



U.S. Nuclear Waste Technical Review Board

Fiscal Year (FY) 2009 Budget Request Submittal

**Including Board Performance Plan for FY 2009,
Board Performance Evaluation for FY 2007, and
Supplementary Information on the Board**

Summary and Highlights

Background

Disposal of commercial spent nuclear fuel and high-level radioactive waste (HLW) in a deep geologic repository is the primary approach being pursued by the United States and other countries worldwide. The U.S. repository program is a challenging undertaking. Not only is the repository a first-of-a-kind undertaking, but the proposed Yucca Mountain site also is geologically complex and repository performance must be estimated for up to one million years.

In 1987, Congress created the U.S. Nuclear Waste Technical Review Board because it realized that an independent and expert evaluation of the technical and scientific validity of the U.S. Department of Energy's (DOE) 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 HLW. By performing unbiased and continual technical and scientific peer review of the highest quality, the Board makes a unique and essential contribution to increasing confidence in the validity of the DOE technical program. The Board also provides important technical and scientific information that is intended to be useful to policymakers in Congress and the Administration who are faced with making crucial decisions about the disposal and management of the nation's spent nuclear fuel and HLW.

Budget Request for Fiscal Year (FY) 2009

To fulfill its congressionally established mandate and support its comprehensive technical review, the Board is requesting \$3,811,000 for FY 2009.

FY 2009 Goals and Objectives

The Board's general goals, strategic objectives, and annual performance goals for FY 2009 are presented in the enclosed performance-based budget and have been established in accordance with the Board's congressional mandate: to conduct an independent evaluation of the technical and scientific validity of DOE activities related to disposing of commercial spent nuclear fuel and HLW. Such activities include estimating the performance of, designing, and potentially constructing a repository at Yucca Mountain in Nevada. Other activities that the Board was specifically directed to review include the packaging and transporting of the waste to the proposed repository site.

The Board's strategic goals and objectives have been organized around the following three technical areas to help facilitate and focus the Board's review, and the Board's panels have been realigned correspondingly.

- *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 proposed repository site.

- *Postclosure* repository performance, including the nature of the source term and the movement of radionuclides that are most significant to dose through the engineered and natural barriers.
- *Integration* of science and engineering and preclosure and postclosure activities, including the effects of temperature on repository performance and the effects of waste package designs on the temperatures in the repository.

The Board's performance goals for FY 2009 have been updated to include expected DOE activities during the period. For example, the Board will review DOE activities related to the release of dose-contributing radionuclides as a function of time from the engineered-barrier system; implementation of the transportation, aging, and disposal (TAD) program; and incorporation of thermal criteria into repository designs and operational plans. The Board's performance in achieving its goals for FY 2007 also has been evaluated and is included in the attached budget document.

Performance-Based Budget Request for FY 2009

Background

Approximately 2,000 metric tons of spent nuclear fuel are produced each year by commercial nuclear reactors and are stored at more than 70 sites nationwide. By the time the presently operating reactors reach the end of their scheduled 40-year lifetimes (at some time in the 2030's), approximately 87,000 metric tons of commercial spent nuclear fuel will have been produced. (This estimate does not include spent nuclear fuel from plants that may be granted license renewals by the Nuclear Regulatory Commission [NRC].) In addition, spent nuclear fuel and HLW from defense activities have been stored at numerous federal facilities throughout the country. Disposal of the commercial spent nuclear fuel and defense HLW 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 to President George W. Bush that the proposed repository site at Yucca Mountain in Nevada be approved. The President then recommended the site to Congress. Exercising a prerogative established in the Nuclear Waste Policy Act (NWPA), the State of Nevada disapproved the President's recommendation. In the summer of 2002, both the U.S. House of Representatives and the U.S. Senate formally approved the site recommendation. Since that time, DOE has focused on preparing an application to be submitted to the NRC for authorization to construct a repository at Yucca Mountain. DOE expects to submit a license application in June 2008. Throughout this process, 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 letters, reports, and congressional testimony.

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 activities undertaken by the Secretary of Energy, including site-characterization activities and activities related to the packaging and transport of HLW and spent nuclear fuel.* The Board's 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 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 HLW.

In FY 2009, the Board will continue its ongoing technical and scientific review of DOE activities. Some of the DOE activities that the Board will review will be directed toward answering questions about repository performance, others will relate to repository and surface facility design and operations, and increasingly more of the activities will focus on transportation and packaging issues, such as implementing the TAD program. The Board will continue its role

* 42 U.S.C. 10263

as an independent peer review body and expert source of technical and scientific information for Congress and the Secretary of Energy.

Board Funding Requirement for FY 2009: \$3,811,000

The Board's budget request of \$3,811,000 for FY 2009 represents the funding needed to accomplish the Board's performance goals for the year.

During FY 2009, the Board will focus on reviewing DOE activities related to determining the source term—the release of dose-contributing radionuclides as a function of time from the engineered-barrier system; implementing the TAD concept; and incorporating thermal criteria into repository designs and operational plans. The amount requested will support the work of the Board members and staff who will conduct the comprehensive review described above. It also will enable the Board to comply with extensive federal security requirements related to the Board's information systems.

**The Board's General Goals, Strategic Objectives,
and Annual Performance Goals**

The nation's goals related to disposing of spent nuclear fuel and HLW were set forth by Congress in the NWPA and the NWPA. The goals are to develop a repository or repositories for disposing of spent nuclear fuel and HLW at a suitable site or sites and to establish a program of research, development, and demonstration for disposing of, transporting, and packaging the waste.

In 1987, the NWPA limited site characterization and repository development to a single site, at Yucca Mountain in Nevada. The NWPA 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 NWPA. The Board's general goals were established in accordance with its statutory mandate and with congressional action in 2002 authorizing DOE to proceed with the preparation and submittal of an application to the NRC for authorization to construct a repository at Yucca Mountain.

General Goals of the Board

The Board's general goals for FY 2008-2013 reflect the importance of gaining a realistic understanding of the potential performance of the proposed repository and the interdependence and interactions of all elements of the nuclear waste management system. The Board's general goals for FY 2008-2013 are the following:

1. Evaluate the technical and scientific validity of activities undertaken by DOE related to preclosure operations.

2. Evaluate the technical and scientific validity of activities undertaken by DOE related to postclosure repository performance.
3. Evaluate the technical and scientific validity of activities undertaken by DOE related to integrating science and engineering and crosscutting preclosure and postclosure issues.

To accomplish its goals, the Board has organized its review 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 the nature of the source term and the movement of the radionuclides that are most significant to dose through the engineered and natural barriers; and *integration of science and engineering and preclosure and postclosure activities*, including the effects of temperature on repository performance and the effects of waste package designs on the temperatures in the repository.

Strategic Objectives of the Board

To achieve its general goals, the Board has established the following five-year objectives.

1. Objectives Related to the Preclosure Period

- 1.1. Evaluate the technical and scientific validity of DOE efforts to implement its canister-based TAD concept.
- 1.2. Evaluate DOE efforts to design and construct surface facilities and infrastructure at the proposed repository site.
- 1.3. Review DOE efforts to develop a plan for transporting waste from nuclear utility reactors and federal storage sites to the proposed repository.

2. Objectives Related to the Postclosure Period

- 2.1. Evaluate DOE studies and analyses related to determining the source term—the release of dose-contributing radionuclides as a function of time from the engineered-barrier system.
- 2.2. Encourage DOE to develop realistic performance models, and review the technical and scientific validity of DOE efforts to gain a more realistic understanding of potential repository performance.
- 2.3. Evaluate the technical and scientific validity of DOE data and analyses related to infiltration, flow, and transport through the natural system and seepage into repository drifts.
- 2.4. Assess DOE efforts to increase understanding of repository tunnel environments and the potential for localized corrosion of waste packages in the proposed repository.

- 2.5. Review DOE activities related to predicting the potential effect(s) on dose of disruptive events.

3. Objectives Related to System Integration

- 3.1. Evaluate DOE efforts to develop thermal criteria for the repository and a strategy for managing the effects of heat on preclosure operations and postclosure repository performance.
- 3.2. Evaluate the integration of science and engineering in the DOE program, especially the integration of new data into repository and waste package designs.
- 3.3. Review DOE integration of operational and performance models.
- 3.4. Review DOE analysis and integration of issues and designs related to receiving, processing, aging, and emplacing spent nuclear fuel and HLW (e.g., TAD and Yucca Mountain surface facilities).

Board Performance Goals for FY 2009

The Board's performance goals for FY 2009 have been established in accordance with its general goals and strategic objectives. The Board's performance-based budget for FY 2009 has been developed to enable the Board to meet its performance goals for the year.

The Board will accomplish its goals by doing the following:

- Holding public meetings with DOE and DOE contractor personnel involving 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 critical documents provided by DOE and its contractors, including total system performance assessment (TSPA), preclosure safety analyses (PCSA), contractor reports, analysis and modeling reports (AMR), and design drawings and specifications.
- 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.

The Board's performance goals for FY 2009, which are described below, are divided into three technical areas that correlate to the Board's panel structure. The numbered goals also correspond to the Board's strategic objectives. Funding allocations for fiscal years 2007, 2008, and 2009 are indicated for each set of performance goals.

1. *Performance Goals Related to Preclosure Operations*

(Dollars in Thousands)

<i>FY 07</i>	<i>FY 08</i>	<i>FY 09</i>
\$890	\$905	\$953

- 1.1.1. Review DOE activities related to the utility and risk/benefit of the TAD canister concept.
- 1.1.2. Evaluate the role of the Total System Model (TSM) in assessing waste management system operations.
- 1.2.1. Evaluate the design of repository surface facilities, including those for fuel handling and aging, and how the design affects and is affected by performance measures, such as safety, efficiency, and complexity.
- 1.2.2. Evaluate DOE's analysis of crosscutting operational issues, such as frequency and duration of fuel handling, plans for fuel aging and repackaging, and use of TAD casks versus dual-purpose casks.
- 1.3.1. Review DOE efforts to develop a national transportation system, including criteria for transportation routing decisions.
- 1.3.2. Evaluate DOE plans for constructing a branch line in Nevada.

2. *Performance Goals Related to Postclosure Repository Performance*

(Dollars in Thousands)

<i>FY 07</i>	<i>FY 08</i>	<i>FY 09</i>
\$1,780	\$1,811	\$1,905

- 2.1.1. Evaluate DOE efforts to analyze the source term and to develop a risk profile for specific radionuclides.
- 2.1.2. Review DOE efforts to develop a convincing assessment of the expected peak dose at the accessible boundary.
- 2.2.1. Review plans and work carried out on possible analogs for the natural components of the repository system.
- 2.2.2. Review DOE efforts to develop a fundamental understanding of the geology, including fault hydraulics, the connectivity of fluid zones, seismic frequency and magnitude, and basaltic volcanism.
- 2.3.1. Monitor the results of flow-and-transport studies to obtain a better understanding of water and vapor transport and disposition in repository tunnels.

- 2.3.2. Review new infiltration work and infiltration estimates.
- 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, in particular, studies related to nitrate/chloride ratios.
- 2.4.2. Evaluate DOE activities related to criticality control for defense waste.
- 2.5.1. Review DOE efforts in addressing questions related to possible seismic and igneous events and consequences.

3. *Performance Goals Related to System Integration.*

(Dollars in Thousands)

<i>FY 07</i>	<i>FY 08</i>	<i>FY 09</i>
<i>\$891</i>	<i>\$905</i>	<i>\$953</i>

- 3.1.1. Evaluate the integration of repository and surface facility designs and operations into a credible thermal management strategy.
- 3.1.2. Evaluate the accuracy and completeness of the technical bases for repository and waste package designs.
- 3.2.1. Review DOE analyses and integration of designs for facilities, systems, and repository components, including TAD.
- 3.3.1. Evaluate the integration of preclosure and postclosure activities, considering the preclosure safety assessment as extending from waste acceptance to repository closure.
- 3.4.1. Review the potential and limits of the TSM.
- 3.4.2. Assess the integration of scientific studies into the TSPA.

FY 2009 Budget Request by Object Class

Object Class 11.1, Full-Time Staff: \$1,800,000

The amount requested for full-time permanent staff is based on the requirement to fund 15 total 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; Budget and financial activities; and meeting logistics for the Board. The small administrative staff supports the very active part-time Board members and full-time professional staff.

Object Class 11.3, Other than Full-Time Permanent Staff: \$301,000

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 on a part-time basis 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 2009.

Object Class 11.5, Other Personnel Compensation: \$46,000

The amount requested for this category covers performance awards under the Performance Management System, and retention/recruitment bonuses, both of which are approved by the Office of Personnel Management (OPM).

Object Class 12.1, Civilian Personnel Benefits: \$484,000

The estimate for this category represents the government's contribution for employee benefits at the rate of 24.9 percent for staff and 7.65 percent for members.

Object Class 21.0, Travel: \$271,000

The amount requested for this object class includes travel costs for Board members, staff, and consultants traveling to Board and panel meetings, miscellaneous meetings, conferences, orientation activities, gathering technical and scientific data, and to Yucca Mountain 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 9 trips during the year at an average of 4 days per trip. In FY 2009, the expectation is that DOE may 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 areas of the country affected by DOE actions.

Object Class 23.1, Rental Payments to the General Services Administration (GSA): \$250,000

The estimate for this object class represents the amount that the Board will pay for office space, including the Arlington and Las Vegas offices.

Object Class 23.3, Communication, Utilities, Miscellaneous: \$35,000

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: \$37,000

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 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 at the meetings. Members of the public who live in rural areas and who do not have Web access receive the Board's material upon request.

Object Class 25.1, Consulting Services: \$83,000

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: \$314,000

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: \$89,000

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: \$62,000

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

Object Class 31.0, Equipment: \$39,000

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 2009 Expenditures
 Object Classifications

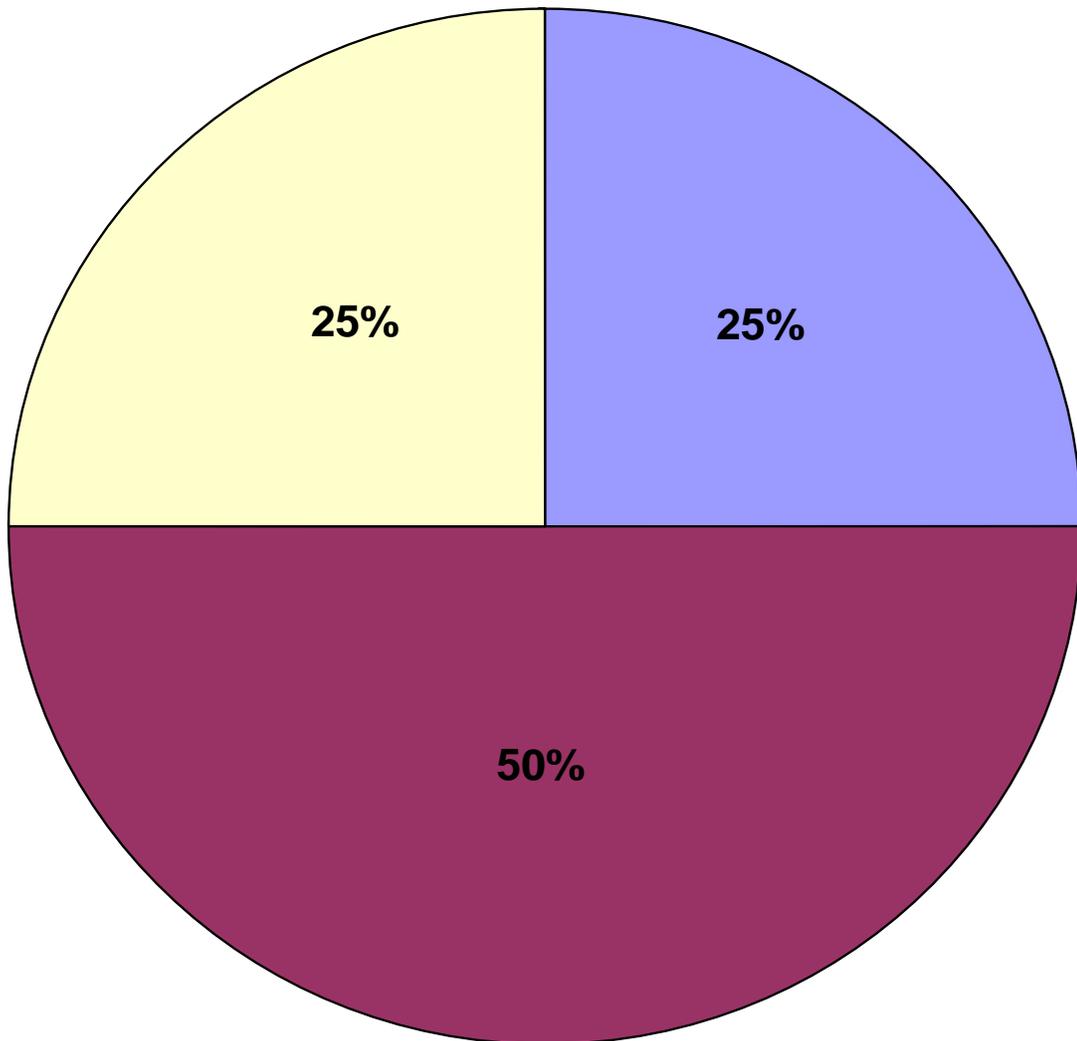
(In Thousands of Dollars)

Classification code 48-0500-0-271	FY 07 ACT	FY 08 EST	FY 09 REQ
<i>Expenditures</i>			
11.1 Full-Time Permanent Staff	\$1,669	\$1,735	\$1,800
11.3 Other than Full-Time Permanent Staff	288	297	301
11.5 Other Personnel Compensation	<u>28</u>	<u>35</u>	<u>46</u>
Total Personnel Compensation	\$1,985	\$2,067	\$2,147
12.0 Civilian Personnel Benefits	418	468	484
21.1 Travel and Transportation	268	270	271
23.1 Rental Payments to GSA	198	202	250
23.3 Communication, Utilities, Miscellaneous	28	25	35
24.0 Printing and Reproduction	17	23	37
25.1 Consulting Specialists	68	63	83
25.2 Other Services (Contract, Meetings, Maintenance, Security, & Transcripts)	373	311	314
25.3 Services from Government Accounts	88	93	89
26.0 Supplies and Material	51	54	62
31.0 Equipment	<u>67</u>	<u>45</u>	<u>39</u>
Total Obligations	<u>\$3,561</u>	<u>\$3,621</u>	<u>\$3,811</u>

(Numbers may not balance due to rounding.)

Identification Code 48-0500-0-1-271	07 ACT	08 EST	09 REQ
Total Number of Full-Time Permanent Positions	16	17	17
Total Compensable Work-Years: Full-Time Equivalent	16	17	17

FY 2009 Budget Request Resource Allocation



 Preclosure Operations	25%
 Postclosure Repository	50%
 Systems Integration	25%

U.S. Nuclear Waste Technical Review Board Performance Evaluation Fiscal Year 2007

The Nuclear Waste Policy Amendments Act of 1987 directed the U.S. Department of Energy (DOE) to characterize one site, at Yucca Mountain in Nevada, to determine its suitability as the location of a permanent repository for disposing of commercial spent nuclear fuel and defense high-level radioactive waste. The Act also 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 disposing of, transporting, and packaging the waste and to 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 completely independent, credible, and timely technical and scientific program evaluations and recommendations achieved 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 its 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 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 goals are 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 key technical issues of concern related to DOE programs, 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 FY 2007 will be submitted to the Office of Management and Budget (OMB), attached to the Board's budget request to Congress for FY 2009, included in the Board's summary report for 2007, and posted on the Board's Web site: www.nwtrb.gov.

The Board accomplishes its goals by doing the following:

- Holding meetings with DOE and DOE contractor personnel involving the full Board, and holding meetings of the 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 provided by DOE and its contractors, including total system performance assessment (TSPA), preclosure safety analyses (PCSA), contractor reports, analysis and modeling reports (AMR), and design drawings and specifications.
- Visiting investigation sites and observing ongoing technical and scientific activities, including those conducted at the national laboratories or potential analog sites.

Evaluation of Board Performance for FY 2007

The following goal-by-goal analysis of the Board's performance for FY 2007 is divided into three topical areas that correspond to the Board's panel structure as reorganized in FY 2006. The numbering of the performance goals also correlates with the Board's general goals and strategic objectives set forth in the Board's strategic plan for FY 2008-2013. Each performance goal is followed by a bullet that contains an explanation of the activities undertaken by the Board that satisfy the performance criteria discussed above. The explanation 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.

1. Performance Goals Related to Preclosure Operations

1.1.1. Review DOE analyses of facilities, systems, and component designs related to implementation of transportation, ageing, and disposal (TAD) concept.

- **Evaluation of 1.1.1: Criterion #1** is satisfied with the following activity: The Board discussed these issues at its meeting in Washington, D.C., on May 15, 2007. **Criterion #2** is satisfied by the following: The Board commented on the interdependencies and utility of TAD canisters in its April 19, 2007, letter to Edward Sproat, director of DOE's Office of Civilian Radioactive Waste Management. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *By satisfying both criteria, the Board's performance in relation to this goal is considered 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** was met by the following: The Board discussed the status of operational issues at its meeting in Washington, D.C., on May 15, 2007. **Criterion #2** is satisfied with the following: The Board discussed issues related to waste management system integration and implementation in its letter to Edward Sproat dated April 19, 2007. In the same letter, the Board encouraged technical interactions between DOE and the nuclear industry on this and related issues. *Because both criteria are satisfied, the Board's performance in achieving this performance goal is considered effective.*

1.2.1. Evaluate the design of surface facilities, including the fuel-handling and fuel-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 with the following activity: The Board met on January 24, 2007, to discuss these and other waste management issues. **Criterion #2** is satisfied with the following: In its April 19, 2007, letter to Edward Sproat, the Board commented in detail on progress in developing repository surface-facility designs. The Board recommended a "systems" analysis and suggested that the Total System Model could be useful in analyzing operational interdependencies. The Board pointed to the need for a "well thought out and clearly articulated thermal management strategy." The Board observed that the role of the Initial Handling Facility needs to be clarified. The Board encouraged DOE to reduce waste handling to the minimum possible and to integrate the activities of the Chief Scientist and the Chief Engineer. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered 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 by the following: The Board met on January 24, 2007, to discuss these and other waste management issues. **Criterion #2** is satisfied with the following: In its April 19, 2007, letter to Edward Sproat, the Board suggested that DOE monitor Department of Homeland Security (DHS) rulemaking and the anticipated changes to security route risk assessments being undertaken by the Federal Motor Carrier Safety Administration. *Because both criteria are satisfied, the Board's performance in achieving this performance goal is considered **effective**.*

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

- **Evaluation of 1.3.2: Criterion #1** is met with the following activity: The Board met on January 24, 2007, to discuss these and other waste management issues. **Criterion #2** is satisfied by the following: The Board recommended that DOE monitor the upcoming DHS rulemakings on routing criteria and route risk assessments in its April 19, 2007, letter to Edward Sproat. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered **effective**.*

1.3.3. Evaluate logistics capabilities of the transportation system.

- **Evaluation of 1.3.3: Criterion #1** is satisfied with the following activity: The Board met on January 24, 2007, to discuss waste management issues. **Criterion #2** is minimally satisfied by the Board stating in its April 19, 2007, letter to Edward Sproat that the Board was encouraged by DOE efforts in developing a transportation strategic plan. However, for budget reasons, numerous transportation activities, including this one, have been deferred by DOE. The Board's performance goal has been likewise deferred. As a consequence, the Board's overall performance in meeting this performance goal is considered ***minimally effective and the goal is deferred***.

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

- **Evaluation of 1.3.4: Criterion #1** is satisfied with the following: The Board met on January 24, 2007, to discuss waste management issues. **Criterion #2** is minimally satisfied by the following: In its April 19, 2007, letter to Edward Sproat, the Board stated that it was encouraged by DOE efforts aimed at developing a transportation strategic plan. Many DOE transportation activities, including those covered by this performance goal have been deferred because of budget constraints. The Board likewise deferred this performance goal until such time as DOE undertakes the activities. As a consequence, the Board's overall performance in meeting this performance goal is considered ***minimally effective and the goal is deferred***.

2. Performance Goals Related to Postclosure Repository Performance

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

- **Evaluation of 2.1.1: Criterion #1** is satisfied by the following: The Board discussed these issues at its meeting on January 24, 2007. **Criterion #2** is satisfied by the following: In commenting on the importance of scientific activities being undertaken under the auspices of the Science and Technology (S&T) program in its letter to Edward Sproat dated April 19, 2007, the Board noted that the S&T work on source term was of particular importance. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered effective.*

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

- **Evaluation of 2.1.2: Criterion #1** is satisfied by the following: The Board discussed these issues at its meeting on January 24, 2007. **Criterion #2** is satisfied by the following: In its April 19, 2007, letter to Edward Sproat, the Board noted that the S&T work on source term was particularly important. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *Because both criteria were satisfied, the Board's performance in achieving this performance goal is considered effective.*

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 activity: The Board met on September 27, 2006, to discuss DOE's repository safety case and related issues, including TSPA. **Criterion #2** is satisfied by the following: In a letter to Edward Sproat dated December 14, 2006, the Board pointed out that an effective safety case must include TSPA, which provides the quantitative core of repository performance estimates. The Board observed that assessing the realism of TSPA can be challenging because some estimates are conservative and others may be nonconservative. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered 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: Criterion #1** is satisfied by the following: The Board discussed natural analogs at its meeting on September 27, 2006. **Criterion #2** is satisfied by the

following: The Board encouraged the use of natural analogs in its letter to Edward Sproat dated December 14, 2006. The Board also noted that analogs provide excellent opportunities for testing prevailing conceptual and numerical models of radionuclide transport and isolation. *Because both criteria are satisfied, the Board's performance in achieving this performance goal is considered effective.*

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

- **Evaluation of 2.2.3: Criterion #1** is satisfied by the following: The Board met on September 27, 2006, to discuss these issues. **Criterion #2** is satisfied by the following: In a follow-up letter to Edward Sproat dated December 14, 2006, the Board noted that investigations supported by the S&T program have the potential to improve fundamental understanding of the repository's ability to isolate radionuclides. In a letter dated April 19, 2007, to Edward Sproat, the Board commented on work conducted by the S&T program related to source term, natural barriers, and materials performance. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered effective.*

2.2.4. Evaluate information from the S&T program on secondary mineral phases and neptunium and plutonium mobilization.

- **Evaluation of 2.2.4: Criterion #1** is satisfied by the following activity: The Board met on September 27, 2006, to discuss these issues. **Criterion #2** is satisfied by the following: In a follow-up letter to Edward Sproat dated December 14, 2007, the Board noted that investigations supported by the S&T program have the potential to improve fundamental understanding of the repository's ability to isolate radionuclides. *Because both criteria are satisfied, the Board's performance in achieving this performance goal is considered effective.*

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

- **Evaluation of 2.2.5: Criterion #1** is satisfied by the following: The Board focused its September 27, 2006, meeting primarily on evaluating DOE's safety case. **Criterion #2** was satisfied by the following: The Board followed up with comments to Edward Sproat in a letter dated December 14, 2006. In general, the Board noted that the presentations at the meeting indicated that DOE has an evolving understanding of the importance of a safety case in building confidence in repository performance estimates. However, the Board made clear that work remains to be done and that the integration of preclosure activities with postclosure activities and issues is very important. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered 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 with the following activity: These issues were discussed at the Board's meeting on January 24, 2007. **Criterion #2** is satisfied by the following: In its April 19, 2007, letter to Edward Sproat, the Board commented on the need to understand how heat and water vapor will move through the mountain. Testing of the saturated zone was discussed at the Board's May 15, 2007, meeting in Washington, D.C. *Because both criteria were satisfied, the Board's performance in achieving this performance goal is considered effective.*

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

- **Evaluation of 2.3.2: Criterion #1** is satisfied by the following activities: The Board's Panel on Postclosure Repository Performance met on March 14, 2007, to examine these issues in detail. Board staff conducted research and field interviews with DOE, Sandia National Laboratory, and USGS investigators. **Criterion #2** is satisfied by the following: The Board commented on these issues in its letter to Edward Sproat dated April 19, 2007. The Board is preparing a comprehensive report detailing its findings and recommendations on infiltration data and estimates that will be sent to Congress and the Secretary before the end of the 2007 calendar year. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered 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** is satisfied by the following activity: On September 25-26, 2006, the Board's Panel on the Engineered Barrier System (previous name) held a workshop on issues related to DOE's plan for screening out deliquescence-based localized corrosion from consideration when calculating dose. The issues were discussed extensively. **Criterion #2** is satisfied by the following: On January 12, 2007, the Board sent detailed comments to Edward Sproat outlining the Board's findings and recommendations from the workshop. In particular, the Board stated that demonstrating an adequate basis for screening out deliquescence-based localized corrosion during the thermal pulse requires (a) determining the nitrate-to-chloride ratios that are inhibitive for the entire range of temperatures in which deliquescent brines may occur on waste package surfaces and (b) confirming the hypothesis that the preferential migration of nitrate ions into crevices is sufficient to maintain nitrate-to-chloride ratios that are inhibitive. On July 10, 2007, the Board sent a second letter to Edward Sproat indicating that in addition to the above two criteria, DOE should show that such inhibitive nitrate-to-chloride ratios persist through the thermal pulse. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *Because both criteria are satisfied, the Board's performance in achieving this*

performance goal is considered effective.

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

- **Evaluation of 2.4.2: Criterion #1** is met with the following activity: These and related issues were discussed at the Board's meeting held on September 27, 2006. **Criterion #2** was not met. Because the Board met only one criterion in relation to the goal, the Board's performance in achieving the goal is considered *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** is satisfied by the following activity: These issues were discussed at the Board's meeting on January 24, 2007. **Criterion #2** is satisfied by the following: The Board commented on the importance of understanding the long-term cumulative effects of seismicity on the geologic environment in its letter to Edward Sproat dated April 19, 2007. The Board also stated that estimates of seismic ground motion during the period of repository operation significantly affect the engineering design of surface facilities; for example, current regulations will require reinforced structural walls that are more than 4 feet thick. The Board long has encouraged DOE to develop more-realistic estimates of ground motion. The Board commended DOE for the sustained support of the Probabilistic Volcanic Hazard Assessment Update (PVHA-U) and noted that when it becomes available, it will aid in a realistic assessment of the significance of low-probably volcanic hazards at Yucca Mountain. The Board was updated on the PVHA-U at its May 15, 2007, meeting in Washington, D. C. *By satisfying both criteria, the Board's performance in achieving this performance goal is considered 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 discussed engineering designs at its meeting on September 27, 2006. **Criterion #2** is satisfied by the following: In a follow-up letter to Edward Sproat dated December 14, 2006, the Board pointed out that the efficacy of engineering and operational designs could be tested by using prototyping. The Board also discussed repository surface facility designs at its January 24, 2007, meeting and commented on progress in this area in an April 19, 2007, letter to Edward Sproat. The Board discussed second-generation waste package design and prototype development at its May 15, 2007, meeting. *Because both criteria are satisfied, the Board's performance in achieving this performance goal is considered 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 with the following activity: The Board discussed these issues at its January 24, 2007, meeting. **Criterion #2** is satisfied by the following: In an April 19, 2007, follow-up letter to Edward Sproat, the Board reiterated its belief that a “systems” analysis is needed to evaluate the interrelationships among diverse components of the waste management system. The Board also commented in that letter that improvement is needed in developing a well-thought-out and clearly articulated thermal management strategy to act as a basis for integrating these interrelationships. *By satisfying both criteria, the Board’s performance in achieving this performance goal is considered 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: Related issues were discussed at the Board’s meeting on January 24, 2007. **Criterion #2** is satisfied by the following: In its April 19, 2007, letter to Edward Sproat, the Board expressed concern about the separation between the offices of the Chief Scientist and the Chief Engineer. The Board said that it had not observed a systematic aligning of the two components or recognition by DOE of the interdependencies of important repository design and operating elements. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *Because both criteria are satisfied, the Board’s performance in achieving this performance goal is considered 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: This issue was discussed at meetings held by the Board in January, May, and September of 2007. **Criterion #2** is satisfied by the following: In its April 19, 2007, letter to Edward Sproat, the Board expressed concern about the separation between the offices of the Chief Scientist and the Chief Engineer. In the same letter, the Board commented on the importance of understanding the long-term cumulative effects of seismicity on the geologic environment on repository surface-facility designs. For example, meeting current preclosure safety requirements for seismicity requires that the walls of the structures are made with steel-reinforced concrete and are more than 4 feet thick. *Because both criteria were satisfied, the Board’s performance in achieving this performance goal is considered 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: The Board discussed these issues at its January 24, 2007, meeting. **Criterion #2** is satisfied by the following: In an April 19, 2007, follow-up letter to Edward Sproat, the Board reiterated its belief that a “systems” analysis is needed to evaluate the interrelationships among diverse components of the waste management system. *By satisfying both criteria, the Board’s performance in achieving this performance goal is considered effective.*
- 3.3.1. Review the potential and limits of the Total System Model (TSM).
- **Evaluation of 3.3.1: Criterion #1** is satisfied by the following: The Board discussed the TSM at its meeting on January 24, 2007. **Criterion #2** is satisfied by the following: In a letter to Edward Sproat dated April 19, 2007, the Board noted that the TSM can play a valuable role in analyzing the operational interdependencies of the waste management system and the utility of the TAD canister. *By satisfying both criteria, the Board’s performance in achieving this performance goal is considered effective.*
- 3.4.1. Review DOE analyses and integration of designs for facilities, systems, and repository components, including TAD.
- **Evaluation of 3.4.1: Criterion #1** is satisfied by the following: The Board discussed these issues at its meeting in Washington, D. C., on May 15, 2007. **Criterion #2** is satisfied by the following: The Board commented on the interdependencies and utility of TAD canisters in its April 19, 2007, letter to Edward Sproat. The Board discussed its concerns in this area in its January 29, 2007, *Report to Congress and the Secretary of Energy*. *By satisfying both criteria, the Board’s performance in achieving this performance goal is considered 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 by the following: The Board discussed these issues at its meeting on January 24, 2007. **Criterion #2** is satisfied by the following: In its letter to Edward Sproat dated April 19, 2007, the Board noted that although DOE has improved its dialogue with nuclear utilities, it is not apparent that the dialogue includes all key issues warranting coordination within a successful waste management system. *By satisfying both criteria, the Board’s performance in achieving this performance goal is considered 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, including the following:

- site characterization
- 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 DOE to implement Board recommendations.*

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 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.

* Taken from *Legislative History of the Nuclear Waste Policy Amendments Act of 1987*, February 26, 1998.

- **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 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 4 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 under 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 under the auspices of the civilian radioactive waste management program. 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, 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; 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 holds 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.

The Board offices are located in Arlington, Virginia.