Perspectives on Consent-Based Siting from an International Workshop on Siting of Radioactive Waste Facilities – 24455

Bret Leslie[1]
[1]U.S. Nuclear Waste Technical Review Board

ABSTRACT

Congress created the U.S. Nuclear Waste Technical Review Board (NWTRB) in 1987 to evaluate the technical and scientific validity of activities undertaken by the Secretary of Energy to implement the Nuclear Waste Policy Act. The NWTRB previously reviewed the geologic repository siting programs of ten countries and found that selecting a repository site is an iterative and adaptive process, involving successive evaluations of technical suitability and social acceptability, and requiring sufficient time to address both technical and social issues. In 2022 and early 2023, the NWTRB considered these findings in reviewing the U.S. Department of Energy's (DOE) nascent efforts to use a consent-based siting process in support of developing one or more federal interim storage facilities for commercial spent nuclear fuel (SNF). The NWTRB recommended that DOE use lessons learned domestically and internationally to develop its process for consent-based siting and implement its program. In August 2023, the NWTRB held an international workshop on radioactive waste facility siting with invited speakers from Canada, Sweden, Switzerland, and the United States, including DOE staff. These speakers emphasized that the foundation of success is strong national government involvement in creating and supporting a legal framework for the selected siting approach. The approach itself must be socially acceptable; reflecting societal norms and country-specific government structure. The invited experts stressed that organizations trying to site a radioactive waste management facility are not in the siting business, but in the trust business. The siting program must move at the speed of trust, which is slow, and not be driven by arbitrary deadlines. The flexibility provided by a private non-governmental implementing organization and the importance of the roles and responsibilities of government agencies involved in the siting process for radioactive waste management facilities were noted by speakers as important to siting success. The NWTRB subsequently held a meeting devoted to DOE's consent-based siting activities, including the purpose and expected activities of DOE's consent-based siting consortia. Based on the information provided in, and developed from, the NWTRB workshop and meeting, DOE is operating from a trust deficit, is making substantial progress in developing and implementing a consent-based siting program to develop one or more federal interim storage facilities but faces substantial challenges. These challenges include a legal framework that limits the possibility of success, the lack of a disposal program, schedule pressures from Congress, and lower levels of trust in government (Congress and the Executive Branch) than in other countries where consent-based siting processes for radioactive waste management facilities have been implemented with some success. Whether Congress and the Executive Branch take actions in the near term to address these challenges and provide DOE, or another implementing organization, the latitude and time (decades) to implement an integrated waste management system that addresses extended storage and disposal of high-level radioactive waste (HLW) and SNF remains to be seen.

INTRODUCTION

Congress established the NWTRB in the 1987 Nuclear Waste Policy Amendments Act, Public Law 100-203. Pursuant to the Act, the NWTRB is charged with evaluating the technical and scientific validity of activities undertaken by DOE related to the management (i.e., packaging, storage, and transportation) and disposal of SNF and HLW.[a] The NWTRB reports the results from its evaluations, including its findings, conclusions, and recommendations, to Congress and the Secretary of Energy. Throughout its existence,

[a] Disclaimer: The views expressed in this paper are those of the author and do not necessarily represent the views of the NWTRB. The author is a member of the NWTRB's senior professional staff.

the NWTRB has interacted with other national and international radioactive waste management organizations to gain additional information to support its review of DOE activities [1-3]. The current mission of DOE's Office of Integrated Waste Management, within the DOE's Office of Nuclear Energy, is to construct one or more federal interim facilities for commercial SNF using a consent-based siting process.

The suspension of DOE's efforts on the Yucca Mountain, Nevada, repository program in 2010 and the Blue Ribbon Commission on America's Nuclear Future efforts led to a reevaluation of the nation's siting process for radioactive waste facilities. Nothwithstanding the country's previous failed attempts to adopt and implement a policy of consent-based siting for radioactive waste facilities, such the work of the Nuclear Waste Negotiator in the 1980s and 1990s, in 2012, the Blue Ribbon Commission on America's Nuclear Future recommended [4] a consent-based siting process be used for future facilities [5]. The Blue Ribbon Commission noted that most of their recommendations require action by the Administration and Congress [4].

The NWTRB used the disruption in the Yucca Mountain program to review the geologic repository siting programs of ten countries [6-7]. The agency's review of the siting success and failures documented the lessons learned and found that selecting a repository site is an iterative process, involving successive evaluations of technical suitability and social acceptability [6-7]. The NWTRB expanded on the concept of social and technical filters from the siting reports [6-7] and developed a figure (Figure 1) that captures the iterative process and overlap of the social and technical aspects of repository siting that leads to mutual acceptance of a site by the implementer and potential host(s) of the facility [8].

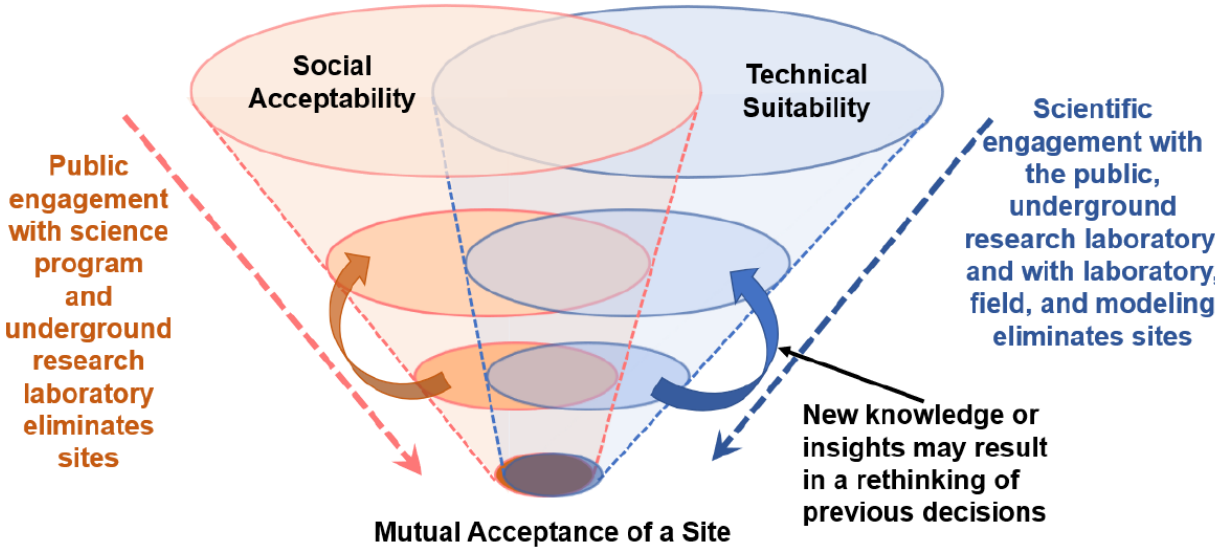

Figure 1. Development of a convergent pathway for siting a repository.

DOE used the NWTRB's reports [6-7] to inform development of a draft consent-based siting process for disposal and storage of SNF and HLW in 2017 and its consent-based siting process for the federal consolidated interim storage of SNF in 2023 [9]. DOE's recent activities have been consistent with direction provided by Congress in the Consolidated Appropriations Act, 2021, the Consolidated Appropriations Act, 2022, and the Consolidated Appropriations Act, 2023 [9].

Congress directed and funded DOE to pursue a range of activities relating to federal consolidated interim storage, also known as "monitored retrievable storage," under its existing authority in the Nuclear Waste Policy Act, as amended. Activities include collaborating with the public and potentially interested communities on the consent-based siting process and working to identify an interim storage site [9]. Current law, including Subtitle C of Title I of the Nuclear Waste Policy Act, as amended, allows DOE to

proceed with a consent-based siting process, negotiate an agreement with a host community, and design, and seek a license for, an interim storage facility [9]. NWTRB has been reviewing DOE's efforts to develop one or more federal interim storage facilities for commercial SNF as part of an integrated waste management system [10-11].

DESCRIPTION

NWTRB's Review of an Integrated Waste Management System

Within the DOE Office of Nuclear Energy, the Office of Integrated Waste Management has focused for the last few years on consent-based siting, transportation preparations, storage implementation, and system analysis [12]. DOE's transportation preparations include railcar development, infrastructure evaluations and operational planning, engagement with tribes and states, and the development of preliminary plans for a package performance study. Storage implementation activities comprise project management, storage facility design, and development of canister inspection and remediation concepts. DOE's system analysis activities include developing computational tools, data management, modeling and simulation (e.g., SNF annual inventory update), and systems engineering (e.g., advanced reactor SNF considerations). Achieving the goal of an operational federal interim storage facility for commercial SNF will require DOE to integrate the social acceptability components of consent-based siting with the technical aspects of transportation preparation, storage implementation, and system analysis.

DOE's initial consent-based siting activities were a focus of the NWTRB's meeting in March 2022 [10]. The NWTRB found that that there were more actions that DOE could take to learn from domestic siting experiences and siting processes in other nations and to strengthen its overall consent-based siting effort. In a fact-finding meeting with DOE shortly after the March public meeting, members of the NWTRB suggested that DOE learn from siting of facilities, perceived by the public as high risk, such as Biosafety Level 4 facilities. Based on the NWTRB's review of DOE documents, NWTRB's accumulated knowledge from interacting with other nations' waste management programs, and the meeting record, the NWTRB recommended "that DOE produce a candid 'lessons learned' document on its deep borehole demonstration siting effort and review key lessons that have been learned from siting processes in other nations" [10].

The NWTRB reviewed DOE's Office of Integrated Waste Management activities in March 2023 [11]. The reviewed activities included DOE's efforts over the last nine years to evaluate the future removal of commercial SNF from nuclear power plant sites. DOE provided an update on the consent-based siting process supporting the development of one or more federal interim storage facilities, as well as updates on transportation research and development (R&D) including site infrastructure evaluations, systems analysis tools, and railcar development [11]. Based on the information presented at the public meeting, a fact-finding meeting, and in related technical reports, the NWTRB developed several findings, conclusions, and recommendations on DOE's integrated waste management program, transportation R&D activities, and consent-based siting program [11]. For example, NWTRB commended DOE for continuing to work closely with tribes and found that the Office of Integrated Waste Management's emphasis on making tribal government engagement a priority is a positive step for its consent-based siting efforts. The NWTRB also commended DOE for looking into developing metrics (i.e., ways to measure and evaluate tribal engagement and progress) to assess or track the extent to which such efforts have been successful [11]. Those metrics will also be important for DOE's consent-based siting process as it begins to interact with communities who want to learn more. NWTRB stated it looked forward "to seeing more detailed information about such metrics at future NWTRB meetings" [11].

NWTRB's Workshop and Meeting on DOE's Consent-Based Siting Activities

With substantial DOE progress in its consent-based siting efforts since 2021 (e.g., DOE's consent-based siting process report [9] and the selection of 13 awardees for consent-based siting consortia [13]), the

NWTRB decided to hold an international workshop and meeting on the topic. In August 2023, the NWTRB held a day-long international workshop on siting of radioactive waste facilities and a meeting the following day that focused on DOE efforts on consent-based siting. Both meetings were held in Idaho Falls, Idaho and online and were recorded [14]. Purposes for the workshop were to update the NWTRB's understanding of the lessons learned from the siting of radioactive waste management facilities domestically and in other countries and to hear how DOE has addressed, or plans to address, the NWTRB's recommendation to incorporate lessons learned into its consent-based siting efforts [10]. The NWTRB also engaged a consultant, an internationally respected radioactive waste program professional, to aid the NWTRB's review of DOE's consent-based siting activities. His report contained observations and suggestions for improvements in the DOE's consent-based siting process for one or more consolidated interim storage facilities for SNF [15].

The workshop included an introductory presentation from NWTRB staff on the workshop objectives and NWTRB perspectives on siting of radioactive waste facilities [16]. The workshop objectives were to obtain information that might be applicable to the DOE efforts to develop one or more federal interim storage facilities for commercial SNF, using a consent-based siting process, and to support the NWTRB's evaluation of the scientific and technical validity of DOE's consent-based siting, transportation preparations, storage implementation, and systems analysis activities [14]. The NWTRB representative explained that the process that leads to a convergent pathway for siting a repository (Figure 1) was also applicable to consent-based siting of an interim storage facility [14]. The speaker also emphasized that siting approaches differ between countries and reflect the national radioactive waste policy framework.

International Workshop Methods and Key Points

The workshop included presentations, facilitated panel discussions, and an open house at the conclusion of the workshop. The NWTRB allowed public comments both in person [17] and virtually. The NWTRB published the public comments submitted online to its website the following morning.[b] For each presentation and panel discussion, NWTRB asked participants questions beyond those addressed in the workshop's agenda [17]. At NWTRB's invitation, DOE displayed at the back of the room its three-dimensional (3-D) models of storage and transportation equipment, written materials describing DOE's consent-based siting efforts, and an immersive 3-D virtual reality tour of an SNF interim storage facility. These materials were available throughout the workshop and meeting and were a focus of the open house.

The workshop included NWTRB invited speakers from Canada, Sweden, and Switzerland who addressed a series of questions [18-20]. The agenda questions included:

- What factors led to the initiation of the siting process and how did the federal government participate in defining the siting process?
- How did the siting process include decisionmakers and address the decisions that needed to be made to achieve an operating radioactive waste facility?
- What were the key scientific and technical issues that needed to be addressed?
- What were the siting criteria and when were they developed in relation to the siting process?
- What were the unanticipated challenges, problems, and developments that had implications to the siting program?
- What were the key components of the siting program, lessons learned during the siting process and keys to success?
- What were the elements of the program that led to success and are they transferable [17]?

[b] [Comments submitted online by virtual attendees during the workshop - Aug 29, 2023]. [Online]. Available: https://www.nwtrb.gov/docs/default-source/meetings/2023/august/comments-submitted-online-by-virtual-attendees-during-the-workshop---aug-29-2023.pdf?sfvrsn=2. [Accessed Nov. 22, 2023].

These speakers emphasized that a key for national success is the need for strong national government involvement in laying, and continuously supporting, the legal framework for a siting approach that will be socially acceptable and reflects the country-specific government structure and societal norms [18-20]. For Canada, after its initial repository siting attempt failed because it had not demonstrated to have broad public support, the Canadian government reset the program by passing the Nuclear Fuel Waste Act in 2002 [18]. The entire plan that the Canadian Nuclear Waste Management Organization (NWMO) is implementing emerged through a dialogue that NWMO was required to conduct by the 2002 waste act [18]. The three-year dialogue between NWMO and both specialists and the public included Indigenous peoples and was designed to determine the values and priorities important in Canada in thinking about how Canadians managed used SNF [18]. Under the waste act the government of Canada was responsible for reviewing the results of the NWMO dialogue, which identified an adaptive phased management approach that included a deep geologic repository as the preferred long-term management option and selecting the long-term management option from those proposed. In 2007, the Canadian government selected the adaptive phased management approach. Since then, the Canadian government has been providing oversight of NWMO's implementation of the Canada's disposal program [18]. Representing Sweden, Engström [19] noted that the way one organizes the nuclear waste management program is key (define the responsibilities and rights of the waste producers and explain the role of each stakeholder). Zuidema [20] identified a national commitment to progress with disposal of radioactive waste and clarity in a stepwise process (defined before start of site selection) as keys to success in Switzerland. Regarding the stepwise process, he also listed: a) defining roles and responsibilities to reach sustainable decisions at the highest level; b) phases and milestones with adequate objectives (stepwise refinement of options); and c) suitable criteria to develop and evaluate the options with 'first priority to safety' as keys to success [20]. Engström also noted that federative governments like the US and Switzerland have the added complexity of states or cantons to address in the siting process. These political structures increase the difficulty of obtaining consent, when compared to countries like Sweden and Finland that do not have a federative government.[c]

The invited speakers stressed that organizations attempting to site a radioactive waste management facility are not in the siting business, but are in the trust business, and that the siting program must move at the speed of trust, which is slow, and not be driven by arbitrary deadlines. Canada has used a learn more approach [18]. "A consent-based siting process needs a foundation of mutual understanding before a decision can really even be considered in good faith by either party" [18]. In Canada, when communities became engaged in the siting process, the implementer "never asked them to commit to or even support the idea of locating the project in their area. All we asked from them was to agree to develop a better understanding of the project, to learn more." Acquiring patience was a key factor for success in Sweden because "building trust takes time" [19]. In Switzerland, providing the time and information needed for society to become an informed partner in the project and to understand the 'why here and not there' were keys to success [20].

The roles and responsibilities of government agencies involved in the siting process for radioactive waste management facilities and the flexibility provided by a private non-governmental implementing organization were noted by NWTRB-invited speakers as important to siting success [18-20]. In Canada, the implementing organization is a private, not-for-profit organization formed and funded by the nuclear electricity producers that are crown corporations, or owned by the provinces in which they reside [18]. The ownership of nuclear utilities by the federal government or provinces incentivizes support from provinces in the siting process. In the US the environmental impact assessment for a repository is conducted by DOE (implementer) and/or NRC (regulator). In contrast, the Impact Assessment Agency of Canada is responsible for delivering impact assessments that look at both positive and negative environmental, economic, social, and health impacts of potential projects. In Switzerland, the

[c] [Transcript, p. 135]. [Online]. Available: https://www.nwtrb.gov/docs/default-source/meetings/2023/august/usnwtrb-aug-29.pdf?sfvrsn=4. [Accessed Nov. 22, 2023].

organizational structure includes a government agency that owns the siting process, a private non-governmental implementing organization, and a credible and independent regulator that is involved throughout the siting process [20]. For Sweden, a trustworthy regulator being present in the siting process is a key factor for success, and the implementer is a private company that is owned by the nuclear utilities [19]. The private non-governmental implementing organization approaches in Sweden and Switzerland gives them flexibility, and an operating environment that is not affected by election changes. These approaches allow them to complete a siting process and implement facilities because they offer longevity, stability, and the ability to act.[d]

The workshop also included a former NWTRB member who addressed US waste facility siting lessons learned and the efforts of the Office of the Nuclear Waste Negotiator. His key over-arching lessons learned were:

- The siting and development process is decades long;
- There is a need for enduring political stability and support (e.g., changes in governance in both states and tribes delayed or stopped efforts, and federal policy changes have stopped interim storage and repository programs);
- States have a key role in determining whether a facility can be sited and operated [e.g., permits beyond a license from the U.S. Nuclear Regulatory Commission (NRC) are required]; and
- A history of mistrust has resulted [21].

The morning session ended with a facilitated discussion among the Swedish, Swiss, and US representatives and included questions from the NWTRB members to the panelists. Questions asked by NWTRB members included how the Swedish and Swiss measured or assessed the effectiveness of engagement, and which forms of engagement were most important. The panelists described their metrics and agreed on the importance of scientists and engineers, rather than communication professionals, interacting with the public and conducting a substantial amount of face-to-face communication [14].[e] The panelists emphasized the importance of addressing the disposal of SNF now, not making management and disposal of waste a burden for future generations, and the importance for policy makers to be aware of these issues and to take relevant action.[f] For example, a panelist recalled in the early days of the US program [1980s] Congress had people who followed the nuclear waste issue and took actions to address the issue and "it seems to be more silent at the moment" [14]. In his view, "that's the first thing, make sure that people in Congress say, 'Hey, you have to move'." He went on to say "there are good reasons trying to get some members of Congress more strongly involved and committed to solve the waste issue (e.g., as part of the revival of nuclear)" [15].

In July 2023, DOE responded to the NWTRB's recommendation to review key lessons that have been learned from siting processes in other nations [10]. DOE said its consent-based siting process builds upon best practices from domestic and international siting cases, and it is continuing to examine how domestic and international siting experiences and/or collaborations can be used to support successful advancement of consent-based siting in the US [22].

The afternoon session focused on DOE's efforts to incorporate best practices and lessons learned from the international siting of radioactive waste facilities [14,17]. DOE described how it is incorporating domestic best practices and lessons learned and using best practices and lessons learned from environmental justice

[d] [Transcript, pp. 299-300]. [Online]. Available: https://www.nwtrb.gov/docs/default-source/meetings/2023/august/usnwtrb-aug-29.pdf?sfvrsn=4. [Accessed Nov. 22, 2023].
[e] ".. people understand and trust him because they know this guy knows what he's talking about, and you gain trust that way. That trust cannot be given by a communicator that has packaged messages." [Transcript, p. 69]. [Online]. Available: https://www.nwtrb.gov/docs/default-source/meetings/2023/august/usnwtrb-aug-29.pdf?sfvrsn=4. [Accessed Nov. 22, 2023].
[f] [Transcript, pp. 136-137]. [Online]. Available: https://www.nwtrb.gov/docs/default-source/meetings/2023/august/usnwtrb-aug-29.pdf?sfvrsn=4. [Accessed Nov. 22, 2023].

[14,17]. Before the in-person public comment period, the NWTRB held a closing facilitated panel discussion on all workshop topics with DOE staff joining the morning panelists.

Regarding international siting, DOE said that their initial literature review and case studies, which focused on Canada, Switzerland, United Kingdom, Finland, and Germany, were meant as internal communication/education tools and are not public [14]. DOE also described bi-lateral agreements with Finland and Canada that could help DOE's consent-based siting program. During questioning of the DOE presenters, an NWTRB member suggested that DOE mine the NWTRB past meeting transcripts that are on www.nwtrb.gov website because the NWTRB routinely asks its foreign presenters to provide their lessons learned [14].

Regarding domestic best practices, DOE described results from three studies of exemplars in different economic sectors and planned studies of exemplars in the wind, petrochemical manufacturing, and mining (i.e., the Western Uranium and Vanadium Mill) sectors [14,23]. The completed studies focused on the Office of the U.S. Nuclear Waste Negotiator (nuclear sector), Spotsylvania Solar Energy Project (solar sector), and the Biosafety Level 4 Facilities: National Bio and Agro-Defense Facility at Kansas State University (biology sector). The reports from the completed studies are not public. DOE acknowledged that they undertook the Biosafety Level 4 facility study based on NWTRB's suggestion in 2022 [10,23]. The biology sector example pointed to large costs for siting, significant licensing and regulatory hurdles for numerous agencies, and the need to get local and state political support early and to work continuously to keep that support by communicating frequently with appropriate staff and politicians [14].[g] The nuclear sector example analysis concluded that political hierarchies complicate the support for a facility in the decision-making process once you want to go bottom-up (comparable to DOE's current consent-based siting process) because those approaches are critical for gaining community support, however, you also want to go top-down because that's the key to gaining state level support [14]. Opposition to hosting an SNF interim storage facility, particularly at the state level, seems to stem from a lack of trust in the federal government [14].[h] While questioning the DOE presenters, NWTRB members emphasized the importance of making both the international and domestic lessons learned reports available to the public and consent-based siting consortia and of thinking about the utility of the information for different audiences when designing new studies to allow all potential audiences to have access to the same information. NWTRB members also questioned DOE on the effectiveness of different forms of engagement in the different studies and how DOE would measure its own program effectiveness (e.g., assessing whether, and how well, consent-based siting consortia are addressing environmental justice issues) [14].[i]

The discussion with closing panelists highlighted the low levels of trust in government in the US (compared to countries like Sweden and Switzerland) that will make implementing a consent-based siting process in the US more difficult [14]. Panelists stressed the importance of key individuals in the siting process, and their continuity, to the success of the process (e.g., champions at each level of decision-making, the same well-respected scientist or engineer communicator interacting with all audiences and hiring locals for offices in communities involved in the siting process) [14]. A panelist noted that the placeholder durations of phases in DOE's siting process [9] seemed ambitious compared to the task of bringing a potential host community's capacity up to the point where informed decision making could occur. A DOE panelist asserted that the timeframe for siting an interim storage facility would not be as long as a repository (Figure 2; [24]) because it is less complex. The Swedish and Swiss panelists

[g] [Transcript, p. 211]. [Online]. Available: https://www.nwtrb.gov/docs/default-source/meetings/2023/august/usnwtrb-aug-29.pdf?sfvrsn=4. [Accessed Nov. 22, 2023].
[h] Transcript, pp. 213-214]. [Online]. Available: https://www.nwtrb.gov/docs/default-source/meetings/2023/august/usnwtrb-aug-29.pdf?sfvrsn=4. [Accessed Nov. 22, 2023].
[i] Each award recipient for a consent-based siting consortia will be a hub for community engagement and resources, reduce barriers for participation, increase outreach, allow for greater community engagement, and allow for cohort development (capacity building).

cautioned that siting an interim storage facility could take much longer than existing storage facilities that were sited without using a consent-based process and would take longer without siting criteria in place before engaging with potential host communities [9,14]. Panelists also noted the difficulty DOE faces for siting an interim storage facility without having a functioning disposal program [9,14].

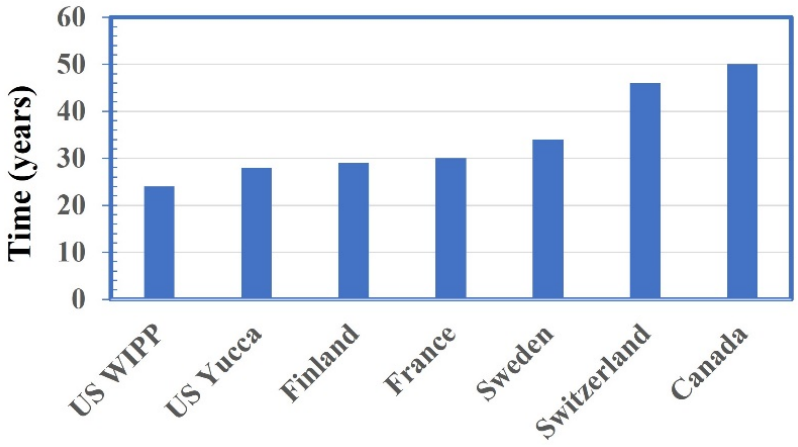

Figure 2. Total years prior to application for a repository.

DISCUSSION

DOE is making substantial progress in developing and implementing a consent-based siting program to develop and operate one or more federal interim storage facilities but faces substantial challenges. Under Congressional direction and support through appropriations in fiscal years 2021-2023, DOE has developed a consent-based siting process, awarded cooperative agreements with consent-based siting consortia, and conducted integrated waste management system R&D, including consent-based siting efforts addressing lessons learned from domestic examples and international radioactive waste management programs [9,13,14,22,23,25]. DOE's challenges include issues of trust, the lack of any funded disposal program, a legal framework that limits the possibility of success, and likely schedule pressures from Congress.

Issues of trust will challenge DOE's potential for success in using a consent-based siting approach to site, and then operate, a federal interim storage facility for commercial SNF. DOE acknowledges that it, as a distinct entity, is operating from a trust deficit [9,14]. If this was the only trust issue DOE faced, it is possible that with sustained efforts, consistent with its consent-based siting process and its recent efforts, DOE could become a trusted partner. Nevertheless, trust in DOE is inescapably tied to trust in the federal government. Trust in government (Congress and the Executive Branch) is lower in the US than in other countries that have implemented a consent-based siting process. A significant factor that adversely affects trust with Congress in dealing with radioactive waste management and disposal of SNF and HLW has been past actions Congress has taken, or not taken (e.g., not continuing funding the disposal program once a siting decision had been made but before licensing for a repository had been completed).

Congressional actions have affected past attempts to develop and implement a consent-based siting approach for radioactive waste management facilities. As Metlay [5] described it, "the failures included:

- Changing the Interagency Review Group's recommendation to use 'consultation and concurrence' in the siting process into 'consultation and cooperation' that was enacted in the Nuclear Waste Policy Act in 1982;
- Passage of the 1987 Nuclear Waste Policy Amendment Act that limited siting to Yucca Mountain; and
- Congress abolishing the Office of the Nuclear Waste Negotiator just as negotiations with the Mescalero Apache Tribe in New Mexico were moving forward" [5].

With this record of mistrust of DOE, Congress, and the Executive Branch, it is doubtful that DOE will find a willing host community and state, or host tribe and state, to consent to siting and operating a federal consolidated interim storage facility for commercial SNF.[j] Potential hosts would have little confidence that Congress would take action to start or restart a disposal program, which is commonly understood as a prerequisite for trusting that the SNF would eventually be removed from an interim storage facility [9,26].

The current US legal and regulatory framework, and policy decisions made under the Nuclear Waste Policy Act,[k] as amended, limit the possibility of success of a consent-based siting process leading to the operation of a federal consolidated interim storage facility for commercial SNF. The Energy Communities Alliance stated that "identifying and implementing final disposal paths for all waste streams is the largest impediment to completing the DOE mission" for cleanup of environmental management sites [27]. This same reason will also impede DOE's consent-based siting efforts for a federal storage facility (the commercial SNF also needs a permanent disposal solution). Both the Nuclear Waste Policy Act, as amended, in particular Subtitle C of Title I under which DOE is conducting its activities, and the NRC's licensing regulations[l] are constructed in a way that runs counter to a consent-based siting approach. The NRC licensing process for a federal consolidated interim storage facility and for a repository includes the opportunity for a contested adjudicatory proceeding. Under this framework, the affected units of local government, affected state and affected tribe, as defined in the Nuclear Waste Policy Act, as amended, would need to contest a technical or legal issue with the DOE license application to potentially become a part of the proceeding. DOE's current consent-based siting process does not envision the host community or tribe participating in the licensing process once the DOE application is submitted to NRC [9]. The NRC adjudicatory proceeding, a decision-making process, provides an additional opportunity for the potential host or tribe and state to be involved in the decision that impacts them, but only if they contest the DOE application after they have provided their consent.

Other aspects of the legal framework that are likely to impede DOE's, or any other federal entity's, efforts have been discussed by others [4,5,9,28]. For example, US federal agencies could not use techniques commonly used by private waste management organizations in other countries such as surveys or questionnaires because of restrictions from the Paperwork Reduction Act that effectively derailed DOE's earlier consent-based siting effort [28]. Any new federal organization would also inherit DOE's (US government) legal liabilities associated with performance under the standard contract.[m] These persistent institutional barriers inhibit the US ability to address the challenge of siting nuclear waste facilities more equitably.

Based on the lessons-learned data from siting programs, Metlay [5] strongly suggested that consent-based processes, which include but are not limited to voluntarism, will not necessarily culminate in a durable selection of a site. The design conditions that may increase the likelihood of a positive outcome are:

- Advancing a persuasive and technically defensible case for the safety of a country's disposal or storage concept prior to seeking a community's consent seems to increase the chances of its being gained [5].

[j] One only must look at the example of Private Fuel Storage, wherein the host tribe was thwarted after NRC licensing by determined state actions, to understand that states are key to the process of siting and operating a storage or disposal facility for SNF or HLW [5,21]. DOE recognizes the important role of states and tribes [9].

[k] On March 24, 2015, President Barack Obama issued a Presidential Memorandum with a finding that "the development of a repository for the disposal of HLW resulting from atomic energy defense activities only is required." This means two repositories must be developed: one for HLW resulting from atomic energy defense activities; and another for all other HLW and SNF. Neither repository program is funded.

[l] NRC. "Agency rules of practice." NRC.gov https://www.nrc.gov/reading-rm/doc-collections/cfr/part002/full-text.html (accessed Nov. 30, 2023).

[m] Federal liabilities for managing commercial SNF reflect the costs that owners and generators of this fuel have paid and are expected to pay in the future because DOE has not met its contractual obligations to begin disposing of the fuel.

- Institutional continuity and culture likely affect whether bonds of trust are formed between waste managers and potential host communities [5].
- Any consent-based process will likely struggle with the issue of how power is distributed among the central government on the one hand and regional/state/local governments on the other [5].

Some policymakers support the current DOE effort to use a consent-based siting process for siting a federal consolidated interim storage facility and recognize challenges under the Nuclear Waste Policy Act (e.g., changes might be required in the law) but at the same time are considering other changes (e.g., an accelerated pilot program using consent-based siting) that will speed up DOE's efforts to achieve consent from a host community, tribe, and state [29,30].[n] Other policymakers have signaled their intent to cut the current DOE efforts [31,32].[o]

CONCLUSIONS

The national capacity-building related to SNF and HLW management that DOE is accomplishing now through its consent-based siting process and its consent-based consortia could serve the nation well by preparing more people to support lasting legislative solutions that are needed to solve the nation's radioactive waste management and disposal conundrum. The challenges include the lack of a funded disposal program, a legal and regulatory framework that is inconsistent with a stated desire to use a consent-based siting approach for radioactive waste management facilities, a low level of trust in government that makes a consent-based siting approach wherein a federal agency is the implementer more difficult, and the desire to solve the problem quickly without recognizing the need for patience because national efforts to site and operate a radioactive waste facility are a decadal endeavor. Whether Congress and the Executive Branch take actions in the near term to address these challenges and provide DOE, or another implementing organization, the latitude and time (decades) to implement an integrated waste management system that addresses extended storage and disposal of HLW and SNF remains to be seen.

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