

**U.S. Nuclear Waste Technical Review Board  
Performance Evaluation  
FY 2003**

## Evaluating the Board's Performance

The Board believes that measuring its effectiveness by directly correlating Board recommendations with improvements in the technical and scientific validity of Department of Energy (DOE) activities would be ideal. However, the Board cannot compel the DOE to comply with its recommendations. Consequently, a judgment about whether a specific recommendation had a positive outcome as defined above, may be (1) subjective or (2) an imprecise indicator of Board performance because implementation of Board recommendations is outside the Board's direct control. Therefore, to measure its performance in a given year, the Board has developed performance measures. For each annual performance goal, the Board considers the following.

1. Did the Board undertake the reviews, evaluations, and other activities needed to achieve the goal?
2. Were the results of the Board's reviews, evaluations, and other activities communicated in a timely, understandable, and appropriate way to Congress and the Secretary of Energy?

If both measures are met in relation to a specific goal, the Board's performance in meeting that goal will be judged effective. If only one measure is met, the performance of the Board in achieving that goal will be judged minimally effective. Failing to meet both performance measures without sufficient and compelling explanation will result in a judgment that the Board has been ineffective in achieving that performance goal. If the goals are deferred, that will be noted in the evaluation.

The Board will use its evaluation of its own performance from the current year, together with its assessment of current or potential key issues of concern related to the DOE program, to develop its annual performance objectives and performance-based budget request for subsequent years. The results of the Board's performance evaluation are included in its annual summary report.

### Board's Performance Evaluation for 2003

On the basis of the following evaluation and consistent with the performance measures described in the previous section, the Board's performance for 2003 was found to be effective overall. However, the Secretary's activities related to the waste management program were again somewhat limited in 2003. In addition, some long-term design activities have not been undertaken by the DOE. Therefore, some of the Board's 2003 goals related to design have been deferred, pending DOE activities related to the goals. Goals not fully achieved are listed at the end of their respective sections.

The reliability and completeness of the performance data used to evaluate the Board's performance relative to its annual performance goals is high and can be verified by accessing the referenced documents on the Board's Web site: [www.nwtrb.gov](http://www.nwtrb.gov).

## Performance Goals for FY 2003

The Board's performance goals for fiscal year (FY) 2003 were developed to further the achievement of the Board's general goals and strategic objectives. An evaluation of the Board's effectiveness in achieving each performance goal is provided in the bullet under the goal.

### **1. Performance Goals Related to Site Suitability and Predicting Repository Performance**

#### *Performance Goals and Evaluations*

1.1.1 Review for technical validity the technical and scientific components of the DOE's ongoing site investigations (if applicable).

- Evaluation of 1.1.1: The Board held a meeting on January 28, 2003, at which it received updates from the DOE on studies attempting to resolve differences in the existence of fast paths for water flow, on work related to low permeability areas that affect water flow and rates, and on scientific studies related to temperatures in repository tunnels and work in the cross drift. On March 5, 2003, the Board sent a letter to Dr. Margaret Chu stating that resolving differences in opinion on chlorine-36 studies is essential for understanding key processes at Yucca Mountain. The letter went on to state that paleosols merit investigation, noting that ongoing scientific studies will require adequate funding and the attention of program managers. At a February 24, 2003, joint meeting of the Board's Panel on the Natural System and Panel on the Engineered System, the Board discussed in detail the DOE's work related to estimating seismic hazard and in particular ground-motion estimates. In a follow up letter to Dr. Chu, the panels pointed out problems associated with very conservative ground-motion estimates. After meeting in September 2003, the Board sent a letter on December 16, 2003, in which it encouraged the DOE to develop boreholes as monitoring wells to obtain hydraulic head, water chemistry, and related hydrogeologic data at small cost. In the same letter, the Board suggested that the DOE undertake a "root cause" analysis to resolve discrepancies in chlorine-36 study results.

1.1.2. Monitor the DOE's efforts to quantify uncertainties related to estimates of repository performance.

- Evaluation of 1.1.2: Duplicate. (See evaluation of 1.3.3)
- 1.2.1. Monitor the results of flow-and-transport studies being conducted to obtain information on the potential performance of the saturated zone (SZ) as a natural barrier in the repository system.
- Evaluation of 1.2.1: At a meeting held on January 28, 2003, the Board discussed the significance of alluvial sedimentary deposits (paleosols) in altering directions and rates of water flow and chemical transport in the saturated zone. The Board sent a letter to the DOE on March 5, 2003, in which it commented on this technical issue. The Board received several updates and a presentation on flow and transport in the SZ and the unsaturated zone at its September 2003 meeting. In a December 16, 2003, letter to Dr. Margaret Chu, the Board suggested that in conjunction with the DOE's planned drilling of aeromagnetic anomalies consideration be given for developing some of the boreholes as monitoring wells to conduct studies related to water flow in the SZ and to obtain information on the ability of the SZ to function as a barrier to migration of radioactive materials.
- 1.2.2. Evaluate geologic, hydrologic, and geochemical information obtained from the enhanced characterization of the repository block at Yucca Mountain.
- Evaluation of 1.2.2: After receiving an update on scientific activities at its January 2003 meeting, the Board sent a letter on March 5, 2003, to Dr. Margaret Chu noting that these studies could be very valuable in increasing understanding of the potential behavior of Yucca Mountain but that adequate funding and attention from program managers would be needed to fully realize the potential of the studies.
- 1.3.1. Determine the strengths and weaknesses of the total system performance assessment (TSPA).
- Evaluation of 1.3.1: In a March 5, 2003, letter to Dr. Margaret Chu, the Board suggested that the DOE gain a better understanding of the potential behavior of the entire repository system through continued scientific studies and by exploring ways to determine and display the contributions of individual barriers to overall repository performance. As part of its comments to the DOE following a February 2003 joint panel meeting on seismic hazard, the Board stated that the lack of physical realism and unrealistic ground-motion estimates had implications for performance assessment, design, and scientific confidence. The Board reviewed and commented on the DOE's technical basis documents in a December 2003 letter to the DOE.
- 1.3.2. On the basis of an evaluation of the natural processes at work at the Yucca Mountain site, recommend additional work needed to address uncertainties, paying particular attention to estimates of the rate and distribution of water seepage into the proposed repository under proposed repository design conditions.

- Evaluation of 1.3.2: In letters to Dr. Margaret Chu sent by the Board in March and December 2004, the Board reiterated the need to resolve discrepancies between chlorine-36 studies related to the possible existence of fast water paths into exploratory tunnels. In its November 25, 2003, technical report on the potential for corrosion of waste packages during the thermal pulse, the Board commented extensively on the DOE's active fracture model, which postulates that a vaporization barrier and the capillary properties of the repository tunnel walls will prevent water from seeping into the drifts and onto the waste packages for hundreds of years.

#### 1.3.3. Evaluate the DOE's quantification of uncertainties and conservatisms used in TSPA.

- Evaluation of 1.3.3: In a letter dated June 27, 2003, the Board commented on the implications of using highly conservative assumptions to address seismic issues. The Board recommended that the DOE not take a physically unrealistic or highly conservative approach to addressing seismic issues for several reasons: Such an approach can skew understanding; compounding conservatisms does not always produce conservative results; unrealistic assumptions can lead to unreasonably high costs; using conservatisms in the place of understanding can undermine confidence in results; actions taken later in light of more-realistic assumptions could be harder to implement.

#### 1.3.4. Recommend additional measures for strengthening the DOE's repository safety case.

- Evaluation of 1.3.4: At its January 2003 meeting, the Board received presentations on the contribution of individual barriers to the performance of the repository system. In a March 2003 letter to Dr. Margaret Chu following the meeting, the Board encouraged the DOE to continue its work to evaluate the contributions of the barriers and found that there appear to be opportunities for improving both the analytical approach and the clarity of the presentation of study results. In a December 2003 letter to Dr. Margaret Chu, the Board urged the DOE to integrate the conclusions from the DOE's technical basis documents into a concise description of the safety case for a Yucca Mountain repository. The Board also encouraged the DOE to include in its safety case a discussion of relevant analogs that can be used as lines of evidence.

#### 1.3.5. Evaluate data from the drift-scale heater test.

- Evaluation of 1.3.5: The Board commented on the drift-scale heater test and other ongoing scientific studies in its letter to Dr. Margaret Chu dated March 5, 2003. The Board pointed out the value of these test in increasing understanding of the potential behavior of a repository system at Yucca Mountain. The Board noted that adequate funding and attention by managers would be necessary to realize the full potential of this scientific work.

#### 1.4.1. Review plans and work carried out on natural and engineered analogs to the repository system.

- Evaluation of 1.4.1: The Board commented on the use of analogs in its June 2003 letter to the DOE on seismic hazard. The Board suggested that the DOE compare tunnel performance under extreme dynamic conditions in DOE models with nuclear test damage data and rockburst damage observed in mines with comparable rock-mass conditions. In its December 2003 letter, the Board suggested the use of analogs as lines of evidence in a repository safety case.

## **2. Performance Goals Related to the Engineered Repository System**

### *Performance Goals and Evaluations*

2.1.1. Monitor the DOE's development of analytical tools for assessing the differences between different repository designs.

- Evaluation of 2.1.1: On February 20, 2003, the Board transmitted to the DOE a compilation of its statements related to uncertainties related to high-temperature repository designs and thermal loads. The Board held a meeting in Washington, D.C., on May 13-14, that focused on the DOE's repository design and operating mode for Yucca Mountain. At the meeting, the DOE made presentations related to thermal aspects of the repository design and operating mode, how the thermal aspects were analyzed for waste isolation, and the results of the analyses. The Board noted in its October 21, 2003, letter to the DOE that data currently available to the Board indicate that perforation of waste packages is unlikely if waste-package surface temperatures are kept below 95°C.

2.1.2. Evaluate the accuracy and completeness of the technical bases for repository and waste package designs.

- Evaluation of 2.1.2: The Board commented on the DOE's technical basis for dealing with the evolution of chemical environments on waste package surfaces in a letter to Dr. Margaret Chu dated March 5, 2003. In the same letter, the Board encouraged the DOE to document carefully and completely the technical basis for its answer to a question related to whether a repository with lower peak temperatures on waste package surfaces would reduce uncertainty and the likelihood or severity of corrosion problems. The Board also commented on the use of dual Alloy-22 lids, observing that they may not be justified. The Board devoted most of its May 2003 meeting to discussions about the technical basis for the DOE's proposed repository design and operating mode. Given the information presented at that meeting, the Board sent a letter to Dr. Margaret Chu on October 21, 2003, on the potential for corrosion of waste packages. On November 25, 2003, the Board issued a detailed technical report supporting its conclusions on the potential for deliquescence-based, localized corrosion during the thermal pulse. In December 2003, the Board combined its October letter and November technical report in a report submitted to Congress and the Secretary of Energy.

2.1.3. Evaluate the extent to which the DOE is using the technical bases for modifying repository and waste package designs.

- Evaluation of 2.1.3: The Board received updates at its meetings held in May and September 2003 on the DOE's plans to include a high-temperature repository design in a license application to the Nuclear Regulatory Commission. The Board commented in its letter of October 21, 2003, to Dr. Margaret Chu that most corrosion data are for temperatures below 95°C. Therefore the DOE's data may constitute an adequate technical basis for estimating generalized corrosion of waste packages if temperatures are kept below that level. The Board further comments that it believes that the high temperatures of the DOE's current repository design will result in perforation of the waste packages. The Board goes on to state that perforation is unlikely at temperatures below 95°C.

2.1.4. Monitor and evaluate the DOE's progress in developing a technical basis for modified or novel design features.

- Evaluation of 2.1.4: In a March 2003 letter to Dr. Margaret Chu, the Board commented on potential modifications of the waste package. The Board observed that the dual lid of the current waste package design may not be justified. In addition, the letter goes on to state that current plans not to mitigate tensile stresses of the inner Alloy-22 closure weld raises questions about the dual-lid concept. In addition, because the trunnion-collar sleeves appear complex and prone to crevice corrosion, it may be necessary to reconsider this part of the design.

2.2.1. Evaluate data from studies of corrosion and the waste package environment on the predicted performance of materials being proposed for the EBS.

- Evaluation of 2.2.1: At its January 2003 meeting, the Board heard a presentation from contractors from the state of Nevada and from the DOE on potentially corrosive environments in repository tunnels and commented on those presentations in a March 2003 letter to Dr. Margaret Chu. In that letter, the Board noted that even though corrosive brines and condensates can be produced at laboratory scale the State presentations did not include estimates of the likelihood that such solutions would occur. The Board devoted most of its May 2003 meeting to discussions about the technical basis for the DOE's proposed repository design and operating mode. Given the information presented at that meeting, the Board sent a letter to Dr. Margaret Chu on October 21, 2003, on the potential for corrosion of waste packages. On November 25, 2003, the Board issued a detailed technical report supporting its conclusions on the potential for deliquescence-based, localized corrosion during the thermal pulse. In December 2003, the Board combined its October letter and November technical report in a report submitted to Congress and the Secretary of Energy. On the basis of data from the DOE, the Board concluded that there is a significant potential for localized corrosion of waste packages during the thermal pulse in the DOE's high-temperature repository design. The Board also found that there are questions about the repository environments predicted by the DOE.

2.3.1. Assess the integration of scientific studies with engineering designs for the repository and the waste package. In particular, monitor the results of ongoing thermal tests and evaluate DOE plans for using the test results to support models of the thermally disturbed region near the repository and for deciding on spacing between emplacement drifts, degree of preclosure ventilation, and closure date of the potential repository.

- Evaluation of 2.3.1: The Board commented in a December 2003 letter to Dr. Margaret Chu that the technical basis documents developed by the DOE have significant potential for improving program integration.

2.3.2. Evaluate the DOE's efforts in identifying natural and engineered analogs (see also 1.4.1.).

- Evaluation of 2.3.2: The Board commented on the use of analogs in its June 2003 letter to the DOE on seismic hazard. The Board suggested that the DOE compare tunnel performance under extreme dynamic conditions in DOE models to nuclear test damage data and rockburst damage observed in mines with comparable rock-mass conditions. In its December 2003 letter, the Board suggested the use of analogs as lines of evidence in a repository safety case.

### **3. Performance Goals Related to the Waste Management System**

#### *Performance Goals and Evaluations*

3.1.1. Monitor efforts by the NRC to update estimates of risk associated with transportation of spent nuclear fuel and high-level radioactive waste.

- Evaluation of 3.1.1: Board staff attended meetings of the NRC study committee and updated other staff and the Board members on the NRC committee deliberations.

3.1.2. Evaluate the operation of the entire repository facility, including the surface and subsurface components.

- Evaluation of 3.1.2: In a letter to Dr. Margaret Chu dated March 5, 2003, the Board urged the DOE to adopt a "systems" approach, addressing both strategic and operational considerations in its transportation planning. The Panel on the Waste Management System held a meeting in February 2003 that tracked the theoretical movement of spent fuel from reactor sites to the repository surface facilities and began identifying issues of concern for future Board meetings. The Board reported its findings from the meeting in a letter to Dr. Margaret Chu dated April 30, 2003.

3.2.1. Evaluate the effects of "off-normal" events at the surface facility and how the events could affect the ability of the facility to receive waste shipments.

- Evaluation of 3.2.1: The Panel on the Waste Management System held a meeting in February 2003 that tracked the theoretical movement of spent fuel from reactor sites to the repository surface facilities and began identifying issues of concern for future Board



meetings. In an April 2003 letter to Dr. Chu, the Board identified two issues of concern related to the surface and subsurface facilities at the repository and asked for additional information on both. First, the Board noted the possibility that a small amount of spent fuel could be damaged in transit, requiring mitigation before the remediation facilities are planned to be constructed. Second, the Board asked for information about new underground design changes, including the use of a wheeled waste transporter and the location of exhaust drifts and fans.

3.3.1. Examine the ability of storage casks and containers, including multipurpose canisters, to serve as disposal casks and containers in a repository.

- Evaluation of 3.3.1: Board staff attended meetings of a National Academy of Sciences committee involved in studying this issue and conveyed the discussions surrounding the issues to Board members and other Board staff.

3.4.1. Evaluate logistics capabilities of the transportation system.

- Evaluation of 3.4.1: In an April 2003 letter to Dr. Margaret Chu following its February panel meeting, the Board pointed out that no casks have been certified for transporting some of the higher-burnup spent fuel likely to be generated in the future. The Board went on to state that coordination of cask development with utility shipping needs and with repository and transportation system capabilities will be important.

3.4.3 Review criteria for waste acceptance for storage to ensure that accepted material has been suitably characterized for subsequent disposal.

- Evaluation of 3.4.3: In its letter to Dr. Chu of April 2003, the Board called attention to the need to coordinate with the nuclear utilities to ensure that the waste acceptance process proceeds smoothly.

3.4.4. Evaluate the DOE's plans for enhancing safety capabilities along transportation corridors, and review the DOE's planning and coordination activities (e.g., route selection), accident prevention activities (e.g., improved inspections and enforcement), and emergency response activities.

- Evaluation of 3.4.4: The Panel on the Waste Management System held a meeting in February 2003 that tracked the theoretical movement of spent fuel from reactor sites to the repository surface facilities and began identifying issues of concern for future Board meetings. In its April 2003 letter to Dr. Margaret Chu, the Board recommended that the DOE adopt safety as guiding principle in planning and developing a transportation system and should develop an integrated safety plan for guiding the development process.

The following goals were deferred to 2004, pending the commencement of activities in these areas by the DOE:

- 3.2.2. Evaluate the effects of reduced receiving capacity at the repository surface facility on the nationwide transportation system.
- 3.3.2. Evaluate effects of human errors in risks associated with packaging and transporting spent nuclear fuel.
- 3.4.2. Monitor progress in implementing new technologies for improving transportation safety for spent fuel (e.g., electronic braking, wheel-bearing monitoring).

#### **4. Performance Goals Related to Long-Term Activities**

(Will apply only if the site is found suitable and a site recommendation is ratified.)

##### *Performance Goals*

- 4.1.1. Monitor the DOE's proposed plans for performance confirmation to help ensure that uncertainties identified as part of the site recommendation process are addressed.
  - Evaluation of 4.1.1: The Board received a presentation on the DOE's performance confirmation plans at its September 2003 meeting and commented on the plans in a December 2003 letter to Dr. Margaret Chu. The Board noted that the operational period for performance confirmation may extend beyond repository closure; therefore, it may serve to increase confidence in DOE models by confirming their predictions. The Board urged the DOE to clearly define what it means by performance confirmation.

The following goal was deferred, pending DOE activities related to design modification.

- 4.1.2. Monitor design modification activities undertaken by the DOE.