U.S. Nuclear Waste Technical Review Board

Technical Workshop on the Impacts of Dry-Storage Canister Designs on the Future Handling, Storage, Transportation, and Geologic Disposal of Spent Nuclear Fuel in the United States

Held in
Washington, DC
November 18–19, 2013

Summary of the Workshop and Issues Identified

March 2014

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1 Introduction

Following discharge from a nuclear reactor, "spent" nuclear fuel (SNF)[1] continues to generate heat, which decreases over time due to radioactive decay. Initially, nuclear power utilities store the SNF in water-filled pools at the nuclear power plant sites. Because the United States has no centralized storage facility or geologic repository for SNF, when these pools approach their licensed capacity most utilities transfer the older, cooler, SNF assemblies to large dry-storage canister systems. By doing this, they create space in the pools to accommodate subsequent discharges of SNF from continued reactor operation. To minimize the near-term economic and operational impacts of transferring SNF from pools to dry storage, nuclear utilities have worked with storage-system vendors to maximize the capacity of the dry-storage systems. However, these storage systems were not designed for disposal, and most dry-storage canisters in use at utility sites today exceed the size, weight, and/or heat-load limits for repository concepts that have been developed to date.

The design of the large dry-storage canisters used by utilities could have major implications for future SNF handling, storage, transportation, and disposal, as well as for the design and operation of a centralized interim storage facility, should one be constructed. Potential impacts include the following:

- Unless the large, dry-storage canisters being used by nuclear utilities can be directly disposed of in a geologic repository, the SNF they contain will need to be repackaged into disposal containers before emplacement in a repository.

- Repackaging SNF currently in dry-storage canisters at nuclear utility sites would significantly impact the SNF management system. For example, repackaging the SNF may be a lengthy process and could affect operational schedules at utility sites, at a consolidated storage facility, or at a repository, depending on where repackaging is performed. Repackaging the SNF also could involve extensive SNF assembly handling that could increase the potential for fuel damage and result in additional radiation exposure to workers although, as for all other operations, worker radiation exposures would be managed in accordance with the appropriate regulatory limits. Repackaging also could generate a large volume of low-level waste that would require disposal.

- Because of the large size and high-heat output of the dry-storage canisters currently in use, direct disposal of the canisters might increase the degree of reliance on engineered barriers in the design of a repository. Direct disposal of the canisters also could increase the complexity of retrieval operations, if required, and may limit the geologic environments considered suitable for siting a repository for disposal of SNF.

On November 18 and 19, 2013, the U.S. Nuclear Waste Technical Review Board (Board or NWTRB) held a workshop in Washington, DC, to explore the impacts of dry-storage canister designs currently in use on the future handling, storage, transportation, and geologic disposal of

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[1] The term "spent nuclear fuel," as used in this report, has the same meaning as the term "used nuclear fuel."

SNF in the United States. The primary objectives of the workshop were to identify and record potential technical issues that would be associated with (1) the repackaging of SNF from large dry-storage canisters into different containers for transport and/or disposal and (2) the direct disposal of the large dry-storage canisters currently used by nuclear utilities in a deep geologic repository. More than 120 people attended the workshop, representing a broad cross-section of interests. Participants came from the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), other agencies of the U.S. government, the U.S. national laboratories, the U.S. nuclear industry and nuclear companies in other countries, affected and interested groups and non-government organizations, the media, and the general public.

This paper describes the format of the workshop and summarizes issues raised at the workshop, without taking a position on them. It is intended to stimulate further discussion and comment. All workshop documents, including the agenda, presentations, and documents submitted for the record during and after the workshop are available on the Board's website at http://www.nwtrb.gov/meetings/meetings.html. Additional comments received by the Board as follow-up to the workshop will be added to the website.

The issues that are identified in this paper are those of the meeting participants as recorded by the Board, but do not necessarily reflect the views of the Board. The Board's findings on a broad-range of issues related to topics discussed at the workshop will be included in a Board report scheduled for release later in 2014.

2 Workshop Format and Presentations

The workshop began at 1:00 p.m. on Monday, November 18, 2013, and continued at 8:00 a.m. on Tuesday, November 19, 2013. The workshop agenda is provided in Appendix A.

During the first afternoon of the workshop, Dr. Peter Lyons, DOE Assistant Secretary for Nuclear Energy, and Dr. Allison Macfarlane, Chairman of the NRC, gave their perspectives on the importance of addressing the impacts on the SNF management system of dry-storage canister designs. The afternoon's agenda also included presentations by Mr. Jeffrey Williams on the types, sizes, and numbers of dry-storage canisters currently in use at nuclear power plant sites; Mr. Robert Howard on the technical implications of repackaging SNF; and Dr. Evaristo J. (Tito) Bonano on potential concepts for directly disposing of large dry-storage canisters in a deep geologic repository. Dr. Thilo von Berlepsch of DBE Technology, GmbH, a German company involved in developing the German repository program, also presented his perspectives on the implications of repackaging and direct disposal of SNF based on research and development work undertaken in Germany.

The six presentations are listed below, in the order in which they were presented:

- "Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," by Dr. Peter Lyons, DOE Assistant Secretary for Nuclear Energy. The presentation can be found at http://www.nwtrb.gov/meetings/2013/nov/lyons.pdf.

- "NWTRB Workshop – Inventory," by Mr. Jeffrey Williams, Director, DOE Nuclear Fuels Storage and Transportation Planning Project. The presentation can be found at http://www.nwtrb.gov/meetings/2013/nov/williams.pdf.

- "Implications of Repackaging Used Nuclear Fuel," by Mr. Robert Howard, Project Manager, Oak Ridge National Laboratory. The presentation can be found at http://www.nwtrb.gov/meetings/2013/nov/howard.pdf.

- "Preliminary Technical Evaluation of Dual-Purpose Canister Direct Disposal Alternatives," by Dr. Evaristo Bonano, Senior Manager, Sandia National Laboratories. The presentation can be found at http://www.nwtrb.gov/meetings/2013/nov/bonano.pdf.

- "International Perspectives on the Impacts of the Design of the Spent Fuel Management Programme on Spent Fuel Handling, Transportation and Disposal," by Dr. Thilo von Berlepsch, International Cooperation Department, DBE Technology GmbH. The presentation can be found at http://www.nwtrb.gov/meetings/2013/nov/von%20Berlepsch.pdf.

- "Regulatory Perspectives on Spent Fuel Management," by Dr. Allison Macfarlane, Chairman, Nuclear Regulatory Commission. The presentation can be found at http://www.nwtrb.gov/meetings/2013/nov/macfarlane.pdf .

On the morning of the second day, two concurrent breakout sessions were held to allow extensive discussion of issues that could impact future handling, storage, transportation, and disposal of SNF, depending on whether the SNF is repackaged for disposal or the dry-storage canisters currently in use at utility sites are disposed of directly. Introductory statements on relevant issues were made in each breakout session by a representative of the nuclear industry and by a representative of a non-governmental organization without ties to the nuclear industry.

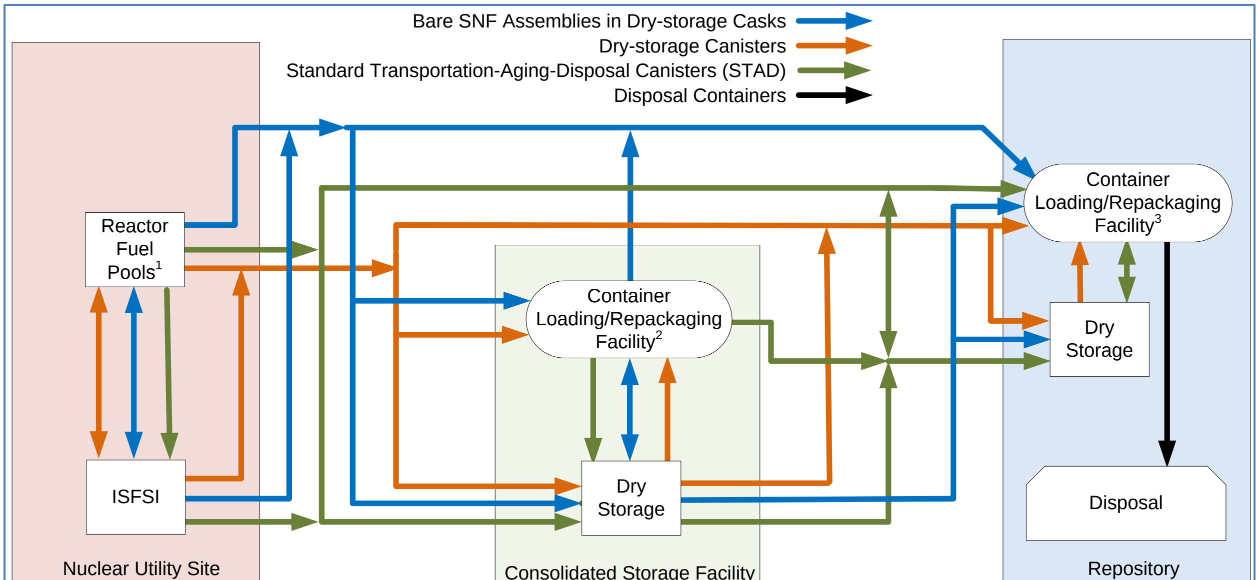
During the afternoon of the second day, a plenary session was held, during which the outcomes of the breakout sessions were summarized. A final comment session for meeting participants and attendees closed out the workshop.

2.1 Workshop Breakout Sessions

The concurrent breakout sessions were intended to identify issues associated with two approaches to SNF management: (1) repackaging SNF from large dry-storage canisters into smaller-capacity, lower-heat output containers and (2) directly disposing of the large dry-storage canisters currently in use at utility sites in a deep geologic repository. In advance of the workshop, the Board developed material flow paths and interaction matrices to help focus the discussion on (1) issues that may arise at each operational stage of the SNF management system and following disposal, and (2) issues that may arise because of interactions between the different operational stages and the implications for the performance of geologic disposal systems.

Potential material flow paths, from initial transfer of SNF assemblies from a reactor to a SNF pool and on to final emplacement in a repository, were used to (1) identify the SNF management activities that could occur at different points in the SNF management system, including at the reactor site, at a potential consolidated storage facility, and at a deep geologic repository, and (2) identify where and how the movement of SNF between each of these points could occur.

The potential material flow paths discussed in the two breakout sessions are shown in Figures 1 and 2. These two figures depict the movement of SNF within a nuclear utility site (light orange box on the left), consolidated storage facility (light green box in the middle), and geologic repository (light blue box on the right), as well as transportation between facilities (arrows between colored boxes). In each figure, colored lines are used to identify the types of storage systems used to store SNF at an independent spent fuel storage installation (ISFSI) on a nuclear utility site and potentially at a consolidated storage facility, the types of containers used for transportation and disposal, and the pathways for SNF movement between the different facilities.



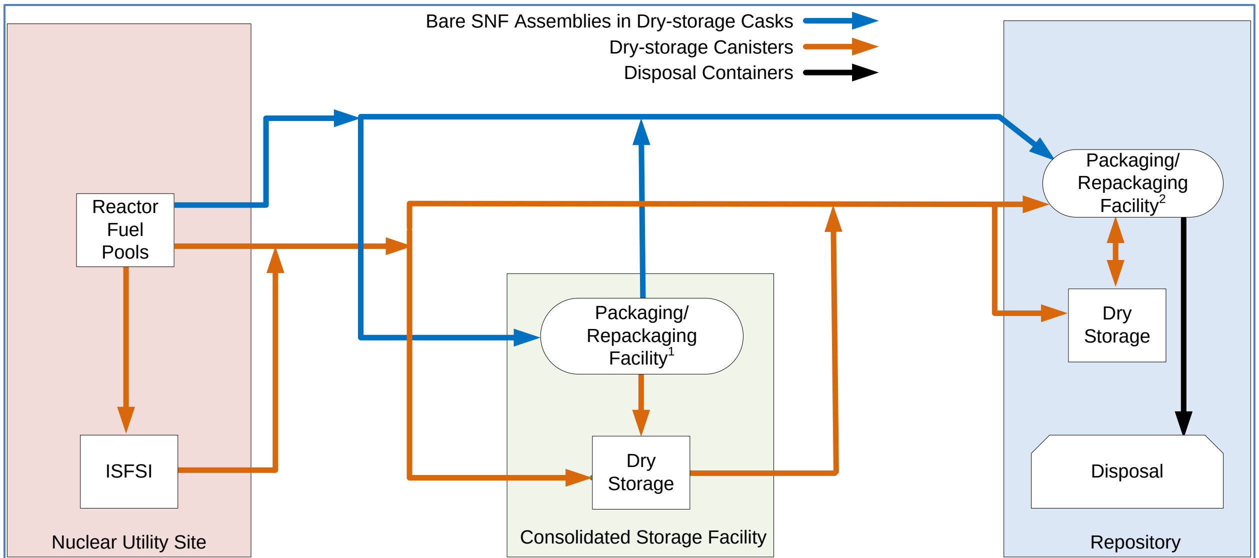
General Notes:

- All arrows outside the shaded facility boxes represent transportation operations.
- There are some dry-storage casks at utility sites that contain bare SNF assemblies which can be loaded into STADs at the utility site, Consolidated Storage Facility, or Repository; or loaded into disposal containers at the repository.

Footnotes:

1. Utility fuel pools can be used to transfer SNF assemblies from a dry-storage canister or dry-storage cask to STADs or dry-storage cask into a STAD or disposal container, if the disposal container is transportable .
2. The Container Loading/Repackaging Facility at the Consolidated Storage Facility can be used to transfer bare SNF assemblies or SNF assemblies in a dry-storage canister to STADs.
3. The Canister Loading/Repackaging Facility at the Repository can be used to transfer bare SNF assemblies or SNF assemblies in a dry-storage cask or dry-storage canister into a STAD or disposal container, or load a STAD into a disposal container.

Figure 1. Breakout Session 1 – Flow Paths if SNF is Repackaged



General Notes:

- All arrows outside the shaded facility boxes represent transportation operations.
- There are some dry-storage casks at utility sites that contain bare SNF assemblies which can be transferred into a canister at the utility site, Consolidated Storage Facility, or Repository; or directly into a disposal container at the repository.

Footnotes:

1. The Container Loading Facility at the Consolidated Storage Facility can be used to transfer bare SNF assemblies from a dry-storage cask into a dry-storage canister or disposal container, if the disposal container is transportable.
2. The Container Loading Facility at the Repository can be used to transfer bare SNF assemblies from a dry-storage cask into a dry-storage canister or disposal container or a dry-storage canister into a disposal container.

Figure 2. Breakout Session 2 – Flow Paths for Direct Disposal

For each breakout session, Board staff also developed an interaction matrix to represent steps in the SNF management system. The matrices are shown in Figures 3 and 4. They were intended to ensure that systematic consideration was given to the potential impacts of dry-storage canister designs on all aspects of the SNF management program. The main operational stages are shown along the leading diagonal of the interaction matrix, with the initial status of the SNF in the upper left corner. The interactions between the main operational stages are associated with the off diagonal cells in the matrices. Interactions can be forward (to the right along a row away from one operational stage on the leading diagonal and down to another operational stage on the leading diagonal) or backward (to the left along a row away from one operational stage on the leading diagonal and up to another operational stage on the leading diagonal). The interaction matrices were used in this way to systematically identify issues and interactions between the operational stages of the SNF management system.

	Nuclear Utility Site[1]					Consolidated Storage			Repository		
	A	B	C	D	E	F	G	H	I	J	K
1	**SNF in Fuel Pool**										
2		**Canister Loading**									
3			**ISFSI**								
4				**Repackaging[2]**							
5					**Transport[3]**						
6						**Storage**					
7							**Container Loading/ Repackaging**				
8								**Transport**			
9									**Storage**		
10										**Container Loading/ Repackaging**	
11											**Disposal**

Footnotes:
1. Before the fuel handling and fuel pool facilities are decommissioned.
2. If the plant fuel pool has been decommissioned, repackaging would require a temporary fuel pool or dry transfer facility
3. If dry-storage canisters do not meet the transportation requirements the canisters may need to be repackaged prior to transporting

Figure 3. Session 1 Interaction Matrix – Implications of Repackaging

	Nuclear Utility Site[1]					Consolidated Storage			Repository		
	A	B	C	D	E	F	G	H	I	J	K
1	**SNF in Fuel Pool**										
2		**Canister Loading**									
3			**ISFSI**								
4				**Repackaging[2] For Transportation**							
5					**Transport[3]**						
6						**Storage**					
7							**Loading into Disposal Overpack**				
8								**Transport**			
9									**Storage**		
10										**Loading into Disposal Overpack**	
11											**Disposal**

Footnotes:
1. Before the fuel handling and fuel pool facilities are decommissioned.
2. If the plant fuel pool has been decommissioned, repackaging would require a temporary fuel pool or dry transfer facility
3. If dry-storage canisters do not meet the transportation requirements the canisters may need to be repackaged prior to transporting

Figure 4. Session 2 Interaction Matrix – Implications of Direct Disposal

Together, the material flow diagrams and the interaction matrices were intended to help workshop participants identify issues that could impact the SNF management system by showing the types of containers (casks, canisters, etc.) potentially in use at different operational stages of the SNF management system, along with possible interactions between these operational stages. For example, the issues that arise in a particular interaction (e.g., how the dry-storage canister design used at a reactor site affects the transport of SNF to a consolidated storage facility) could differ depending on whether fuel is stored as bare fuel assemblies in bolted casks or in welded canisters.

The primary objective of the workshop was to hear from the participants and, consequently, the discussion was not limited to technical issues. As a result, the points raised during the breakout sessions included many general comments and observations as well as technical issues related specifically to the elements of the two interaction matrices. Two Board members in each session served as rapporteurs to record the main points, which were discussed during the afternoon plenary session. These main points are recorded, along with additional comments made during the plenary, in the following section.

3 Comments and Issues Identified by Workshop Participants

This section records issues identified by workshop participants during the two breakout sessions and the plenary session on the final day of the workshop. *The issues identified are those of the meeting participants as recorded by the Board, but do not necessarily reflect the views of the Board.* The Board's findings on a broad-range of issues related to the topics discussed at the workshop will be included in a Board report scheduled for release later in 2014.

Issues and comments common to both repackaging and direct disposal of dry-storage canisters are summarized in Section 3.1, issues and comments associated only with repackaging are summarized in Section 3.2, and issues and comments associated only with direct disposal of dry-storage canisters are summarized in Section 3.3. Under each heading, the issues are organized in three categories: General; Programmatic or Regulatory; and Scientific, Engineering, and Operational.

A complete record of comments made by workshop participants can be found in the transcripts of the workshop on the Board's website at
http://www.nwtrb.gov/meetings/2013/nov/13nov18.pdf. and
http://www.nwtrb.gov/meetings/2013/nov/13nov19.pdf.

3.1 Issues Associated with both Repackaging and Direct Disposal

3.1.1 General Issues

- Among the non-technical issues that will affect all stages of SNF management are:
  - Need for public input/consultation
  - Time required and potential impact on program schedules
  - Costs
  - Safety
  - Security

- Introduction of new dry-storage canister designs could improve the overall efficiency of the backend of the nuclear fuel cycle.
  - Currently, over 1,700 dry-storage systems of several different designs have been loaded with SNF.
  - Future canister-system designs could be standardized and used for storage, transportation, and disposal, which would eliminate the need for repackaging SNF. The extent to which repackaging could be avoided would depend, in part, on when a standard canister design is introduced.

- Because of actions already taken, over time, SNF may follow different paths from reactors to eventual disposal. The backend of the nuclear fuel cycle may include a combination of repackaging of some dry-storage canisters and direct disposal of others.

- Without a repository or consolidated storage facility for SNF, utilities do not have the option of taking into account the impacts of their storage decisions on the SNF management system and are currently making decisions about dry storage of SNF on a site-specific basis. The nation's strategy for managing SNF would benefit from a more comprehensive "end-to-end" systems approach to decision-making.

- SNF management issues are becoming more complex over time because of the introduction of new fuel and canister designs, new materials, and increased burnups of the SNF being loaded into dry-storage canisters at utility sites.

- It will be necessary to make provision for disruptions in the transportation system that would prevent moving SNF off utility sites.

- It also will be necessary to make provision for responding to a situation in which the storage license for a dry-storage canister or a facility reaches expiration, but the canister or facility does not meet the regulatory requirements for renewal of the license.

- The design of new fuel and its irradiation history during reactor operations could have significant implications for the management of SNF.

- When large numbers of reactors shut down in the future, sufficient fabrication capacity and infrastructure will be necessary to produce the numbers of storage systems needed to off-load SNF to dry-storage.

3.1.2 Programmatic and Regulatory Issues

- The regulatory requirements for storage, transportation, and disposal were not developed systematically and this will have implications for the SNF management program. For example, the regulatory requirements for SNF storage do not require that criticality calculations take account of the possibility that the canister may become flooded with water, while the regulatory requirements for SNF transportation do require that criticality calculations take account of the possibility that the canister may become flooded with water.

- In moving forward with a program for SNF management, uncertainties in policy and strategy may be as challenging as technical uncertainties.

- Storage regulations were based initially on the assumption that SNF would be in dry-storage at nuclear power plants for 20 to 40 years. It is now clear that SNF will need to be stored at nuclear power plant sites for much longer periods and it is possible that some fuel will need to be repackaged because of changes in the condition of the SNF or the storage canisters, even if the design of the storage canisters would meet the regulatory requirements for transportation and disposal.

- The possibility of fuel damage during transportation may limit the ability to retrieve spent fuel assemblies from a canister after transportation.

3.1.3 Scientific, Engineering, and Operational Issues

- The wide range of cask and canister designs in use today makes all downstream operations more complex and costly and complicates emergency response planning.

- The primary mode selected to transport SNF in the future might impact decisions related to the size and types of containers that are used for SNF storage and for transporting the SNF from the site.

- Upgrades to the transportation infrastructure, particularly in the vicinity of some nuclear utility sites, may be necessary to support the SNF management program and this may have implications for the sizes of canisters/containers that could be transported from those sites.

- The implications of delays associated with implementing each stage of the SNF management system for other parts of the system cannot be defined at this time but may be significant.

- SNF assemblies with cladding defects and SNF assemblies with mechanical damage that prevents them being handled using standard refueling equipment may not all be managed the same way at different utility sites. Differences in management may include whether or not they are inserted into single-assembly canisters prior to loading into dry-storage canisters for long-term storage and, if so, the type of single-assembly canisters that are used. Such decisions may have implications for whether or not it will be necessary to repackage the SNF from dry-storage canisters containing these assemblies prior to transportation or disposal.

- The potential for degradation of high-burnup fuel in long-term storage is not well understood, which could make it difficult to meet the requirements for the transport, and disposal of high-burnup fuel.

- Data-management systems need to be put in place to track the history of each fuel assembly through all stages of the back-end of the fuel cycle.

3.2 Issues Associated with Repackaging

3.2.1 General Issues

- It is not clear what organization(s) would be responsible for performing repackaging of SNF, if it becomes necessary.

3.2.2 Programmatic and Regulatory Issues

- It is unclear under which NRC regulations repackaging at a shutdown utility site or consolidated storage facility would be licensed.

3.2.3 Scientific, Engineering, and Operational Issues

- Repackaging SNF from existing dry-storage canisters would be a complicated process with many potential material flow paths and options.

- If repackaging is needed, a detailed evaluation of the relative merits of dry and wet repackaging would be necessary as the basis for determining which one should be used.

- Decisions about when and where to repackage (e.g., utility site, consolidated storage facility, or repository) would need to be taken into account in determining the scope of operations to be performed at a consolidated storage facility.

- Repackaging of SNF from dry-storage canisters at a utility site prior to final reactor shutdown would impact utility operating costs, personnel radiation exposure, and utility outage schedules.

- Repackaging of SNF from dry-storage canisters at a utility site following final reactor shutdown may present particular problems depending on what facilities and infrastructure remain available at these sites.

- Because dry-storage canisters have complex internal structures, and because access to all parts of the internal structure of a canister may not be possible, verification that no SNF particles or irradiated material remains inside a canister will be difficult. This raises questions about whether empty canisters can be disposed of as LLW.

- The potential for degradation of canister materials and SNF during storage could impact transportation, repackaging, and disposal requirements.

3.3 Issues Associated with Direct Disposal

3.3.1 General Issues

- Direct disposal of dry-storage canisters could eliminate the need to repackage SNF, thus avoiding the potential for additional worker radiation exposure associated with repackaging. However, direct disposal of the large dry-storage canisters in use today could make the design and operation of a future repository more difficult.

- Geologic repository designs in other countries utilize disposal containers that are significantly smaller than the dry-storage canisters being used by U.S. utilities. The lower heat output from these containers reduces the impact of the early thermal pulse on the corrosion rate of disposal containers and the degradation of the backfill and the near-field host rock compared with the impact of the thermal pulse that would result from direct disposal of large dry-storage canisters. An evaluation of the potential advantages of applying this approach in the United States could be useful input to decisions related to the siting and design of a geologic repository.

3.3.2 Programmatic and Regulatory Issues

- Waiting until geologic disposal requirements are defined would allow storage-system designs to be optimized, taking account of the operational requirements and other interests of the utilities, the receipt and disposal responsibilities of DOE, and the appropriate regulatory requirements.

- Alternately, decisions regarding dry-storage canister designs could be made today to accommodate a range of potential regulatory requirements for geologic disposal.

3.3.3 Scientific, Engineering, and Operational Issues

- Direct disposal of large dry-storage canisters raises several technical issues, associated with:
  - Size and weight of the canisters (e.g., large, heavy canisters will be more difficult to handle and may limit the ability to move the canisters into the repository via a hoist)
  - Thermal effects on the near-field environment (e.g., degradation of backfill and the host rock in the immediate vicinity of the canisters, and changes to the geochemistry and hydrology)
  - Risk of criticality (e.g., dry-storage canister not meeting long-term criticality control requirements due to corrosion and loss of the neutron absorber material)
  - Stability of the host rock (e.g., direct disposal of large dry-storage canisters would require larger drift diameters, which could increase the risk of rock fall with the potential for compromising the integrity of the canisters)

4 Acronyms and Abbreviations

Board	U.S. Nuclear Waste Technical Review Board
DOE	U.S. Department of Energy
ISFSI	Independent Spent Fuel Storage Installation
NRC	U.S. Nuclear Regulatory Commission
NWTRB	U.S. Nuclear Waste Technical Review Board
SNF	Spent Nuclear Fuel

Appendix A—Workshop Agenda

Technical Workshop on the Impacts of Dry-Storage Canister Designs on Future Handling, Storage, Transportation and Geologic Disposal of Spent Nuclear Fuel in the United States

Embassy Suites
1250 22nd Street, NW
Washington, DC 20037
(202) 857-3388

Agenda

Monday November 18, 2013

1:00 pm: **Call to order and introductory statement**
Dr. Rod Ewing, Board Chairman

1:15 pm: **DOE remarks**
Dr. Peter Lyons, DOE Assistant Secretary for Nuclear Energy

1:45 pm: *Open Discussion*

2:00 pm **Present U.S dry-storage system designs and projected inventory**
Mr. Jeffrey Williams, DOE Director, Nuclear Fuels Storage and Transportation Planning Project

2:30 pm: **Implications of repackaging spent nuclear fuel from large dry-storage systems into smaller packages for transport or disposal.**
Mr. Robert Howard, Project Manager Oak Ridge National Laboratory

3:00 pm: *Open Discussion*

3:15 pm: **BREAK**

3:30 pm **Implications of direct disposal of large dry-storage system designs for repository design**
Dr. Evaristo J. (Tito) Bonano, Senior Manager, Sandia National Laboratories

4:00 pm: *Open Discussion*

4:15 pm: **International perspective**
Dr. Thilo von Berlepsch, International Cooperation Department, DBE Technology, GmbH.

4:45 pm: *Open Discussion*

5:00 pm: **NRC remarks**
Dr. Allison M. Macfarlane, Chairman, U.S. Nuclear Regulatory Commission

5:30 pm: *Open Discussion*

5:45 pm: **ADJOURN**

<u>Tuesday November 19, 2013</u>

8:00 am: **Call to order and observations from the first day**
Dr. Rod Ewing, Board Chairman

8:15 am: **Logistics for the second day and framework for the breakout sessions.**
Mr. Nigel Mote, Board Executive Director

8:45 am: *Open Discussion*

9:00 am: **Breakout sessions**

<u>Session 1</u>

Facilitated open discussion of the implications of repackaging SNF for transport or disposal

<u>Facilitator</u>: *Mr. Rick Daniel,* Cool Landing Facilitating
<u>Rapporteurs</u>: *Dr. Lee Peddicord and Dr. Paul Turinsky,* Board Members
<u>Opening industry perspective</u>: *Mr. Adam Levin,* AHL Consulting
<u>Opening NGO perspective</u>: *Dr. Marvin Resnikoff,* Radioactive Waste Management Associates

<u>Session 2</u>

Facilitated open discussion of the implications of direct disposal of large dry-storage canisters

<u>Facilitator</u>: *Dr. Bret Leslie,* Board Senior Professional Staff
<u>Rapporteurs</u>: *Dr. Sue Clark and Dr. Jerry Frankel,* Board Members
<u>Opening industry perspective</u>: *Dr. Andrew Sowder*, Electric Power Research Institute
<u>Opening NGO perspective</u>: *Ms. Beatrice Brailsford*, Snake River Alliance

12:00 pm: **LUNCH**

1:30 pm: **Report on issues identified in Breakout Session 1**
Presentation on the Implications of Repackaging SNF for Transportation or Disposal
Rapporteur from Breakout Session 1 (Dr. Lee Peddicord, Board Member*)*

2:15 pm: *Facilitated Open Discussion*

2:30 pm: **Report on issues identified in Breakout Session 2**
Presentation on the Implications of Direct Disposal of Large Dry-Storage Canisters
Rapporteur from Breakout Session 2 (Dr. Jerry Frankel, Board Member*)*

3:15 pm: *Facilitated Open Discussion*

3:30 pm: **BREAK**

4:00 pm: **Take aways from workshop**
Mr. Nigel Mote, Board Executive Director

4:45 pm: **Open discussion**
Moderated by: *Dr. Rod Ewing*, Board Chairman

5:00 pm: **ADJOURN**