



Department of Energy

Washington, DC 20585

September 20, 1999

SEP 24 1999

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

Dear Dr. Cohon:

This letter transmits the Department of Energy's response to the Nuclear Waste Technical Review Board's *A Report to the U.S. Congress and the Secretary of Energy*, issued in April 1999, summarizing the Board's 1998 activities. The Department is pleased with the Board's finding that the viability assessment (VA) was a useful management tool for integrating our work and setting priorities. We agree that the VA is not the same as a suitability evaluation; in fact, the VA identified the additional work to evaluate suitability and prepare a license application for the viability assessment reference design.

The Department is also pleased that the Board agrees in general with the research needs described in the VA. The enclosure addresses the particular research needs emphasized by the Board: water seepage into repository drifts, retardation of radionuclides in the unsaturated zone, long-term corrosion rates of waste package materials, and flow and transport properties in the saturated zone.

The enclosure also addresses the Board's comments on the defensibility of taking credit for cladding in performance assessment and the Board's suggestions regarding development of our transportation program.

The other major topics discussed in the report have been addressed in previous correspondence. Characterization of the saturated and unsaturated zones and design of the repository and waste package were addressed in our April 29, 1999, response to the Board's November 1998 report, as well as our June 15, 1999, response to the Board's letter of March 3, 1999. Total system performance assessment was addressed in our October 19, 1998, response to your letter of July 30, 1998.

The Department values the input provided by the Board in 1998 as we completed the VA. We look forward to the Board's feedback as we proceed with the additional work to support a decision for the Nation on geologic disposal at Yucca Mountain. If you have any questions, please contact me at (202) 586-6850.

Sincerely,

A handwritten signature in black ink, appearing to read "L. Barrett", with a long horizontal stroke extending to the right.

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

Enclosure

**Department of Energy's Response to the
Nuclear Waste Technical Review Board's April 1999
Report to the U.S. Congress and the Secretary of Energy
Summarizing the Board's 1998 Activities**

Research Needs

Overall, the Board agrees with the research needs identified by the DOE in the VA. In particular, the Board supports the DOE's plans to gather information on the following issues (page ix):

How much water seeps into repository drifts under ambient conditions as well as during the first 1,000 years after waste emplacement, when the rock surrounding the facility is heated?

Response:

We appreciate the Board's support for our assessment that seepage into drifts under ambient and thermally perturbed conditions is considered one of the most important areas for further characterization and modeling. Seepage testing in the Exploratory Studies Facility niches and in Alcove 1 has suggested that a minimum "seepage-threshold" percolation flux of between 8 and 100 mm/yr must be present in the rock mass surrounding an excavated opening in order to induce seepage into the opening. Substantiating the existence of and determining the applicable bounds on a "seepage-threshold" flux could provide substantial benefit to overall potential repository system performance.

Current planning calls for testing of seepage parameters in Niche 5 in the East-West Cross-Drift. This information will significantly extend our knowledge of seepage parameters and reduce uncertainty in seepage predictions. Modeling studies will incorporate this and other recent information and include a more representative drift geometry that incorporates partial drift collapse and asperities on the drift wall. Additionally, the ongoing Drift Scale Test will provide data to support modeling not only of the effects of thermal perturbations on seepage, but also the effects of coupled thermal, hydrologic, and chemical processes in the drift environment.

Can the zeolitic formations beneath the repository retard the migration of radionuclides to the environment?

Response:

We appreciate the Board's support for our assessment that the capability of zeolitic minerals beneath the potential repository to retard radionuclides remains an area of priority. Both vitric and zeolitic units, which contain zeolites in differing abundances, can retard the migration of radionuclides. Zeolites have a high sorptive capacity for radioactive alkali and alkaline-earth

cations (Sr, Cs) and a much lower sorptive capacity for transuranic elements (Pu, Np). Retardation of radionuclides in units containing zeolites depends on the amount of matrix activated by the migration front and by the abundance of zeolites at that location.

Currently, performance assessment analyses incorporate some retardation of radionuclides by zeolites in total system performance assessment (TSPA) models; however, data on perched-water occurrences and results from the Busted Butte Field Transport test are indicating that more credit may be taken for this retardation process.

What are the long-term corrosion rates of waste package materials, such as Alloy 22?

Response:

We appreciate the Board's support for our assessment that the long-term corrosion rates of waste package materials is an area of investigation that requires additional work to increase confidence in the predictive models. Samples of key materials have been exposed in the Long Term Corrosion Test Facility for over two years. In addition, literature data on long-term exposures have been collected to augment the available database. Also, similar materials have been considered, such as the performance of Alloy C, a precursor alloy to Alloy 22, to further expand the database. Models for performance prediction will be developed from qualified data. Other data will be utilized to corroborate the predictions developed.

What are the flow-and-transport properties of the groundwater that lies approximately 200 meters beneath the repository horizon?

Response:

We appreciate the Board's support for our assessment that the definition of groundwater flow and radionuclide transport within the saturated zone (SZ) from beneath the potential repository to the compliance point is an important priority. Current Project activities are focusing on the development of a 3-D SZ flow and transport model to support TSPA evaluations of potential repository system performance. The model is based on an updated hydrogeologic framework, includes recent data from hydraulic and tracer testing at the C-Wells Complex, and is incorporating new data from the Nye County Early Warning Drilling Program as these data become available.

Although currently supported by relatively sparse data down-gradient from the immediate site area, the model is expected to provide an improved basis for evaluating flow and transport from the potential repository to the compliance point relative to the representation used in TSPA for the viability assessment. In developing the model, the following specific priorities have been identified:

Definition of the ground-water flow and transport pathways down-gradient from the site;
Determination of the advective flow velocity along these pathways;
Determination of the sorptive properties of the alluvial materials (especially with regard to I¹²⁹); and
Quantification of matrix diffusion in the fractured volcanic-rocks aquifers.

Cladding Credit

The final report from the waste form expert elicitation provided little support for taking a significant amount of cladding credit. One expert even indicated that cladding credit probably could never be taken because of the large uncertainties in the environmental conditions surrounding the cladding. Despite these objections, the DOE took full cladding credit in the TSPA-VA. The Board is concerned that the DOE seemingly ignored the judgments of its own experts on this issue, (page 10)

Response:

In general, the expert elicitation panel members concluded there is insufficient information to support significant credit for cladding. However, many of the experts felt that credit for cladding could be taken if some of the concerns regarding the potential for degradation of the cladding as a result of crevice corrosion or delayed hydrogen cracking could be resolved. Other experts outside of the expert elicitation panel felt that there was a need for better understanding of the initial condition of the cladding.

As a first step in resolving the cladding performance issue, a detailed literature review has been undertaken which has involved internationally known and respected experts in cladding performance. These experts have provided insight as to the likely mechanisms that will be active under expected Yucca Mountain conditions, particularly later in the long expected lifetime of the alternative waste package designs being considered. In addition, several kinds of cladding integrity tests are already underway at Argonne National Laboratory. Crevice corrosion testing will be initiated shortly.

These test results, coupled with a detailed evaluation based on a review of the literature, will determine under what conditions credit cladding performance can justifiably be included in the overall performance of the spent fuel waste form. The Department will continue to examine the performance of a multi-barrier system with and without cladding credit.

Transportation

In developing its transportation program, the DOE might learn much from experiences in Europe and Japan, where there is already large-scale transportation activity. In those countries, there is an antinuclear element that the industry must deal with.

The DOE also might learn some lessons from what is taking place in Europe and should make every effort to build trust and a good working relationship with the groups, especially in Nevada, that will be affected by a large-scale shipping campaign. One possible approach to maximizing safety and to preventing undue burdens on the nationwide railroad network could be the use of dedicated trains for transporting spent nuclear fuel. The Board also feels that the design of the transportation cask should be integrated with that of the rail car. An integrated design concept would be a way to increase safety and performance, (page 23)

Response:

The Department appreciates the suggestions on the transportation program from the Board. The Department continues to follow with interest the international transportation and cask development activities along with the other various related issues as they emerge. It appears that every country, including the United States, has or will have, an antinuclear element as mentioned by the Board. The Department is continuing to work with stakeholder groups, including those in Nevada, toward a productive working environment.

In regard to the dedicated train and integrated rail car design, the Department agrees with both suggestions and believes that the current draft Request for Proposals for Waste Acceptance and Transportation Services (RFP) is compatible with the suggestions. The RFP calls *for...maximum use of special train service and advanced rail equipment features where this type of service or equipment can be demonstrated to enhance operating efficiency, dependability, cost effectiveness or lessen the potential of adverse railroad equipment incidents.*

In addition, the RFP requires the testing and operational demonstration of a *Transportation Cask System*, which is defined to include *the transportation cask, or transportation overpack (as applicable), the rail car (for rail-mounted casks), the trailer (for truck-mounted casks), and all other integral (i.e., shipped with/or on the rail car or trailer) transportation-related items including, but not limited to, transport skid, lifting trunnions, removable shielding (if needed), and applicable tie-down mechanisms.* While the rail equipment has not yet been built to support the next generation of rail casks being licensed by the U.S. Nuclear Regulatory Commission, the Department believes that the procurements resulting from this RFP will result in integrated designs.

In summary, the Department believes that we have developed an initial plan and acquisition approach that is consistent with the Board's suggestions. There may be several different, but acceptable solutions to general safety concerns, and the Department expects that there will be additional modifications to the requirements and approach described in the draft RFP prior to its final release.