing work by providing early insights into the Board's perspective on technical issues. To ensure that important issues are being addressed appropriately, the Department would like to provide the Board with responses to its comments. The enclosure is our response to your letter of January 12, 1998, with the Board's comments from the October 1997 meeting, three panel meetings, and one field trip.

We continue to value the Board's feedback as we pursue completion of the viability assessment and the future work beyond. If you have any questions, please contact me at (202) 586-6842.

Sincerely,

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

Enclosure

bcc:
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DOE Response to Comments of the Nuclear Waste Technical Review Board from its October 1997 Meeting

Alternative Designs

As explained at the Board's meeting in Amargosa Valley in January 1998, the Department is preserving flexibility to ensure that design alternatives identified in the viability assessment (VA) for the engineered barriers, as well as those that emerge with advancements in technology, can be accommodated in the repository development process. The Department agrees that the repository and waste package designs should not be prematurely fixed and that other potential alternatives, such as those suggested by the Board, should not be foreclosed. As pointed out by the Board, design alternatives should be reevaluated as relevant new data become available. We expect that design alternatives will continue to be evaluated throughout repository licensing, construction, and operation. As modifications to the reference design and concept of operations are proposed and analyzed, the Department will share those with the Board.

For the VA, the Department is addressing the feasibility of geologic disposal at Yucca Mountain by focusing on a reference design concept which is only one of a number of workable concepts. This reference design and an assessment of its performance provide the frame of reference necessary to evaluate the sufficiency of site characterization data and analyses. The VA will include qualitative analyses of design alternatives and plans for further evaluation of alternatives before submittal of the license application. The VA will not include cost estimates or performance assessments for the design alternatives.

Remote Operations and Ventilation

The Department agrees with the Board on the need to develop and demonstrate systems for remote operations in the repository. However, the detailed designs of these systems are not critical to the VA, because the main components of the subsurface waste transportation and emplacement systems use existing technology. No additional research needs have been identified. The VA design description will contain discussion of the remote systems, including limited information on failure modes and responses. The detailed design work will be undertaken at the appropriate time after the VA and shared with the Board. As suggested by the Board, the estimated costs of such systems, including contingencies for potential problems, will be included in the VA.

The Board questioned the need for and location of the north-south central main exhaust drift and suggested taking advantage of natural convection. In the reference design, air flows from the east and west mains toward the center of the block, enters the central main exhaust drift, and is carried in the exhaust drift to the exhaust shaft. The use of a central exhaust allows both the east and west mains to be used for intake, or fresh air mains. The benefit of the central main exhaust is that it reduces the length of the emplacement drifts that needs to be ventilated by a single intake from a maximum of approximately 1,200 meters to about 600 meters. This reduction in length shortens the maximum travel and communications distance between the remote equipment and the

drift entrance, and also enables faster "cooldown" of drifts where wastes have been emplaced, if re-entry is required.

The rationale for the location of the central main exhaust drift is based on post-closure water movement. One design objective is to avoid placing any non-emplacement drift in a position such that, if water enters that drift, it could pass directly through a man-made opening into an waste emplacement area. Other drifts above the emplacement areas, such as performance confirmation drifts, are not directly connected with man-made openings to the underlying emplacement area and are laid out to have a consistent gradient which will promote gravity drainage away from emplacement areas. The central main exhaust drift must, because of its function, be directly connected to the emplacement drifts. For this reason, it was placed below the emplacement area.

Regarding the utilization of natural convection, the location of the central main exhaust above or below the emplacement block will have little impact on the magnitude of natural ventilation pressure developed by the repository system. The dominating factor in the determination of the natural ventilation pressure is the depth of the emplacement exhaust shaft. This shaft is over 400 meters deep, and it is the density of this column of warm air compared to a similar column of air with characteristics of the outside atmosphere which will determine the natural ventilation pressure. Whether the exhaust main is 10 meters below, or 10 meters above, the emplacement block will have no more than about a 5 percent impact on the magnitude of natural ventilation pressure.

Galvanic Protection and Waste Package Fabrication

The Department agrees with the Board that there are unresolved issues with demonstrating the value of galvanic protection. Accordingly, the Department considered the input received from our outside experts along with our testing information to determine the level of credit for galvanic protection defensible for the total system performance assessment (TSPA) for the VA. The decision has been made that credit for galvanic protection is not being included in the TSPA-VA base case calculation.

As the Board has noted, galvanic protection has significant potential. Therefore, the Department has initiated experiments that could provide the results needed to take credit for galvanic protection in the license application, if needed.

In completing TSPA-VA, the performance assessment staff are using a design baseline to ensure that the design assumptions in performance assessment are consistent with the engineering design assumptions. This formally controlled process is structured to avoid disconnects between engineering design and performance assessment.

The concerns expressed by the Board on residual stress from shrink-fitting of the two cylinders constituting the inner and outer waste package barriers are understood and are being investigated. Shrink-fitting is being considered for ensuring that the two cylinders do not move relative to each

other, in addition to its potential benefit for providing some galvanic protection of the inner barrier. Preliminary calculations of the additional stress imparted to the waste package barrier system as a result of shrink-fitting have shown that the stress is well below the level that would cause stress corrosion cracking in the inner barrier. Shrink-fitting is being further investigated during Fiscal Year 1998.

The Board's concerns on the inspectability of final closure welds will be fully addressed before selecting the final fabrication and welding processes. The inspection by ultrasonic testing of the inner barrier on the Fiscal Year 1997 waste package mock-up was successfully accomplished. The inspectability of the inner weld by remote ultrasonic testing will be further investigated during Fiscal Year 1998.

Independent Cost Estimate

The Department appreciates the Board's interest in the independent review of the cost estimate of repository construction, operation, and closure. The VA cost estimate is being externally reviewed by Foster Wheeler, a major U.S. engineering-construction company. Foster Wheeler's scope of work is limited to an evaluation of project cost estimating assumptions, methodologies, and bases of estimates associated with the VA base case design. The review includes examination of estimates relating to waste packages, surface and subsurface facilities, and performance confirmation, as well as related project development and evaluation costs. Foster Wheeler will be preparing individual assessments of these cost segments, as well as a summary report. Foster Wheeler initiated its review in October 1997 and is scheduled to complete all cost segment reviews by May 1998. The summary report, expected in June 1998, will address Foster Wheeler's findings on each VA cost estimate segment and its integration into the overall cost summary.

The Department provided the Board with the statement of work for Foster Wheeler on April 8, 1998.

Enhanced Characterization of the Repository Block and Performance Confirmation

We understand the Board's desire to see the data collected from the Enhanced Characterization of the Repository Block (ECRB) initiative included in the VA. Construction of the cross-drift will be completed about the time that the VA will be completed. We expect that observational data collected during the construction of the cross-drift will be included to the extent practicable. This data could include identification of faults that are exposed in the cross-drift and preliminary information on fracture distributions. It is not likely that there will be sufficient time to complete sample collection and analysis or in situ testing in the cross-drift prior to issuing the VA. The results of these investigations will be included in the site recommendation and license application. The Department will keep the Board informed on plans and developments for the ECRB and performance confirmation.

DOE Response to Comments of the Nuclear Waste Technical Review Board from its Panel Meetings and Field Trip

Definition of Critical Group

The Department recognizes the Board's concern regarding dose estimates to children. At this time, there are no Environmental Protection Agency (EPA), Nuclear Regulatory Commission (NRC), or Departmental radiation protection standards that specifically include children. Currently, regulatory practice is to estimate doses using physiological parameters developed by the International Commission on Radiological Protection, collectively known as the Reference Man. The dose conversion factors estimated based on the Reference Man have uncertainties that are comparable in magnitude to the uncertainties in exposure assessments and to the estimates of cancer risks.

For purposes of radiation protection, the Department concurs with EPA's and NRC's positions that the assumptions exemplified by the Reference Man adequately characterize the general public, and a detailed consideration of factors such as age and sex is generally not necessary. As the Board is aware, estimating doses to children and other age-specific groups is a complex task because of factors such as systemic biokinetic models, gastrointestinal uptake factors, organ masses and positions, and food consumption habits, all of which change as a person ages.

The Department will evaluate impacts to children in a technical report. The report will address the impacts to children and other age groups from a repository at Yucca Mountain. To estimate these impacts, the Department will use recently developed national and international guidance.

Contingency Plans for Transportation

The Department recognizes the public's concerns with the transportation of spent fuel. To identify and address potential difficulties in implementing our market-driven approach to transportation, the Department issued for comment a draft request for proposals in December 1996 and a revised draft in November 1997. In addition, the Department interacts regularly with a broad range of stakeholders on issues related to transportation. The Department will consider the input from these forums in developing its strategy for transportation and the need for contingency plans. In the meantime, we would welcome the Board's comments on the revised draft request for proposals.

Drift Scale Thermal Test Facility

The Department thanks the Board for its positive comments on the timely planning, design, and start up of the drift-scale thermal test.

Highly Enriched Aluminum-Clad Spent Fuel

The Department agrees with the Board that the effects on repository performance of accepting highly-enriched aluminum-clad spent fuel need careful consideration. The Department is addressing issues raised in your letter concerning long-term doses and criticality.

Although the aluminum-clad spent fuels degrade faster than zircalloy-clad commercial fuels, the burnup of the aluminum-clad spent fuel is less than the burnup of commercial fuels, leading to a lower source term for the long-term dose. Preliminary evaluations indicate that the relatively small amount of aluminum-clad spent fuel, with its smaller source term compared to the commercial fuel, does not have a significant impact on overall repository performance, even with the higher degradation rate.

The proposed design features and loading limits for the aluminum-clad spent fuel are expected to make criticality control for this fuel no greater a concern than for the commercial spent fuel.

The Department is developing acceptance criteria for disposal of Department-owned spent fuel, including the highly enriched aluminum-clad spent fuel, which will also address these waste form issues. We look forward to your review of these criteria.