U.S. Nuclear Waste Technical Review Board Mission and its Survey of National Programs

Presented to:
DOE's Consent-based Siting Consortia

Presented By:
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Senior Professional Staff

February 14, 2024

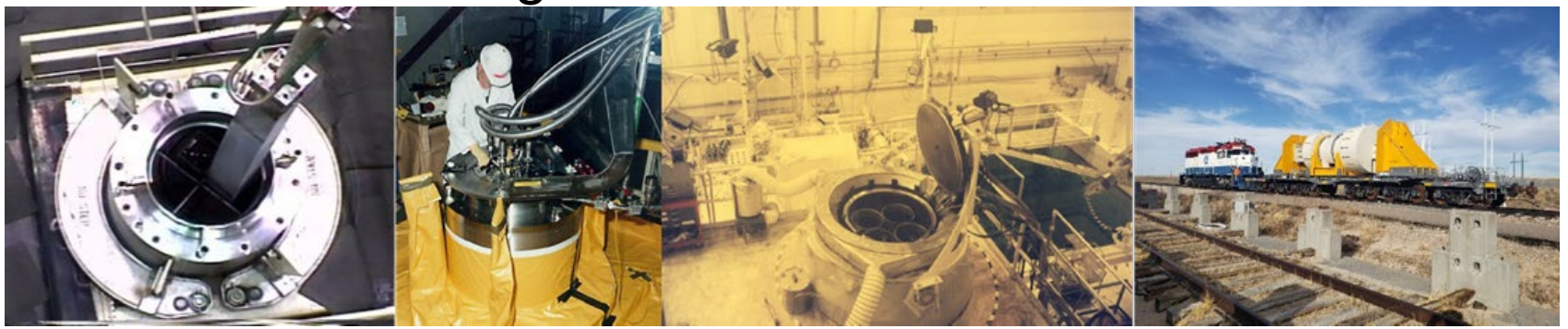
Third Quarterly Meeting – Virtual

Independent Federal Agency

The U.S. Nuclear Waste Technical Review Board (Board) was established by Congress as an independent federal agency in the 1987 amendments to the Nuclear Waste Policy Act


Board Mission

- The Board evaluates the “technical and scientific validity” of U.S. Department of Energy (DOE) activities related to implementing the Nuclear Waste Policy Act
- These DOE activities include:
  - Packaging of spent nuclear fuel and high-level radioactive waste and transportation of the wastes to a DOE storage or disposal facility
  - Site characterization, design, and development of facilities for disposing of spent nuclear fuel or high-level radioactive waste

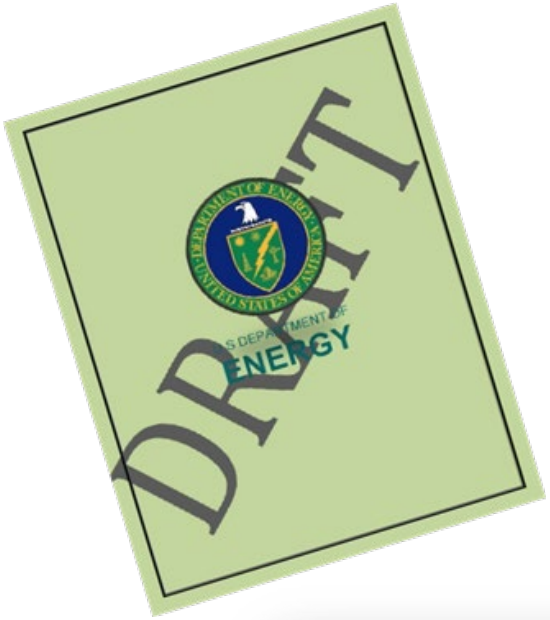


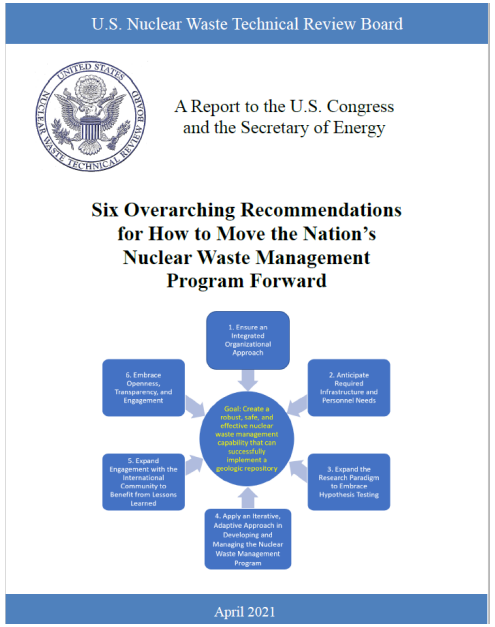
Board Members

At full strength, the Board has eleven members:

- Candidates nominated by National Academy of Sciences solely on the basis of eminence and expertise
- Appointed by the President
- Serve part time for four-year, staggered terms
- May serve until replaced
- Supported by permanent, full-time staff

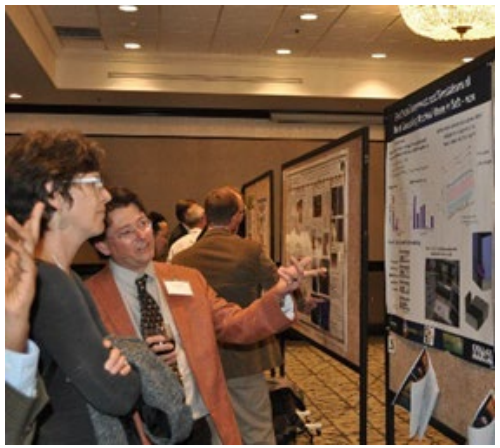
About the Board

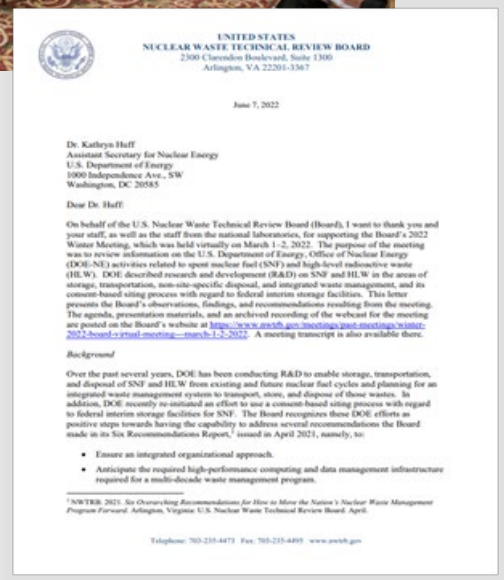




- Required to report its findings, conclusions, and recommendations to the U.S. Congress and the Secretary of Energy
- By law, has access to draft DOE documents – allows Board recommendations to be made during decision-making, not after the fact
- Provides congressional testimony at the invitation of Congress

About the Board (cont.)





UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD
2300 Clarendon Boulevard, Suite 1300
Arlington, VA 22201-3367

June 7, 2022

Dr. Kathryn Huff
Assistant Secretary for Nuclear Energy
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

Dear Dr. Huff:

On behalf of the U.S. Nuclear Waste Technical Review Board (Board), I want to thank you and your staff, as well as the staff from the national laboratories, for supporting the Board's 2022 Winter Meeting, which was held virtually on March 1–2, 2022. The purpose of the meeting was to review information on the U.S. Department of Energy, Office of Nuclear Energy (DOE-NE) activities related to spent nuclear fuel (SNF) and high-level radioactive waste (HLW). DOE described research and development (R&D) on SNF and HLW in the areas of storage, transportation, non-site-specific disposal, and integrated waste management, and its consent-based siting process with regard to federal interim storage facilities. This letter presents the Board's observations, findings, and recommendations resulting from the meeting. The agenda, presentation materials, and an archived recording of the webcast for the meeting are posted on the Board's website at https://www.nwtrb.gov/meetings/past-meetings/winter-2022-board-virtual-meeting---march-1-2-2022. A meeting transcript is also available there.

Background

Over the past several years, DOE has been conducting R&D to enable storage, transportation, and disposal of SNF and HLW from existing and future nuclear fuel cycles and planning for an integrated waste management system to transport, store, and dispose of those wastes. In addition, DOE recently re-initiated an effort to use a consent-based siting process with regard to federal interim storage facilities for SNF. The Board recognizes these DOE efforts as positive steps towards having the capability to address several recommendations the Board made in its Six Recommendations Report,[1] issued in April 2021, namely, to:

- Ensure an integrated organizational approach.
- Anticipate the required high-performance computing and data management infrastructure required for a multi-decade waste management program.

[1] NWTRB. 2021. *Six Overarching Recommendations for How to Move the Nation's Nuclear Waste Management Program Forward*. Arlington, Virginia: U.S. Nuclear Waste Technical Review Board. April.

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- Holds public meetings two or three times per year in different geographic locations in the United States
- The meetings are webcast
- Provides technical and scientific comments in letters to DOE following public meetings
- Makes all official documents (meeting transcripts and materials, reports, correspondence, congressional testimony, etc.) available on its website: www.nwtrb.gov

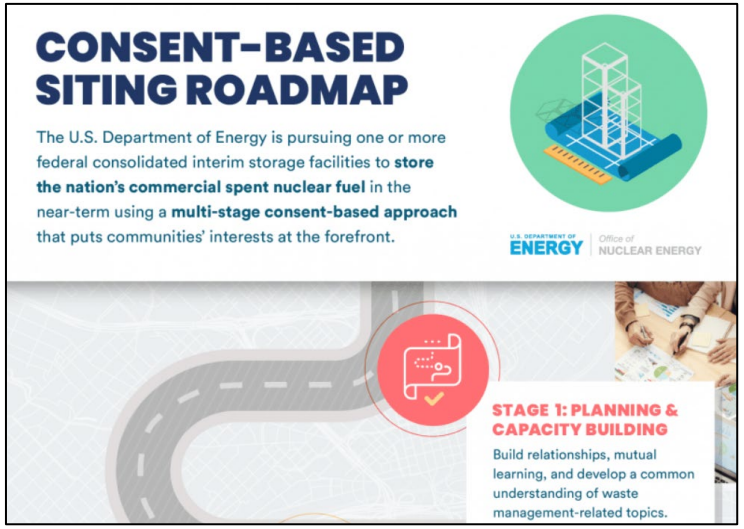
Current Board Members

- **Nathan Siu, Ph.D., Chair** – Consultant, Risk Assessment
- **Ronald Ballinger, Sc.D.** – Massachusetts Institute of Technology, emeritus
- **Steven M. Becker, Ph.D.** – Old Dominion University
- **Allen G. Croff, Graduate Nuc. Engr. Degree** – Vanderbilt University
- **Tissa Illangasekare, Ph.D.** – Colorado School of Mines
- **Kenneth Lee Peddicord, Ph.D.** – Texas A&M University, emeritus
- **Paul J. Turinsky, Ph.D.** – North Carolina State University, emeritus
- **Scott Tyler, Ph.D., Deputy Chair** – University of Nevada, Reno, emeritus
- **Brian Woods, Ph.D.** – Oregon State University
- (Two positions vacant)

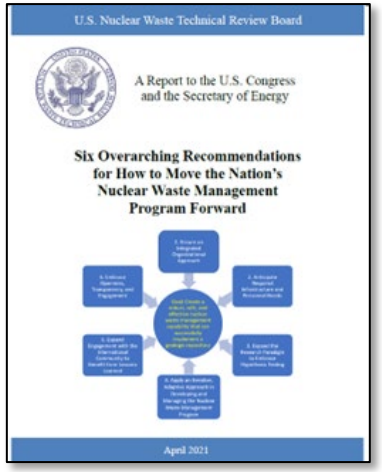
Recent Board Meetings

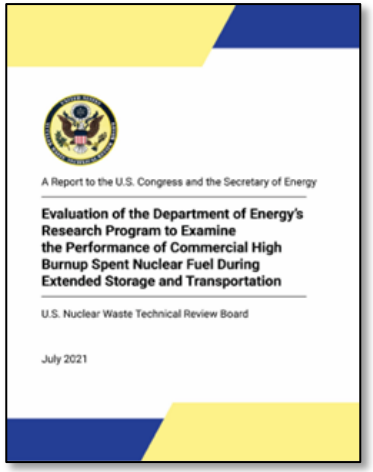
- Spring 2023 Meeting – March 28, 2023
  - Location: Orlando, Florida / Virtual
  - Topic: DOE activities to evaluate the removal of commercial spent nuclear fuel from nuclear power plant sites (link)

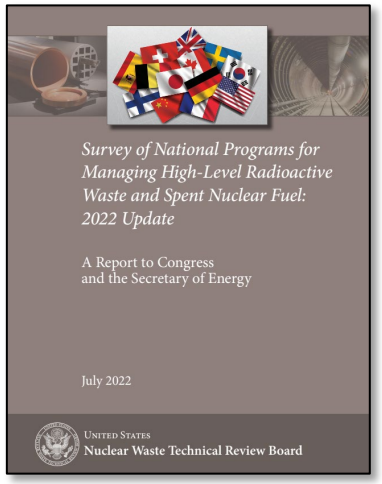
- Summer 2023 Meeting – August 29-30, 2023
  - Location: Idaho Falls, Idaho / Virtual
  - Topic: DOE activities to develop a consent-based siting process for a federal interim storage facility; issues related to management of spent nuclear fuel (link)

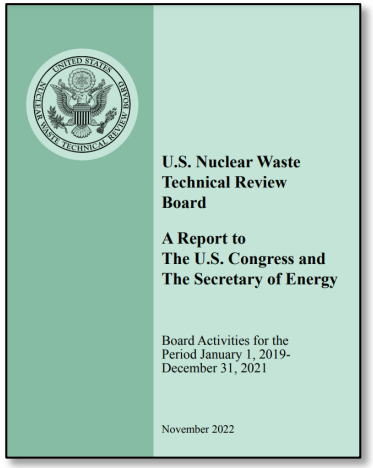


Recent Board Reports









- *Six Overarching Recommendations for How to Move the Nation's Nuclear Waste Management Program Forward – April 2021 (link)*
- *Evaluation of the Department of Energy's Research Program to Examine the Performance of Commercial High Burnup Spent Nuclear Fuel during Extended Storage and Transportation – July 2021 (link)*
- *Survey of National Programs for Managing High-Level Radioactive Waste and Spent Nuclear Fuel: 2022 Update – July 2022 (link)*
- *Report to the U.S. Congress and the Secretary of Energy: Board Activities for the Period January 1, 2019 - December 31, 2021 – November 2022 (link)*

Survey of National Programs

- First issued in 2009 and updated in 2016 and in 2022
- Includes an overview section and detailed tables containing information on institutional arrangements and technical attributes for groups of countries
- Describes 15 institutional arrangements and 15 technical attributes of nuclear waste management programs in 13 countries

Institutional Arrangements

Country	Legislation Specific to Radioactive Waste Management	Implementing Organization	Independent Regulator	Independent Technical/Program Oversight	Dedicated Funding Source for Repository Development
United States	Nuclear Waste Policy Act (1982) Nuclear Waste Policy Amendments Act (1987) Energy Policy Act (1992)	U.S. Department of Energy (DOE) (government agency)	U.S. Environmental Protection Agency (EPA) (sets environmental standards) U.S. Nuclear Regulatory Commission (NRC) (implements standards and licenses facilities)	U.S. Nuclear Waste Technical Review Board (NWTRB) (advises Congress and the Secretary of Energy)	Nuclear Waste Fund* Generators of nuclear electricity pay a $0.001 per kilowatt-hour surcharge into the Fund. The fee has not been collected since May 2014.
Belgium	Law of 8 August 1980, as amended Law of 3 June 2014 transposing European Directive 2011/70 (implementation) Law of 29 March 1958, modified by Law of 15 April 1994 (regulation)	National Agency for Radioactive Waste and Enriched Fissile Materials (Organisme national des déchets radioactifs et des matières fissiles/ Nationale Instelling voor Radioactief Afval en verrijkte Splijtstoffen [ONDRAF/NIRAS]) (government agency)	Federal Agency for Nuclear Control (Federaal Agentschap voor Nucleaire Controle [FANC])	None	Long-Term Fund Costs of developing a repository will be fully paid by waste producers. Payments determined by Royal Decree 25 April 2014 Pre-license expenditures (e.g., research and development [R&D]) are paid by the waste producers.
Canada	Nuclear Fuel Waste Act (2002) Nuclear Safety and Control Act (2000)	Nuclear Waste Management Organization (NWMO), subject to Government approval of key policies and decisions (private, not-for-profit organization formed by the nuclear electricity producers)	Canadian Nuclear Safety Commission (CNSC)	Advisory Council; Adaptive Phased Management Geoscientific Review Group; Council of Elders and Youth (advises the implementer) Independent Advisory Group (advises the regulator)	Nuclear Fuel Waste Act Trust Fund: Owners pay into the fund, subject to the formula approved by Government. Pre-license expenditures are paid contemporaneously by owners.

*Appropriations from the Nuclear Waste Fund are controlled by the U.S. Congress and are subject to annual apportionment.

Technical Attributes

Country	Operating Nuclear Reactors/ Generating Capacity	Reprocessing Included in Fuel Cycle	Transportation System in Place to Move SNF/HLW to a DGR	Centralized Interim Storage Facility Established
United States	93 nuclear reactors (95.5 gigawatts of electric power [GWe]) 2 nuclear reactors are under construction (2.2 GWe)	The U.S. reprocessed defense-related SNF as part of its weapons plutonium production program. Small amounts of commercial SNF were reprocessed at West Valley, New York. Two other commercial reprocessing plants were constructed, but never operated. The U.S. does not currently reprocess commercial SNF.	Depends on where the repository is developed. No rail transportation system is available for the Yucca Mountain site.	No
Belgium	7 nuclear reactors (5.9 GWe) The nuclear phase-out law of 2003 limits the operational lifetimes of the nuclear reactors to 40 (4 reactors) and 50 (3 reactors) years. The current fleet of reactors is expected to be retired by 2025 per this law.	Commercial SNF was reprocessed at La Hague. Moratorium on new reprocessing contracts was instituted in 1993 and confirmed in 1998 by the Council of Ministers. A small amount of commercial SNF was reprocessed by the pilot facility Eurochemic in Dessel (1966–1974).	No decision has been made.	Yes. HLW is stored at the Belgoprocess site in Dessel.
Canada	19 nuclear reactors (13.6 GWe)	No	No decision has been made.	No

Overview Section Tables

- Nuclear-generated electricity
- Organizational form of the implementer
- Independent technical/program oversight
- Waste forms authorized for disposal and establishment of centralized interim storage facilities

- Geologic investigations
- Health and safety requirements for disposal
- Status of site selection
- Anticipated start of repository operations

WASTE FORMS AUTHORIZED FOR DISPOSAL AND ESTABLISHMENT OF CENTRALIZED INTERIM STORAGE FACILITY

COUNTRY	WASTE FORMS AUTHORIZED FOR DISPOSAL IN A DEEP GEOLOGIC REPOSITORY	CENTRALIZED INTERIM STORAGE FACILITY ESTABLISHED
United States	Commercial and defense high-level radioactive waste (HLW), commercial spent nuclear fuel (SNF), and U.S. Department of Energy (DOE)-managed SNF	No
Belgium	No decision has been made.	No
Canada	SNF	No
China	HLW	No
Finland	SNF	No
France	HLW and long-lived intermediate-level waste	Yes. Vitrified HLW is stored at the La Hague reprocessing facility.
Germany	HLW and SNF	Yes. At Gorleben Ahaus, Rubenow, and Jülich.
Japan	HLW and transuranic (TRU) waste	Yes; Recyclable-Fuel Storage Center at Mutsu in Aomori Prefecture for SNF
Republic of Korea	SNF and possibly pyroprocessed HLW.	No
Spain	HLW, SNF, and long-lived intermediate-level waste	No. A site for the Centralized Temporary Storage facility, Villar de Cañas, was approved in 2011, but the project was suspended by the government in July 2018.
Sweden	SNF	Yes. At Oskarshamn.
Switzerland	HLW and SNF	Yes; at Würenlingen, for both HLW and SNF
United Kingdom	HLW and possibly SNF, long-lived, intermediate-level radioactive waste, and low-level waste not suitable for near-surface disposal	Yes; at Sellafield for both HLW and SNF

Institutional Arrangements

- Legislation specific to radioactive waste management
- Implementing organization
- Independent regulator
- Independent technical/program oversight
- Dedicated funding source for repository development

- Regulations and decrees applicable to licensing a deep geologic repository (DGR)—site selection
- Regulations and decrees applicable to licensing a DGR—environmental impact assessment
- Regulations and decrees applicable to licensing a DGR—health and safety protection
- Formal legislative/executive approvals required for developing a DGR—selection of a waste management option

Institutional Arrangements (cont.)

- Formal legislative/executive approvals required for developing a deep geologic repository (DGR)—site selection
- Formal legislative/executive approvals required for developing a DGR—facility construction and operation
- Interactions with local jurisdictions—local veto
- Interactions with local jurisdictions—limitations on local veto
- Interactions with local jurisdictions—benefits to be provided to local community for accepting a facility
- Explicit adoption of a staged decision-making process

Technical Aspects

- Operating nuclear reactors/generating capacity
- Reprocessing included in fuel cycle
- Transportation system in place to move spent nuclear fuel/high-level radioactive waste to a deep geologic repository (DGR)
- Centralized interim storage facility established

- Geologic environments considered or investigated for a DGR
- Engineered barrier system—design
- Engineered barrier system—importance to safety case
- Waste forms authorized to be disposed of in a DGR
- Underground research laboratories

Technical Aspects (cont.)

- Requirements for defense in depth
- Long-term health and safety requirements
- Methodology for demonstrating compliance with post-closure standards
- Requirements for retrievability
- Status of repository site-selection process
- Anticipated start of repository operations

Summary

- The Board is an independent agency whose mission is to evaluate the scientific and technical validity of DOE activities under the Nuclear Waste Policy Act
- The Board reports its findings, conclusions, and recommendations to Congress and the Secretary of Energy in letters and reports
- Together the country-specific institutional arrangements and technical attributes (e.g., technical criteria) define the socially acceptable approach for radioactive waste management for spent nuclear fuel and high-level radioactive waste that leads to disposal in a deep geologic repository