

# **U.S. Nuclear Waste Technical Review Board**

## **Fiscal Year 2006 Budget Request Submittal Including Supplementary Information about the Board**

## SUMMARY AND HIGHLIGHTS

The U.S. Nuclear Waste Technical Review Board's (Board) budget request for fiscal year (FY) 2006 has been developed to enable the Board to achieve its performance goals for the year. The goals are listed in the budget document and have been established in accordance with the Board's congressional mandate: to conduct an independent evaluation of the technical and scientific validity of U.S. Department of Energy (DOE) activities related to implementing the Nuclear Waste Policy Amendments Act of 1987. These activities include disposing of, packaging, and transporting commercial spent nuclear fuel and defense high-level radioactive waste. The Board's ongoing review is vital to the credibility of the DOE's technical and scientific activities.

In 2002, Congress approved the President's recommendation of the Yucca Mountain site. Since then, the DOE has been preparing an application to be submitted to the Nuclear Regulatory Commission (NRC) for a license to construct a repository at Yucca Mountain. Throughout this process, the Board has evaluated the technical and scientific validity of DOE work and reported its findings to Congress and the Secretary.

The appointment of 7 new Board members by President Bush in September 2004 brings the Board to its full membership for the first time in several years. In FY 2006, the Board intends to evaluate the technical and scientific validity of DOE activities related to estimating the performance of the repository system and of activities related to planning and implementing a waste management system. The Board anticipates that its focus on the DOE's work related to the waste management system, including waste transportation, handling, packaging, and repository operations, will increase commensurately with additional DOE activity in these areas in FY 2006.

To support the Board's activities in FY 2006, the Board is requesting **\$3,608,000**. This is the first time in 3 years that the Board has requested an increase over the previous-year's appropriated level. This amount will allow the Board to support the activities of the full complement of 11 Board members as they conduct the comprehensive review described above, to provide orientation activities for new members, and to comply with new and extensive federal security requirements related to the Board's information systems.

U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD

Salaries and Expenses

(Including Transfer of Funds)

For necessary expenses of the Nuclear Waste Technical Review Board, as authorized by Public Law 100-203, section 5051, \$3,608,000, to be derived from the Nuclear Waste Fund and to remain available until expended.

*(2006 Energy and Water Development Appropriations Act, P.L. 108-007)*

## FISCAL YEAR 2006 BUDGET REQUEST

### **Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste**

Approximately 2,000 metric tons of spent nuclear fuel is produced each year by nuclear reactors at more than 70 sites nationwide. By the time the presently operating reactors reach the end of their scheduled 40-year lifetimes (sometime in the 2030's), approximately 87,000 metric tons of spent fuel will have been produced. (This estimate does not include spent nuclear fuel from plants that may be granted license renewals from the NRC.) Spent nuclear fuel currently is being stored at reactor sites across the country. Disposal of this waste in a deep geologic repository is the primary approach being pursued by the United States and other countries.

In early 2002, the Secretary of Energy recommended approval of the Yucca Mountain site to the President. The President then recommended the site to Congress. Nevada later disapproved the recommendation. Both the U.S. House of Representatives and the U.S. Senate went on to approve the site recommendation. The DOE is currently preparing an application to be submitted to the NRC for authorization to construct a repository at the site. Throughout this process, the Board provided its evaluation of the technical basis of DOE work and communicated its views to Congress and the Secretary in letters, reports, and congressional testimony.

### **The Board's Continuing Role**

The Board was established by Congress in the Nuclear Waste Policy Amendments Act of 1987 (NWPAA). The Board is charged with evaluating the technical and scientific validity of activities undertaken by the Secretary of Energy, including site-characterization activities and activities related to the packaging and transportation of high-level radioactive waste and spent nuclear fuel.<sup>1</sup> Board technical and scientific findings and recommendations are included in reports that are submitted at least twice each year to Congress and the Secretary. In creating the Board, Congress realized that an ongoing independent and expert evaluation of the technical and scientific validity of the DOE's site-evaluation and other waste-management activities would be crucial to acceptance by the public and the scientific community of any approach for disposing of spent nuclear fuel and high-level radioactive waste.

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<sup>1</sup> 42 U.S.C. 10263

## **The Board's Funding Requirement for Fiscal Year 2006: \$3,608,000**

As described below, the Board's budget request of \$3,608,000 for FY 2006 represents the funding needed to accomplish the Board's performance goals for the year. During FY 2006, the Board will review information and analyses developed by the DOE, including data related to corrosion studies and repository tunnel environments, the basis for the DOE's proposed waste package and repository designs and revisions of the designs, technical and scientific work underlying the DOE's total system performance assessment of the site, and technical issues related to the DOE's plans for implementing a waste management system. The Board's request also provides for technical and scientific evaluation of DOE activities related to the packaging and transportation of spent nuclear fuel and high-level radioactive waste to Yucca Mountain. The Board has maintained level funding for several budget cycles. This is the first time in 3 years that the Board has requested an increase over the previous-year's appropriated level. This amount will allow the full complement of 11 Board members to conduct the comprehensive review described above, will provide orientation for 7 new members, and will enable the Board to comply with new and extensive federal security requirements related to the Board's information systems.

### **Goals and Strategic Objectives**

The nation's goals related to the disposal of spent nuclear fuel and high-level radioactive wastes were set forth by Congress in the NWPAA. The goals are to develop a deep geologic repository or repositories for disposing of high-level radioactive waste and spent nuclear fuel at a suitable site or sites and to establish a program of research, development, and demonstration for the disposal of such waste.

The NWPAA limited repository-development activities to a single site at Yucca Mountain in Nevada. The NWPAA also established the Board and charged it with evaluating the technical and scientific validity of the Secretary of Energy's activities associated with implementing the NWPAA. Such activities include characterizing the Yucca Mountain site and packaging and transporting spent nuclear fuel and high-level radioactive waste.

The Board's general goals and strategic objectives, which are set forward in its strategic plan for FY 2004-2009, have been established in accordance with its statutory mandate and with congressional action in 2002 authorizing the DOE to proceed with the development of an application to be submitted to the NRC for authorization to construct a repository at Yucca Mountain. The Board's goals reflect the continuity of the Board's ongoing technical and scientific evaluation and the Board's view that both the repository and waste management activities should be evaluated as systems.

The Board's performance goals for FY 2006 are listed below. The performance goals are divided into four areas that correlate with Board panel jurisdictions and have been numbered according to the appropriate strategic objectives included in the Board's Strategic Plan for FY 2004-2009. Budget amounts for FY 2006 have been preliminarily allocated to each set of performance goals.

## BOARD PERFORMANCE GOALS FOR FY 2006

### 1. *Performance Goals Related to the Natural System and Strategy for Achieving the Goals*

(Dollars in Thousands)		
<b>FY 04</b>	<b>FY 05</b>	<b>FY 06</b>
<b>868</b>	<b>852</b>	<b>903</b>

#### Performance Goals

- 1.1.1. Review the technical activities and plans for the DOE's science and technology program.
- 1.1.2. Monitor the results of flow-and-transport studies to obtain information on the potential performance of the saturated zone as a natural barrier in the repository system.
- 1.1.3. Review DOE efforts to confirm estimates of natural-system performance, including tests of models and assumptions, and the pursuit of independent lines of evidence.
- 1.2.1. Review DOE efforts to resolve questions related to possible seismic events and igneous consequences.
- 1.3.1. Evaluate geologic, hydrologic, and geochemical information obtained from the enhanced characterization of the repository block (ECRB) at Yucca Mountain.
- 1.3.2. Evaluate data from the drift-scale heater test.
- 1.3.3. Review plans and work carried out on possible analogues for the natural components of the repository system.
- 1.3.4. Recommend additional work needed to address uncertainties, paying particular attention to estimates of the rate and distribution of water seepage into the repository under proposed repository design conditions.
- 1.4.1. Evaluate tunnel-stability studies undertaken by the DOE.
- 1.5.1. Review the DOE's efforts to integrate results of scientific studies on the behavior of the natural system into repository designs.

## Strategy for Achieving Goals

The Board will accomplish its goals by doing the following.

- Holding three public meetings with the DOE and DOE contractor personnel involving the full Board and holding meetings of the Panel on the Natural System, as needed.
- Reviewing critical documents provided by the DOE and its contractors, including contractor reports, process model reports, and total system performance assessment (TSPA).
- Meeting with contractor principal investigators on technical issues, including those related to climate change, seismic and volcanic events, flow and transport in the unsaturated and saturated zones, seepage, and the biosphere.
- Visiting and observing ongoing exploratory studies facility (ESF), ECRB, and laboratory investigations, including the facilities at Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, and Sandia National Laboratories. Observing other field investigations and visiting potential analogue sites.
- Visiting programs in other countries and attending national and international symposia and conferences.

## 2. Performance Goals Related to the Engineered System and Strategy for Achieving the Goals

(Dollars in Thousands)		
<b>FY 04</b>	<b>FY 05</b>	<b>FY 06</b>
<b>1,041</b>	<b>1,023</b>	<b>1,082</b>

### Performance Goals

- 2.1.1. Monitor the DOE's performance allocation studies.
- 2.2.1. Review thermal testing and rock stability testing related to potential conditions in repository tunnels.
- 2.2.2. Evaluate data from studies of the effects of corrosion and the waste package environment on the predicted performance of materials being proposed for engineered barriers.
- 2.3.1. Review the progress and results of materials testing being conducted to address uncertainties about waste package performance.

- 2.3.2. Evaluate the DOE's efforts in identifying natural and engineered analogs for corrosion processes.
- 2.4.1. Monitor the DOE's development of analytical tools for assessing the differences between repository designs.
- 2.4.2. Evaluate the accuracy and completeness of the technical bases for repository and waste package designs and the extent to which the DOE is using the technical bases for modifying repository and waste package designs.
- 2.4.3. Evaluate the integration of the subsurface design and layout with thermal management and preclosure facility operations.
- 2.5.1. Assess the integration of scientific studies with engineering designs for the repository and the waste package.

#### Strategy for Achieving Goals

The Board will accomplish its goals by doing the following.

- Holding three public meetings of the full Board with DOE and contractor personnel involving the full Board and holding meetings of the Panel on the Engineered System, as needed.
- Reviewing critical documents provided by the DOE and its contractors, including contractor reports, process model reports, and TSPA.
- Meeting with contractor principal investigators on technical issues.
- Reviewing DOE documents and databases, paying particular attention to design features developed to promote drainage, control ventilation, and protect workers in the exhaust end of the ventilation system.
- Reviewing the common database (literature, laboratory, and field data) and judging the adequacy of the database for a decision on repository development.
- Visiting and observing ongoing laboratory investigations, including the facilities at Lawrence Livermore National Laboratory and Lawrence Berkeley National Laboratory.
- Visiting programs in other countries and attending national and international symposia and conferences.

*3. Performance Goals Related to Repository System Performance and Integration and Strategy for Achieving the Goals*

(Dollars in Thousands)

<b>FY 04</b>	<b>FY 05</b>	<b>FY 06</b>
<b>694</b>	<b>682</b>	<b>721</b>

Performance Goals

- 3.1.1. Identify which technical and scientific activities are on the critical path to reconciling uncertainties related to the DOE's performance estimates.
- 3.1.2. Determine the strengths and weaknesses of TSPA.
- 3.1.3. Evaluate the DOE's treatment of seismic and volcanism issues in TSPA.
- 3.2.1. Evaluate the DOE's quantification of uncertainties and conservatisms used in TSPA.
- 3.2.2. Review new data and updates of TSPA models, and identify models and data that should be updated.
- 3.3.1. Evaluate the DOE's efforts to create a transparent and traceable TSPA.
- 3.3.2. Evaluate the DOE's efforts to develop simplified models of repository performance.
- 3.3.3. Evaluate the DOE's efforts to identify analogues for performance estimates of the overall repository system.
- 3.4.1. Evaluate the DOE's efforts to analyze the contribution of the different engineered and natural barriers to waste isolation.
- 3.5.1. Evaluate technical aspects of value engineering and performance-related trade-off studies, including criteria, weighting factors and decision methodologies for such studies and how technical uncertainties are taken into account.
- 3.6.1. Recommend additional measures for strengthening the DOE's repository safety case.
- 3.7.1. Evaluate the DOE's efforts to develop a feedback loop among performance-confirmation activities and TSPA models and data.
- 3.7.2. Monitor the DOE's proposed performance confirmation plans to help ensure that uncertainties identified as part of the site recommendation process are addressed.

## Strategy for Achieving Goals

The Board will accomplish its goals by doing the following.

- Holding three public meetings of the full Board with DOE and contractor personnel involving the full Board and holding meetings of the Panel on the Repository System Performance and Integration, as needed.
- Reviewing critical documents provided by the DOE and its contractors, including contractor reports, process model reports, and the DOE's TSPA.
- Meeting with contractor's principal investigators on technical issues.
- Visiting and observing ongoing laboratory investigations, including the facilities at Lawrence Livermore National Laboratory, Lawrence Berkeley National Laboratory, Sandia National Laboratories, and the engineered-barrier test facility. Observing field investigations.
- Visiting programs in other countries and attending national and international symposia and conferences.

### 4. *Performance Goals Related to the Waste Management System and Strategy for Achieving the Goals*

(Dollars in Thousands)		
<b>FY 04</b>	<b>FY 05</b>	<b>FY 06</b>
<b>869</b>	<b>853</b>	<b>902</b>

#### Performance Goals

- 4.1.1. Evaluate the operation of the entire repository facility, including the surface and subsurface components.
- 4.1.2. Monitor the identification of research needs to support improved understanding of the interaction of components of the waste management system.
- 4.1.3. Review the technical and scientific basis of the DOE's analyses of component interactions under various scenarios, including the degree of integration and redundancy across functional components over time.
- 4.1.4. Evaluate the effects of reduced receiving capacity at the repository surface facility on the nationwide transportation system.

- 4.1.5. Review criteria for waste acceptance for storage to ensure that accepted material has been suitably characterized for subsequent disposal.
- 4.2.1. Monitor the DOE's efforts to implement Section 180 (c) of the NWPA.
- 4.3.1. Monitor the DOE's progress in developing and implementing a transportation plan for shipping spent nuclear fuel and high-level radioactive waste to a Yucca Mountain repository.
- 4.3.2. Review the DOE's efforts to develop criteria for transportation mode and routing decisions.
- 4.3.3. Evaluate logistics capabilities of the transportation system.
- 4.3.4. Monitor progress in implementing new technologies for improving transportation safety for spent nuclear fuel.
- 4.3.5. 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.

#### Strategy for Achieving Goals

The Board will accomplish its goals by doing the following.

- Holding three public meetings with DOE and contractor personnel involving the full Board and holding meetings of the Board's Panel on the Waste Management System in appropriate areas of the country.
- Reviewing critical documents provided by the DOE and its contractors, including contractor reports, process model reports, and TSPA.
- Meeting with groups involved in implementing transportation plans, including the NRC, the Department of Transportation, railroad and trucking companies, nonprofit groups, the utilities, and other stakeholders.
- Visiting programs in other countries and attending national and international conferences and symposia.

## **Budget Request by Object Class**

### *Object Class 11.1, Full-Time Staff: \$1,709,000*

The amount requested for full-time permanent staff is based on the requirement to fund a total of 16 positions. Because the Board's technical and scientific evaluations are conducted by Board members supported by professional staff, the Board's enabling legislation authorizes the Chairman to appoint and fix the compensation of not more than 10 senior professional staff members. This request assumes the use of all 10 positions under this authority. In addition, the chairman is authorized to appoint such clerical and administrative staff as may be necessary to discharge the responsibilities of the Board. The other 6 positions funded under this object class are support staff engaged in clerical, secretarial, and administrative activities; development and dissemination of Board publications; information technology, including maintenance of the Board's Web site; public affairs; and meeting logistics for the Board. The small administrative staff supports the very active, part-time Board members and the 10 full-time professional staff.

The estimate assumes a 1.023 combined cost-of-living adjustment and locality raise in January 2006, for both general schedule and executive schedule employees.

### *Object Class 11.3, Other than Full-Time Permanent Staff: \$321,000*

The amount requested for this category includes compensation for Board members. Each Board member will be compensated at the rate of pay for Level III of the Executive Schedule for each day the member is engaged in work for the Board. The 11 Board members serve on a part-time basis equaling 2 full-time equivalent positions. The budget assumes that each member will attend 3 full Board meetings, 4 panel meetings, and on average 5 additional meetings or field trips during the year. This estimate represents an average of 50 workdays per member in FY 2006. This estimate also assumes a 2.3 percent increase in Executive Schedule compensation for employees in this category for FY 2006 (effective January 2006).

### *Object Class 11.5, Other Personnel Compensation: \$63,000*

The amount requested for this category covers approximately 100 hours of staff overtime and performance awards under the Performance Management System approved by the Office of Personnel Management (OPM). Most Board and panel meetings require considerable overtime for handling preparations and on-site meeting logistics.

### *Object Class 12.1, Civilian Personnel Benefits: \$432,000*

The estimate for this category represents the government's contribution for employee benefits at the rate of 26 percent for staff and 7.65 percent for members.

*Object Class 21.0, Travel: \$320,000*

The amount requested for this object class includes travel costs for Board members, staff, and consultants traveling to Board and panel meetings, to other meetings (including professional meetings, conferences, and orientation activities) and sites for acquiring technical and scientific data, and to Yucca Mountain, Nevada, for reviewing site activities within the scope of the Board's mission. The request is based on 11 Board members attending 3 Board and 4 panel meetings and making on average 5 other trips during the year at an average length of 4 days each, including travel time. In addition, the 10 professional staff members will travel on similar activities an average of 7 trips during the year at an average of 5 days per trip. The estimate is that consultants, whom the Board reimburses for travel expenses, will make a total of 15 trips, to attend Board and panel meetings and other meetings as required to cover expertise scientific and technical areas otherwise not covered by staff or Board members. The Board now has a full complement of 11 members for the first time since 2003. In FY 2006, it is anticipated that DOE will significantly increase its activities related to planning for transportation and packaging of the waste and designing the repository surface and subsurface facilities. The Board's meetings will increase commensurately and will be held in parts of the country affected by the DOE action. New members will attend orientation sessions to gain experience with the issues and the program activities that are the subjects of the Board's evaluation.

*Object Class 23.1, Rental Payments to GSA: \$184,000*

The estimate for this object class represents the amount the Board will pay to the General Services Administration (GSA) for rental of office space totaling 6,288 sq. ft. at an annual rate of \$29.19 per sq. ft.

*Object Class 23.3, Communications, Utilities, Miscellaneous: \$33,000*

The requested amount represents estimates for telephone service, postage, local courier services, video teleconferencing, FTS long-distance telephone service, the Internet, and mailing services related to management and use of the Board's mailing list. In order to meet new government standards the Board is preparing to make available approximately 5 Gigabytes of data and information on its website. This will increase communications by approximately \$15,000 in FY 2006.

*Object Class 24.0, Printing and Reproduction: \$20,000*

The major items in this object class are the publication of reports to the U.S. Congress and the Secretary of Energy, publication of meeting notices in the *Federal Register*, production of press releases announcing meetings and report publication, and production of other informational materials for Board members and the public. All Board meetings are open to the public, and copies of meeting materials are provided. The Board anticipates significantly more

requests for its letters and reports once licensing proceedings begin. Members of the public who live in rural areas, and who do not have Web access, may be interested in obtaining printed copies of Board documents.

*Object Class 25.1, Consulting Services: \$149,000*

Consultants will be hired to support and supplement Board and staff analysis of technical and scientific issues related to the DOE's plans for packaging and transporting waste. Although the Board is rich in expertise in several areas there is a need to expand their experience in the geosciences field along with other disciplines. This will enable the Board to conduct the kind of comprehensive technical and scientific review mandated by Congress. In addition, the Board expects to contract with part-time technical consultants to supplement and support in-house operations in systems management, Web site management, report production, and editing.

*Object Class 25.2, Other Services: \$115,000*

This category includes court-reporting services for an estimated seven Board or panel meetings, meeting-room rental and related services, maintenance agreements for equipment, professional development, and miscellaneous supplies and services from commercial sources.

*Object Class 25.3, Services from Other Government Agencies: \$69,000*

This category includes GSA administrative support services (payroll, accounting, personnel, etc.), legal advice from GSA, security clearances through the Office of Personnel Management, and other miscellaneous interagency agreements.

*Object Class 26.0, Supplies and Materials: \$73,000*

Anticipated expenses include routine office supplies, subscriptions and library materials, off-the-shelf technical reports and studies, and upgrades and computer software for the library.

*Object Class 31.0, Equipment: \$120,000*

This estimate is for miscellaneous equipment costs, including audiovisual equipment and computer hardware, and computer-network software maintenance. In addition, funds are included to support the Federal Information Security Act, which requires Federal agencies to periodically test and evaluate the effectiveness of their information security policies, procedures and practices. Includes continued upgrades to the IT security and COOP availability, support to e-gov telecommuting efforts, and technical support in the increase of the management of electronic records and e-mails.

**NUCLEAR WASTE TECHNICAL REVIEW BOARD**

**2006 SALARIES AND EXPENSES**

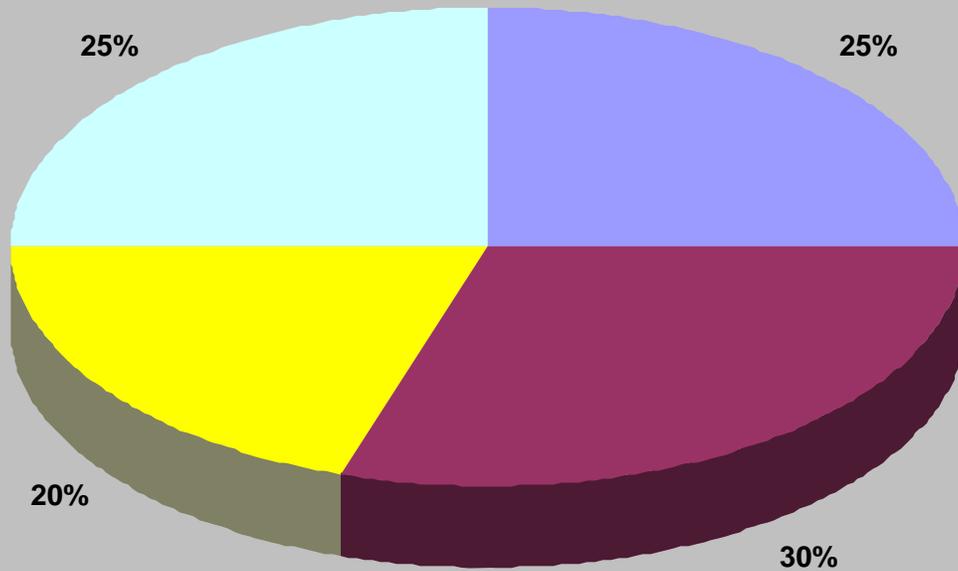
**OBJECT CLASSIFICATION (in thousands of dollars)**

Identification code 48-0500-0-1-271	FY 04 ACT	FY 05 EST	FY06 REQ
<i>Personnel compensation</i>			
11.1 Full-time permanent	\$1,560	\$1,610	\$1,709
11.3 Other than Full-Time Permanent	248	314	321
11.5 Other Personnel Compensation	43	62	63
11.9 Total Personnel Compensation	1,851	1,986	2,093
12.1 Civilian Personnel Benefits	363	390	432
21.0 Travel and Transportation	238	330	320
23.1 Rental Payments to GSA	184	183	184
23.3 Communication, Utilities, Miscellaneous	23	27	33
24.0 Printing and Reproduction	19	16	20
25.1 Consulting Services	188	140	149
25.2 Other Services	412	115	115
25.3 Services from Government Accounts	59	68	69
26.0 Supplies and Materials	55	70	73
31.0 Equipment	80	85	120
<b>99.9 Total Obligations*</b>	<b>\$3,472</b>	<b>\$3,410</b>	<b>\$3,608</b>

Identification Code 48-0500-0-1-271	04 ACT	05 EST	06 REQ
Total Number of Full-Time Permanent Positions	16	16	16
Total Compensable Work-Years: Full-Time Equivalents	17	18	18

\*FY05 estimate reflects the President's request of \$3,177,000, plus carryover, minus rescission of \$25,416.

## FY 2006 Budget Request Resources



<b>Natural System</b>	<b>25%</b>
<b>(natural barriers at Yucca Mt.)</b>	
<b>Engineered System</b>	<b>30%</b>
<b>(engineered barriers at Yucca Mt.)</b>	
<b>Repository System Performance</b>	<b>20%</b>
<b>And Integration</b>	
<b>Waste Management System</b>	<b>25%</b>
<b>(including transportation)</b>	

**U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD  
PERFORMANCE EVALUATION  
FISCAL YEAR 2004**

**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 the following performance measures.

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 2004**

On the basis of the following evaluation and consistent with the performance measures described in the previous section, the Board's performance for 2004 was found to be effective overall. However, the Board did not have access to TSPA results in 2004. Consequently, performance goals related to reviewing that important aspect of the DOE program were partially met or deferred. Several other performance goals were not possible to meet fully because the DOE did not undertake activities in those areas in 2004. When that is the case, it is noted under the evaluation of the specific performance goal.

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).

The Board's performance goals for fiscal year (FY) 2004 were developed to achieve the general goals and strategic objectives in its strategic plan for the years 2004-2009. The goals also have been established in accordance with the Board's statutory mandate and reflect congressional action in 2002 authorizing the U.S. Department of Energy (DOE) to proceed with developing an application to be submitted to the Nuclear Regulatory Commission (NRC) for authorization to construct a repository at Yucca Mountain. The Board's performance goals reflect the continuity of the Board's ongoing technical and scientific evaluation and the Board's efforts to evaluate program activities taking into account the interdependence of components of the repository system and the waste management system.

For purposes of this evaluation, the Board's performance goals for FY 2004 have been organized and numbered to correlate with appropriate strategic objectives in the Board's strategic plan for FY 2004-2009.

## **1. Performance Goals and Evaluation Related to the Natural System**

### **1.1.1 Review the technical activities and agenda of the DOE's science and technology (S&T) program.**

- *Evaluation of 1.1.1:* The Board held a panel meeting on January 20, 2004, at which it received an update on the S&T program. In a May 3, 2004, letter to the DOE, the Board commended the S&T program for including on its agenda study of the Peña Blanca analogue site in Chihuahua, Mexico. The Board commented on the importance of the S&T program in a letter to the DOE on November 30, 2004, and in its report to Congress and the Secretary of Energy dated December 30, 2004.

### **1.1.2. Monitor the results of flow-and-transport studies to obtain information on the potential performance of the saturated zone as a natural barrier in the repository system.**

- *Evaluation of 1.1.2:* The Board held a two-day panel meeting on March 9-10, 2004, at which one day was devoted to reviewing activities undertaken by the DOE related to saturated zone flow and transport. The Board sent a letter to the DOE on May 3, 2004, in which it commented extensively on fluid flow and radionuclide transport and the potential of the natural barriers to provide a barrier to the migration of radionuclides. Understanding the interaction of the components of the natural system and how they act together to isolate waste was identified as a Board priority in its December 30, 2004, report to Congress and the Secretary of Energy.

### **1.1.3. Review DOE efforts to confirm estimates of natural-system performance and pursue independent lines of evidence, including tests of models and assumptions.**

- *Evaluation of 1.1.3:* On March 9-10, 2004, the Board held a two-day panel meeting on the natural system at Yucca Mountain. During these two days, the Board heard several presentations on the DOE's approach to estimating the performance of the natural barriers and on supplementing those estimates with additional lines of evidence. Several of the presentations dealt with assumptions underlying the modeling of the natural system. In a May 3, 2004, letter to the DOE, the Board pointed out that unsaturated zone fluid flow and transport predictions are influenced significantly by assumptions inherent in the formulation of the active fracture model. The Board also noted that updating the site-scale model on the basis of these calculations could affect predictions of radionuclide transport times. In the same letter, the Board observed that multiple lines of evidence could be used to supplement conceptual understanding, models used to represent the concepts, and the scenarios predicted by the models. Understanding the interaction of the components of the natural system and how they act together to isolate waste was identified as a Board priority in its December 30, 2004, report to Congress and the Secretary of Energy.

1.2.1. Review DOE efforts to resolve questions related to possible seismic events and igneous consequences.

- *Evaluation of 1.2.1:* The Board received DOE updates on seismic issues at meetings held May 18, 2004, and September 20, 2004. In follow-up letters to the DOE, the Board noted that the DOE had made progress in developing realistic estimates of ground motions. The Board encouraged the use of sound physical principles to limit ground motions, the integration of technical and scientific studies and activities, and the submission of study results to external peer review. In its December 30, 2004, letter to Congress and the Secretary, the Board noted progress in this area. At its September 20, 2004, meeting, the Board was briefed by representatives of the Electric Power Research Institute on the results of preliminary short-term tests with synthetic magma indicating that the metal used for the waste packages (Alloy-22) may have significant corrosion resistance to some magmas. In a November 30, 2004, letter to the DOE following that meeting, the Board noted that the composition of magmas at Yucca Mountain vary widely. Consequently, the Board believes that the EPRI tests are early indicators, but do not provide a sufficient technical basis for determining the corrosion resistance of the waste package in magma. In the same letter, the Board reiterated that if the repository design is modified to mitigate the effects of igneous activity, such modifications should be evaluated for their effects on repository operation and performance. The Board listed volcanic consequences as an area requiring further study in its December 30, 2004, report to Congress and the Secretary.

1.3.1. Evaluate geologic, hydrologic, and geochemical information obtained from the enhanced characterization of the repository block (ECRB) at Yucca Mountain.

- *Evaluation of 1.3.1:* The Board noted in its letter to the DOE dated November 30, 2004, that because several significant scientific issues related to a fundamental understanding of the Yucca Mountain site remain unresolved, maintaining access to the ECRB is important. The Board also observed that water collected in the ECRB and the possible presence of chlorine-36 continue to raise questions about water flow inside Yucca Mountain.

1.3.2. Evaluate data from the drift-scale heater test.

- *Evaluation of 1.3.2:* In the Board's November 30, 2004, letter to the DOE, the Board observed that the Drift-Scale Test, which was planned for 8 years, is currently in its "cool down" phase. Observations of hydrogeologic changes in response to heat fluxes in this test will be needed to evaluate models predicting repository performance.

1.3.3. Review plans and work carried out on possible analogues for the natural components of the repository system.

- *Evaluation of 1.3.3:* In its May 3, 2004, letter to the DOE, the Board observed that the Peña Blanca site in Chihuahua, Mexico, could be used as an analogue to test and evaluate Yucca Mountain modeling approaches, the conceptual understanding of the natural systems at the site, and the scenarios predicted by the models. The Board commended the S&T program for its plans to test Yucca Mountain modeling approaches at the Peña Blanca site.

1.3.4. Recommend additional work needed to address uncertainties, paying particular attention to estimates of the rate and distribution of water seepage into the repository under proposed repository design conditions.

- *Evaluation of 1.3.4:* The Board's May 3, 2004, letter to the DOE contains extensive comments on work that could be undertaken or continued to address uncertainties related to the natural system, including large-scale hydraulic tests, improvements in characterization of the saturated alluvium, and a better empirical basis for predicting matrix diffusion. The letter also identifies areas of substantial unresolved uncertainty related to the natural system, including colloid-facilitated transport, the active fracture modeling approach, and boundary fluxes, and makes recommendations to reduce the uncertainties. In its July 28, 2004, letter to the DOE, the Board lists examples of uncertainties that need to be addressed to characterize better environments in repository tunnels post closure. Those uncertainties include the conceptual basis for the drift-scale thermohydrologic seepage analysis, the source of water in the ECRB, the effects of drift degradation, and potentially unrealistic parameters in the performance-assessment calculations of seepage.

4.3.1. Evaluate tunnel-stability studies undertaken by the DOE.

- *Evaluation of 1.4.1:* The Board observed in its July 28, 2004, letter to the DOE that the extent to which the DOE has characterized accurately the likely waste package environments (i.e. repository tunnel environments post-closure) is unclear at this time. The Board identified accurate characterization of repository tunnels as an area requiring additional attention and a major focus of the Board's ongoing technical and scientific review in its report to Congress and the Secretary, dated December 30, 2004. In its July 28, 2004, letter to the DOE, the Board identified tunnel stability as an uncertainty that needs to be addressed related to postclosure repository tunnel environments.

4.3.2. Review the DOE's efforts to integrate results of scientific studies on the behavior of the natural system into repository designs.

- *Evaluation of 1.5.1:* In its November 30, 2004, letter to the DOE, the Board observed that if the repository design is modified to mitigate the effects of igneous activity, such modifications should be evaluated for their effects on repository operation and performance. In a May 3, 2004, letter to the DOE, the Board reiterated its view that an integrated explanation is needed of how elements of the repository act as a system to isolate waste. The Board noted in an April 5, 2004, letter to the DOE that changes in the subsurface design will affect postclosure waste-package temperatures and could exacerbate "cold trap" effects near and in the repository tunnel turnouts. The Board went on to recommend that temperature and relative humidity calculations be revised to reflect repository design changes. The Board commented on the need for thorough integration and close cooperation among diverse technical disciplines (e.g., geochemists and corrosion scientists/engineers) in its July 28, 2004, letter to the DOE.

## **2. Performance Goals and Evaluation Related to the Engineered System**

4.3.3. Monitor the DOE's studies related to the relative contribution of engineered barriers to repository performance.

- *Evaluation of 2.1.1:* At the Board's meeting on September 20, 2004, the DOE updated the Board on the total system performance assessment (TSPA) process. The TSPA includes estimates of repository performance based on the contributions of various elements of the repository system. The Board identified TSPA as a priority area of evaluation in its December 30, 2004, report to Congress and the Secretary.

4.3.4. Review thermal testing and rock stability testing related to potential conditions in repository tunnels.

- *Evaluation of 2.2.1:* The Board heard DOE presentations on predicted conditions in repository tunnels during the thermal pulse at its May 18-19, 2004, meeting. In its July 28, 2004, letter to the DOE, the Board identified drift degradation as an important uncertainty affecting the accurate characterization of repository tunnel environments after closure of the repository.

4.3.5. Evaluate data from studies of the effects of corrosion and the waste package environment on the predicted performance of materials being proposed for engineered barriers.

- *Evaluation of 2.2.2:* The Board devoted most of its meeting on May 18-19, 2004, to a review of DOE activities related to corrosion testing and repository tunnel environments. In a July 28, 2004, letter to the DOE, the Board concluded that a key corrosion issue raised by the Board in 2003 was addressed by DOE data and analyses, indicating that tunnel conditions during the thermal pulse will likely not lead to the initiation of localized corrosion of waste packages due to deliquescence of calcium chloride salts. This conclusion also was included in the Board's report to Congress and the Secretary of Energy, dated December 30, 2004. In

its July letter and December report, the Board also commented on additional corrosion issues, including the corrosion resistance of Alloy-22 in magma, the possibility of stress corrosion cracking of the titanium drip shield, and the need to carry out corrosion tests in environments that closely approximate expected conditions in repository tunnels. At its September 30, 2004, meeting, the Board was briefed by representatives of the Electric Power Research Institute on the results of preliminary short-term tests with synthetic magma indicating that the metal used for the waste packages may have significant corrosion resistance to some magmas. In a November 30, 2004, letter to the DOE following that meeting, the Board noted that the composition of magmas at Yucca Mountain vary widely. Consequently, the Board believes that the EPRI tests are early indicators, but do not provide a sufficient technical basis for determining the corrosion resistance of the waste package in magma. The Board suggested that further testing was needed in this area.

4.3.6. Review the progress and results of materials testing being conducted to address uncertainties about waste package performance.

- *Evaluation of 2.3.1:* See evaluation of 2.2.2.

2.3.2. Evaluate the DOE's efforts in identifying analogues for corrosion processes.

- *Evaluation of 2.3.2.* The Board is unaware of any DOE activities related to identifying natural or engineered analogues for corrosion process in 2004.

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

- *Evaluation of 2.4.1.* On January 20, 2004, the Board held a panel meeting on repository design, at which it received various updates and briefings on DOE activities in this area. The Board commented extensively on repository design in an April 5, 2004, letter to the DOE following the panel meeting. The Board is unaware of any DOE activities related specifically to developing analytical tools for assessing differences in repository designs. At the Board's meeting on September 20, 2004, the DOE updated the Board on the total system performance assessment (TSPA) process. The TSPA includes estimates of repository performance *overall*. The Board identified TSPA as a priority area in its December 30, 2004, report to Congress and the Secretary.

2.4.2. Evaluate the accuracy and completeness of the technical bases for repository and waste package designs and the extent to which the DOE is using the technical bases for modifying repository and waste package designs.

- *Evaluation of 2.4.2.* On January 20, 2004, the Board held a panel meeting on repository design, at which it received various updates and briefings on DOE activities in this area. The Board commented extensively on repository design in an April 5, 2004, letter to the DOE following the panel meeting.

2.4.4. Evaluate the integration of the subsurface design and layout with thermal management and preclosure facility operations.

- *Evaluation of 2.4.4.* On January 20, 2004, the Board held a panel meeting on repository design, at which it received various updates and briefings on DOE activities in this area. The Board observed in an April 5, 2004, letter to the DOE following the panel meeting that changes that have been made in the subsurface repository design will affect postclosure waste-package temperatures. In its November 30, 2004, letter to the DOE, the Board encouraged the DOE to analyze how the aging of spent fuel in surface storage at Yucca Mountain would be used to achieve thermal goals as part of a clearly-articulated thermal management strategy. The Board also stated in that letter that it believes that waste handling and surface storage at Yucca Mountain should be viewed and analyzed as parts of an integrated waste management system that begins when waste is accepted for shipment at reactors and other sites and ends after placement of the waste in a repository. This thought was reiterated in the Board's December 30, 2004, report to Congress and the Secretary.

4.3.7. Assess the integration of scientific studies with engineering designs for the repository and the waste package.

- *Evaluation of 2.5.1.* In the Board's July 28, 2004 letter to the DOE, the Board emphasized the need for thorough integration and close cooperation among technical disciplines working on the Yucca Mountain program. In its November 30, 2004, letter to the DOE, the Board noted the need to integrate scientific and engineering activities, and to use TSPA to evaluate changes in engineering design or operations for their effects on the overall repository system. The Board noted specifically that repository design changes made to mitigate igneous activity should be evaluated for their effects on repository operation and performance.

**3. Performance Goals and Evaluation Related to Repository System Performance and Integration** [Note: TSPA results were not presented by the DOE to the Board in 2004. The Board looks forward to receiving the results of TSPA in 2005. In the meantime, to be prepared to evaluate TSPA results, Board members and staff are reviewing analysis and modeling reports and technical basis documents that will be used to support TSPA-LA.]

3.1.1. Identify which technical and scientific activities are on the critical path to reconciling uncertainties related to the DOE's performance estimates.

- *Evaluation of 3.1.1:* The Board observed in a letter to the DOE dated November 30, 2004, that the DOE had made progress in developing realistic estimates of ground motions. The Board commented to the DOE in a July 28, 2004, letter that a significant corrosion issue had been addressed. These observations were reiterated in a report to Congress and the Secretary on December 30, 2004. In that report, the Board also identified a number of issues that require additional attention, including a better understanding of the natural system, an improved understanding of postclosure repository tunnel environments, other corrosion issues, resolution of discrepancies between chlorine-36 studies, improvements in the modeling of volcanic consequences, and work undertaken by the S&T program.

3.1.2. Determine the strengths and weaknesses of TSPA.

- *Evaluation of 3.1.2:* The Board held a meeting on September 20, 2004, at which it received a comprehensive update from the DOE on the TSPA process. Following the meeting the Board sent a letter to the DOE observing that the presentations at the September meeting highlight the critical need to complete the testing and validation of the process computer models and methods that support TSPA. The Board suggested that TSPA could be used to determine the effects of changes in repository design on other components of the repository system. The Board also indicated that it would like to review the results of TSPA, the technical and integration problems associated with TSPA and model validation activities, and how TSPA activities will be affected by potential changes in the regulatory compliance period. TSPA was identified as a Board priority for the coming year in the Board's December 30, 2004, letter to Congress and the Secretary.

4.3.8. Evaluate the DOE's treatment of seismic and volcanism issues in TSPA.

- *Evaluation of 3.1.3:* See evaluation of 3.1.2.

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

- *Evaluation of 3.2.1:* The Board noted in its May 3, 2004, letter to the DOE that the DOE's approach of dealing with uncertainties related to the performance of natural barriers by making very conservative assumptions tends to emphasize more-rapid advective transport processes. To address this problem, the Board recommended that the DOE work to increase its fundamental understanding of the behavior of the natural system.

3.2.2. Review new data and updates of TSPA models, and identify models and data that should be updated.

- *Evaluation of 3.2.2:* The Board noted the critical need to complete the testing and validation of process computer models and methods that support TSPA in its November 30, 2004, letter to the DOE.

3.3.1. Evaluate the DOE's efforts to create a transparent and traceable TSPA.

- *Evaluation of 3.3.1:* See evaluation of 3.1.2.

3.3.2. Evaluate the DOE's efforts to develop simplified models of repository performance.

- *Evaluation of 3.3.2:* The Board is unaware of any DOE activities in this area in 2004.

3.3.3. Evaluate the DOE's efforts to identify analogues for performance estimates of the overall repository system.

- *Evaluation of 3.3.3:* In its May 3, 2004, letter to the DOE, the Board observed that the Peña Blanca site in Chihuahua, Mexico, could be used as an analogue to test and evaluate Yucca Mountain modeling approaches, the conceptual understanding of the natural systems at the site, and the scenarios predicted by the models. The Board commended the S&T program for its plans to test Yucca Mountain modeling approaches at the Peña Blanca site.
- 3.4.1. Evaluate the DOE's efforts to analyze the contribution of the different engineered and natural barriers to waste isolation.
- *Evaluation of 3.4.1.* A Board panel held a two-day meeting on March 9-10, 2004, at which the DOE presented substantial information related to the contribution of the natural barriers to waste isolation. The Board also participated in a field trip following the meeting. In its May 3, 2004, follow-up letter to the DOE, the Board observed that analyses presented by the DOE suggest that the natural system provides an effective barrier to migration of some radionuclides. However, the Board noted several key hydrogeologic features central to the analyses that are not well understood or are poorly constrained. The Board also reiterated its long-held view that an integrated explanation is needed of how elements of the repository act as a system to isolate waste and recommended that the DOE work to improve its basic understanding of how the natural barriers will perform. The DOE's analysis of the overall contribution of engineered and natural barriers is imbedded in the DOE's TSPA. The Board looks forward to receiving the results of the TSPA, which will illuminate the DOE's analysis of the contributions of the different barriers.
- 4.3.9. Evaluate technical aspects of value engineering (providing a needed function reliably and at the lowest cost) and performance-related trade-off studies, including criteria, weighting factors, and decision methodologies for such studies; how technical uncertainties are taken into account; and what factors are included or excluded from such studies and why.
- *Evaluation of 3.5.1:* This performance goal applies specifically to work conducted under a contract to produce a prototype waste package. The contract was awarded by the DOE later than anticipated. Consequently, the work was not undertaken in 2004.
- 4.3.10. Recommend additional measures for strengthening the DOE's repository safety case.
- *Evaluation of 3.6.1:* In a May 3, 2004, letter to the DOE, the Board restated its long-held view that an integrated explanation is needed of how elements of the repository act as a system to isolate waste. The Board suggested that such an explanation should be based on a fundamental understanding of the system and that multiple lines of evidence and argument can be used to supplement and evaluate TSPA models. These comments were reiterated in the Board's December 30, 2004, report to Congress and the Secretary.
- 4.3.11. Evaluate the DOE's efforts to develop a feedback loop among performance-confirmation activities and TSPA models and data.

- *Evaluation of 3.7.1:* The Board did not receive information from the DOE on performance-confirmation activities in 2004.

4.3.12. 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 3.7.2:* See evaluation for 3.7.1.

#### **4. Performance Goals and Evaluation Related to the Waste Management System**

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

- *Evaluation of 4.1.1:* The Board held a panel meeting on January 20, 2004, devoted in its entirety to issues related to the design of the repository, including the surface and subsurface components. On April 5, 2004, the Board sent a follow up letter to the DOE, in which the Board commented extensively on technical and scientific factors affecting the DOE's repository design.

4.1.2. Monitor the identification of research needs to support improved understanding of the interaction of components of the waste management system.

- *Evaluation of 4.1.2:* The Board referenced the importance of integrating design and operational factors in its letter to the DOE dated April 5, 2004. Specifically, the Board noted that design changes that have been made could affect waste package temperatures and create "cold trap" effects in the repository. The Board recommended that temperature and relative humidity calculations be revised to reflect design changes. The Board held a panel meeting on January 21, 2004, at which it received updates on the status of DOE transportation activities. In a March 28, 2004, follow-up letter to that meeting, the Board observed that waste acceptance may emerge as a key transportation planning consideration. The Board suggested that the DOE work with the utility industry on this important issue. The Board received updates on DOE transportation planning activities at a meeting held May 18-19, 2004, and a panel meeting held October 13-14, 2004. The Board was updated on repository design issues at its September 20, 2004, meeting. In the Board's November 30, 2004, letter to the DOE, the Board stated its view that waste handling and surface storage at Yucca Mountain should be viewed and analyzed as parts of an integrated waste management system. The Board noted that the DOE's presentations on waste handling operations illustrated the vital importance of integrating waste management activities as part of facility design. The Board suggested that among other things, the implications of aging of the waste at the Yucca Mountain site should be explained as part of a clearly-articulated thermal management strategy. In its letter to the DOE dated December 1, 2004, the Board suggested that to achieve successful integration of transportation planning activities, it is important for the DOE to identify the entity responsible for each system component as well as the integration of those components. The Board also observed that DOE presentations at the Board's October meeting indicated that substantial work remains to be done on integrating

waste management system components. Similar comments were included in the Board's December 30, 2004, report to Congress and the Secretary. In the same letter, transportation activities and integrating the waste management system were included among Board priorities for the coming year.

- 4.1.3. Review the technical and scientific basis of the DOE's analyses of component interactions in various scenarios, including the degree of integration and redundancy across functional components over time.
- *Evaluation of 4.1.3:* See evaluation of 4.1.2.
- 4.3.13. Evaluate the effects of reduced receiving capacity at the repository surface facility on the nationwide transportation system.
- *Evaluation of 4.1.4:* The Board suggested that the DOE undertake a review and inventory of infrastructure and facility needs in its letter to the DOE dated March 29, 2004.
- 4.3.14. Review criteria for waste acceptance for storage to ensure that accepted material has been characterized suitably for subsequent disposal.
- *Evaluation of 4.1.5:* In its March 29, 2004, letter to the DOE, the Board suggested that the DOE and the utility industry work together to facilitate the determination of cask requirements and transport logistics that are compatible with the waste to be shipped. The Board also recommends a thorough review of waste inventory and acceptance assumptions.
- 4.3.15. Monitor the DOE's efforts to implement Section 180 (c) of the NWPA.
- *Evaluation of 4.2.1:* The Board observed in its March 29, 2004, letter to the DOE that emergency response capability is seen by states and local communities as a vital component of transportation safety and security. The Board also noted that it will be important for the DOE to demonstrate that it has invested adequate preparation time and financial resources to emergency preparedness. Emergency-response was discussed at the Board's panel meeting on October 13-14, 2004. In a December 1, 2004, letter to the DOE following that meeting, the Board noted the difficulty of forecasting disruptive events, but suggested that the DOE's approach to security risk assessment appears to be organized appropriately. The Board observed that the DOE's 180(c) program appears to be based too much on funding formulas and not enough on ensuring adequate emergency-response capability. The Board recommended that the DOE define a minimally acceptable level of emergency response along each transport route.
- 4.3.16. Monitor the DOE's progress in developing and implementing a transportation plan for shipping spent nuclear fuel and high-level radioactive waste to a Yucca Mountain repository.

- *Evaluation of 4.3.1:* The Board reviewed DOE transportation activities at its meetings held January 21, May 18-19, and October 13-14, 2004. In its March 29, 2004, letter to the DOE, the Board stated that the DOE's transportation strategic plan lacks the necessary detail for truly understanding the DOE's transportation planning effort. In a letter dated July 28, 2004, the Board noted that the DOE had made real progress in planning a transportation system. The Board's December 1, 2004, letter to the DOE includes more extensive comments on the DOE's transportation plans. For example, the Board suggests that the DOE needs to focus its attention on transportation options within the state of Nevada for both rail and truck. In particular, the Board suggests that contingency plans need to be developed for higher levels of truck use in the event that a rail spur is not build or is delayed.

4.3.17. Review the DOE's efforts to develop criteria for decisions on transportation mode and routing.

- *Evaluation of 4.3.2:* The Board notes in its December 1, 2004, letter to the DOE that the DOE should ensure that the technical issues involved in route selection are identified and that sound methods for addressing the issues are developed and applied.

4.3.18. Evaluate logistics capabilities of the transportation system.

- *Evaluation of 4.3.3:* The Board suggested that the DOE undertake a review and inventory of infrastructure and facility needs in its letter to the DOE dated March 29, 2004.

4.3.19. Monitor progress in implementing new technologies for improving transportation safety for spent nuclear fuel.

- *Evaluation of 4.3.4:* The Board reviewed the DOE's model for estimating transportation risk at its meeting held October 13-14, 2004. The Board commented on this issue in a letter to the DOE dated December 1, 2004.

4.3.20. 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 4.3.5:* See evaluation of 4.1.2.

## SUPPLEMENTARY INFORMATION ON THE U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD

The Nuclear Waste Technical Review Board was established as an independent agency of the federal government on December 22, 1987, in the Nuclear Waste Policy Amendments Act (NWPAA). The Board is charged with evaluating the technical and scientific validity of activities undertaken by the Secretary of Energy, including

- site characterization; and
- activities related to packaging and transporting high-level radioactive waste and spent nuclear fuel.

The Board was given broad latitude to review activities undertaken by the Secretary of Energy in implementing the Nuclear Waste Policy Act. However, the Board was not given authority to require the DOE to implement Board recommendations.<sup>2</sup>

### **Board Members**

The NWPAA authorized a Board of 11 members who serve on a part-time basis; are eminent in a field of science or engineering, including environmental sciences; and are selected solely on the basis of distinguished professional service. The law stipulates that the Board shall represent a broad range of scientific and engineering disciplines relevant to nuclear waste management. Board members are appointed by the President from a list of candidates recommended by the National Academy of Sciences. To prevent gaps in the Board's comprehensive technical review, Board members whose terms have expired continue serving until they are reappointed or their replacements assume office. The first members were appointed to the Board on January 18, 1989. Current members were appointed by President George W. Bush. The names and affiliations of the current 11 Board members are listed below.\*

- *B. John Garrick*, Ph.D., P.E., is chairman of the Board. A founder of PLG, Inc., he retired from the firm in 1997, and is currently a private consultant. His areas of expertise include probabilistic risk assessment and the application of the risk sciences to technology-based industries.
- Mark Abkowitz, Ph.D., is a professor in the department of Civil & Environmental Engineering and director of the Vanderbilt Center for Environmental Management studies at Vanderbilt University. His areas of expertise include risk management, transportation of hazardous materials, emergency preparedness, and applications of advanced information technology.

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<sup>2</sup> Taken from *Legislative History of the Nuclear Waste Policy Amendments Act of 1987. February 26, 1998.*

\* Recently appointed Board member names are in italics.

- *William Howard Arnold*, Ph.D., P.E., a private consultant, retired from Louisiana Energy Services in 1996. He holds a doctorate in experimental physics and has special expertise in nuclear project development.
- *Daryle H. Busch*, Ph. D., is the Roy A. Roberts Distinguished Professor of Chemistry at the University of Kansas and deputy director of the NSF Engineering Research Center. His areas of expertise include homogeneous catalysis, bioinorganic chemistry, and orderly molecular entanglements.
- *Thure Cerling*, Ph.D., is a professor in the department of Geology and Geophysics at the University of Utah. His areas of expertise include terrestrial geochemistry.
- *David Duquette*, Ph.D., is professor and head of the department of Materials Science and Engineering at the Rensselaer Polytechnic Institute in New York. His areas of expertise include the physical, chemical, and mechanical properties of metals and alloys.
- *George M. Hornberger*, Ph.D., is the Ernest H. Ern Professor of Environmental Sciences in the Department of Environmental Sciences at the University of Virginia. His areas of expertise include catchment hydrology and hydrochemistry and transport of colloids in geologic media.
- *Andrew C. Kadak*, Ph.D., is a Professor of the Practice in the Nuclear Engineering Department of the Massachusetts Institute of Technology. His areas of expertise include nuclear engineering and the development of advanced reactors.
- *Ron Latanision*, Ph.D., is professor at the Massachusetts Institute of Technology with joint appointments in the department of Materials Science and Engineering and the department of Nuclear Engineering. His areas of expertise include materials processing and the corrosion of metals and other materials in aqueous environments.
- *Ali Mosleh*, Ph. D., is professor of Reliability Engineering at the University of Maryland. His areas of expertise include risk and safety assessment reliability analysis, and decision analysis.
- *Henry R. Petroski*, Ph.D., P.E., is professor of civil engineering and professor of history at Duke University. His areas of expertise include failure analysis and design theory.

### **Board Staff**

The NWPAA limits the Board's professional staff to 10 positions. An additional 5 full-time and 1 part-time employees provide administrative support to Board members and the professional staff. Because of the comprehensive nature of the program, the diversity of Board member experience and expertise, and the part-time availability of Board members, the small, highly qualified staff is employed to its full capacity in supporting the Board's review of the DOE program. The Board's offices are located in Arlington, Virginia.

### **Board Reporting Requirements**

As required under the NWPAA, the Board reports to the U.S. Congress and the Secretary of Energy at least two times each year. The reports include Board recommendations to the DOE on improvements in the civilian radioactive waste management program. The DOE's written responses to Board recommendations are published in subsequent Board reports.

### **Board Activities**

The Board and its panels sponsor meetings and technical exchanges with program participants and interested parties, including representatives of the DOE and its contractors, the U.S. Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, the U.S. Geological Survey, the U.S. Department of Transportation, the State of Nevada, affected units of local governments, Native American tribes, nuclear utilities, environmental groups, state utility regulators, and members of the public. Board members and staff attend relevant technical conferences, meetings, symposia, and workshops. They participate in field trips to examine first-hand the DOE's characterization of the Yucca Mountain site and the geologic and ecological features in the surrounding area. Board and staff occasionally visit foreign programs to gain insights from the experience of other countries' repository development efforts.

Board and panel meetings are open to the public and are announced in the *Federal Register* 4 to 6 weeks before each meeting. Press releases also are issued on all public meetings. To facilitate access for program participants and the public, the Board holds the majority of its meetings in Nevada, and time is set aside for public comment at each meeting. Transcripts of meetings and minutes of business sessions are available to the public through the Board's library or on the Board's Web site: [www.nwtrb.gov](http://www.nwtrb.gov), as are all Board reports, correspondence, and congressional testimony.