



UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD
2300 Clarendon Boulevard, Suite 1300
Arlington, VA 22201-3369

July 24, 2026

Mr. Theodore J. Garrish
Assistant Secretary for Nuclear Energy
United States Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Mr. Garrish:

This letter transmits the U.S. Nuclear Waste Technical Review Board (Board) observations from its June 9, 2026, meeting in Arlington, VA,¹ on Technical Lessons Learned from National Deep Geologic Repository Programs. The Board was established as a federal agency in the 1987 Amendments to the Nuclear Waste Policy Act (NWPA) to evaluate the technical and scientific validity of activities undertaken by the Secretary of Energy to implement the NWPA, including (i) site characterization activities, and (ii), activities relating to the packaging or transportation of spent nuclear fuel and high-level radioactive waste. Specific to the topic of the June 9 meeting, information provided by radioactive waste management programs in other nations supports the Board's mission to provide independent scientific and technical expert advice to the Secretary of Energy and Congress on efforts to implement the NWPA.

In March of 2025, the Board found that the U.S. needs one or more deep geologic repositories and recommended that the U.S. Department of Energy (DOE) create a workable pathway to site, license, construct, and operate a geologic repository for the permanent disposal of spent nuclear fuel and high-level radioactive waste, working with Congress as needed.² The Board's position has not changed. In January 2026, DOE issued a request for information inviting states to express interest in hosting a Nuclear Lifecycle Innovation Campus that includes a waste disposition function.³ The Board commends DOE for beginning a public dialog that includes looking for solutions for spent nuclear fuel and high-level waste disposal and is encouraged by the publicly available responses from states. Recognizing that this development puts the U.S. in the opening stages of a siting process, the Board convened this meeting to examine lessons learned from other national programs during the siting and development of deep geologic disposal facilities for spent nuclear fuel and high-level radioactive waste and is using this letter to provide the Board's observations on those lessons to DOE.

¹ The meeting agenda, presentation materials, transcript, and an archived recording of the webcast are available online at <https://www.nwtrb.gov/meetings/past-meetings/spring-2026-board-meeting---june-9--2026>.

² [Board Letter to Congress and Secretary of Energy, March 2025](#).

³ [Request for Information on Establishment of Nuclear Lifecycle Innovation Campuses](#).

Summary of the Meeting

The objective of the June 2026 meeting was to understand other countries' experiences from the siting and development of deep geologic disposal facilities for spent nuclear fuel and high-level radioactive waste. Implementers from four countries in early stages of repository site selection (Republic of Korea, Japan, Germany, the Czech Republic), one country with site selection completed (Switzerland), and one country preparing to begin disposal operations (Finland) described their experiences. The presentations addressed national approaches to repository siting, including policy and regulatory frameworks; technical and scientific criteria; the tools and methodologies used in site selection; the influence of siting decisions on post-selection activities, including licensing, design evolution, and implementation; and the lessons derived from these experiences. The attachment includes additional information on the meeting and summaries of the presentations with the lessons presented.

The common lessons learned by implementers include the importance of:

- Ensuring sufficient disposal capacity to accommodate current and future inventories of spent nuclear fuel and high-level radioactive waste.
- Establishing organizational capacity, tools, and processes early in the siting process to support siting, licensing, and implementation.
- Establishing a robust legislative and institutional framework to support repository development and implementation prior to starting, or restarting, a repository program. Such a framework will have a significant impact on scientific and technical activities undertaken in all stages of the disposal program.
- Adopting a phased, flexible, and adaptable repository program development approach is necessary so programs can periodically assess and change as knowledge and experience grows.
- Focusing on safety early, and throughout repository development, helps the implementer prepare for their eventual role as a licensee and the interrelated role of interacting with stakeholders during siting and subsequent steps.

In addition, the Board notes that those programs where early decisions were made to limit considerations for repository siting to a single rock type (e.g., crystalline rocks in the Czech Republic, argillaceous rocks in Switzerland) report benefits from having an underground research laboratory or characterization facility that can support repository program development.

Board Observations on Lessons Learned

A significant lesson is the need to ensure sufficient disposal capacity to accommodate a nation's existing and projected waste inventory. In its March 2025 letter,⁴ the Board found "the nation needs one or more deep geologic repositories for permanent disposal of domestic spent nuclear fuel and high-level radioactive waste." The Board's evaluation documented that almost all existing spent nuclear fuel has no plausible pathway for reuse and precludes disposal in deep boreholes without expensive and dose-intensive waste treatment and/or repackaging. The Board

⁴ [Board Letter to Congress and Secretary of Energy, March 2025](#).

recognizes that DOE is in the initial stages of the Nuclear Lifecycle Innovation Campus initiative and that DOE has not prescribed the waste amount or disposition modes (deep borehole or deep geologic repository) that states may wish to pursue. This is consistent with the intent of the Nuclear Life Cycle Campus approach, and leads the Board to observe that the full set of disposal solutions pursued by DOE should address the total inventory of spent nuclear fuel and high-level radioactive waste, including both existing and future inventories. The Board therefore reiterates its March 2025 finding that one or more deep geologic repositories will be required to dispose of this inventory.

Another important observation is that countries whose repository programs have advanced beyond siting learned that the implementer should have established organizational capacity, tools, and processes earlier in the siting process to support siting, licensing, and implementation. The Board observes that recent DOE efforts, such as the January 2026 Request for Information that initiated the Nuclear Lifecycle Innovation Campuses program, have focused on the siting process for new radioactive waste management facilities, while DOE has given less attention to putting in place the organizational capacity, tools and procedures that DOE will need once it decides how to move forward. Experience from other national programs shows that delaying key safety capabilities—such as quality assurance, requirements management, and related licensing support systems—often leads to avoidable inefficiencies and delays. Those same experiences also highlight the importance for implementers to focus on repository design, continuity over a multi-decadal program duration, and overall system optimization from the beginning, rather than trying to incorporate these considerations after major decisions.

As the implementers from the six nations observed, establishing a robust legislative and institutional framework to support repository development and implementation prior to starting, or restarting, a repository program is an important contributor to program success. Such a framework has a significant impact on scientific and technical activities undertaken in all stages of the disposal program. Consistent with the Board’s statutory mandate, the Board’s observation presented here is limited to the technical and scientific aspects of those activities needed to successfully implement an integrated nuclear waste management program. The Board concurs that creating a workable pathway to site, license, construct, and operate a repository includes the need for a clear and durable legislative and institutional framework. Such a framework will guide a disposal program, and as the implementers described, define the roles and responsibilities of the implementing organization, the regulator, industry, and other stakeholders and specify the decision-making processes. In its March 2025 letter,⁵ the Board recommended that DOE take the steps necessary, working with Congress as needed, to create a workable pathway to site, license, construct, and operate a geologic repository for the permanent disposal of spent nuclear fuel and high-level radioactive waste. We make no recommendations regarding policy actions that may be taken to create a workable pathway to geologic disposal but observe that each nation established its own pathway prior to starting, or restarting, a repository program.

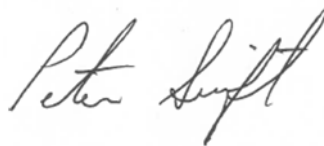
The Board observes that nations that have chosen to focus their disposal programs on a single host rock type and that have access to an underground characterization facility—either at a candidate disposal site or at a separate underground research laboratory in geologically equivalent host rock—have found that the facility serves important and variable roles depending

⁵ [Board Letter to Congress and Secretary of Energy, March 2025](#).

on repository program maturity. Early in the siting process a facility in a geologically equivalent host rock provides confidence that the nation can develop a repository elsewhere. Such a facility can reduce uncertainty, build confidence in site characterization techniques that the implementer will apply during the repository siting process and serve as an information basis for discriminating among candidate sites at an early stage. An underground characterization facility supports the development and testing of models and engineered barrier concepts in situ that are directly relevant to licensing, while providing practical insights that inform later design and implementation decisions. The Board specifically notes that Czech Republic program's use of an underground research facility at repository-relevant depth in crystalline rock illustrates how data and insights gained early in an equivalent geologic setting can be effectively transferred to prospective disposal sites through application of generic safety assessments and can be used to inform subsequent design and implementation decisions. The Board makes no recommendations specific to the U.S. program at this time regarding construction of a new underground characterization facility, recognizing the merits of keeping multiple host rock options open in the early stages of site selection. Rather, the Board notes that DOE has made good use in the past of information gathered from existing underground characterization activities in various rock types worldwide.

The Board believes the lessons from other national repository implementers and our observations can help DOE determine a workable pathway towards the permanent disposal of spent nuclear fuel and high-level radioactive waste. We look forward to learning more about DOE's Nuclear Lifecycle Innovation Campus initiative and continuing our ongoing evaluation of the technical and scientific validity of DOE's activities related to managing and disposing of spent nuclear fuel and high-level radioactive waste.

Sincerely,

A handwritten signature in dark ink, appearing to read "Peter Swift", with a stylized, cursive script.

Peter Swift
Chair

cc: Ms. Marla Morales, Acting Deputy Assistant Secretary, Office of Spent Fuel and High-Level Waste Disposition

Attachment

Meeting Details and Summaries of Presentations Including Lessons Presented

The Board held a meeting in Arlington, VA, on June 9, 2026, on technical lessons learned from national deep geologic repository programs during the siting and development of deep geologic repositories for the disposal of spent nuclear fuel and high-level radioactive waste.⁶ The meeting examined programs in the Republic of Korea, Japan, the Czech Republic, Germany, Finland, and Switzerland to provide perspective across the full range of repository development activities. These countries collectively illustrate how a repository program progresses from early conceptual planning through site selection and implementation. For instance, the Republic of Korea is at an early stage in shaping its siting approach, while the Czech Republic has narrowed an initial group of thirty-two candidate areas to four potential sites. By contrast, Finland and Switzerland have selected repository sites and are focusing on post-selection activities, including site characterization, regulatory licensing and construction. Viewed collectively, these experiences illustrate how repository programs, and the range of considerations, evolve over time. While the Board recognizes that both technical and social considerations are important and interrelated in repository site selection, the Board focused the June 2026 meeting on the technical factors that support successful repository program outcomes.⁷

The presenters, all representing repository implementers, organized their presentations around a shared set of questions listed in the meeting agenda and provided in advance by the Board. These questions focused on national approaches to repository siting such as policy and regulatory frameworks, technical and scientific criteria, tools, and methodologies used in site selection, lessons learned, and how siting decisions influenced post-selection stages such as licensing, design evolution, and implementation. The Board also sought insight into the value of early application of practices such as quality assurance, requirements management, and systems engineering. Reflecting the order of their respective stages of repository program development, the following paragraphs summarize the presentations and technical lessons from the Republic of Korea, Germany Japan, , the Czech Republic, Switzerland, and Finland implementers.

Dr. Sungbok Lee described the Republic of Korea's high-level radioactive waste management program. The country established the legal and institutional framework in the 2025 Special Act on High-Level Waste Management and set a clear national path toward interim storage and deep geologic disposal. He chronicled how the program has moved from planning into implementation through a consent-based, stepwise siting process that begins with nationwide screening to exclude unsuitable areas. The program will progress to voluntary participation and increasingly detailed surface and subsurface investigations. The implementer, the Korea Radioactive Waste Agency (KORAD), uses a phased safety assessment approach that systematically evaluates geological conditions, engineered barriers, and long-term radionuclide isolation, which will culminate in the safety case required for licensing, to guide repository

⁶ The meeting agenda, presentation materials, transcript, and an archived recording of the webcast are available online at <https://www.nwtrb.gov/meetings/past-meetings/spring-2026-board-meeting---june-9--2026>.

⁷ The Board's international siting workshop in 2023 focused on the social and institutional considerations for developing consent during siting of a new radioactive waste facility. https://www.nwtrb.gov/docs/default-source/reports/nwtrb_2024_proceedings-report.pdf?sfvrsn=d004c305_3.

development. KORAD will design the repository to accommodate their inventory of spent fuel from both pressurized water and pressurized heavy water reactors. Research and demonstration activities include development of a generic underground research laboratory in crystalline rock. KORAD is using its research and demonstration program, including repository design and performance assessment efforts to build technical confidence and support future storage and disposal facilities.

Dr. Axel Liebscher described Germany's repository site selection program including the inventory of spent nuclear fuel and vitrified high-level waste that needs disposal in a deep geologic repository.⁸ The program is guided by a systematic and robust legal framework based on the 2017 Repository Site Selection Act and 2020 safety ordinances. The Act established a multi-phase process that begins with a "white map," meaning no sites are preselected. Other main principles in the Act include a participative, science-based, transparent, self-questioning, and learning procedure for siting and the requirement to meet a "best possible safety" for a period of one-million years standard. Using information gathered by the implementer, Bundesgesellschaft für Endlagerung (Federal Company for Radioactive Waste Disposal, BGE), the German parliament and the regulator will decide what that "best possible safety" standard means. BGE is conducting representative preliminary safety analyses which follow an iterative, four-step screening sequence to evaluate all potential repository sites identified in salt, crystalline and argillite host rocks found in Germany. The implementer applies uniform exclusion criteria and progressively detailed safety and geoscientific requirements to identify areas with the largest safety margins. In 2025, BGE largely completed the initial representative preliminary safety analyses steps and published interim results, which showed that many sub-areas in the country have advanced beyond preliminary safety screening. BGE anticipates identifying the first areas of high suitability in 2026, and a formal proposal for siting regions for surface investigations by the end of 2027. BGE learned it needed to define host-rock-specific safety criteria and develop comparison methodologies to effectively distinguish among different geologic environments and support identification of the most suitable sites because generic host-independent criteria in the site selection act were insufficient.

Mr. Hiromitsu Saegusa presented an overview of Japan's deep geologic repository program, describing a phased site-selection process established under the Final Disposal Act of 2000. As of 2026, Japan has 28,000 canisters of vitrified waste and the implementer, the Nuclear Waste Management Organization of Japan (NUMO), is planning the disposal facility to accommodate more than 40,000 canisters. Disposal of vitrified high-level waste would occur at depths greater than three hundred meters in stable geologic settings and rely on a multi-barrier system that combines engineered components with the surrounding host rock. NUMO conducts its site selection activities and safety evaluations under clearly defined statutory and regulatory criteria. The criteria screen out areas affected by active faults, Quaternary volcanism, significant uplift or erosion, or economically valuable mineral resources. NUMO supports its siting process by conducting site descriptive modeling to understand long-term geologic conditions. The siting process begins with a literature survey based on desk-top evaluations and will advance, only with local consent, to progressively more detailed investigations. As of mid-2026, NUMO has literature survey activities underway in four locations. NUMO's completed literature surveys in two municipalities helped clarify program readiness to move forward, including identifying

⁸ Germany's inventory of waste is fixed because the nation stopped producing nuclear power in 2023.

specific technical issues that NUMO would address if the siting process moved forward. Mr. Saegusa emphasized that the nationwide map of scientific features has played a vital role in supporting dialogue and improving public understanding in the siting process by clearly distinguishing favorable and unfavorable areas and showing that geological disposal is feasible in Japan.

Dr. Markéta Dohnálková presented the Czech Republic's approach to siting a deep geologic repository. Správa úložišť radioaktivních odpadů (Czech Radioactive Waste Repository Authority, SÚRAO) implements this program within a defined legislative and regulatory framework in which long-term safety is the primary basis for decision-making. The program follows a phased, stepwise process—screening, preliminary safety assessment, and comparative evaluation—to narrow candidate locations to a final and backup site. The Czech repository siting approach requires identification of a sufficiently large and suitable rock volume, with an adequate reserve, to accommodate the entire, current, and projected, Czech waste inventory of radioactive wastes requiring deep geologic isolation. Site evaluations consider the structural integrity and thermal properties of the host rock to support long-term performance at a depth of five hundred meters in crystalline rock. SÚRAO uses a reference-site safety case that defines transferability parameters to compare with site-specific data to assess whether the disposal concept can perform safely under local conditions. The Czech program uses the Bukov Underground Research Facility to generate site-relevant data and test key aspects of the repository concept, helping to inform both safety assessment and design. Dr. Dohnálková described SÚRAO's program as an evidence-based approach in which siting decisions are transparent, traceable, and grounded in systematic evaluation of geologic conditions and barrier system performance. SÚRAO has learned that a clear, well-defined process and a consistent focus on safety supports credible decision-making. As the Czech repository program has progressed, SÚRAO has learned that transparency, stakeholder engagement, and systematic management of uncertainty are essential throughout the disposal program. Dr. Dohnálková concluded that the Czech deep geologic repository program's long-term progress depends on sustained commitment, continuity of expertise, and allowing sufficient time for data collection and evaluation.

Dr. Michael Schnellmann described Switzerland's radioactive waste management program. The deep geologic repository will contain all Swiss spent nuclear fuel and high-level radioactive waste. Switzerland used the federal Sectoral Plan for Deep Geological Repositories, which is a legally defined, stepwise, and safety-driven process for siting. The sectoral plan clearly defines institutional roles and responsibilities, requires federal review of decisions, and includes a provision for a national referendum at final approval. The implementer, Nationale Genossenschaft für die Lagerung radioaktiver Abfälle (National Cooperative for the Disposal of Radioactive Waste, Nagra), advanced through successive stages of technical screening and confirmation using a set of explicit safety criteria and extensive site investigations to identify a preferred location in northern Switzerland for the repository site. The site investigations included large-area three-dimensional seismic surveys and multiple deep exploration boreholes that provided a robust data set for comparative safety evaluation and demonstration of long-term isolation capability. The location is not tectonically complex, which would allow Nagra to develop the entire multi-square-kilometer repository in a single block of rock not crossed by faults. The site is underlain by a thick and laterally extensive clay-rich formation with favorable and well-characterized properties, including very low hydraulic conductivity, strong sorption

capacity, efficient self-sealing behavior, and long-term geologic stability. Nagra learned that a science-based, criteria-driven approach, staged decision making supported by progressively more detailed data, early and sustained engagement with regulators, stakeholders, and local communities, and transparent sharing and discussion of technical information to build trust and avoid delays were keys to their success. Nagra has submitted general license applications for the repository project, which are under regulatory review, and has begun transitioning to project development. Nagra is planning a detailed shaft design, preparing more subsurface investigations, establishing site monitoring systems, completing an environmental impact assessment, and continuing data acquisition to support confirmation of reference models, the safety case, and subsequent construction licensing and implementation.

Dr. Barbara Pastina described the Finnish implementer's (Posiva) experience as a source of practical lessons on siting, licensing, construction, and implementation. Posiva's phased repository program began with site investigation and selection and then focused on preparing a construction license application. The program evolved to focus on constructing the repository and preparing an operating license application. Posiva is now preparing to operate the facility and is further developing the disposal system. Dr. Pastina described the phased, iterative, flexible, adaptive process for repository design development, emphasized that change is expected, and explained how Posiva's knowledge and experience grew during each phase of the program. Posiva learned that planning for safety and long-term performance from the outset is important. The organization developed increasingly robust and streamlined designs that met all safety requirements, while relying more on proven, off-the-shelf, components and well-established processes—an approach that improves implementability and reduces sensitivity to operational variations or human error. Dr. Pastina noted that requirements management is important particularly during the early phases and during optimization and highlighted the value of employing a formal requirements management system to document and track evolving site-specific design criteria. Such a system maintains transparency and traceability as the repository design is refined over time and ensures that modifications remain aligned with safety objectives. Because repository development spans several decades, the implementing organization must be flexible and plan and adapt its management structure and technical competencies as the project evolves. Posiva learned that a strong safety culture and sustained, open dialogue with regulators and other stakeholders are essential for facilitating safe implementation of changes, sustaining trust, and ensuring that continuous improvement is achieved throughout the repository program's lifecycle.

The following common key lessons are relevant to the siting and development of deep geologic repositories.

1. Disposal programs are developed to dispose of the existing and projected inventories of waste. Five implementers summarized their current and projected inventories and their disposal plans. SÚRAO and Nagra use adequacy of host rock size as a criterion in their siting process to determine whether a site could contain a repository and its wastes.
2. All disposal programs benefit from a robust legislative and institutional framework that is established before siting begins, including well-defined laws and regulations governing safety, security, and environmental protection. The framework supports repository

program development, from site selection and licensing through repository closure, and provides the clarity and direction needed for implementation.

3. All national programs use a phased, flexible, and adaptable approach to develop their repositories and a stepwise site selection process beginning with some version of a nationwide screening, progressively narrowing candidate sites through surveys, boreholes, and underground investigations.
4. Underground research and characterization facilities can play an important role in repository programs. Five countries highlighted planned or existing underground research laboratories that can collect long-term data, assess models, and build scientific and technical capacity. Finland, Germany, and Switzerland have used, or plan to develop, underground characterization facilities at candidate repository sites to test and demonstrate technologies and for additional detailed site characterization.
5. Focusing on safety early, and continuously, helps the implementer prepare to become a licensee and facilitates interactions with stakeholders during siting and subsequent steps. Five countries described using safety assessments as well as explicit safety criteria approved by the regulator to justify the selection or exclusion of candidate sites. Posiva noted that early planning around safety ensures they can comply with regulatory safety requirements even as their program evolves.
6. Organizational capacity, tools, and processes are needed to support licensing and implementation from the outset. Presentations from countries in more advanced stages of repository development, particularly Finland and Switzerland, highlighted the importance of maintaining the technical capabilities, institutional processes, and management systems needed to sustain progress through successive phases of licensing, construction, and disposal.