



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

## **Fiscal Year (FY) 2010 Budget Request Submittal**

**Including Board Performance Plan for FY 2010,  
Board Performance Evaluation for FY 2008, and  
Supplementary Information on the Board**

## **Summary and Highlights**

Congress created the U.S. Nuclear Waste Technical Review Board in the Nuclear Waste Policy Amendments Act (NWPAA) of 1987 as an independent federal agency in the executive branch. The Board was charged with performing an unbiased evaluation of the technical and scientific validity of all activities undertaken by the U. S. Department of Energy (DOE) related to implementing the Nuclear Waste Policy Act. By performing ongoing peer review of the highest quality, the Board provides the only independent and integrated evaluation of the entire waste management system, including waste acceptance; transportation; storage; facility design, operation, and performance; and waste emplacement. The Board's long history of providing unbiased technical findings and recommendations can increase confidence in and add credibility to assessments of long-term waste management and disposal options.

The Board is apolitical and nonpartisan. It is composed of 11 members who are nominated by the National Academy of Sciences based solely on eminence in relevant fields of science and engineering and who are then appointed by the President. The Board makes all of its technical and scientific information, including reports, correspondence, testimony, and meeting transcripts, available on its Web site at [www.nwtrb.gov](http://www.nwtrb.gov).

### ***Budget Request for Fiscal Year (FY) 2010***

To fulfill its congressionally established mandate and support its comprehensive technical review, the Board is requesting \$3,891,000 for FY 2010.

### ***FY 2010 Goals and Objectives***

The Board's annual performance goals for FY 2010 are presented in the Board's performance-based budget and are based on current DOE activities. If DOE activities change to accomplish a different approach for meeting the federal government's legal obligation to manage and dispose of spent nuclear fuel and high-level radioactive waste, the Board's goals and objectives will be revised accordingly.

## 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, [\$3,811,000] \$3,891,000, to be derived from the Nuclear Waste fund, and to remain available until expended.

(Energy and Water Development and Related Agencies Appropriations Act, 2009)

# Performance-Based Budget Request for FY 2010

## *The Board's Ongoing Role*

The Board was established by Congress in the Nuclear Waste Policy Amendments Act (NWPAA) of 1987. The Board is charged with evaluating the technical and scientific validity of all activities undertaken by the Secretary of Energy related to implementing the Nuclear Waste Policy Act. In creating the Board, Congress realized that an ongoing independent and expert evaluation of the technical and scientific validity of DOE activities would be crucial for acceptance by the public and the scientific community of any approach for managing spent nuclear fuel and high-level radioactive waste (HLW). In accordance with its statutory mandate, since 1989 the Board has evaluated the technical basis of DOE's work and has communicated Board findings and recommendations to Congress and the Secretary of Energy in biannual reports and in letters and congressional testimony.

In FY 2010, the Board will continue its ongoing technical and scientific review of DOE activities, focusing on fundamental understanding as opposed to regulatory compliance. Using the extensive scientific and engineering expertise of its members, the Board will evaluate the technical basis of DOE's approach to the entire waste management system, from waste acceptance (i.e., handling of waste at generation sites); waste package fabrication; waste transportation; facility design, operation, and performance; and, finally, storage at a central facility or reactors or emplacement in an underground repository. The Board provides an integrated technical assessment of whether the waste management system will function as designed. *The Board's independent peer review role will continue whatever approach is selected for managing spent nuclear fuel and HLW.*

## ***Board Funding Requirement for FY 2010: \$3,891,000***

The Board's budget request of \$3,891,000 for FY 2010 represents the funding needed to accomplish the Board's performance goals for the year. (Note: *The Board's performance goals may be revised on the basis of changes in DOE activities.*)

During FY 2010, the Board's findings and reports will focus on the following questions:

- Can DOE effectively implement the designing, prototyping, or fabricating of waste containers; accept spent nuclear fuel at reactor sites or high-level radioactive waste at federal facilities; transport the waste; perform necessary surface operations at a central facility; or store the waste or emplace waste packages and other engineered barriers underground?
- What are the technical advantages and disadvantages of near-term and long-term options for managing spent nuclear fuel and high-level radioactive waste?

## The Board's Annual Performance Goals

The Board's annual performance goals for FY 2010 were established in accordance with the Board's statutory mandate. The goals reflect the importance of gaining a realistic understanding of the interdependence and expected function of all elements of the nuclear waste management system. Currently, the Board is organized around three technical areas: *preclosure operations*, including surface-facility design and operations and transport of spent nuclear fuel and HLW from nuclear utility reactors or storage facilities to the repository site; *postclosure repository performance*, including performance of the engineered barriers and the natural barriers; and *integration* of science and engineering and preclosure and postclosure activities. *The Board's panel organization may change in FY 2010 to correspond to changes in DOE policies or approaches related to managing spent nuclear fuel and HLW.*

The Board will accomplish its goals by doing the following:

- Holding public meetings of the full Board and holding meetings of Board panels and technical workshops, as needed.
- When appropriate, holding fact-finding sessions involving small groups of Board members who will focus in-depth on specific technical topics.
- Reviewing and analyzing critical documents and conducting analytical evaluations.
- When appropriate, visiting and observing ongoing investigations, including those conducted at the National Laboratories or potential analog sites.
- On occasion, visiting other countries to observe their programs and attending national and international symposia and conferences.

### 1. *Performance Goals Related to Preclosure Operations*

<i><b>FY 2008</b></i>	<i><b>FY 2009</b></i>	<small>(Dollars in Thousands)</small> <i><b>FY 2010</b></i>
<b>902</b>	<b>954</b>	<b>1,297</b>

- 1.1. Evaluate implications and requirements for DOE spent fuel and HLW.
- 1.2. Evaluate potential problems related to fabricating and installing drip shields and waste packages, including potential preclosure drift stability.
- 1.3. Review DOE national transportation plan.

2. *Performance Goals Related to Postclosure Performance*

(Dollars in Thousands)

<i>FY 2008</i>	<i>FY 2009</i>	<i>FY 2010</i>
<b>1,805</b>	<b>1,907</b>	<b>1,297</b>

- 2.1. Examine igneous requirements and evaluate activities.
- 2.2. Review DOE efforts to develop more-realistic understanding of potential for deliquescence-induced localized corrosion.
- 2.3. Evaluate efforts to determine validity of revised limits on seismic ground motion.

3. *Performance Goals Related to System Integration.*

(Dollars in Thousands)

<i>FY 2008</i>	<i>FY 2009</i>	<i>FY 2010</i>
<b>902</b>	<b>953</b>	<b>1,297</b>

- 3.1. Evaluate facility throughput assumptions by conducting in-house analysis.
- 3.2. Evaluate the implications of problems in installing drip shields for facility operations and performance.
- 3.3. Review implications of transportation plan.

## **FY 2010 Budget Request by Object Class**

*Object Class 11.1, Full-Time Staff: \$1,879,000*

The amount requested for full-time permanent staff is based on the requirement to fund 15 positions. Because the Board's technical and scientific evaluations are conducted by Board members who are supported by professional staff, the Board's enabling legislation authorizes the Board 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 5 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; financial activities; and meeting logistics for the Board. The administrative staff supports the very active part-time Board members and full-time professional staff. The estimate assumes a 1.032 percent combined cost-of-living adjustment and locality raise in January 2010 for both General Schedule and Executive Schedule employees.

*Object Class 11.3, Other than Full-Time Permanent Staff: \$315,000*

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 that the member is engaged in work for the Board. The 11 Board members serve part-time equaling 2 full-time-equivalent positions. The budget assumes that each member will attend 3 full Board meetings, 1 panel meeting, and an average of 3 additional meetings or field trips during the year. This estimate represents an average of 44 workdays per member in FY 2010, which will accommodate additional time for orientation and transition activities of new Board members, if appointed. This estimate also assumes a 1.032 percent increase in Executive Schedule compensation for employees in this category for FY 2010 (effective January 2010).

*Object Class 11.5, Other Personnel Compensation: \$57,000*

The amount requested for this category covers performance awards under the Performance Management System and retention/recruitment bonuses.

*Object Class 12.1, Civilian Personnel Benefits: \$507,000*

The estimate for this category represents the government's contribution for employee benefits at the rate of 26.8 percent for staff and 7.65 percent for members.

*Object Class 21.0, Travel: \$272,000*

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), to sites to acquire technical and scientific data, and to review site activities within the scope of the Board's mission. The request is based on 11 Board members attending 3 Board and 1 panel meeting and making an average of 3 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 for similar activities at an average of 7 trips during the year at an average of 4 days per trip.

*Object Class 23.1, Rental Payments to the General Services Administration (GSA): \$206,000*

The estimate for this object class represents the amount that the Board will pay to the General Services Administration (GSA) for 5,216 square feet of office space.

*Object Class 23.3, Communication, Utilities, Miscellaneous: \$31,000*

The requested amount represents estimates for telephone service, postage, local courier, video teleconferencing, FTS long-distance telephone service, the Internet, and mailing services related to management and use of the Board's mailing list.

*Object Class 24.0, Printing and Reproduction: \$24,000*

The major items in this object class are the publication of reports to Congress and the Secretary of Energy, publication of meeting notices in the *Federal Register*, production of press releases announcing meetings, 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 at the meetings. Members of the public who live in rural areas and who do not have Web access receive the Board's material on request.

*Object Class 25.1, Consulting Services: \$86,000*

Consultants will be hired to support and supplement Board and staff analysis of specific technical and scientific issues. This will enable the Board to conduct the kind of comprehensive technical and scientific review mandated by Congress.

*Object Class 25.2, Other Services: \$312,000*

This category includes court-reporting services for an estimated four Board or panel meetings, meeting-room rental and related services, maintenance agreements for equipment, professional development, and services from commercial sources. In addition, the Board will contract with part-time technical consultants to supplement and support in-house operations, in-systems management, Web site management, report production, and editing. Costs of a financial audit for complying with the Accountability of Tax Dollars Act and moving expenses for future hires also are included in this category.

*Object Class 25.3, Services from Other Government Agencies: \$98,000*

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

*Object Class 26.0, Supplies and Materials: \$64,000*

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

*Object Class 31.0, Equipment: \$40,000*

This estimate is for miscellaneous equipment costs, including computer hardware, and computer-network software maintenance. In addition, funds are included to support the Federal Information Security Act, which requires federal agencies to test and evaluate the effectiveness of their information security policies, procedures, and practices periodically. The category also includes continued upgrades to IT security, continuity of operations (COOP) support of E-Gov telecommuting efforts, and technical support of the management of electronic records and e-mails.



**Nuclear Waste Technical Review Board**  
**Projected Fiscal Year (FY) 2010 Expenditures**  
**Object Classifications**  
(In Thousands of Dollars)

<b>Classification code 48-0500-0-271</b>		<b>A</b>	<b>B</b>	<b>C</b>
		<b>ACT</b>	<b>EST</b>	<b>REQ</b>
		<b>FY 2008</b>	<b>FY 2009</b>	<b>FY 2010</b>
<i>Expenditures</i>				
11.1	Full-time permanent	\$1,644	\$1,800	1,879
11.3	Board members	295	301	315
11.5	Other Personnel Compensation	<u>33</u>	<u>46</u>	<u>57</u>
<b>Total</b>	<b>Total Personnel Compensation</b>	<b>\$1,972</b>	<b>\$2,147</b>	<b>\$2,251</b>
12.0	Civilian Personnel Benefits	442	484	507
21.1	Travel and Transportation	286	272	272
23.1	Rental Payments to GSA	250	250	206
23.3	Communication, Utilities, Misc.	23	35	31
24.0	Printing and Reproduction	38	37	24
25.1	Consulting Specialists	86	82	86
25.2	Other Services	325	314	312
25.3	Services from Government Accounts	93	89	98
26.0	Supplies and Technical publications	59	62	64
31.0	IT Equipment and upgrades	<u>35</u>	<u>39</u>	<u>40</u>
<b>Total Obligations</b>		<b><u>\$3,609</u></b>	<b><u>\$3,811</u></b>	<b><u>\$3,891</u></b>

(Numbers may not balance due to rounding.)

Identification Code 48-0500-0-1-271	2008 ACT	2009 EST	2010 REQ
Total Number of Full-Time Permanent Positions	16	17	17
Total Compensable Work-Years: Full-Time Equivalents	16	17	17

## **U.S. Nuclear Waste Technical Review Board Performance Evaluation Fiscal Year 2008**

The Nuclear Waste Policy Amendments Act established the U.S. Nuclear Waste Technical Review Board as an independent agency within the executive branch of the United States Government. The Act directs the Board to evaluate continually the technical and scientific validity of activities undertaken by the Secretary of Energy related to implementing the Nuclear Waste Policy Act. The Board must report its findings and recommendations to Congress and the Secretary of Energy at least twice yearly. The Board only can make recommendations; it cannot compel DOE to comply. The Board strives to provide Congress and the Secretary of Energy with independent, credible, and timely technical and scientific findings and recommendations arrived at through peer review of the highest quality.

### **Board Performance Criteria and Method of Evaluation**

The Board believes that measuring its effectiveness by directly correlating Board recommendations with improvements in the technical and scientific validity of DOE activities would be ideal. However, the Board cannot compel DOE to comply with Board recommendations. Consequently, a judgment about whether a specific recommendation had a positive effect on DOE actions or technical activities could be (1) subjective or (2) an imprecise indicator of Board performance because implementation of Board recommendations is outside the Board's direct control. Therefore, the Board has developed the following criteria for measuring its annual performance in achieving its individual performance goals.

*Criterion 1:* Did the Board undertake the reviews, analyses, or other activities needed to evaluate the technical and scientific validity of the DOE activity identified in the annual performance goal?

*Criterion 2:* Were the results of the Board's evaluation communicated in a timely, understandable, and appropriate way to Congress, the Secretary of Energy, the DOE Office of Civilian Radioactive Waste Management (OCRWM), or the public?

If both criteria are met in relation to a specific goal, the Board's performance in meeting that goal will be considered effective. If only one criterion 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 performance goal is deferred or outdated, that will be noted in the evaluation.

The Board uses its annual performance evaluations, together with its assessment of current or potential priority technical issues, to develop its annual performance goals and to inform spending allocations in its performance-based budget for subsequent years. The Board's evaluation of its success in achieving its performance goals for fiscal year (FY) 2008 will be submitted to the Office of Management and Budget (OMB), attached to the Board's budget request to Congress for FY 2010, included in the Board's summary report for 2008, and posted on the Board's Web site: [www.nwtrb.gov](http://www.nwtrb.gov).

The Board accomplishes its goals by engaging in some or all of the following:

- Holding meetings involving the full Board and other interested parties or holding meetings of Board panels, as needed.
- Holding fact-finding sessions involving small groups of Board members who focus in-depth on specific technical topics.
- Reviewing critical technical documents and performing technical analysis.
- Visiting current sites, analog sites, and sites being investigated in other countries; observing ongoing technical and scientific activities, including those conducted at the National Laboratories or internationally.

## **Evaluation of Board Performance for FY 2008**

The following goal-by-goal analysis of the Board's performance for FY 2008 is based on the Board's evaluation of activities undertaken by DOE during that period and is divided into three topical areas that correspond to the Board's panel structure. Each performance goal is followed by a bullet that contains a description of the activities undertaken by the Board that satisfy the performance criteria discussed above. The description is followed by an overall evaluation of the Board's performance in achieving the specific performance goal.

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

### **1. Performance Goals Related to Preclosure Operations**

- 1.1.1. Review DOE analyses of facilities, systems, and component designs related to implementation of the transportation, aging, and disposal (TAD) canister concept.
- **Evaluation of 1.1.1: Criterion 1 is satisfied with the following activities:** The Board held a meeting on September 19, 2007, at which these issues were discussed and will hold a meeting on September 24, 2008, on these and related issues.

**Criterion 2 is satisfied by the following:** The Board sent a letter to Office of Civilian Radioactive Waste Management (OCRWM) director Edward Sproat on January 16, 2008, following up on discussions at the September 19, 2007, Board meeting. In the letter, the

Board observed that although the TAD canister is a promising concept, its success depends on its being effectively integrated by DOE into the overall waste management system. DOE has established requirements for a TAD-based repository design assuming that 90 percent of commercial spent nuclear fuel (CSNF) will arrive at the repository in TAD canisters. Some nuclear power plants appear to lack the necessary infrastructure for using TAD canisters. The Board recommended that DOE carry out a comprehensive analysis to understand better the implications of not achieving the 90 percent TAD utilization rate and that DOE actively study all possible options for dealing with spent nuclear fuel in dual-purpose canisters. The letter goes on to say that DOE should consider adding supplemental features to current facility layouts, such as increasing the capacity of the Wet Handling Facility (WHF), adding a welding station to the WHF, and increasing the number of welding stations in the Canister Receipt and Closure Facility (CRCF).

Board Chairman B. John Garrick reiterated the Board's comments on 90 percent utilization of TAD canisters in testimony before the House Subcommittee on Energy and Air Quality, Committee on Energy and Commerce, on July 15, 2008. Dr. Garrick noted that if TAD utilization falls below the planned 90 percent, the lower rate could adversely affect surface-facility throughput and may require constructing additional waste handling facilities or increasing the amount of spent nuclear fuel that must be placed in storage at the repository site. Dr. Garrick conveyed the Board's recommendation that operational and design contingencies should be considered if the TAD utilization rate falls below 90 percent.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

1.1.2 Review DOE procedures for ensuring that waste accepted for disposal has been suitably characterized.

- ***Evaluation of 1.1.2: Criterion 1 is satisfied by the following activity:*** This issue will be discussed at a Board meeting scheduled for September 24, 2008.

***Criterion 2 is deferred:*** The Board will send a follow-up letter to DOE on issues discussed at the September 24, 2008, meeting in FY 2009.

***By satisfying Criterion 1 and deferring Criterion 2 until FY 2009, the Board's performance in relation to this goal is judged minimally effective.***

1.2.1 Evaluate the design of surface facilities, including the fuel handling and aging facilities, and how the design affects and is affected by the thermal management of the repository.

- ***Evaluation of 1.2.1: Criterion 1 is satisfied by the following activity:*** These issues were discussed at meetings held by the Board on September 19, 2007, and on January 16, 2008.

***Criterion 2 is satisfied by the following:*** In a letter to Edward Sproat dated April 22, 2008, the Board noted that DOE's 96°C midpillar temperature limit is controlling. The Board questioned the technical basis for the limit and asked for a better justification of the

thermal limit and its relationship to water movement near the repository. The Board noted that if the 96°C limit were eliminated, the 200°C drift-wall temperature would be the controlling thermal limit. This could increase flexibility in thermal loading of the repository and waste package sequencing. The Board also recommended that DOE consider the feasibility and technical advantages of determining the thermal conditions at repository closure and varying the duration of the ventilation as needed to achieve thermal limits. The Board also noted that because DOE's current thermal limits will produce waste package surface temperatures that exceed 150°C, the potential for deliquescence-induced localized corrosion should be analyzed.

In July 2008, Board staff under the leadership of Board member Andrew Kadak developed a White Paper, *Thermal-Response Evaluation of Yucca Mountain during the Preclosure and Postclosure Phases*, which addresses these and other thermal issues.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

1.3.1 Evaluate DOE's analysis of the comparative risks of alternative transportation modes and routes.

- ***Evaluation of 1.3.1: Criterion 1 is satisfied with the following activities:*** The Board received updates on related issues at meetings held on September 19, 2007, and on January 16, 2008. During the week of August 18, 2008, Board member Mark Abkowitz and two staff members toured the proposed Caliente, Nevada, rail route.

***Criterion 2 is satisfied by the following:*** The Board commented on these issues in two letters to Edward Sproat. In its letter dated January 18, 2008, the Board noted that given the current configuration of the waste management system, the Nevada rail line is a critical factor that potentially will affect the viability of the entire waste management system. At that time, DOE did not consider alternative transportation modes. The Board pointed out that technical, economic, political, and legal issues could create significant programmatic risks for the transportation system that DOE proposes to implement.

In its letter to DOE on April 22, 2008, the Board noted that DOE had acknowledged that constructing the Nevada rail line would present significant institutional challenges. The Board therefore reiterated its recommendation that DOE initiate contingency planning to identify alternatives to rail that can be implemented if significant delays are encountered during construction of the rail spur. The Board also acknowledged DOE's review of the capability of short-line railroads to move loaded TAD canisters from utility sites to mainline connections. The Board looks forward to the results of this study.

In testimony before the House Subcommittee on Energy and Air Quality on July 15, 2008, Dr. Garrick identified dependence on a Nevada rail line as an issue that would benefit from additional study.

In the coming fiscal year, the Board may update its recommendations related to Nevada rail on the basis of information gathered on the tour of the proposed route by Board member Abkowitz.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

1.3.2. Review DOE efforts to develop criteria for routing decisions.

- ***Evaluation of 1.3.2: The performance goal is deferred, pending future DOE activities.***

1.3.3 Evaluate logistics capabilities of the transportation system.

- ***Evaluation of 1.3.3: Criterion 1 was satisfied by the following:*** The Board received a briefing on related issues at its meetings held on September 19, 2007, and January 16, 2008.

***Criterion 2 was satisfied by the following:*** The Board sent a letter to Edward Sproat on January 16, 2008, following up on discussions at the September 19, 2007, Board meeting. In the letter, the Board observed that although the TAD canister is a promising concept, its success depends on its being effectively integrated by DOE into the overall waste management system. DOE has established requirements for a TAD-based repository design assuming that 90 percent of CSNF will arrive at the repository in TAD canisters. Some nuclear power plants may lack the necessary infrastructure for using TAD canisters. The Board recommended that DOE carry out a comprehensive analysis to understand better the implications of not achieving the 90 percent TAD utilization rate and that DOE actively study all possible options for dealing with spent nuclear fuel in dual-purpose canisters. The letter goes on to say that DOE should consider adding supplemental features to current facility layouts, such as increasing the capacity of the WHF, adding a welding station to the WHF, and increasing the number of welding stations in the CRCF.

Chairman Garrick reiterated the Board's comments on 90 percent utilization of TAD canisters in testimony before the House Subcommittee on Energy and Air Quality, Committee on Energy and Commerce, on July 15, 2008. Dr. Garrick noted that if TAD utilization falls below the planned 90 percent, the lower rate could adversely affect surface-facility throughput and may require constructing additional waste handling facilities or increasing the amount of spent nuclear fuel that must be placed in storage at the repository site. Dr. Garrick conveyed the Board's recommendation that operational and design contingencies should be considered if the TAD utilization rate falls below 90 percent.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

1.3.4. Evaluate DOE plans for enhancing safety capabilities along transportation corridors, and review DOE planning and coordination activities, accident prevention activities, and emergency response activities.

- ***Evaluation of 1.3.4:*** DOE has deferred work in this area, pending additional funding.

## 2. Performance Goals Related to Postclosure Repository Performance

2.1.1 Evaluate DOE efforts to analyze the source term and to estimate the time it will take for radionuclides to be mobilized and transported through the natural system.

- **Evaluation of 2.1.1:** Except for analysis related to developing the license application, DOE did not undertake these specific activities during the period covered by the report. The Board plans to hold a panel meeting on source term in November 2008.

*The performance goal is deferred.*

2.1.2. Evaluate activities undertaken by DOE to develop a risk profile for specific radionuclides.

- **Evaluation of 2.1.2:** Except for analysis related to developing the license application (LA), DOE did not undertake this specific activity during the period covered by the report. The Board plans to hold a panel meeting on source term in November 2008.

*The performance goal is deferred.*

2.2.1. Review updates of Total System Performance Assessment (TSPA) models; identify models and data that should be updated.

- **Evaluation of 2.2.1: Criterion 1 is satisfied by the following:** The Board held a meeting on May 29, 2008, at which this topic was discussed extensively.

**Criterion 2 is satisfied by the following:** The Board commented on issues related to TSPA-LA in a letter to Edward Sproat on September 4, 2008. In the letter, the Board noted that the understanding and representation of the natural and engineered systems at Yucca Mountain have improved, but there are notable uncertainties related to TSPA-LA calculations. For example, according to DOE analyses, in the nominal scenario, none of the drip shields fail before 265,000 years and, on average, more than 99 percent of waste packages containing civilian spent nuclear fuel remain sealed at least 500,000 years after repository closure. However, the extent to which the drip shield reduces calculated doses by extending waste package lifetime is uncertain because it has not been analyzed. Some of the underlying assumptions in TSPA-LA may overestimate radioactive dose. For example, rather than trying to predict the location and extent of an igneous intrusion, DOE assumes that such an intrusion will damage all 11,629 waste packages in the repository. On the other hand, an important waste package failure mechanism does not seem to be treated conservatively in TSPA-LA. Deliquescence-induced localized corrosion, if it were to cause penetration of the waste packages, would have potentially significant performance

implications. Because DOE's assumptions are not always conservative, the overall degree of conservatism of the assumptions in TSPA-LA is difficult to assess. The Board recommended that DOE improve the technical basis for screening out deliquescence-induced localized corrosion, develop prototypes of novel engineered systems used at Yucca Mountain, and continue to enhance fundamental understanding of the geologic environment.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

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

- ***Evaluation of 2.2.2:*** DOE has deferred work in this area.

***This performance goal is deferred, pending future DOE activities.***

2.2.3. Evaluate results of studies undertaken by the science and technology program related to reducing uncertainties about the performance of the natural and engineered components of the repository.

- ***Evaluation of 2.2.3:*** The science and technology program has been eliminated.

***The performance goal is deferred, pending future DOE activities.***

2.2.4. Evaluate information from the science and technology program on secondary mineral phases and neptunium and plutonium mobilization.

- ***Evaluation of 2.2.4:*** The science and technology program has been eliminated.

***The performance goal is deferred, pending future DOE activities.***

2.2.5. Review DOE efforts to develop and articulate a repository safety case.

- ***Evaluation of 2.2.4: Criterion 1 is satisfied by the following:*** Board staff obtained a copy of DOE's simplified TSPA and is reviewing it.

***Criterion 2 was not satisfied.***

***By satisfying criterion 1 and partially satisfying criterion 2, the Board's performance in relation to this performance goal is judged minimally effective.***

2.3.1. 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 2.3.1: Criterion 1 is satisfied by the following:*** The Board discussed related issues at its meeting on May 29, 2008.

***Criterion 2 is partially satisfied by the following:*** In its letter to Edward Sproat dated September 4, 2008, the Board stated that a sound fundamental understanding of the geologic environment is important for predicting both the environmental controls on engineered barrier system (EBS) degradation and subsequent radionuclide transport.

***By satisfying Criterion 1 and partially satisfying Criterion 2, the Board's performance in relation to this performance goal is judged minimally effective.***

2.3.2. Review new infiltration work undertaken in response to questions about quality assurance (QA) procedures used to obtain previous infiltration estimates.

- ***Evaluation of 2.3.2: Criterion 1 was satisfied by the following:*** Before and after holding a meeting on March 14, 2007, on DOE's infiltration work, staff conducted field studies and interviews, reviewed papers and analyses, and supported the work of the Board's hydrologist, who analyzed these issues.

***Criterion 2 is satisfied by the following:*** In December 2007, the Board issued a significant report in which the Board presented its views on revised DOE estimates of water infiltration at Yucca Mountain. Among the Board's findings in the report were the following. Minor deficiencies in the USGS model were identified, but no significant errors in USGS infiltration estimates were found. The Board found no significant errors in the computational approach used for estimating infiltration by either the USGS model or the Sandia National Laboratory (SNL) model. When the values and variables are specified as being the same, the infiltration estimates from the two approaches are similar. USGS estimates of infiltration were based on an extensive suite of site-specific data and are consistent with multiple lines of evidence.

In contrast, the SNL model does not include all available site-specific data; however, the SNL procedure has a more complete representation of parameter uncertainties than the one used by USGS. As a result, SNL estimates of present-day infiltration are about three times higher than the USGS estimates. The SNL estimates also are less consistent with multiple lines of evidence. SNL estimates, for example, do not include consideration of evapotranspiration, and the SNL model was not calibrated to infiltration data at Yucca Mountain. To make the SNL estimates compatible with observed site data in the TSPA, DOE used a statistical process that does not have a strong technical basis.

The Board acknowledged the importance of the QA program to the regulatory program but noted that valuable data can be obtained from scientific endeavors not conducted in strict compliance with QA procedures and that strict observance of QA procedures does not guarantee sound technical analysis and data. In the report, the Board made the following recommendations: DOE should use all site-specific data in estimating infiltration and calibrating infiltration models; DOE should include parameterization, including associated uncertainty that represents evapotranspiration from shallow buried

bedrock in its model. The Board does not endorse the use of the statically modified SNL infiltration estimates in TSPA.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

2.4.1. 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 2.4.1: Criterion 1 was satisfied by the following:*** The Board held meetings on January 16, 2008, and on May 29, 2008, at which these issues were discussed.

***Criterion 2 was satisfied by the following:*** In a letter to Edward Sproat dated April 22, 2008, the Board noted that DOE research plans do not appear to address issues raised by the Board related to deliquescence-induced localized corrosion. The Board explicitly described work that could be undertaken by DOE to strengthen the technical basis for screening out deliquescence-induced localized corrosion as has currently been done in DOE's TSPA-LA. The Board told DOE that providing the evidence asked for in previous Board letters is important because DOE's repository design will produce temperatures that far exceed the boiling point of water for the first 2,000 years after repository closure. The Board urged DOE to make use of USGS dust data in characterizing the evolution of likely waste package environments after repository closure.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

2.4.2. Review thermal-mechanical and rock-stability testing on potential conditions in repository tunnels.

- ***Evaluation of 2.4.2: Criterion 1 was partially satisfied by the following:*** Staff reviewed and reported to the Board on pertinent DOE documents.

***Criterion 2 was satisfied by the following:*** Dr. Garrick discussed the implications of drift degradation for drip shield installation when he appeared before the House Subcommittee on Energy and Air Quality on July 15, 2008.

***By partially satisfying criterion 1 and satisfying criterion 2, the Board's performance in relation to the performance goal is judged minimally effective.***

2.5.1. Review DOE efforts in addressing questions related to possible seismic and igneous events and consequences.

- **Evaluation of 2.5.1: Criterion 1 was satisfied by the following:** The Board utilized the services of expert consultants who analyzed DOE work on seismic ground motion and igneous consequences and reported to the Board.

**Criterion 2 was partially satisfied by the following:** In his testimony before the House Subcommittee on Energy and Air Quality on July 15, 2008, Dr. Garrick identified these issues as being among those that would continue to be followed by the Board. The Board plans to hold panel meetings on these issues later in 2008.

**By satisfying Criterion 1 and partially satisfying Criterion 2, the Board's performance in relation to this performance goal is judged minimally effective.**

### 3. Performance Goals Related to System Integration.

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

- **Evaluation of 3.1.1: Criterion 1 is satisfied by the following:** The Board held meetings on September 19, 2007, and May 29, 2008, at which these and related issues were discussed.

**Criterion 2 is satisfied by the following:** The Board commented on repository design, specifically the thermal strategy, and on issues related to the corrosion resistance of materials used in the waste packages in its letter to Edward Sproat dated April 22, 2008.

**By satisfying both criteria, the Board's performance in relation to the performance goal is judged effective.**

3.1.2. Evaluate the integration of subsurface and repository designs, layout, and operational plans into an overall thermal management strategy.

- **Evaluation of 3.1.2: Criterion 1 is satisfied by the following:** The Board held meetings on September 19, 2007, and May 29, 2008, at which these and related issues were discussed.

**Criterion 2 is satisfied by the following:** The Board commented on repository design, specifically the thermal strategy, and on issues related to the corrosion resistance of materials used in the waste packages in its letter to Edward Sproat dated April 22, 2008.

**By satisfying both criteria, the Board's performance in relation to the performance goal is judged effective.**

3.2.1. Assess the integration of scientific studies into engineering designs for the repository and the waste package.

- **Evaluation of 3.2.1: Criterion 1 is satisfied by the following:** The Board held meetings on September 19, 2007, and May 29, 2008, at which these and related issues were discussed.

**Criterion 2 is satisfied by the following:** The Board commented on repository design, specifically the thermal strategy, and on issues related to the corrosion resistance of materials used in the waste packages in its letter to Edward Sproat dated April 22, 2008.

**By satisfying both criteria, the Board's performance in relation to the performance goal is judged effective.**

3.2.2. Review DOE efforts in integrating results of scientific studies related to the behavior of the natural system into repository designs.

- **Evaluation of 3.2.2: Criterion 1 is satisfied by the following:** The Board held a meeting on May 29, 2008, at which this and related topics were discussed.

**Criterion 2 is satisfied by the following:** The Board commented on related issues in a letter to Edward Sproat on September 8, 2008. In the letter, the Board noted that although the understanding and representation of the natural and engineered systems at Yucca Mountain have improved, the extent to which the drip shield reduces calculated doses by extending waste package lifetime is uncertain because it has not been analyzed. In addition, deliquescence-induced localized corrosion, if it were to cause penetration of the waste packages, would have potentially significant performance implications. The Board recommended that DOE improve the technical basis for screening out deliquescence-induced localized corrosion, develop prototypes of novel engineered systems, and continue to enhance fundamental understanding of the geologic environment.

**By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.**

3.2.3. Evaluate the integration of the repository facility, including the surface and subsurface components.

- **Evaluation of 3.2.3: Criterion 1 is satisfied by the following activity:** These issues were discussed at meetings held by the Board on September 19, 2007, and on January 16, 2008.

**Criterion 2 is satisfied by the following:** In a letter to Edward Sproat dated April 22, 2008, the Board noted that if the 96°C controlling heat limit were eliminated, the 200°C drift-wall temperature would be the controlling thermal limit. This could increase flexibility in thermal loading of the repository and waste package sequencing. The Board also recommended that DOE consider the feasibility and technical advantages of determining the thermal conditions at repository closure and varying the duration of the ventilation as needed to achieve thermal limits.

In a letter to Director Sproat dated January 16, 2008, the Board noted that DOE has established requirements for a TAD-based repository design assuming that 90 percent of CSNF will arrive at the repository in TAD canisters. Some nuclear power plants appear to lack the necessary infrastructure for using TAD canisters. The Board recommended that DOE carry out a comprehensive analysis to understand better the implications of not achieving the 90 percent TAD utilization rate and that DOE actively study all possible options for dealing with spent nuclear fuel in dual-purpose canisters. The letter goes on to say that DOE should consider adding supplemental features to current facility layouts, such as increasing the capacity of the WHF, adding a welding station to the WHF, and increasing the number of welding stations in the CRCF.

Board Chairman B. John Garrick reiterated the Board's comments on 90 percent utilization of TAD canisters in testimony before the House Subcommittee on Energy and Air Quality on July 15, 2008. Dr. Garrick noted that if TAD utilization falls below the planned 90 percent, the lower rate could adversely affect surface-facility throughput and may require constructing additional waste handling facilities or increasing the amount of spent nuclear fuel that must be placed in storage at the repository site. Dr. Garrick conveyed the Board's recommendation that operational and design contingencies should be considered if the TAD utilization rate falls below 90 percent.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

3.3.1. Review the potential and limits of the Total System Model (TSM).

- ***Evaluation of 3.3.1:*** DOE did not undertake work in this area.

***The performance goal is deferred.***

3.4.1. Review DOE analyses and integration of designs for facilities, systems, and repository components, including the TAD canister concept.

- ***Evaluation of 3.4.1: Criterion 1 is satisfied with the following activity:*** The Board held a meeting on September 19, 2007, at which these issues were discussed.

***Criterion 2 is satisfied by the following:*** The Board sent a letter to Office of Civilian Radioactive Waste Management (OCRWM) director Edward Sproat on January 16, 2008, following up on discussions at the September 19, 2007, Board meeting. In the letter, the Board observed that although the TAD canister is a promising concept, its success depends on its being effectively integrated by DOE into the overall waste management system. DOE has established requirements for a TAD-based repository design assuming that 90 percent of CSNF will arrive at the repository in TAD canisters. Some nuclear power plants appear to lack the necessary infrastructure for using TAD canisters. The Board recommended that DOE carry out a comprehensive analysis to understand better the implications of not achieving the 90 percent TAD utilization rate and that DOE

actively study all possible options for dealing with spent nuclear fuel in dual-purpose canisters. The letter goes on to say that DOE should consider adding supplemental operational features to current facility layouts, such as increasing the capacity of the WHF, adding a welding station to the WHF, and increasing the number of welding stations in the CRCF.

Board Chairman B. John Garrick reiterated the Board's comments on 90 percent utilization of TAD canisters in testimony before the House Subcommittee on Energy and Air Quality, Committee on Energy and Commerce, on July 15, 2008. Dr. Garrick noted that if TAD utilization falls below the planned 90 percent, the lower rate could adversely affect surface-facility throughput and may require constructing additional waste handling facilities or increasing the amount of spent nuclear fuel that must be placed in storage at the repository site. The Board recommended that operational and design contingencies should be considered if the TAD utilization rate falls below 90 percent.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

3.4.2. Evaluate DOE efforts to assess and integrate information on surface facilities and infrastructure at nuclear utility reactor sites.

- ***Evaluation of 3.4.2: Criterion 1 is satisfied with the following activity:*** The Board held a meeting on September 19, 2007, at which these issues were discussed.

***Criterion 2 is satisfied by the following:*** The Board sent a letter to Edward Sproat on January 16, 2008, commenting on these issues. In the letter, the Board noted that some nuclear power plants appear to lack the necessary infrastructure for using TAD canisters. The Board recommended that DOE carry out a comprehensive analysis to understand better the implications of not achieving the 90 percent TAD utilization rate and that DOE actively study all possible options for dealing with spent nuclear fuel in dual-purpose canisters.

***By satisfying both criteria, the Board's performance in relation to this performance goal is judged effective.***

## **Supplementary Information On The U.S. Nuclear Waste Technical Review Board**

The U.S. Nuclear Waste Technical Review Board was established on December 22, 1987, in the Nuclear Waste Policy Amendments Act (NWPAA) as an independent agency in the executive branch of the federal government. The Board is charged with evaluating the technical and scientific validity of activities undertaken by the Secretary of Energy related to implementation of the Nuclear Waste Policy Act. 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 DOE to implement Board recommendations.

### ***Board Members***

The Board is apolitical and nonpartisan. 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.

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 a private consultant. His areas of expertise include probabilistic risk assessment and application of the risk sciences to technology-based industries.
- **Mark D. Abkowitz, Ph.D.**, is professor of civil and environmental engineering and director of the Vanderbilt Center for Environmental Management studies at Vanderbilt University. His areas of expertise include transportation safety and security, systems analysis, all-hazards risk management, and applications of advanced information technologies.
- **William Howard Arnold, Ph.D., P.E.**, is a private consultant. He retired from Louisiana Energy Services in 1996. He holds a doctorate in experimental physics and has special expertise in nuclear project management, organization, and operations.

- **Thure E. Cerling, Ph.D.**, is Distinguished Professor of Geology and Geophysics and professor of biology at the University of Utah. His areas of expertise include terrestrial geochemistry and geochemistry processes.
- **David J. Duquette, Ph.D.**, is department head and professor of materials engineering at Rensselaer Polytechnic Institute. His areas of expertise include the physical, chemical, and mechanical properties of metals and alloys.
- **George M. Hornberger, Ph.D.**, is 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 Professor of the Practice in the Nuclear Science and Engineering Department at the Massachusetts Institute of Technology. His areas of expertise include nuclear engineering and the development of advanced reactors.
- **Ronald M. Latanision, Ph.D.**, is emeritus professor of materials science and engineering at the Massachusetts Institute of Technology and a principal in Exponent, a science and engineering firm. His areas of expertise include materials processing and corrosion of metals and other materials in aqueous environments.
- **Ali Mosleh, Ph.D.**, is Nicole J. Kim Professor of Engineering, director of the Reliability Engineering Program, and director of the Center for Risk and Reliability at the University of Maryland. His areas of expertise include methods for probabilistic risk analysis and reliability of complex systems.
- **William M. Murphy, Ph.D.**, is professor of Geological and Environmental Sciences at California State University, Chico. His research focuses on geochemistry, including the interactions of nuclear wastes and geologic media.
- **Henry Petroski, Ph.D., P.E.**, is Aleksandar S. Vesic Professor of Civil Engineering and professor of history at Duke University. His areas of expertise include the interrelationship between success and failure in engineering design. He also has a strong interest in invention and in the history of evolution of technology.

### ***Board Staff***

The NWPAA limits the Board's professional staff to 10 positions. An additional 5 full-time employees provide administrative support to Board members and the professional staff. Because of the comprehensive nature of the DOE 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 full capacity in supporting the Board's review of DOE programs.



### ***Board Reporting Requirements***

As required by the NWPAA, the Board reports to Congress and the Secretary of Energy at least two times each year. Board reports include findings and recommendations related to improving the technical and scientific validity of activities undertaken by the Secretary of Energy. Board reports and DOE written responses to Board recommendations are published in the Board's annual summary reports.

### ***Board Activities***

The Board and its panels sponsor meetings and technical exchanges with program participants and interested parties, including representatives of 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 and other states, regional state groups, affected units of local governments, Native American tribes, nuclear utilities, environmental groups and other affected states, state utility regulators, and members of the public. Board members and staff attend relevant technical conferences, meetings, symposia, and workshops; participate in field trips; and occasionally visit foreign countries to gain insights from observing their programs and learning about their experience in repository development.

Board and panel meetings are open to the public and are announced in the *Federal Register* four to six weeks before each meeting. To facilitate access for program participants and the public, the Board has held the majority of its meetings in Nevada, and time is set aside for public comment at each meeting. Transcripts of Board and panel meetings and all Board reports, correspondence, and congressional testimony are available to the public via telephone or written request or from the Board's Web site: [www.nwtrb.gov](http://www.nwtrb.gov).

The Board offices are in Arlington, Virginia.