DOE Request for Information on Private Initiatives to Develop Consolidated Interim Storage Facilities

PURPOSE

The U.S. Department of Energy (DOE) requests information regarding private initiatives (PI) for making consolidated interim storage facility (ISF) services available to DOE for spent nuclear fuel (SNF) storage, whether a pilot-scale or larger-scale facility. DOE believes that potential host/neighboring communities, potential ISF operators and existing nuclear waste facility operators, among others, may be interested in responding to this RFI.

BACKGROUND

In 2010, the Secretary of Energy chartered the Blue Ribbon Commission (BRC) on America's Nuclear Future to conduct a comprehensive review and recommend a plan of action for the management and disposal of the nation's used nuclear fuel and high-level radioactive waste. In January of 2012, the BRC issued a Report to the Secretary of Energy, which included a number of recommendations. In January 2013, the Administration released its Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, which serves as a statement of Administration policy regarding the importance of addressing the disposition of used nuclear fuel (also referred to as spent nuclear fuel) and high-level radioactive waste; lays out the overall design of an integrated system to address the issue; outlines the reforms needed to implement such a system; and represents the Administration's response to the BRC recommendations. This Strategy includes the siting, licensing, constructing and operating of facilities for consolidated interim storage.

Consistent with the Strategy, the Department is planning an integrated waste management system to transport, store, and dispose of our nation's spent nuclear fuel and high-level radioactive waste. Such an integrated waste management system would include facilities and other key infrastructure needed to safely manage spent nuclear fuel from commercial electricity generation. The Department envisions an integrated waste management system that may include (among other elements): pilot interim storage facilities, initially focused on accepting spent nuclear fuel from shutdown reactor sites; and full-scale, consolidated interim storage facilities that provide greater capacity and flexibility within the waste management system.

The Department is aware that PIs to develop interim storage facilities, that could provide the Department with spent nuclear fuel interim storage services, are in various stages of development. Although not envisioned in the Administration's Strategy, PIs represent a potentially promising alternative that can be used either solely or in addition to federal facilities

for consolidated interim storage. We therefore are issuing this RFI to seek input on key questions related to the role PIs could play in an integrated waste management system.

REQUEST FOR INFORMATION

DOE seeks information on PIs for a consolidated ISF, whether pilot-scale or larger-scale, as an alternative or in addition to federal facilities sited using a consent based siting process. In particular, DOE seeks information in the following areas (all questions do not need to be addressed by prospective respondents):

1. What key factors should be considered to ensure that PIs, as part of the overall integrated nuclear waste management system, would provide a workable solution for interim storage of spent nuclear fuel and high-level waste?

2. How could a PI benefit:

   a. the local community and state or Tribe in which an ISF is sited?

   b. neighboring communities?

3. What type of involvement if any should the Department or other federal agency consider having with the PI and the community regarding organizational, structural, and contractual frameworks and why?

4. What are the benefits and drawbacks of a PI, compared to a federally-financed capital project resulting in a government-owned contractor-operated (GOCO) interim storage facility?

5. What assurances to the Government do you think would be appropriate, to ensure that SNF stored at a private ISF, would be managed effectively so as to contain costs to the Government?

6. What possibilities are there with respect to business models for a PI, and what are the benefits and disadvantages of those models?

7. How could a PI manage liabilities that might arise during the storage period?

8. What state/local/tribal authorizations/approvals would be needed?

9. How can the Government continue to explore or implement the PI concept in a fair, open and transparent manner going forward?

10. What, if any, supporting agreements might be expected between the Government and the host state/tribe/local community associated with a PI?

11. What other considerations should be taken into account?

12. Are there any alternative approaches to developing non-federally-owned facilities that might be proposed (e.g. how projects would be financed, anticipated regulatory and legal issues, etc.). If so, what are they, are there proposed solution, and how would the above questions be answered with respect to such approaches?

RESPONSE PREPARATION AND TRANSMITTAL INSTRUCTIONS

Responses to this RFI are due by January 27, 2017, shall be sent by email to the mailbox *PrivateISF@hq.doe.gov* and shall include the subject line "Response to RFI on Private Initiatives to Develop Consolidated SNF Storage Facilities". The responses shall be in Microsoft Word, Microsoft PowerPoint, or Portable Data Format (PDF) readable by Adobe Acrobat software and should be limited to approximately 15 pages.

DOE intends to make the responses submitted to this RFI publicly available in their entirety. Therefore, DOE recommends that respondents do not include any business sensitive, proprietary, or otherwise privileged information (Confidential Business Data or CBI), or any personally identifiable information (PII) such as personal email or phone numbers, in their submission. Responses to this RFI will be automatically posted and made publicly available; DOE will not review submissions for any CBI or PII so it is the respondents' responsibility to ensure no such information is submitted.

If a respondent would like to respond with information that contains potential CBI or PII, they may do so by submitting responses to *PrivateISF_Sensitive@hq.doe.gov*. Responses are subject to disclosure statutes such as the Freedom of Information Act. As such, the respondent should clearly identify any CBI or PII and indicate the rationale why such information should not be released. For further details on DOE's treatment of potential CBI that is subject to a FOIA request, see 10 CFR 1004.11 and 5 U.S.C. 552 (b) (4).

Respondents may be provided the opportunity to make a presentation (no longer than 90 minutes in duration including question & answer time) regarding their submitted response at DOE Headquarters, at DOE's discretion. Respondents desiring to make an on-site presentation are asked to make their request known with their submittal to this RFI. Presentations are likely to be conducted during early 2017. Respondents who wish to make a presentation at DOE Headquarters should prepare a presentation package of no more than 20 slides, and provide 15 hardcopies to session participants at the presentation (if a presentation is elected). An electronic version (PDF) of the briefing shall be sent by email to the POC one day prior to the presentation.

Any files transmitted in response to this RFI which contain a virus will not be opened.

POINT OF CONTACT

The Point of Contact (POC) for this RFI is Mr. Andrew Griffith, DOE Office of Nuclear Energy.

Questions concerning this RFI may be emailed to *PrivateISF@hq.doe.gov*. Please include in the subject line "Question on RFI on Private Initiatives to Develop Consolidated SNF Storage Facilities".

This RFI does not obligate the U.S. Government to any future procurement. Responses that are received will not be returned, and will be disposed of after reviews of the responses are completed. DOE has no current procurement or acquisition requirement, and information received will not be used to award contracts. DOE will not reimburse or otherwise compensate for any costs associated with the submission of information. DOE will utilize information received from this RFI to assist in planning efforts for an integrated waste management system.

Thank you in advance for your input, and we look forward to receiving your response.

DEPARTMENT OF ENERGY

Office of Nuclear Energy

Request for Information on Approaches Involving Private Initiatives for Consolidated Interim Storage Facilities

AGENCY: Spent Fuel and Waste Disposition, Office of Nuclear Energy, Department of Energy.

ACTION: Notice of availability and request for information.

SUMMARY: The U.S. Department of Energy (DOE), Office of Nuclear Energy, released on its website a Request for Information (RFI) on Private Initiatives (PIs) for Consolidated Interim Storage Facilities. The purpose of the RFI is to gather input on the role of PIs for private consolidated interim storage facilities (ISF) services as part of an integrated waste management system.

DATES: Written comments and information are requested on or before January 27, 2017.

ADDRESSES: Interested parties are to submit requested information by any of the following methods:

Email: Responses may be provided by email to *PrivateISF@hq.doe.gov*.

Mail: Responses may be provided by mail to the following address: U.S. Department of Energy, Office of Nuclear Energy, Response to RFI on Private Initiatives to Develop Consolidated SNF Storage Facilities, 1000 Independence Ave S.W., Washington, DC 20585.

Fax: Responses may be faxed to 202-586-0544. Please include "Response to RFI on Private Initiatives to Develop Consolidated SNF Storage Facilities" on the fax cover page.

Online: Responses will be accepted online at www.regulations.gov.

Instructions: All submissions received are to include "Response to RFI on Private Initiatives to Develop Consolidated SNF Storage Facilities" in the subject of the message. The complete RFI, including the additional instructions, can be found at www.energy.gov/ne/downloads/Private-ISF.

FOR FURTHER INFORMATION CONTACT: Requests for further information should be sent to Mr. Andrew Griffith via *PrivateISF@hq.doe.gov*.

SUPPLEMENTARY INFORMATION:

Since the Administration's Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste was issued, PIs for interim storage facilities that could provide DOE or utilities with consolidated SNF interim storage services are in various stages of development. PIs, although were not envisioned in the Administration's Strategy, represent a potentially promising alternative to federal facilities for consolidated interim storage. The RFI seeks input on key questions related to the role PFIs could play in an integrated waste

management system. The RFI is available on the DOE-NE Web site at: www.energy.gov/ne/downloads/Private-ISF.

The DOE Office of Nuclear Energy invites all interested parties to submit in writing by January 27, 2017, comments and information on matters addressed in the notice.

Submitting Comments

Instructions: Submit comments via any of the mechanisms set forth in the **ADDRESSES** section.

DOE intends to make the responses submitted to this RFI publicly available in their entirety. Therefore, DOE recommends that respondents do not include any business sensitive, proprietary, or otherwise privileged information (Confidential Business Data or CBI), or any personally identifiable information (PII) such as personal email or phone numbers, in their submission. Responses to this RFI will be automatically posted and made publicly available; DOE will not review submissions for any CBI or PII so it is the respondents' responsibility to ensure no such information is submitted.

If a respondent would like to respond with information that contains potential CBI or PII, they may do so by submitting responses to *privateISF_Sensitive@hq.doe.gov*. Responses are subject to disclosure statutes such as the Freedom of Information Act. As such, the respondent should clearly identify any CBI or PII and indicate the rationale why such information should not be released. For further details on DOE's treatment of potential CBI that is subject to a FOIA request, see 10 CFR 1004.11 and 5 U.S.C. 552 (b)(4).

NUCLEAR WASTE

DOE, Navy to build $1.6B storage site for spent warship fuel

Published: Wednesday, December 7, 2016

The Energy Department and the Navy announced yesterday the construction of a $1.65 billion facility in Idaho that will store waste from the country's nuclear warship fleet.

The plant is necessary to keep nuclear-powered submarines and aircraft carriers running, officials said.

The storage unit will be built at DOE's Naval Reactors complex that covers 890 square miles across southeastern Idaho's sagebrush steppe.

"This action will provide the infrastructure necessary to support the naval nuclear reactor defueling and refueling schedules to meet the operational needs of the U.S. Navy," DOE said.

Construction is slated to start in 2019, with the facility opening in late 2024.

The facility will submerge fuel waste in water for six years to cool it before moving it to dry storage tanks.

"Appropriate security will be provided for the new facility," said Don Dahl, Naval Reactors spokesman.

Idaho entered an agreement with the federal government in 1995 to remove most nuclear waste from the Naval Reactors site by 2035. The agreement applies to the new facility, meaning that once fuel cools, it will have to be shipped out of Idaho.

But the United States currently has no dry nuclear fuel repository (Keith Ridler, ***AP/Albuquerque Journal***, Dec. 6). **— GD**

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AUTHENTICATED
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115TH CONGRESS
1ST SESSION

H. R. 474

To amend the Nuclear Waste Policy Act of 1982 to authorize the Secretary of Energy to enter into contracts for the storage of certain high-level radioactive waste and spent nuclear fuel, take title to certain high-level radioactive waste and spent nuclear fuel, and make certain expenditures from the Nuclear Waste Fund.

IN THE HOUSE OF REPRESENTATIVES

JANUARY 12, 2017

Mr. ISSA (for himself, Mr. CONAWAY, Mr. CALVERT, Mr. CULBERSON, Mr. YOUNG of Alaska, Ms. PINGREE, Mr. SAM JOHNSON of Texas, Mr. CARTER of Texas, Ms. BORDALLO, Mr. PETERS, Mr. WELCH, Ms. MATSUI, Mr. GENE GREEN of Texas, Mr. HUNTER, Mr. BERA, Mr. NEAL, Mr. COURTNEY, and Mr. LEWIS of Minnesota) introduced the following bill; which was referred to the Committee on Energy and Commerce

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A BILL

To amend the Nuclear Waste Policy Act of 1982 to authorize the Secretary of Energy to enter into contracts for the storage of certain high-level radioactive waste and spent nuclear fuel, take title to certain high-level radioactive waste and spent nuclear fuel, and make certain expenditures from the Nuclear Waste Fund.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ''Interim Consolidated Storage Act of 2017''.

SEC. 2. DEFINITION OF INTERIM CONSOLIDATED STORAGE FACILITY.

Section 2 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101) is amended by adding at the end the following new paragraph:

''(35) The term 'interim consolidated storage facility' means a facility that possesses a specific license issued by the Commission that authorizes storage of high-level radioactive waste or spent nuclear fuel received from the Secretary or from two or more persons that generate or hold title to high-level radioactive waste or spent nuclear fuel generated at a civilian nuclear power reactor.''.

SEC. 3. INTERIM CONSOLIDATED STORAGE OF HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL.

(a) STORAGE OF SPENT NUCLEAR FUEL.—Section 135(h) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10155(h)) is amended by striking ''Notwithstanding any other provisions of law'' and inserting ''Except as provided in section 302, and subtitle I of title I''.

(b) INTERIM CONSOLIDATED STORAGE.—Title I of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10121 et seq.) is amended by adding at the end the following:

"Subtitle I—Interim Consolidated Storage

"SEC. 190. INTERIM CONSOLIDATED STORAGE.

"(a) IN GENERAL.—The Secretary may enter into contracts for the storage of high-level radioactive waste or spent nuclear fuel with any person that holds a license for an interim consolidated storage facility.

"(b) DEFINITION OF HIGH-LEVEL RADIOACTIVE WASTE.—For purposes of this subtitle and section 302, the term 'high-level radioactive waste' includes Greater than Class C waste as defined in section 72.3 of title 10, Code of Federal Regulations. Nothing in this section or section 191 shall be interpreted to affect existing judicial interpretation of the term high-level radioactive waste or to require the disposal of Greater than Class C waste in a repository.

"SEC. 191. CONTRACTS.

"(a) IN GENERAL.—The Secretary may enter into new contracts or modify existing contracts with any person who generates or holds title to high-level radioactive waste or spent nuclear fuel of domestic origin for the acceptance of title and subsequent storage of such waste or fuel at

an interim consolidated storage facility, with priority for storage given to high-level radioactive waste and spent nuclear fuel located on sites without an operating nuclear reactor.

''(b) CONTRACT TERMS.—A contract entered into or modified under this section shall provide that acceptance by the Secretary, and transfer of title under subsection (d), of any high-level radioactive waste or spent nuclear fuel for an interim consolidated storage facility satisfies the Secretary's responsibility under a contract entered into under section 302(a) to accept title to such waste or fuel for disposal, with respect to such accepted waste or fuel.

''(c) LIMITATION.—The Secretary shall not require a person to settle claims against the United States for the breach of a contract entered into under section 302(a) for the disposal of high-level radioactive waste or spent nuclear fuel as a condition precedent of entering into or modifying a contract under this section.

''(d) TITLE TO MATERIAL.—Delivery, and acceptance by the Secretary, of any high-level radioactive waste or spent nuclear fuel for an interim consolidated storage facility shall constitute a transfer to the Secretary of title to such waste or fuel.''.

(c) NUCLEAR WASTE FUND.—Section 302(d) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10222(d)) is amended—

(1) in paragraph (4), by striking ''in a monitored, retrievable storage site'' and inserting ''in an interim consolidated storage facility or monitored retrievable storage site,'';

(2) in paragraph (5)—

(A) by striking ''a monitored, retrievable storage site'' and inserting ''an interim consolidated storage facility site, a monitored retrievable storage site,'';

(B) by striking ''such repository, monitored, retrievable storage facility'' and inserting ''such repository, interim consolidated storage facility, monitored retrievable storage facility,''; and

(C) by striking ''; and'' and inserting a semicolon;

(3) by redesignating paragraph (6) as paragraph (7);

(4) by inserting after paragraph (5) the following:

''(6) the fees and costs in connection with the storage of high-level radioactive waste or spent nu-

clear fuel in an interim consolidated storage facility; and''; and

(5) by inserting ''For purposes of the preceding sentence, fees and costs described in paragraph (6) shall not be considered amounts for the construction or expansion of any facility.'' after ''this or subsequent legislation.''.

(d) APPROPRIATIONS FROM THE WASTE FUND.—Section 302(e)(2) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10222(e)(2)) is amended—

(1) by inserting ''(A)'' before ''The Secretary shall submit''; and

(2) by adding at the end the following:

''(B) Notwithstanding subparagraph (A), subject to subparagraph (C), necessary amounts shall be available to the Secretary from the Waste Fund without additional appropriations to pay for the following:

''(i) Costs described in subsection (d)(4) in connection with storage in an interim consolidated storage facility.

''(ii) Costs described in subsection (d)(5) in connection with an interim consolidated storage facility.

''(iii) Fees and costs described in subsection (d)(6).

''(C) The Secretary shall not expend, on fees for dry modes of storage of high-level radioactive waste or spent nuclear fuel, amounts totaling more than the cumulative amount of interest generated by the Waste Fund each fiscal year, beginning in fiscal year 2018.''.

○

PRELIMINARY EVALUATION OF REMOVING USED NUCLEAR FUEL FROM SHUTDOWN SITES

In January 2013, the Department of Energy issued the *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste*. Among the elements contained in this strategy is an initial focus on accepting used nuclear fuel from shutdown reactor sites. This focus is consistent with the recommendations of the Blue Ribbon Commission on America's Nuclear Future, which identified removal of stranded used nuclear fuel at shutdown sites as a priority so that these sites may be completely decommissioned and put to other beneficial uses. Shutdown sites are defined as those commercial nuclear power reactor sites where the nuclear power reactors have been shut down and the site has been decommissioned or is undergoing decommissioning. In this report, a preliminary evaluation of removing used nuclear fuel from 13 shutdown sites was conducted. The shutdown sites are: Maine Yankee, Vermont Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, Kewaunee, and San Onofre. These sites have no other operating nuclear power reactors at their sites and have also notified the U.S. Nuclear Regulatory Commission that their reactors have permanently ceased power operations and that nuclear fuel has been permanently removed from their reactor vessels. Shutdown reactors at sites having other operating reactors are not included in this evaluation.

Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites - September 2016 Revision (11.8 MB)
Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites - September 2015 Revision (19.14 MB)
Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites - October 2014 Revision (13.15 MB)

MORE DOCUMENTS & PUBLICATIONS

Nuclear Fuel Storage and Transportation Planning Project Overview

Dry Cask Inventory Assessment, Rev. 1

Summary of Design Criteria for Dry Cask Storage Systems for ISFSI Storage of Shutdown Reactor SNF

1000 Independence Ave. SW
Washington DC 20585
202-586-5000

Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites

Fuel Cycle Research & Development

Prepared for
U.S. Department of Energy
Nuclear Fuels Storage and
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September 30, 2016
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EXECUTIVE SUMMARY

This report fulfills the M3 milestone M3FT-16PN0904020314, "Final Shutdown Sites Report." Changes from Revision 3 (September 2015) of the report include incorporating spent nuclear fuel data from the GC-859 database; updating of Google Earth imagery; incorporating revisions to transportation certificates of compliance; adding information obtained from site visits to the Pacific Sun Railroad and Camp Pendleton, California; adding rail assessments for Kewaunee, Crystal River, and San Onofre to Appendix B; and adding information obtained from the site visit to Vermont Yankee.

In January 2013, the U.S. Department of Energy (DOE) issued the *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (DOE 2013). Among the elements contained in this strategy are siting, designing, licensing, constructing and operating a pilot interim storage facility with an initial focus on accepting used nuclear fuel from shutdown reactor sites. This focus is consistent with the recommendations of the Blue Ribbon Commission on America's Nuclear Future, which identified removal of stranded used nuclear fuel at shutdown sites as a priority so that these sites may be completely decommissioned and put to other beneficial uses (BRC 2012). The strategy also includes a phased, adaptive, and consent-based approach to siting. New statutory authority would be required to construct an interim storage facility, but DOE's existing authorities would allow the DOE to begin a consent-based siting process. Shutdown sites are defined as those commercial nuclear power reactor sites where the nuclear power reactors have been shut down and the site has been decommissioned or is undergoing decommissioning. In this report, a preliminary evaluation of removing used nuclear fuel from 13 shutdown sites was conducted. The shutdown sites evaluated were Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee.[1] These sites have no operating nuclear power reactors at their sites and have also notified the U.S. Nuclear Regulatory Commission (NRC) that their reactors have permanently ceased power operations and that nuclear fuel has been permanently removed from their reactor vessels. Shutdown reactors at sites also having operating reactors are not included in this evaluation.

The evaluation was divided into four components:

- characterization of the used nuclear fuel and greater-than-Class C (GTCC) low-level radioactive waste inventory[2]
- a description of the on-site infrastructure and conditions relevant to transportation activities

[1] To the extent the discussions or recommendations in this report conflict with the provisions of the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste, 10 CFR § 961.11, the Standard Contract provisions prevail.

[2] Removal of GTCC low-level radioactive waste at shutdown sites was analyzed in this report because the Court of Appeals for the Federal Circuit (Fed. Cir. 2008a, 2008b) has held that because the NRC has determined by rule that, unless the NRC approves an alternative method, GTCC low-level radioactive waste requires disposal in a geologic repository, such waste is considered high-level radioactive waste under the terms of the Standard Contract.

- an evaluation of the near-site transportation infrastructure and experience relevant to shipping transportation casks containing used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites, including gaps in information
- an evaluation of the actions necessary to prepare for and remove used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites.

Using these evaluations, the authors developed time sequences of activities and time durations for removing the used nuclear fuel and GTCC low-level radioactive waste from a single shutdown site and from the Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion sites. The Crystal River, Kewaunee, San Onofre, and Vermont Yankee sites were not included because these sites only recently shut down and are at the beginning stages of the decommissioning process.

The 13 shutdown sites use designs from 4 different suppliers, including 11 different (horizontal and vertical) storage systems that would require 9 different transportation cask designs. At the 13 shutdown sites, a total of 17,963 used nuclear fuel assemblies and a total of 6227.6 metric tons heavy metal (MTHM) of used nuclear fuel are forecast to be stored in 506 to 512 storage canisters (actual plus estimated). In addition, 35 canisters (actual plus estimated) containing GTCC low-level radioactive waste are forecast to be stored at these sites. Several issues were identified during the characterization of the used nuclear fuel and GTCC low-level radioactive waste inventory at the shutdown sites. The most important of the issues was at the Rancho Seco site, where six damaged fuel assemblies in five of the storage canisters were not placed in failed fuel dry shielded canisters (FF-DSCs). Further evaluation would be needed to determine if the canisters containing this damaged fuel can be shipped in the MP187 transportation cask without repackaging. In addition, the transportation certificate of compliance for the HI-STAR HB cask would need to be revised to allow transport of 44 used nuclear fuel assemblies at the Humboldt Bay site with initial enrichments of 2.08 weight percent, which is less than the minimum initial enrichment of 2.09 weight percent authorized by the transportation certificate of compliance for the HI-STAR HB cask.

The lists of approved contents in the certificates of compliance for the TS125, HI-STAR HB, HI-STAR 100, and MP187 transportation casks do not include GTCC low-level radioactive waste. For GTCC low-level radioactive waste to be shipped from the Humboldt Bay, Rancho Seco, San Onofre, and Vermont Yankee sites in these transportation casks, changes to the transportation certificates of compliance would be required. Also, the certificates of compliance for the TS125 and MP187 transportation casks would need to be updated from a -85 to a -96 designation before the casks or impact limiters could be fabricated. In addition, the used nuclear fuel or GTCC low-level radioactive waste that may be stored in 32PTH2 canisters at San Onofre would not be transportable without changes to the list of approved contents in the certificate of compliance for the MP197HB transportation cask.

Six of the sites, Maine Yankee, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee, have high burnup (>45 gigawatt-day per metric ton heavy metal [GWd/MTHM]) used nuclear fuel assemblies in storage. At Maine Yankee and Zion, these high burnup used nuclear fuel assemblies are packaged in damaged fuel cans, which eliminates the concern over the transportability of this high burnup fuel. High burnup used nuclear fuel stored in 32PTH1 canisters at Crystal River and 24PT4 canisters at San Onofre would be transportable in the

MP197HB transportation cask. High burnup used nuclear fuel that will be stored in MPC-68 canisters at the Vermont Yankee site would not be transportable without changes to the list of approved contents in the certificate of compliance for the HI-STAR 100 transportation cask. An application for a certificate of compliance for the HI-STAR 190 transportation cask has been submitted to the NRC; high burnup used nuclear fuel that will be stored in MPC-37 canisters at San Onofre would be transportable if it is included in the list of approved contents in the certificate of compliance for the HI-STAR 190 transportation cask.

All sites were found to have at least one off-site transportation mode option for removing their used nuclear fuel and GTCC low-level radioactive waste, and some sites have multiple options. Table S-1 provides a summary of these transportation mode options for the shutdown sites. Experience with large component removals during reactor decommissioning provided an important source of information in developing Table S-1. In addition, it is assumed that any refurbishment or upgrade of on-site infrastructure required prior to receipt of equipment for loading and transportation would be performed by the shutdown site organization to facilitate timely shipping of used nuclear fuel and GTCC low-level radioactive waste from the site.

The actions necessary to prepare for and remove the used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites are listed as tasks in Table S-2. These identified actions are based on the assumption that DOE or another management and disposal organization would be responsible for shipping to, and the operation of, the pilot interim storage facility, and might differ if a private entity were responsible for shipping to, or the operation of, the pilot interim storage facility. Based on these tasks, the characteristics of the sites' inventories of used nuclear fuel and GTCC low-level radioactive waste, the on-site conditions, and the near-site transportation infrastructure and experience, time sequences of activities and time durations were developed to prepare for and remove the used nuclear fuel and GTCC low-level radioactive waste from a single shutdown site and from nine of the shutdown sites. Figure S-1 presents the ranges in the estimates of time durations for the single-shutdown site scenario. For a single shutdown site, the estimated time to prepare for and remove the used nuclear fuel and GTCC low-level radioactive waste ranged from 6.2 to 11.2 years. These estimates were based on a range of time durations for tasks, and on varying numbers of available transportation casks, which combine to yield the upper and lower estimates in Figure S-1.

Figure S-2 presents the representative durations and sequence of activities to prepare for and remove all used nuclear fuel and GTCC low-level radioactive waste from the nine shutdown sites. In Figure S-2 the cumulative duration of 11.5 to 14.5 years was based on staggered shipping campaigns and optimistic estimates of time durations for tasks and includes the schedule uncertainty associated with procurement of casks and railcars and coordination of shipping campaigns. As mentioned previously, the representative durations and sequence of activities shown in Figure S-2 do not include Crystal River, Kewaunee, San Onofre, and Vermont Yankee.

The estimated durations presented in Figure S-1 and Figure S-2 were most affected by the time required to load and transport the used nuclear fuel and GTCC low-level radioactive waste; procure casks, components, and campaign kits; and the time required to procure railcars that meet Association of American Railroads (AAR) Standard S-2043 (AAR 2008). While the latter two activities could take place in parallel, they still represent a significant fraction of the time it

would take to prepare for and remove the used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites.

Table S-1. Summary of Transportation Mode Options for Shipments from Shutdown Sites

Site	Transportation Mode Options		Comments
Maine Yankee	Direct rail	Barge to rail	The on-site rail spur is not being maintained. The condition of the Central Maine and Quebec Railway would need to be verified.
Yankee Rowe	Heavy haul truck to rail	–	The shortest heavy haul would be 7.5 miles to the east portal of the Hoosac Tunnel.
Connecticut Yankee	Barge to rail	Heavy haul truck to rail	The on-site barge slip has not been used since decommissioning but remains intact. It is uncertain whether the cooling water discharge canal is deep enough to accommodate barges without dredging. The shortest heavy haul would be about 12.5 miles to the end of the Portland rail spur. The rail infrastructure at the end of the Portland rail spur would need to be evaluated.
Humboldt Bay	Heavy haul truck to rail	Heavy haul truck to barge to rail	The heavy haul distance to a rail siding or spur would be in the range of 160 to 280 miles. The condition of the Fields Landing Terminal located 2 miles from the Humboldt Bay site would need to be verified for barge transport.
Big Rock Point	Heavy haul truck to rail	Barge to rail	The heavy haul would probably be about 52 miles to Gaylord, Michigan. A shorter heavy haul of 13 miles to Petoskey, Michigan may be possible. The rail infrastructure at these locations would need to be evaluated.
Rancho Seco	Direct rail	–	The rail spur is not being maintained. Weight restrictions on the Ione Industrial Lead would require route clearance by the railroad or a track upgrade.
Trojan	Direct rail	Barge to rail	The on-site rail spur was removed.
La Crosse	Direct rail	Barge to rail	An on-site rail spur was used to ship the reactor pressure vessel. The location and method for loading the transportation cask and moving the transportation cask to a rail spur is uncertain.
Zion	Direct rail	Barge to rail	The rail spur was recently refurbished to support reactor decommissioning waste shipments.
Crystal River	Direct rail	Barge to rail	Extensive on-site rail system serves co-located fossil fuel plants.
Kewaunee	Heavy haul truck to rail	Heavy haul truck to barge to rail	Condition of potential heavy haul truck routes, transload locations, and rail infrastructure would need to be evaluated.
San Onofre	Direct rail	Heavy haul truck to barge to rail	The rail spur was recently refurbished to support reactor decommissioning waste shipments for San Onofre-1.
Vermont Yankee	Direct Rail	–	On-site rail spur will be reactivated to support decommissioning.

Table S-2. Activities to Prepare for and Remove Used Nuclear Fuel from Shutdown Sites

Task	Task Activity Description
Programmatic Activities to Prepare for Transport Operations from a Shutdown Site	
1 – Assemble Project Organization	Assemble management teams, identify shutdown site existing infrastructure, constraints, and transportation resource needs and develop interface procedures.
2 – Acquire Casks, Railcars, Ancillary Equipment and Transport Services	Develop specifications, solicit bids, issue contracts, and initiate preparations for shipping campaigns. Includes procurement of transportation casks and revisions to certificates of compliance as may be needed, procurement of AAR Standard S-2043 railcars, and procurement of off-site transportation services.
3 – Conduct Preliminary Logistics Analysis and Planning	Determine fleet size, transport requirements, and modes of transport for shutdown site.
4 – Coordinate with Stakeholders	Assess and select routes and modes of transport and support training of transportation emergency response personnel.
5 – Develop Campaign[a] Plans	Develop plans, policies, and procedures for at-site operational interfaces and acceptance, support operations, and in-transit security operations.
Operational Activities to Prepare, Accept, and Transport from a Shutdown Site	
6 – Conduct Readiness Activities	Assemble and train at-site operations interface team and shutdown site workers. Includes readiness reviews, tabletop exercises and dry run operations.
7 – Load for Off-site Transport	Load and prepare casks and place on transporters for off-site transportation.
8 – Accept for Off-site Transport	Accept loaded casks on transporters for off-site transportation.
9 – Transport	Ship shutdown site casks.

AAR = Association of American Railroads

a. A campaign plan contains step-by-step, real-time instructions for completing a shipment from an origin site.

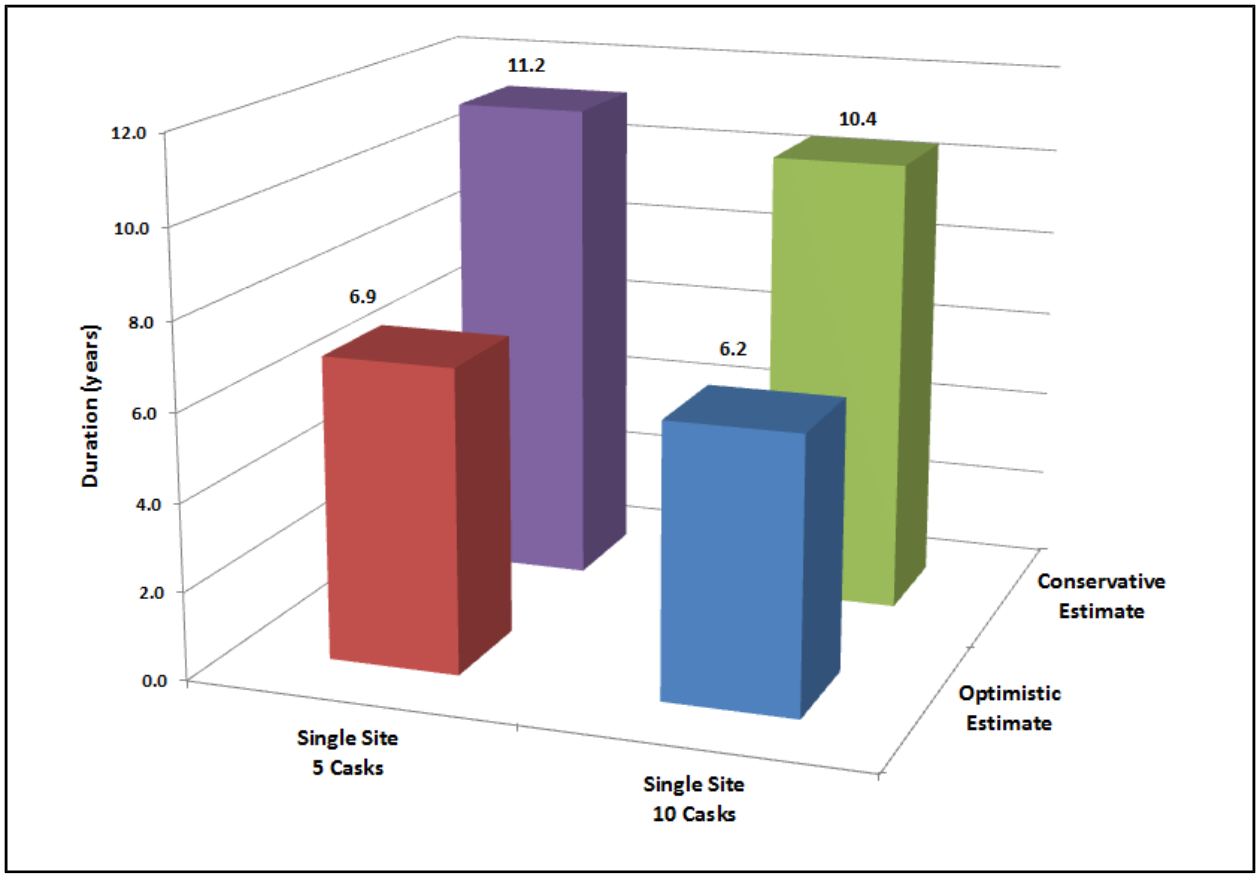


Figure S-1. Estimated Time Durations to Prepare for and Remove Used Nuclear Fuel and GTCC Low-Level Radioactive Waste from a Single Shutdown Site

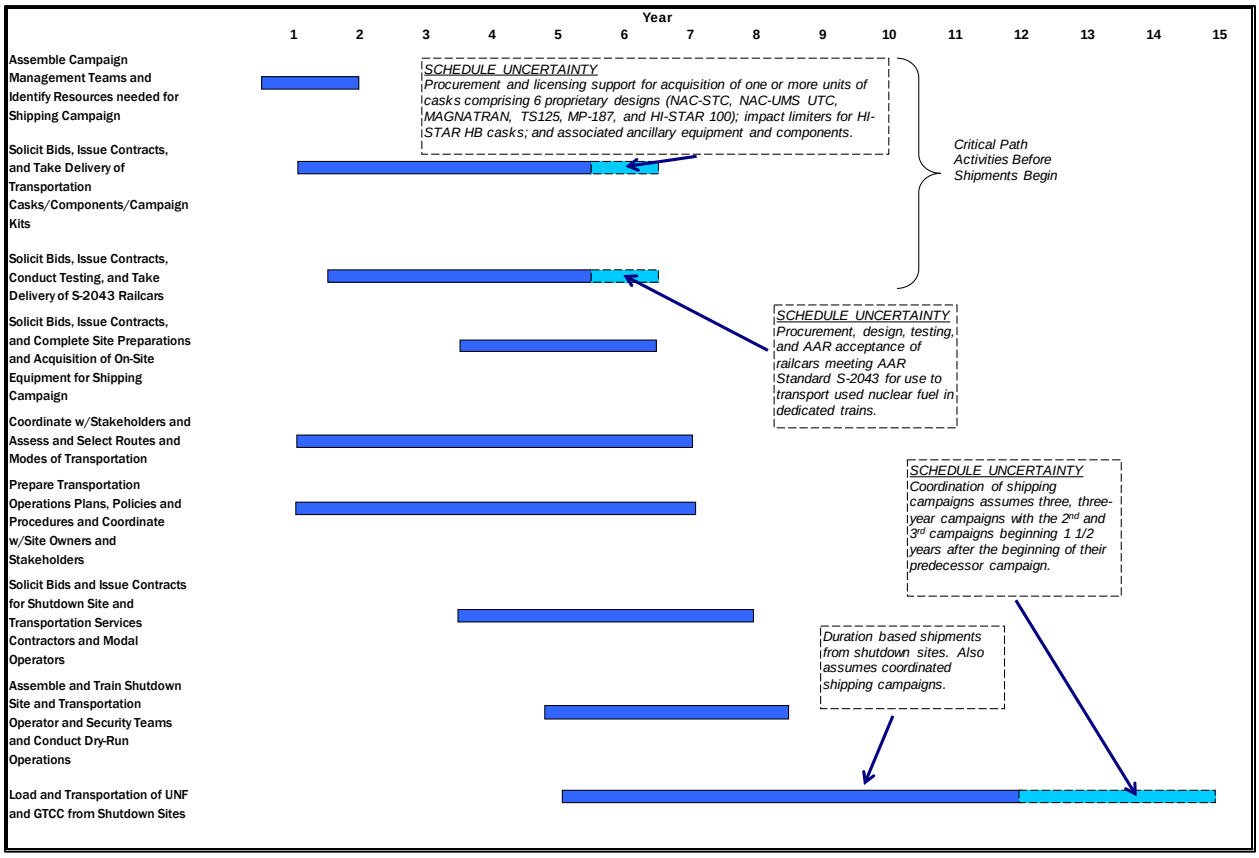


Figure S-2. Estimated Durations of Key Activities to Prepare for and Remove Used Nuclear Fuel and GTCC Low-Level Radioactive Waste from Nine Shutdown Sites

Project activities that would precede shipments from all of the shutdown sites would require only a slightly greater amount of time than that which would be required for one shutdown site. This assumes that project resources (personnel, funding, and functions such as procurement and quality assurance) would be adequate to support concurrent acquisitions of transportation casks and associated components that would include several units of each of the seven transportation casks that would be used at Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion—the NAC-STC, NAC-UMS UTC, MP187, TS125, HI-STAR 100, HI-STAR HB, and MAGNATRAN; and to acquire and certify the fleet of cask, buffer, and escort railcars that would be needed. It also assumes that there would be flexibility in making acquisitions such as limited constraints on procuring casks and associated components from non-domestic suppliers.

As part of this preliminary evaluation, thirteen shutdown sites have been visited: Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee. As additional nuclear power reactor sites such as Fort Calhoun, Clinton, Quad Cities, Pilgrim, Oyster Creek, and Diablo Canyon shut down, these sites should be included in updates to the report.

The estimates of durations for project tasks presented here are preliminary and depend on the many identified assumptions. Consequently, in preparing a comprehensive project plan to

prepare for and remove used nuclear fuel from the shutdown sites it will be necessary to refine the estimates using improved information regarding each of the sites and their near-site transportation infrastructure, and using methods that will allow managers to gauge the importance of assumptions and project considerations. In this regard, it is recommended that DOE or another management and disposal organization use a quantitative risk analysis tool to provide estimates of project risks and opportunities. Such quantitative analyses would support estimating, managing, and funding of contingencies, and would increase confidence that the project would be successfully executed. Risk-informed estimates would also allow the project's managers to anticipate time and funding resources, and alternative courses of action that might be needed to effectively respond to changing circumstances.

DOE or another management and disposal organization should also take advantage of improved information regarding loading and transportation of used nuclear fuel from the shutdown sites to refine the data used in integrated waste management system analyses to evaluate optimizations that may be possible in acquiring and using transportation resources. Integrated waste management system analysis could also be used to conduct sensitivity analyses and identify important gaps in information that could be filled with additional data collected from the shutdown sites. Information developed using these analysis tools could also be used in case studies conducted using the quantitative analysis tools discussed above.

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ACRONYMS

AAR	Association of American Railroads
AC&T	American Cranes & Transport
ADAMS	U.S. Nuclear Regulatory Commission Agencywide Documents Access and Management System
BRC	Blue Ribbon Commission on America's Nuclear Future
BWR	boiling water reactor
CN	Canadian National Railway
CSI	Criticality Safety Index
CY	Connecticut Yankee
DOE	U.S. Department of Energy
DSI	DeskMap Systems, Inc.
EIA	Energy Information Agency
EPRI	Electric Power Research Institute
FC-DSC	fuel with control component dry shielded canister
FF-DSC	failed fuel dry shielded canister
FO-DSC	fuel only dry shielded canister
GTCC	greater-than-Class C
GWd/MTHM	gigawatt-day per metric ton heavy metal
HBHRCD	Humboldt Bay Harbor, Recreation & Conservation District
IAEA	International Atomic Energy Agency
ISFSI	independent spent fuel storage installation
MCBCP	Marine Corps Base Camp Pendleton
MPC	multipurpose canister
MTHM	metric tons heavy metal
MWe	megawatt electric
MWt	megawatt thermal
NCTD	North County Transit District
NRC	U.S. Nuclear Regulatory Commission
PG&E	Pacific Gas and Electric Company
PSR	Pacific Sun Railroad
PWR	pressurized water reactor
QA	quality assurance

SCRRA	Southern California Regional Rail Authority
STB	Surface Transportation Board
STC	storage transport cask
STRACNET	Strategic Rail Corridor Network
TN	Transnuclear, Inc.
TOM	Transportation Operations Model
TOPO	Transportation Operations Project Office
TSC	Transportable Storage Canister
UNF	used nuclear fuel
USACE	U.S. Army Corps of Engineers
UTC	Universal Transport Cask

NUCLEAR FUELS STORAGE AND TRANSPORTATION PLANNING PROJECT

Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites

1. INTRODUCTION

This report provides a preliminary evaluation of removing stranded used nuclear fuel from 13 shutdown sites.[3] Changes from the Revision 3 (September 2015) of the report include incorporating spent nuclear fuel data from the GC-859 database; updating of Google Earth imagery; incorporating revisions to transportation certificates of compliance; adding information obtained from site visits to the Pacific Sun Railroad and Camp Pendleton, California; adding rail assessments for Kewaunee, Crystal River, and San Onofre to Appendix B; and adding information obtained from the site visit to Vermont Yankee.

Shutdown sites are defined as those commercial nuclear power reactor sites where the nuclear power reactors have been shut down and the site has been decommissioned or is undergoing decommissioning. The shutdown sites evaluated are Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee. These sites have no other operating nuclear power reactors at their sites and have also notified the U.S. Nuclear Regulatory Commission (NRC) that their reactors have permanently ceased power operations and that nuclear fuel has been permanently removed from their reactor vessels. Shutdown reactors at sites having operating reactors are not included in this evaluation. Reactors that have agreements to shut down in the future but that have not notified the NRC that they have permanently ceased power operations and that nuclear fuel has been permanently removed from their reactor vessels are also not included in this evaluation.

The locations of the shutdown sites are shown in Figure 1-1. The material to be removed from the shutdown sites includes both the used nuclear fuel and the greater-than-Class C (GTCC) low-level radioactive waste[4] that is stored, or will be stored, at the independent spent fuel storage installations (ISFSIs) at each one of the sites.

The preliminary evaluation of removing the used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites was divided into four components:

- characterization of the used nuclear fuel and GTCC low-level radioactive waste inventory

[3] To the extent the discussions or recommendations in this report conflict with the provisions of the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste, 10 CFR § 961.11, the Standard Contract provisions prevail.

[4] In the used nuclear fuel litigation, the Court of Appeals for the Federal Circuit (Fed. Cir. 2008a, 2008b) has held that because the NRC has determined by rule that, unless the NRC approves an alternative method, GTCC low-level radioactive waste requires disposal in a geologic repository, such waste is considered high-level radioactive waste under the terms of the Standard Contract. Accordingly, for purposes of this report, the removal of GTCC low-level radioactive waste along with used nuclear fuel at shutdown reactor sites was analyzed.



Figure 1-1. Locations of Shutdown Sites

- a description of the on-site infrastructure and conditions relevant to transportation activities
- an evaluation of the near-site transportation infrastructure and experience relevant to shipping transportation casks containing used nuclear fuel from the shutdown sites, including gaps in information
- an evaluation of actions necessary to prepare for and remove used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites.

These evaluations are contained in Section 2. Section 3 contains an overview of the requirements for off-site transportation infrastructure.

Section 4 contains time sequences of activities and their durations developed from the lists of actions that are necessary to prepare for and remove used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites. Total time durations for a single-site scenario are developed for conservative and optimistic estimates of the time durations for tasks, and assuming varying numbers of available casks. Representative durations and sequences of activities to prepare for and remove all used nuclear fuel and GTCC low-level radioactive waste from nine of the shutdown sites are also presented, and include the schedule uncertainty associated with procurement of casks and railcars and coordination of shipping campaigns. Crystal River, Kewaunee, San Onofre, and Vermont Yankee were not included because these sites only recently shut down and are at the beginning stages of the decommissioning process.

2. SITE INVENTORY, SITE CONDITIONS, NEAR-SITE TRANSPORTATION INFRASTRUCTURE AND EXPERIENCE, AND GAPS IN INFORMATION

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the shutdown sites. The primary sources for the inventory of used nuclear fuel and GTCC low-level radioactive waste are the GC-859 database (EIA 2013), industry sources such as *StoreFUEL* and *SpentFUEL*, and government sources such as the NRC. The primary sources for the information on the site conditions and near-site transportation infrastructure and experience include site visits to the Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee sites; information provided by managers at the shutdown sites; Facility Interface Data Sheets compiled for the U.S. Department of Energy (DOE) in 2005 (TriVis Incorporated 2005); Services Planning Documents prepared for DOE in 1993 and 1994; industry publications such as *Radwaste Solutions*; and Google Earth (Google 2015). Where on-site infrastructure upgrades or refurbishments are needed or where specialized equipment is required, they are assumed to be known by the shutdown site organization and that the shutdown site organization will complete the necessary tasks by the time of the delivery of transportation casks and equipment.

Table 2-1 lists the characteristics of the commercial nuclear power reactors that operated at the shutdown sites. These reactors operated between the years 1961 and 2014. Four of the reactors (Humboldt Bay, Big Rock Point, La Crosse, and Vermont Yankee) were boiling water reactors and twelve of the reactors were pressurized water reactors (Maine Yankee, Yankee Rowe, Connecticut Yankee, Rancho Seco, Trojan, Zion 1 and 2, Crystal River, Kewaunee, and San Onofre-1, -2, and -3). The licensed capacities for these reactors ranged from 165 to 3438 MWt (48 to 1130 MWe). Decommissioning has been completed for five of the sites and is ongoing at Humboldt Bay, Rancho Seco, La Crosse, Zion, and San Onofre-1. Decommissioning activities are commencing at Crystal River, Kewaunee, San Onofre-2 and -3, and Vermont Yankee. At these four sites, the used nuclear fuel that was in the reactor vessels at shutdown has been removed from the reactor vessels and transferred to spent fuel pools.

Figure 2-1 illustrates the number of canisters and type of storage canisters containing used nuclear fuel and GTCC low-level radioactive waste that are stored or will be stored at each of the shutdown sites. The number of canisters stored at Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion represent actual canisters in storage. The number of used nuclear fuel canisters at Crystal River, Kewaunee, San Onofre, and Vermont Yankee represents an estimate of the number of canisters that will be stored at the conclusion of canister loading and the number of canisters at Crystal River, Kewaunee, and San Onofre containing GTCC low-level radioactive waste represents an estimate of the number of canisters generated during decommissioning. There are expected to be a total of 541 to 547 canisters in storage at the 13 sites (actual plus estimated). The number of canisters ranges from 5 at La Crosse to an estimated 134 to 140 at San Onofre.

Table 2-1. Characteristics of Shutdown Site Reactors[a]

Site Location	Reactor Type	MWt	MWe (net)	Operating Period[b]	Current Status
Maine Yankee, Wiscasset, Maine	PWR	2700	860	1972-1996	DECON[c] completed
Yankee Rowe, Rowe, Massachusetts	PWR	600	167	1961-1991	DECON completed
Connecticut Yankee, Haddam Neck, Connecticut	PWR	1825	560	1968-1996	DECON completed
Humboldt Bay, Eureka, California	BWR	200	63	1963-1976	DECON in progress
Big Rock Point, Charlevoix, Michigan	BWR	240	67	1963-1997	DECON completed
Rancho Seco, Herald, California	PWR	2772	913	1975-1989	DECON in progress
Trojan, Rainier, Oregon	PWR	3411	1130	1976-1992	DECON completed
La Crosse, Genoa, Wisconsin	BWR	165	48	1969-1987	SAFSTOR[d,e]
Zion 1, Zion, Illinois	PWR	3250	1040	1973-1997	DECON in progress
Zion 2, Zion, Illinois	PWR	3250	1040	1974-1996	DECON in progress
Crystal River, Crystal River, Florida	PWR	2609	860	1977-2009	SAFSTOR in progress UNF removed from reactor vessel 05/28/2011
Kewaunee, Kewaunee, Wisconsin	PWR	1772	574	1974-2013	SAFSTOR in progress UNF removed from reactor vessel 05/14/2013
San Onofre-1, San Clemente, California	PWR	1347	436	1968-1992	SAFSTOR
San Onofre-2, San Clemente, California	PWR	3438	1070	1983-2013	SAFSTOR in progress UNF removed from reactor vessel 07/18/2013
San Onofre-3, San Clemente, California	PWR	3438	1080	1984-2013	SAFSTOR in progress UNF removed from reactor vessel 10/05/2012
Vermont Yankee, Vernon, Vermont	BWR	1912	605	1972-2014	SAFESTOR in progress UNF removed from reactor vessel 12/29/2014

a. Sources: NRC (2013) and IAEA (2012)
b. The operating period represents the date of commercial operation to the date of shutdown.
c. DECON is a method of decommissioning in which structures, systems, and components that contain radioactive contamination are removed from a site and safely disposed of at a commercially operated low-level radioactive waste disposal facility or decontaminated to a level that permits the site to be released for unrestricted use shortly after it ceases operation (NRC 2013).
d. SAFSTOR is a method of decommissioning in which a nuclear facility is placed and maintained in a safe and stable condition, and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use (NRC 2013).
e. DECON expected to resume in 2016.
PWR= pressurized water reactor
BWR= boiling water reactor
UNF= used nuclear fuel

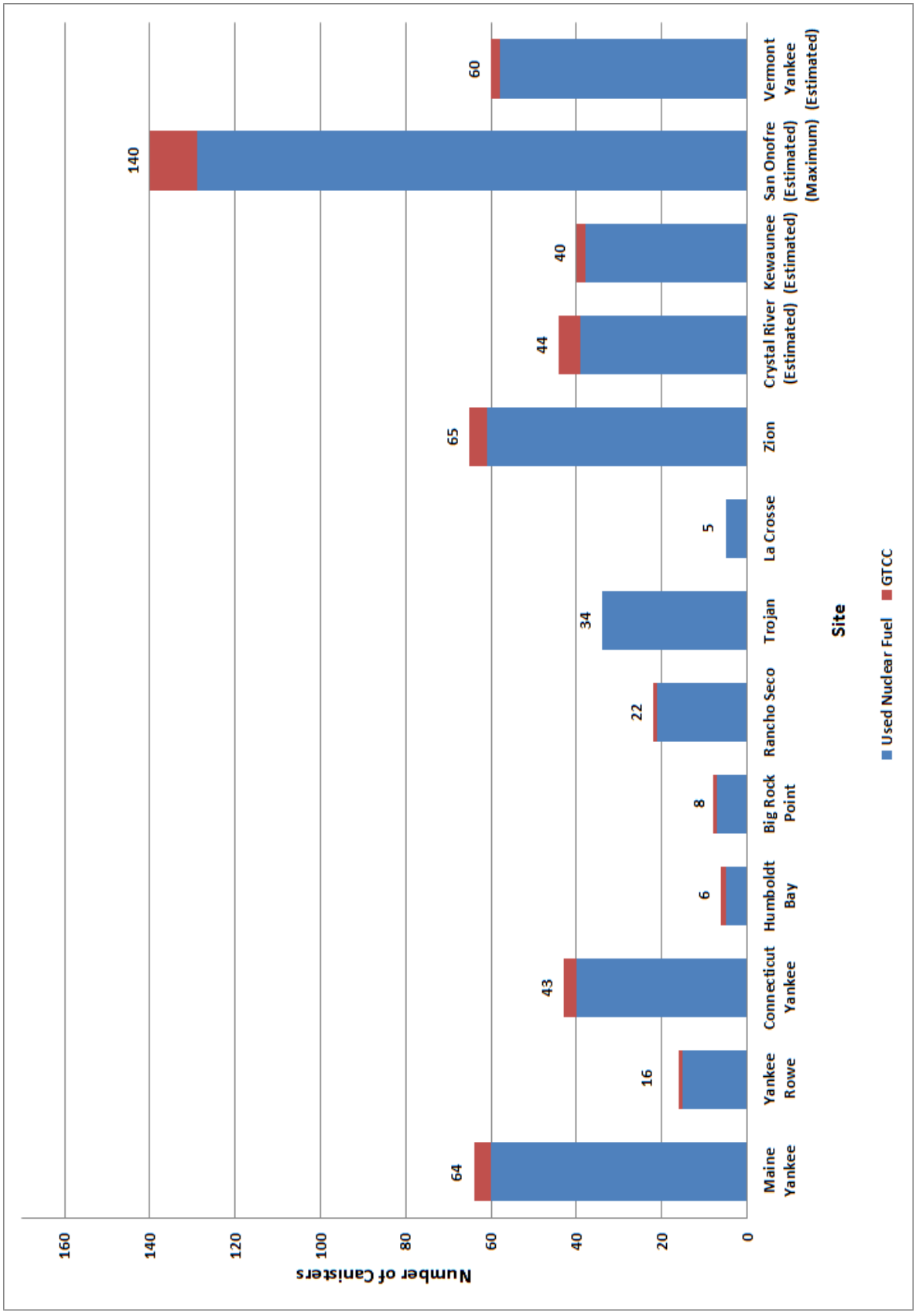


Figure 2-1. Number of Canisters at Shutdown Sites

Figure 2-2 illustrates the number of used nuclear fuel assemblies stored at each site. There are a total of 17,963 used nuclear fuel assemblies present at the shutdown sites. These assemblies are composed of 12,919 pressurized water reactor assemblies and 5044 boiling water reactor assemblies. The number of assemblies ranges from 333 at La Crosse to 3880 at Vermont Yankee. The majority (16,301) of the used nuclear fuel assemblies are zirconium alloy-clad;[5] but Yankee Rowe, Connecticut Yankee, La Crosse, and San Onofre-1 have 1662 stainless steel-clad used nuclear fuel assemblies in storage.

Figure 2-3 illustrates the same information in terms of the metric tons of heavy metal stored at each site. A total of 6227.6 metric tons heavy metal (MTHM) of used nuclear fuel at the shutdown sites consists of 5399.3 MTHM of pressurized water reactor used nuclear fuel and 828.2 MTHM of boiling water reactor used nuclear fuel. The number of assemblies and MHTM of used nuclear fuel at each shutdown site were obtained from the GC-859 database (EIA 2013), from information provided by the shutdown sites, and from projections made using the TSL-CALVIN computer code (Nutt et al. 2012), and may not include material such as fuel debris and failed fuel rods that may also be present in the storage canisters at the shutdown sites.

Table 2-2 lists the storage systems used at the shutdown sites and the corresponding transportation casks that are certified to ship the storage canisters containing used nuclear fuel and GTCC low-level radioactive waste at each of the sites.[6] Out of the nine transportation cask designs listed in Table 2-2, only three types have been fabricated for U.S. use: the HI-STAR HB, the MP187, and the HI-STAR 100.[7] The HI-STAR HB can only be used to ship used nuclear fuel from the Humboldt Bay site. The MP187 can be used to ship used nuclear fuel from the Rancho Seco and San Onofre sites. The HI-STAR 100 casks that have been fabricated are already being used as storage casks at the Dresden and Hatch sites (Ux Consulting 2016a). For these HI-STAR 100 casks to be used to ship used nuclear fuel from the Trojan or Vermont Yankee sites, they would need to be unloaded, their contents placed in other storage overpacks, and the casks transported to the Trojan or Vermont Yankee sites. It would also be necessary to procure impact limiters and spacers for these HI-STAR 100 casks. Two NAC-STC transportation casks have been fabricated for use in China (Washington Nuclear Corporation 2003), but not for use in the United States. In addition, an MP197HB transportation cask is being fabricated in Japan (Vanderniet 2012). Fabrication is currently on hold.[8] Currently, there is no transportation cask certified to ship used nuclear fuel stored in NUHOMS 32PTH2 or Holtec MPC-37 canisters.

[5] The term zirconium alloy clad encompasses Zircaloy-2, Zircaloy-4, ZIRLO, and M5 clad assemblies.

[6] Appendix A lists the docket number, package identification number, revision number, certificate of compliance expiration date, and the U.S. Nuclear Regulatory Commission Agencywide Documents Access and Management System (ADAMS) accession number for the transportation casks certified to transport used nuclear fuel from the shutdown sites; the docket number, certificate of compliance number issue date, certificate of compliance expiration date, amendment number, amendment effective date, and ADAMS accession number for the general licensed storage systems used at the shutdown sites; and the license number, docket number, license issue date, license expiration date, amendment number, amendment date, and ADAMS accession number for the Humboldt Bay, Rancho Seco, and Trojan site-specific licenses. Appendix B discusses rail infrastructure assessments conducted during site visits to the Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion sites. Appendix C presents a summary of state permitting requirements for oversize and overweight truck shipments in California, Connecticut, Florida, Illinois, Maine, Massachusetts, Michigan, Oregon, Vermont, and Wisconsin.

[7] Impact limiters have not been fabricated for these transportation casks.

[8] Guibert N. 2016. Personal communication between N Guibert (AREVA TN) and SJ Maheras (PNNL), August 4, 2016.

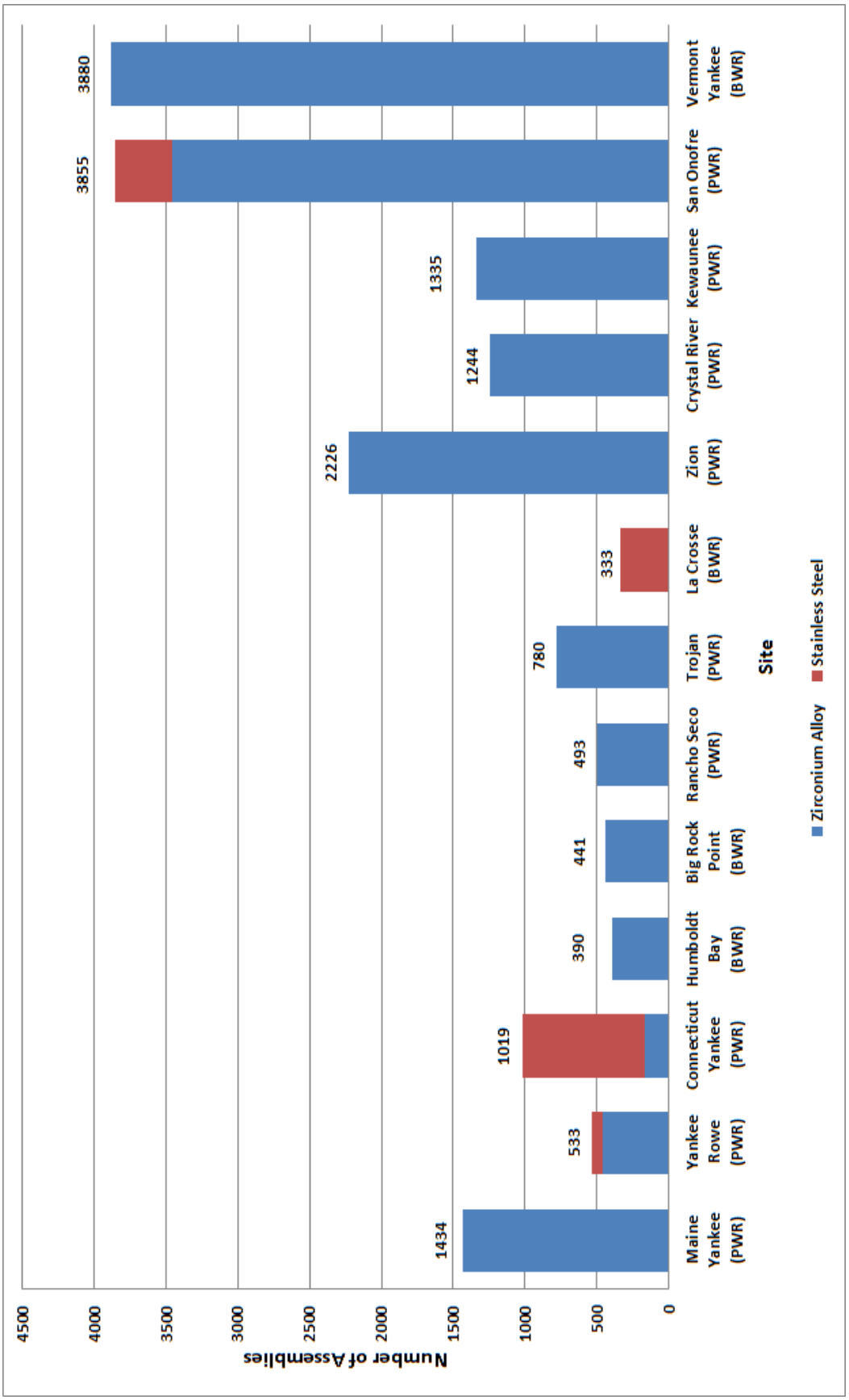


Figure 2-2. Number of Assemblies by Cladding Type at Shutdown Sites

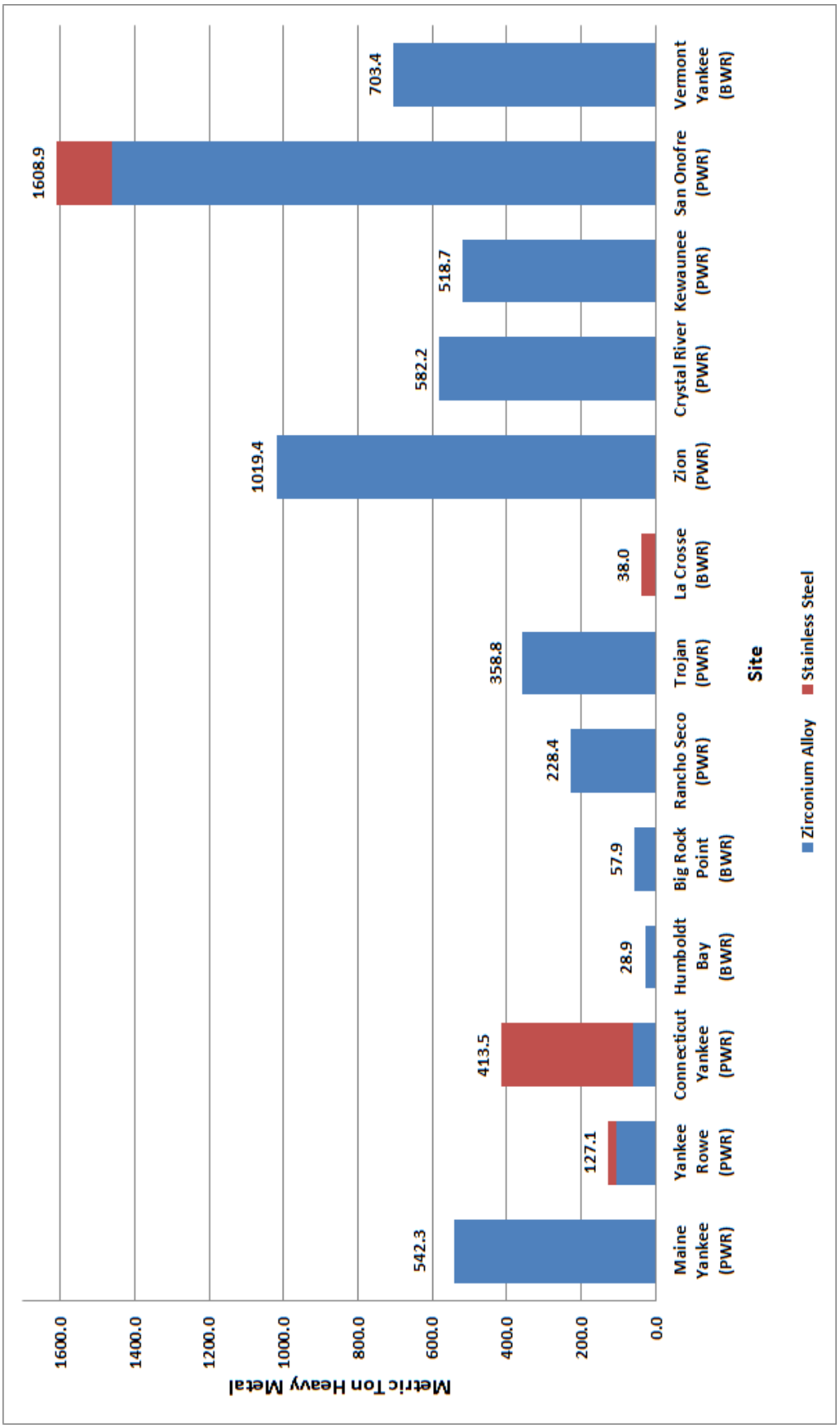


Figure 2-3. Metric Tons Heavy Metal by Cladding Type at Shutdown Sites

Table 2-2. Storage Systems and Transportation Casks Used at Shutdown Sites

Reactor Site	Type	ISFSI Load Dates[a]	Storage System/Canister(s)	Transportation Cask Status	Canisters UNF/GTCC
Maine Yankee	PWR	08/2002-03/2004	NAC-UMS/transportable storage canister	NAC-UMS UTC (Docket No. 71-9270) Certificate expires 10/31/2017. None fabricated	60/4
Yankee Rowe	PWR	06/2002-06/2003	NAC-MPC/Yankee-MPC transportable storage canister	NAC-STC (Docket No. 71-9235) Certificate expires 05/31/2019. Foreign use versions fabricated.	15/1
Connecticut Yankee	PWR	05/2004-03/2005	NAC-MPC/CY-MPC transportable storage canister	NAC-STC (Docket No. 71-9235) Certificate expires 05/31/2019. Foreign use versions fabricated.	40/3
Humboldt Bay	BWR	08/2008-12/2008	Holtec HI-STAR HB/MPC-HB canister	HI-STAR HB (Docket No. 71-9261) Certificate expires 04/30/2019. Fuel in canisters in fabricated casks. No impact limiters.	5/1
Big Rock Point	BWR	12/2002-03/2003	Fuel Solutions W150 Storage Overpack/W74 Canister	TS125 (Docket No. 71-9276) Certificate expires 10/31/2017. None fabricated.	7/1
Rancho Seco	PWR	04/2001-08/2002	TN NUHOMS/FO-DSC, FC-DSC, and FF-DSC canisters	MP187 (Docket No. 71-9255) Certificate expires 11/30/2018. One cask fabricated. No impact limiters.	21/1
Trojan	PWR	12/2002-09/2003	TranStor Storage Overpack/Holtec MPC-24E and MPC-24EF canisters	HI-STAR 100 (Docket No. 71-9261) Certificate expires 04/30/2019. Units fabricated but dedicated to storage at other sites. No impact limiters or spacers.	34/0
La Crosse	BWR	07/2012-09/2012	NAC MPC-LACBWR/MPC-LACBWR transportable storage canister	NAC-STC (Docket No. 71-9235) Certificate expires 05/31/2019. Foreign use versions fabricated.	5/0
Zion 1 and 2	PWR	12/2013-03/2015	NAC MAGNASTOR/TSC-37 canister	MAGNATRAN (Docket No. 71-9356) Application for certificate of compliance under review. None fabricated.	61/4

Table 2-2. (contd.)

Reactor Site	Type	ISFSI Load Dates[a]	Storage System/Canister(s)	Transportation Cask Status	Canisters UNF/GTCC
Crystal River	PWR	Planned 01/2018-08/2019	TN Standardized NUHOMS/32PTH1 canister	MP197HB (Docket No. 71-9302) Certificate expires 08/31/2017. Fabrication on hold.	39/5[b,c]
Kewaunee	PWR	08/2009-08/2014	TN Standardized NUHOMS/32PT canister	MP197HB (Docket No. 71-9302) Certificate expires 08/31/2017. Fabrication on hold.	14
Kewaunee	PWR	Planned 2016	NAC MAGNASTOR/TSC-37 canister	MAGNATRAN (Docket No. 71-9356) Application for certificate of compliance under review. None fabricated.	24/2[b,c]
Kewaunee Total					38/2
San Onofre-1	PWR	09/2003-06/2005	TN Standardized Advanced NUHOMS/24PT1 canisters	MP187(Docket No. 71-9255) Certificate expires 11/30/2018. One cask fabricated. No impact limiters.	17/1
San Onofre-2 and -3	PWR	03/2007-07/2012	TN Standardized Advanced NUHOMS/24PT4 canisters	MP197HB (Docket No. 71-9302) Certificate expires 08/31/2017. Fabrication on hold.	33
San Onofre-2 and -3	PWR	Not Announced	TN Standardized Advanced NUHOMS/24PT4 canisters	MP197HB (Docket No. 71-9302) Certificate expires 08/31/2017. Fabrication on hold.	0-12/0-12[b]
San Onofre-2 and -3	PWR	Not Announced	TN Standardized Advanced NUHOMS/ 32PTH2 canisters	MP197HB (Docket No. 71-9302)[d] Certificate expires 08/31/2017. Fabrication on hold.	0-6/0-6[b]
San Onofre-2 and -3	PWR	Not Announced	Holtec HI-STORM UMAX/MPC-37 canisters	HI-STAR 190 (Docket No. 71-9373) Application for certificate of compliance submitted in 2015.	≤73/0[b]
San Onofre Total					123-129/11

Table 2-2. (contd.)

Reactor Site	Type	ISFSI Load Dates[a]	Storage System/Canister(s)	Transportation Cask Status	Canisters UNF/GTCC
Vermont Yankee	BWR	05/2008-06/2012	Holtec HI-STORM 100S/MPC-68 canisters	HI-STAR 100 (Docket No. 71-9261) Certificate expires 04/30/2019. Units fabricated but dedicated to storage at other sites. No impact limiters or spacers.	13/0
Vermont Yankee	BWR	Not Announced	Holtec HI-STORM 100S/MPC-68 canisters	HI-STAR 100 (Docket No. 71-9261) Certificate expires 04/30/2019. Units fabricated but dedicated to storage at other sites. No impact limiters or spacers.	45/2[b,c]
Vermont Yankee Total					58/2
Total					506-512/35

a. Dates represent the dates that the used nuclear fuel was transferred to the ISFSI.
b. Estimated.
c. Additional canisters of GTCC low-level radioactive waste could be generated during decommissioning.
d. The list of approved contents in the certificate of compliance for the MP197HB transportation cask would need to be modified to include the 32PTH2 canister.
BWR= boiling water reactor
GTCC= greater-than-Class C
ISFSI= independent spent fuel storage installation
PWR= pressurized water reactor
UNF= used nuclear fuel

2.1 Maine Yankee

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Maine Yankee site. The Maine Yankee site is about 25 miles south of Augusta and about 45 miles north of Portland, Maine (TOPO 1993a).

2.1.1 Site Inventory

Sixty canisters containing 1432 used nuclear fuel assemblies, 2 consolidated fuel rod containers, and 2 failed fuel rod containers (i.e., damaged fuel cans[9]) and 4 canisters of GTCC low-level radioactive waste are stored at the Maine Yankee ISFSI (Docket No. 72-30). Figure 2-4 shows the Maine Yankee ISFSI. The storage system used at Maine Yankee is the NAC-UMS system (Docket No. 72-1015), which consists of a transportable storage canister, a vertical concrete storage cask, and a transfer cask. The transportable storage canister holds 24 pressurized water reactor used nuclear fuel assemblies. The fuel assemblies from Maine Yankee were loaded into transportable storage canisters from August 2002 through March 2004 (Leduc 2012). The fuel assemblies have zirconium alloy-clad fuel rods. The transportation cask that is certified to transport the canisters containing this used nuclear fuel or GTCC low-level radioactive waste is the NAC-UMS Universal Transport Cask (UTC) Package (Docket No. 71-9270). No NAC-UMS UTC transportation casks have been fabricated.

Figure 2-5 illustrates the number of used nuclear fuel assemblies at Maine Yankee based on their discharge year. The oldest fuel was discharged in 1974 and the last fuel was discharged in 1996. The median discharge year of the fuel is 1984.

Figure 2-6 illustrates the number of used nuclear fuel assemblies at Maine Yankee based on their burnup. The lowest burnup is 2.8 gigawatt-day per metric ton heavy metal (GWd/MTHM) and the highest burnup is 49.2 GWd/MTHM. The median burnup is 32.1 GWd/MTHM. Used nuclear fuel with a burnup greater than 45 GWd/MTHM is termed as high burnup used nuclear fuel by the NRC. There are 90 of these high burnup used nuclear fuel assemblies at Maine Yankee. These high burnup used nuclear fuel assemblies were packaged in Maine Yankee Fuel Cans (i.e., damaged fuel cans, see Figure 2-7 through Figure 2-9) and were loaded in the four basket corner positions in the transportable storage canisters. Twenty-three transportable storage canisters containing high burnup used nuclear fuel are stored at Maine Yankee. There are also 12 transportable storage canisters containing 43 damaged fuel assemblies in damaged fuel cans stored at Maine Yankee.

[9] A damaged fuel can is a stainless steel container that confines damaged used nuclear fuel. A damaged fuel can is closed on its end by screened openings. These screened openings allow gaseous and liquid media to escape but minimize the dispersal of gross particulate material.



Photo courtesy of Maine Yankee

Figure 2-4. Maine Yankee Independent Spent Fuel Storage Installation (2014)

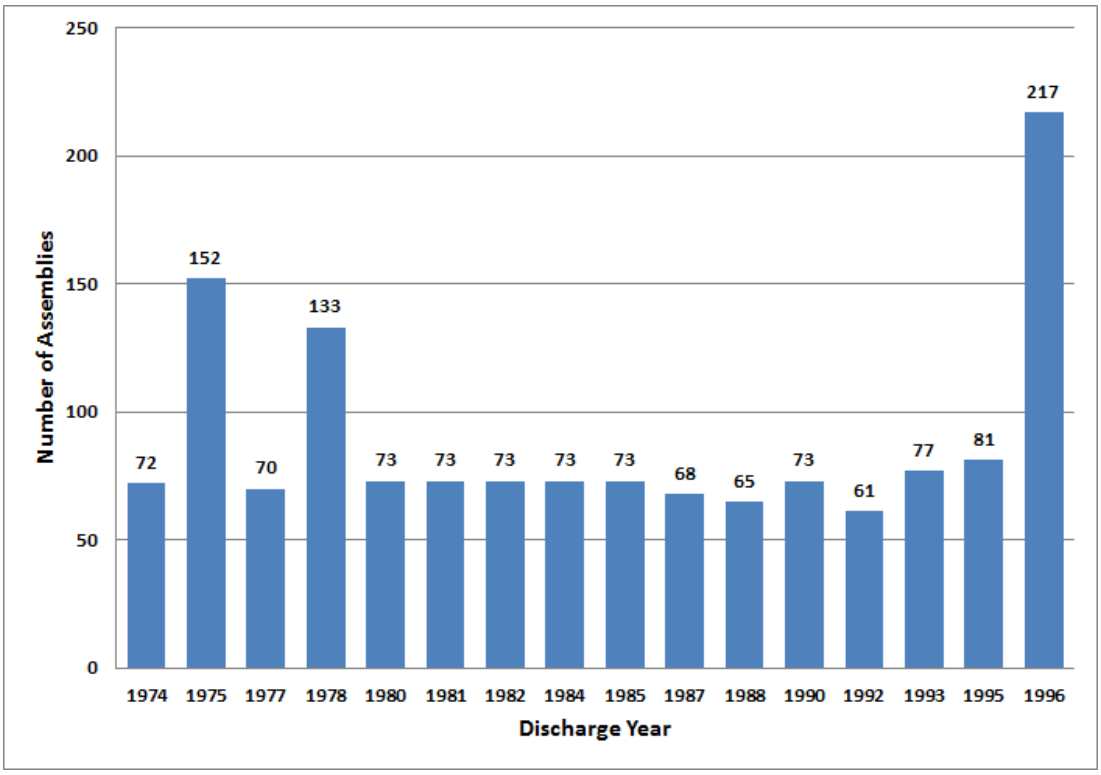


Figure 2-5. Maine Yankee Number of Assemblies versus Discharge Year (EIA 2013)

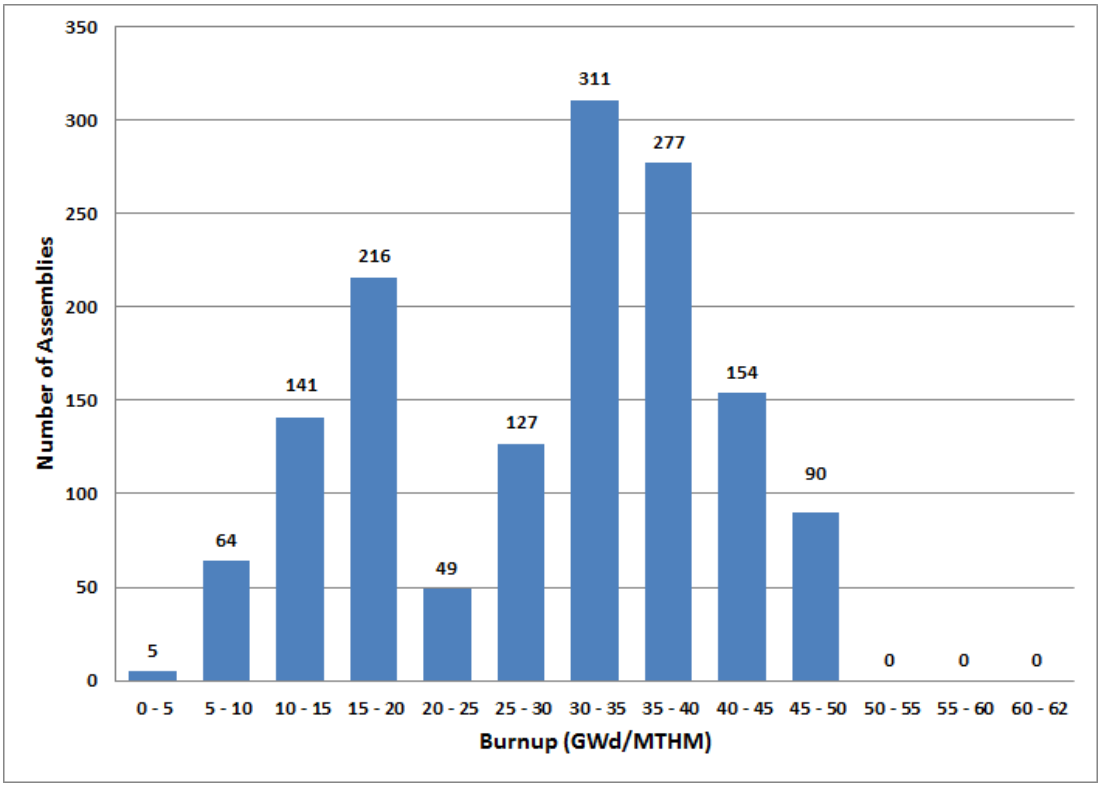


Figure 2-6. Maine Yankee Number of Assemblies versus Burnup (EIA 2013)



Photo courtesy of NAC International

Figure 2-7. Damaged Fuel Cans



Photo courtesy of NAC International

Figure 2-8. Ends of Damaged Fuel Cans with Screened Openings

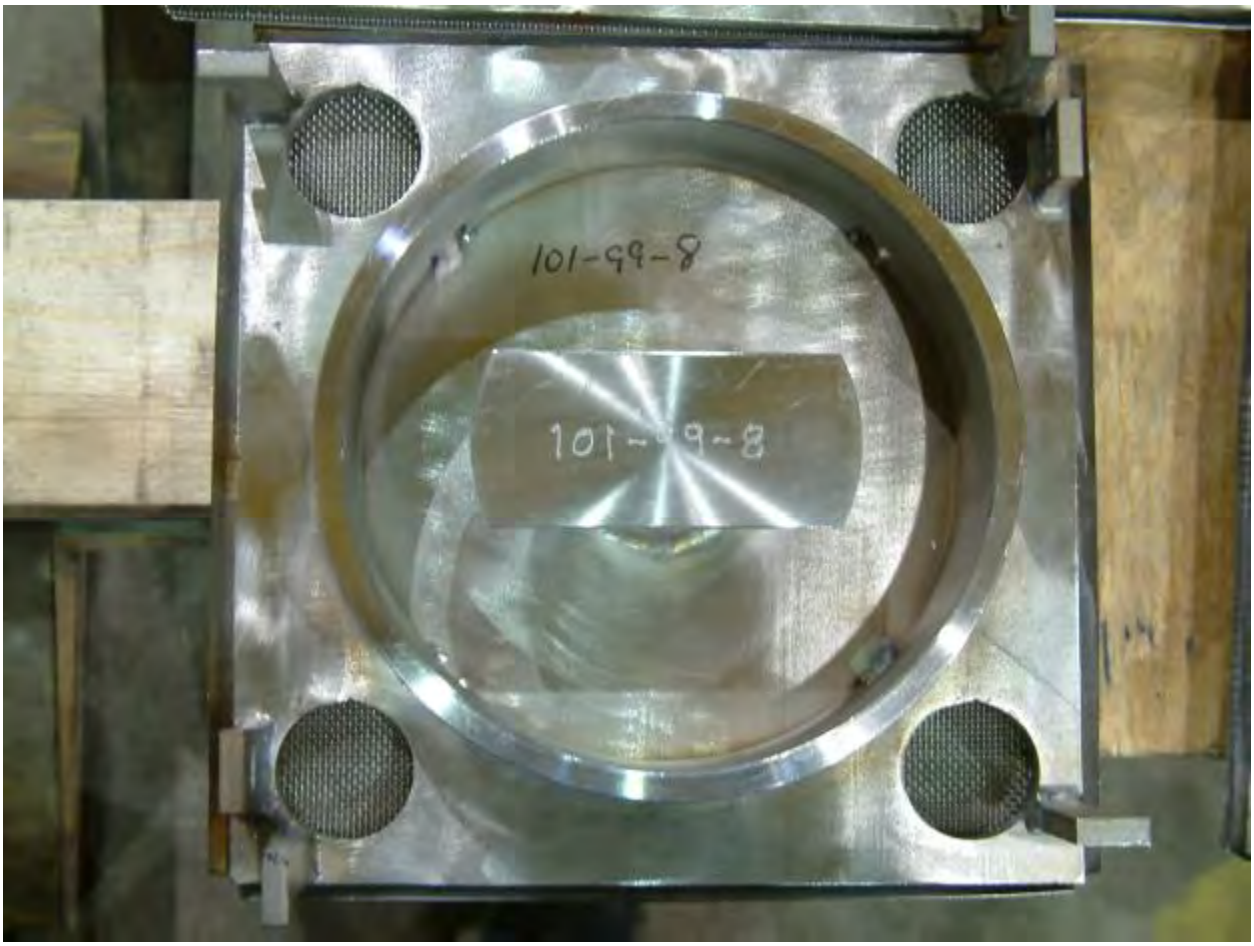


Photo courtesy of NAC International

Figure 2-9. Damaged Fuel Can Lid with Screened Openings

2.1.2 Site Conditions

Figure 2-10 provides an aerial view of the Maine Yankee site, where the Maine Yankee reactor and associated structures have been removed. Electrical power is available at the Maine Yankee ISFSI. However, mobile equipment such as cranes to unload the NAC-UMS vertical concrete storage casks used at Maine Yankee and to load the NAC-UMS UTC transportation cask that is certified to transport the Maine Yankee used nuclear fuel and GTCC low-level radioactive waste, is not present at the site. In addition, a transfer cask, which is used to transfer the transportable storage canister from a NAC-UMS vertical concrete storage cask to a NAC-UMS UTC transportation cask, is not present at the site.

An on-site rail spur exists at Maine Yankee (Figure 2-11). This spur connects to the Rockland branch of the Central Maine and Quebec Railway at milepost 46.66, which is designated as track class 2.[10] The distance from the Maine Yankee ISFSI to the Rockland branch is about 2.2 miles. The Rockland branch connects to the Pan Am Railways in Brunswick, Maine. The distance from

[10] Track class is a measure of track quality. In 49 CFR Part 213, the Federal Railroad Administration has categorized all track into nine classes (1-9), segregated by maximum allowable operating speed.

the Rockland branch to the Pan Am Railways in Brunswick, Maine is about 25 miles. Pan Am Railways is a Class II regional railroad.[11] During decommissioning, 238 radioactive and nonradioactive waste shipments were made over the period 2000 to 2005 using this rail spur (EPRI 2005). There appears to be sufficient room within the Owner Controlled Area to permit staging of railcars. However, the rail spur has been paved over in spots (see Figure 2-12) and is not being maintained.

A barge dock that exists at Maine Yankee (Figure 2-13) would provide access to the Atlantic Ocean. The distance from the Maine Yankee ISFSI to the barge dock is about 0.5 mile. The Maine Yankee steam generators, pressurizer, and reactor pressure vessel were shipped off-site using this barge dock (Wheeler 2002, Feigenbaum 2005). The three steam generators weighed 356 tons each (491 tons each when the shielding and carriage assembly are included) and the pressurizer weighed 100 tons (Radwaste Solutions 2000). These components were transported to Memphis, Tennessee for decontamination (Radwaste Solutions 2000). The reactor pressure vessel package weighed 1175 tons and was transported to the Barnwell, South Carolina low-level radioactive waste disposal facility (Feigenbaum 2005). In addition, EPRI (2005) states that the site's main power transformers were shipped off-site by barge. The barge dock is approximately 10 feet above the water and the depth of the water is about 6 feet at high tide (TOPO 1993a). The barge dock and access road were last used in 2003 (TriVis Incorporated 2005) and are not being maintained.

[11] Railroads are classified by the Surface Transportation Board based on their annual operating revenues. The class to which a carrier belongs is determined by comparing its adjusted operating revenues for three consecutive years to the following scale: Class I - $250 million or more, Class II - $20 million or more, and Class III - $0 to $20 million. The following formula is used to adjust a railroad's operating revenues to eliminate the effects of inflation: Current Year's Revenues × (1991 Average Index ÷ Current Year's Average Index). The average index (deflator factor) is based on the annual average Railroad Freight Price Index for all commodities (STB 2012). The U.S. Class I railroads in 2013 are the BNSF Railway, CSX Transportation, Grand Trunk Corporation, Kansas City Southern Railway, Norfolk Southern Combined Railroad Subsidiaries, Soo Line Corporation, and Union Pacific Railroad.



Figure 2-10. Aerial View of the Maine Yankee Site (Google 2015)



Figure 2-11. On-site Rail Spur at the Maine Yankee Site (Google 2015)



Figure 2-12. Paved-over Railroad Tracks at the Maine Yankee Site (2012)



Figure 2-13. Barge Dock at the Maine Yankee Site (2012)

2.1.3 Near-site Transportation Infrastructure and Experience

As discussed in Section 2.1.2, Maine Yankee has direct rail access to the Central Maine and Quebec Railway via an on-site rail spur (see Figure 2-14). This rail spur was used for radioactive and nonradioactive waste shipments during decommissioning. There is sufficient room at Maine Yankee for a long on-site rail spur that should be able to accommodate trains having eight or more railcars (two buffer cars, a security escort car, and five or more cask cars).

The Maine Yankee site is located on Bailey Point on the Back River and has access to the Atlantic Ocean through the Sheepscot River. The Back River and Sheepscot River are navigable waterways and Maine Yankee has an on-site barge dock (see Figure 2-13) and therefore could be accessible by barges that would transport used nuclear fuel transportation casks to nearby ports served by railroads or to barge-accessible rail sidings or spurs. The nearest port with rail access is in Portland, Maine (DSI 2004).

As discussed in Section 2.1.2, during decommissioning at Maine Yankee, three steam generators, the pressurizer, and reactor pressure vessel were transported off-site using barges. Figure 2-15 and Figure 2-16 show the Maine Yankee reactor pressure vessel being loaded onto a barge and being transported by barge, respectively.

For a site such as Maine Yankee that is directly accessible by barge, transportation casks could be loaded, prepared for off-site transportation, and placed onto transport skids/cradles. Because the location of the Maine Yankee ISFSI is not immediately adjacent to the barge dock, heavy-lift equipment could be used to place the casks and transport skids/cradles onto heavy haul vehicles for transport from the ISFSI to the on-site barge dock. Heavy-lift equipment could then transfer the casks from the heavy haul vehicles onto the deck of the transporting barges. Alternatively, the heavy haul transport vehicles with their transport casks could roll onto the barge, thereby not requiring heavy-lift capability at the barge dock to move the casks from the heavy haul truck to the barge.

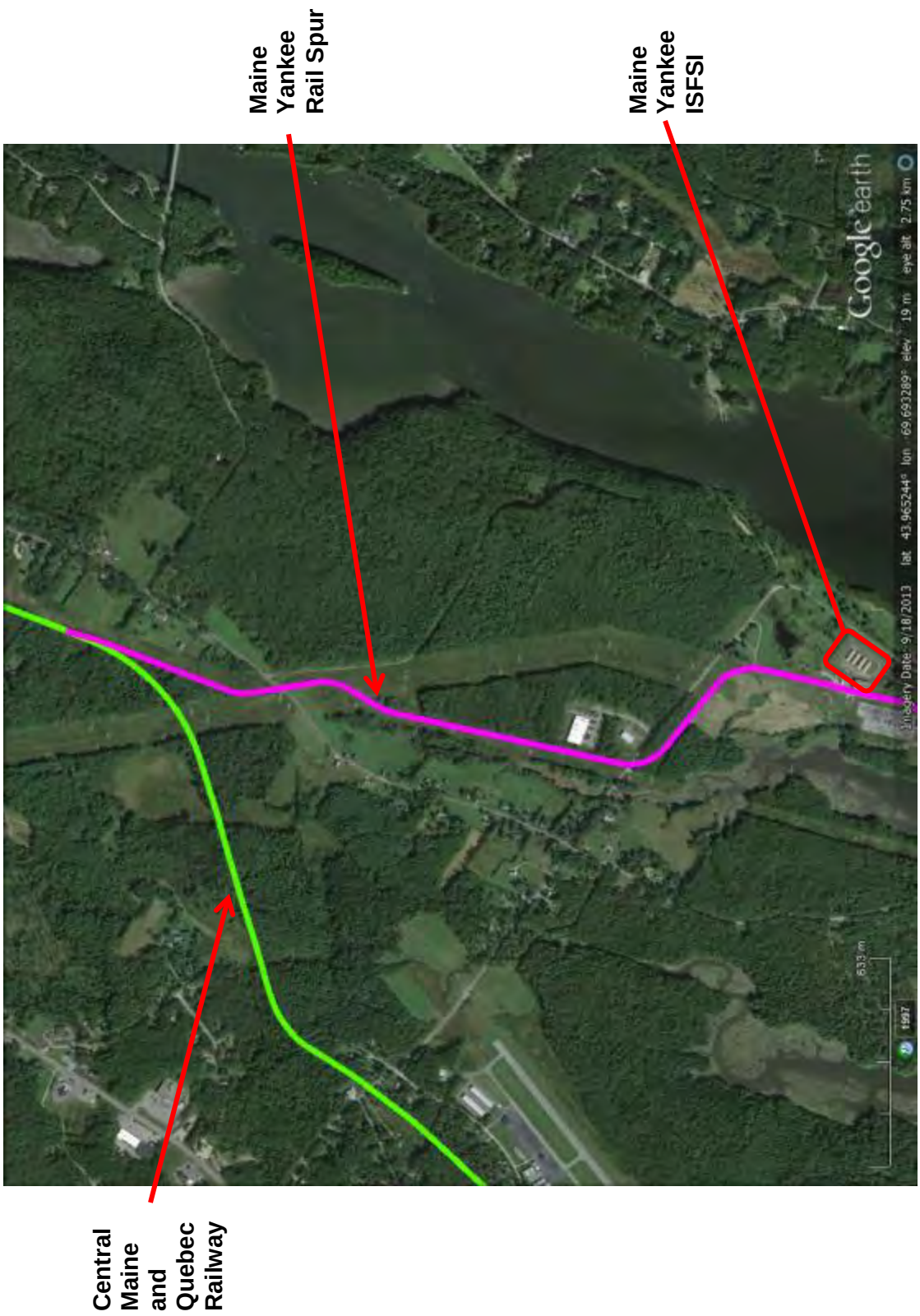


Figure 2-14. Rail Interface at Maine Yankee (Google 2015)



Photo courtesy of Maine Yankee

Figure 2-15. Maine Yankee Reactor Pressure Vessel Being Loaded onto Barge (2003)



Photo courtesy of Maine Yankee

Figure 2-16. Maine Yankee Reactor Pressure Vessel Being Transported on Barge (2003)

2.1.4 Gaps in Information

The principal question for the Maine Yankee site regarding the capability of the off-site transportation infrastructure to accommodate shipments of large transportation casks is whether the Central Maine and Quebec Railway is capable of accepting and moving used nuclear fuel railcars. An assessment by the Federal Railroad Administration's track safety engineers and of the Central Maine and Quebec Railway's maintenance-of-way staff would be necessary. If the railroad's infrastructure cannot accommodate the shipments, it would be necessary to ship casks on barges from the site to a port where they would be transferred to railcars. Because the Maine Yankee reactor pressure vessel was shipped from the site by barge, there is substantial confidence that barges could be used to move used nuclear fuel casks from the site. Nonetheless, it would be necessary to obtain a marine engineer's assessment of the condition of the channel leading to the Maine Yankee barge siding and to do any dredging and restoration of navigation aids in the channel that may be necessary.

2.2 Yankee Rowe

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Yankee Rowe site. The Yankee Rowe site is in the northwest corner of Massachusetts, about 0.5 mile south of the Vermont border, 3.5 miles northwest of the town of Rowe, and 48 miles north of Pittsfield, Massachusetts (TOPO 1993b).

2.2.1 Site Inventory

There are 15 canisters containing 533 used nuclear fuel assemblies and 1 reconfigured fuel assembly,[12] and 1 canister of GTCC low-level radioactive waste stored at the Yankee Rowe ISFSI (Docket No. 72-31). The 15 canisters contain 7 damaged used nuclear fuel assemblies, which have been placed in damaged fuel cans.

Figure 2-17 shows the Yankee Rowe ISFSI. The storage system used at Yankee Rowe is the NAC Multi-Purpose Canister system (NAC-MPC) (Docket No. 72-1025), which consists of a transportable storage canister, a vertical concrete storage cask, and a transfer cask. The transportable storage canister used for the Yankee Rowe used nuclear fuel is the Yankee-MPC, which holds 36 Yankee Rowe pressurized water reactor used nuclear fuel assemblies. The Yankee Rowe fuel assemblies were loaded into NAC-MPC canisters from June 2002 through June 2003 (Leduc 2012). The fuel rods in the fuel assemblies at Yankee Rowe are either zirconium alloy-clad (457 assemblies) or stainless steel-clad (76 assemblies). The NAC-STC transportation cask (Docket No. 71-9235) is certified to transport the Yankee-MPC canisters,

[12] A Yankee Rowe reconfigured fuel assembly is a stainless steel container having approximately the same external dimensions as a used nuclear fuel assembly that ensures criticality control geometry and permits gaseous and liquid media to escape while preventing the dispersal of gross particulates. A Yankee Rowe reconfigured fuel assembly may contain intact fuel rods, damaged fuel rods, and fuel debris. The Yankee Rowe reconfigured fuel assembly consists of a shell (square tube with end fittings) and a basket assembly that supports 64 tubes in an 8 × 8 array, which hold the intact fuel rods, damaged fuel rods, or fuel debris. The shell, basket assembly and tubes are stainless steel. The spent fuel rods are confined in the fuel tubes, which are closed with end plugs. The shell is closed with top and bottom end fittings. The tube end plugs and the shell end fittings have drilled holes to permit draining, drying, and helium backfilling (NAC 2006).

including canisters containing GTCC low-level radioactive waste. Figure 2-18 illustrates the NAC-STC transportation cask. No NAC-STC transportation casks have been fabricated for use in the United States. Two NAC-STC transportation casks have been fabricated for use in China (Washington Nuclear Corporation 2003).

Figure 2-19 illustrates the number of used nuclear fuel assemblies at Yankee Rowe, based on their discharge year. The oldest fuel was discharged in 1972 and the last fuel was discharged in 1991. The median discharge year of the fuel is 1984.

Figure 2-20 illustrates the number of used nuclear fuel assemblies at Yankee Rowe based on their burnup. The lowest burnup is 4.2 GWd/MTHM and the highest burnup is 36.0 GWd/MTHM. The median burnup is 28.0 GWd/MTHM. There are no high burnup used nuclear fuel assemblies (burnup greater than 45 GWd/MTHM) stored at Yankee Rowe.



Photo courtesy of Yankee Rowe

Figure 2-17. Yankee Rowe Independent Spent Fuel Storage Installation



Photo courtesy of NAC International

Figure 2-18. NAC-STC Transportation Cask

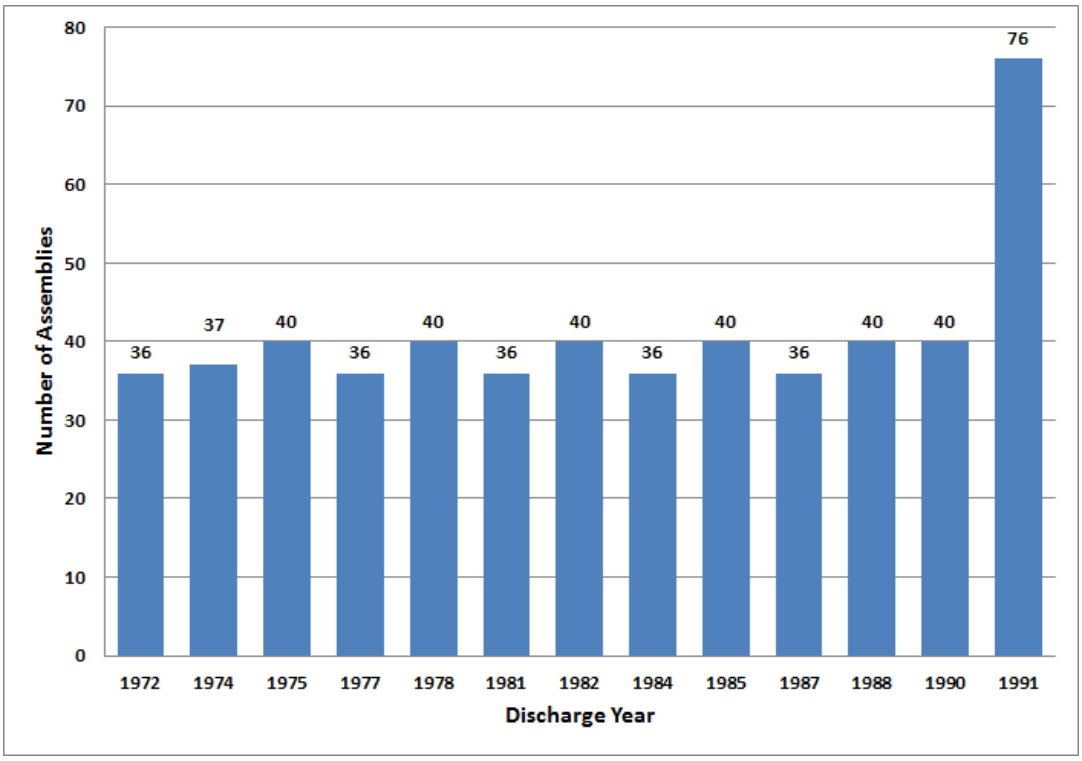


Figure 2-19. Yankee Rowe Number of Assemblies versus Discharge Year (EIA 2013)

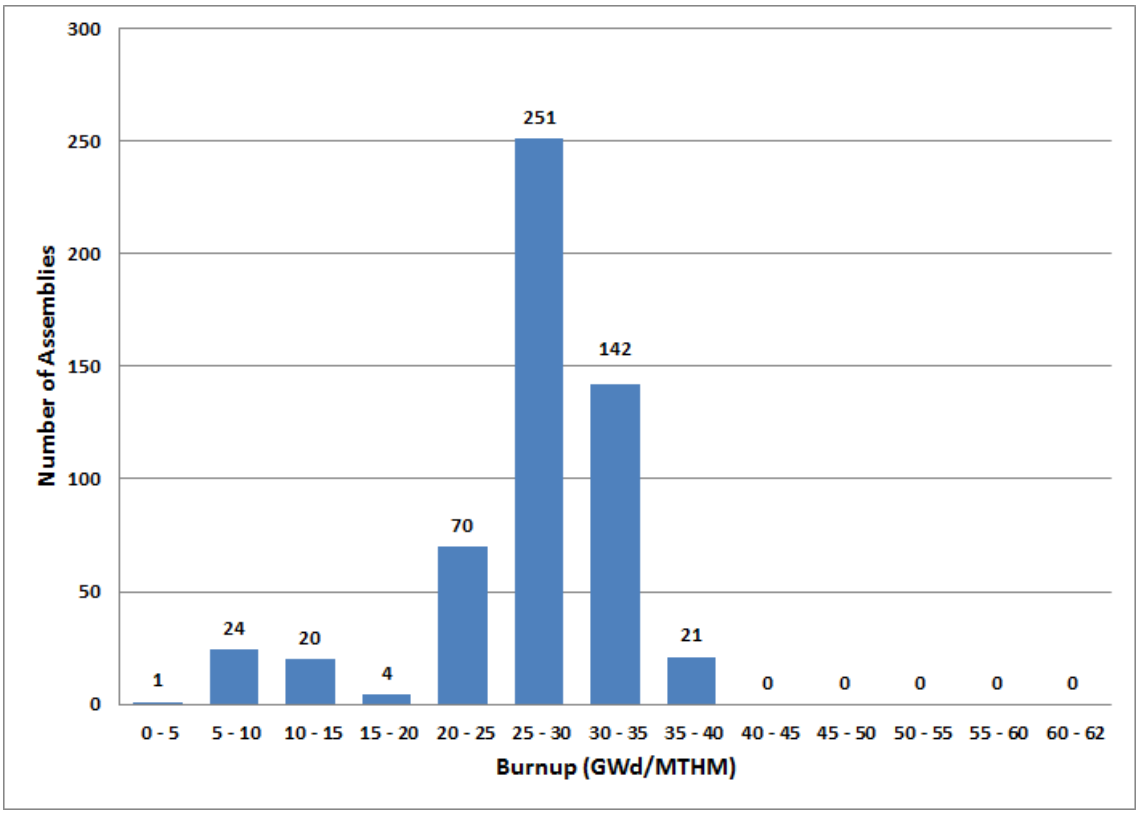


Figure 2-20. Yankee Rowe Number of Assemblies versus Burnup (EIA 2013)

2.2.2 Site Conditions

Figure 2-21 provides an aerial view of the Yankee Rowe site, where the reactor and associated structures have been removed. Electrical power is available at the Yankee Rowe ISFSI. However, mobile equipment such as cranes to unload the NAC-MPC vertical concrete storage casks used at Yankee Rowe and to load the NAC-STC transportation cask that is certified to transport the Yankee Rowe used nuclear fuel and GTCC low-level radioactive waste is not currently present at the site. In addition, a transfer cask, which is used to transfer the Yankee-MPC transportable storage canister from a NAC-MPC vertical concrete storage cask to a NAC-STC transportation cask, is not currently present at the site. There are two compatible transfer casks without doors or hydraulic components stored at the Connecticut Yankee site and one compatible transfer cask at the La Crosse site.

There is no barge access or direct rail access at the Yankee Rowe site. The nearest off-site barge facility is located in Albany, New York, a distance of 50 miles from Yankee Rowe (TriVis Incorporated 2005). Yankee Rowe had direct rail service, but the rail spur to the site was removed in the early 1970s and cannot be reinstalled because the construction of the Cockwell (formerly Bear Swamp) Pumped Storage Plant resulted in submersion of the rail line to Yankee Rowe (TOPO 1993b). The nearest rail access is at the east end of the Hoosac Tunnel, a distance of about 7.5 miles from the Yankee Rowe site. Heavy haul truck transport would be required to move NAC-STC transportation casks containing used nuclear fuel or GTCC low-level radioactive waste to this location.

2.2.3 Near-site Transportation Infrastructure and Experience

The Yankee Rowe site does not have an on-site rail spur or a railroad that passes near to the site or along the site boundary. For Yankee Rowe, heavy haul trucks could be used to move transportation casks over public highways to a rail siding or spur that provides access to a railroad that can accommodate the loaded transportation casks.

For shipments of casks containing used nuclear fuel that require the use of heavy haul trucks, the casks would be prepared for shipment at the Yankee Rowe ISFSI site and loaded onto a transport cradle that would be loaded onto the transport trailer of a heavy haul truck. The truck, led and followed by technical and security escorts, would move over an approved, designated highway route to a nearby rail siding or spur. Heavy lift equipment would be used to transload the cask and its cradle as a unit from the truck to a railcar at the rail siding or spur.

Heavy haul trucks were used to move the reactor pressure vessel and steam generators from the Yankee Rowe site. For example, in 1997, the Yankee Rowe reactor pressure vessel was moved 7.5 miles on an improved county road by a heavy haul truck from the Yankee Rowe site to the rail line at the east portal of the Hoosac Tunnel in western Massachusetts (see Figure 2-22 through Figure 2-24). The rail line is operated by the Pan Am Southern Railroad, a partnership of the Norfolk Southern Railroad and the Pan Am Railroad Company, a northeastern U.S. Class II regional railroad. The Pan Am Southern rail line at the Hoosac Tunnel is designated as track class 3. To reach the east portal of the Hoosac Tunnel, the heavy haul truck and reactor pressure vessel had to cross the Sherman Dam. EPRI (1997a, 1998) states that the spillway bridge on the Sherman Dam was replaced prior to shipping the reactor pressure vessel and the slope stability along the roadway, as well as the roadway culverts, were assessed for the loaded transport conditions. The reactor pressure vessel package weighed 365 tons with saddle and tie downs (EPRI 1997a, 1998). At the Hoosac Tunnel rail crossing, the reactor pressure vessel package was transloaded from the roadway transporter to a TransAlta CAPX 1001 railcar. The railcar was equipped with a lateral shift mechanism that enabled handlers to move the cargo left or right up to 12 inches (Lessard 2000). The loaded gross weight of the railcar and reactor pressure vessel package was 1,122,700 lb. (EPRI 1997a, 1998). The reactor pressure vessel was then transported to the Barnwell, South Carolina low-level radioactive waste disposal facility (Lessard 2000). During the trip to Barnwell, South Carolina, the lateral shift mechanism had to be used on six separate occasions to maneuver around structures or other railcars along the route (Lessard 2000). These shifts ranged from 3 to 12 inches (Lessard 2000).

Figure 2-25 shows the rail line at the east portal of the Hoosac Tunnel and Figure 2-26 shows the east portal of the Hoosac Tunnel. Figure 2-27 shows the Yankee Rowe reactor pressure vessel on the railcar used to transport it to the Barnwell, South Carolina low-level radioactive waste disposal facility. Figure 2-28 shows the route taken from the Yankee Rowe site to the east portal of the Hoosac Tunnel.

2.2.4 Gaps in Information

The Yankee Rowe site is located inland in the western part of Massachusetts and thus does not have access to a navigable waterway. In addition, the Yankee Rowe site does not have direct rail access.



Figure 2-21. Aerial View of the Yankee Rowe Site (Google 2015)



Photo courtesy of AREVA

Figure 2-22. Yankee Rowe Reactor Pressure Vessel Crossing the Sherman Dam (1997)



Photo courtesy of Yankee Rowe

Figure 2-23. Yankee Rowe Reactor Pressure Vessel on Heavy Haul Truck Moving Under Power Lines (1997)



Photo courtesy of AREVA

Figure 2-24. Yankee Rowe Reactor Pressure Vessel on Heavy Haul Truck (1997)



Figure 2-25. Rail Line at East Portal of the Hoosac Tunnel (2012)



Figure 2-26. East Portal of the Hoosac Tunnel (2012)



Photo courtesy of Yankee Rowe

Figure 2-27. Yankee Rowe Reactor Pressure Vessel on Railcar (1997)

Consequently, it would be necessary to use heavy haul trucks to transport casks containing used nuclear fuel from the site for a distance of about 7.5 miles over a local, improved road to the nearest location for a rail siding at the eastern portal of the Hoosac Tunnel. This would require constructing an on-site access road from the Yankee Rowe ISFSI to the Sherman Dam and obtaining authorization for the heavy haul vehicles to cross the dam. The Sherman Dam is owned and operated by TransCanada Hydro Northeast, Inc. Based on the experience during decommissioning, TransCanada would need to be notified of the intent to use the roadway and bridge to move heavy loads across the dam; the load evaluation used for the removal of the reactor pressure vessel and steam generators would have to be verified and modified if necessary, and an engineering walk down of the roadway and bridge would be needed to confirm that there had been no changes or deterioration that would invalidate the previous load evaluation.

The heavy haul truck route from Yankee Rowe to the Hoosac Tunnel can be ice covered at times during the winter and could need treatment to prepare it for shipments. A route survey and load evaluation for the heavy haul truck route would also be required. The siding that was installed at the tunnel for the purpose of loading the reactor pressure vessel onto a railcar has been removed and would need to be reinstalled before shipments of casks to this location could take place. Alternative routing for heavy haul trucks that would lead to North Adams, Massachusetts, where casks could be loaded onto railcars, would require travel north over mountainous local roads into Vermont then south to the North Adams area, a distance of about 20 miles.

There is sufficient land in the Hoosac Tunnel area to stage handling equipment. This is based on the use of this area to load the reactor pressure vessel from the transporter to the railcar. However, site preparation work would most likely be required. The available space is limited for a rail siding at the Hoosac Tunnel location, making it likely that only one or two railcars could be placed for loading. It would be necessary to move loaded railcars from the siding to a staging area, possibly in North Adams, where trains with possibly two locomotives, buffer cars, and an escort car could be assembled. A staging location has not been identified.

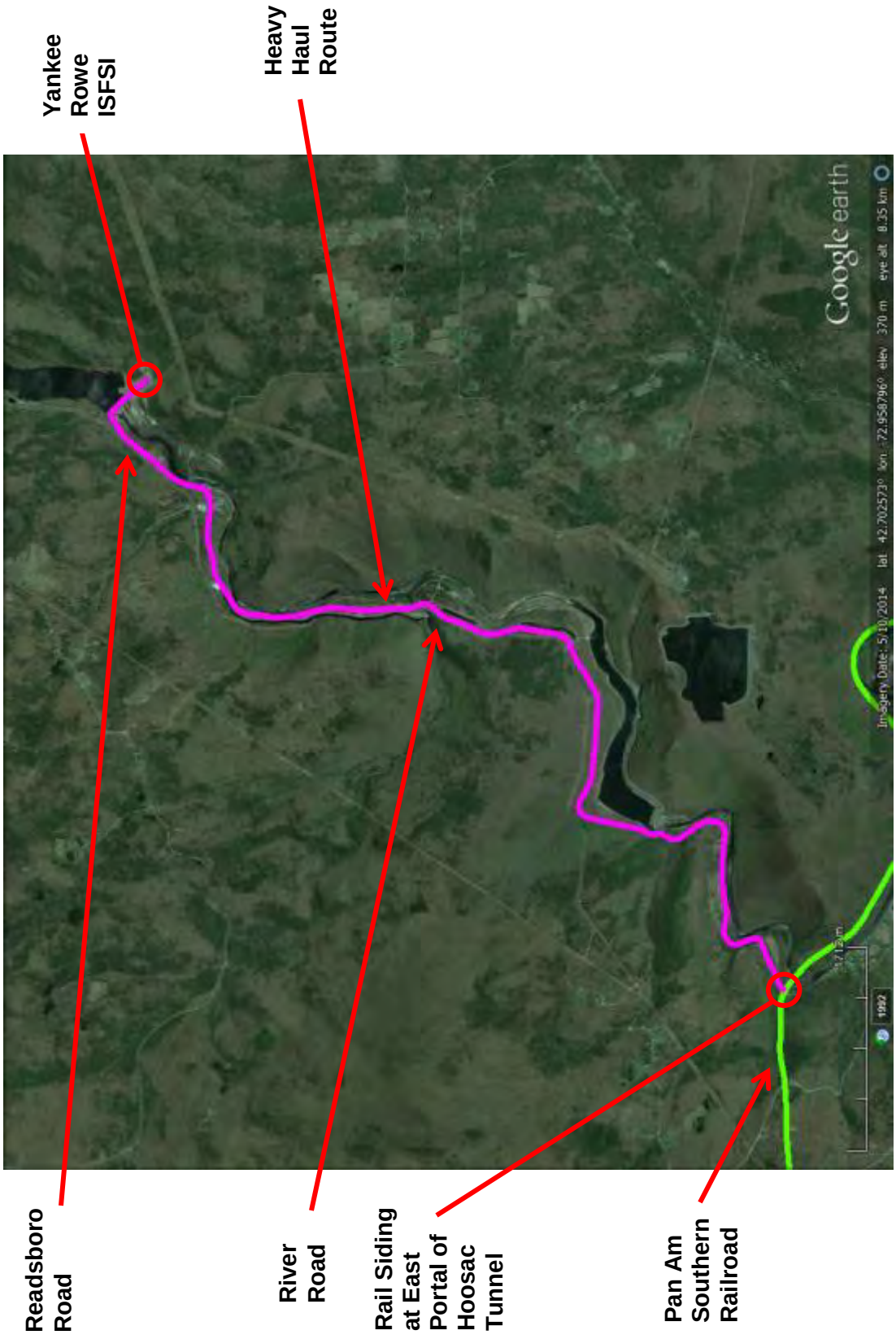


Figure 2-28. Yankee Rowe Reactor Pressure Vessel Heavy Haul Truck Route (Google 2015)

2.3 Connecticut Yankee

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Connecticut Yankee site. The Connecticut Yankee site is located on the eastern shore of the Connecticut River near Haddam Neck, Connecticut, about 13 miles southeast of Middletown and 25 miles southeast of Hartford, Connecticut (TOPO 1993c).

2.3.1 Site Inventory

Forty canisters containing 1019 used nuclear fuel assemblies and 5 fuel rod storage containers, and 3 canisters of GTCC low-level radioactive waste are stored at the Connecticut Yankee ISFSI (Docket No. 72-39). The 40 canisters contain 71 damaged fuel cans, which contain 66 damaged used nuclear fuel assemblies and 5 fuel rod storage containers. There are also an additional 82 stainless steel-clad used nuclear fuel assemblies from Connecticut Yankee that are stored at the Morris, Illinois ISFSI (Docket No. 72-1).

Figure 2-29 shows the Connecticut Yankee ISFSI. The storage system used at Connecticut Yankee is the NAC Multi-Purpose Canister system (NAC-MPC) (Docket No. 72-1025), which consists of a transportable storage canister, a vertical concrete storage cask, and a transfer cask. The transportable storage canister used for the Connecticut Yankee (CY) used nuclear fuel is the CY-MPC. This canister may be configured to hold 24 or 26 pressurized water reactor used nuclear fuel assemblies. The fuel assemblies from Connecticut Yankee were loaded into CY-MPC canisters from May 2004 through March 2005 (Leduc 2012). The fuel rods in the fuel assemblies at Connecticut Yankee are either zirconium alloy-clad (161 assemblies) or stainless steel-clad (858 assemblies). The NAC-STC transportation cask (Docket No. 71-9235) is certified to transport the CY-MPC canisters, including canisters containing GTCC low-level radioactive waste. No NAC-STC transportation casks have been fabricated for use in the United States. Two NAC-STC transportation casks have been fabricated for use in China (Washington Nuclear Corporation 2003).



Photo courtesy of Connecticut Yankee

Figure 2-29. Connecticut Yankee Independent Spent Fuel Storage Installation

In addition to the 43 canisters of used nuclear fuel and GTCC low-level radioactive waste stored at the Connecticut Yankee ISFSI, two transfer casks are stored at the Connecticut Yankee ISFSI. These transfer casks could also be used at the Yankee Rowe site.

Figure 2-30 illustrates the number of used nuclear fuel assemblies at Connecticut Yankee, based on their discharge year. The oldest fuel was discharged in 1971 and the last fuel was discharged in 1996. The median discharge year of the fuel is 1984.

Figure 2-31 illustrates the number of used nuclear fuel assemblies at Connecticut Yankee, based on their burnup. The lowest burnup is 8.2 GWd/MTHM and the highest burnup is 43.0 GWd/MTHM. The median burnup is 33.1 GWd/MTHM. There is no high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) stored at Connecticut Yankee.

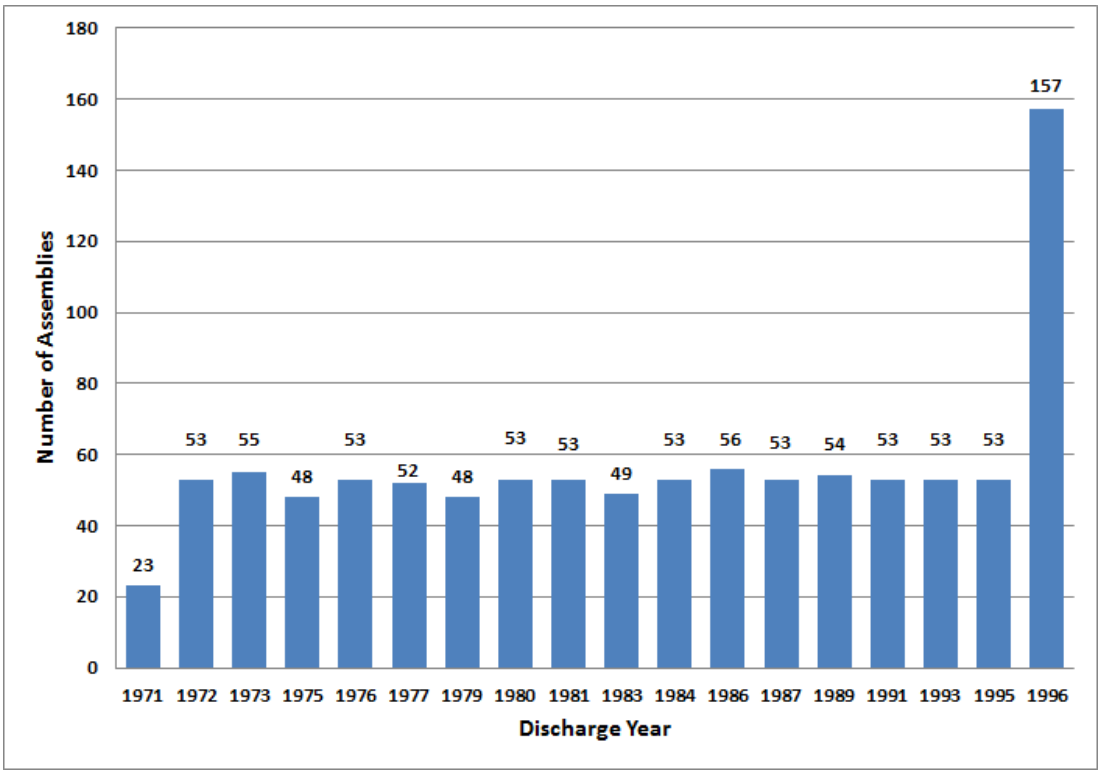


Figure 2-30. Connecticut Yankee Number of Assemblies versus Discharge Year (EIA 2013)

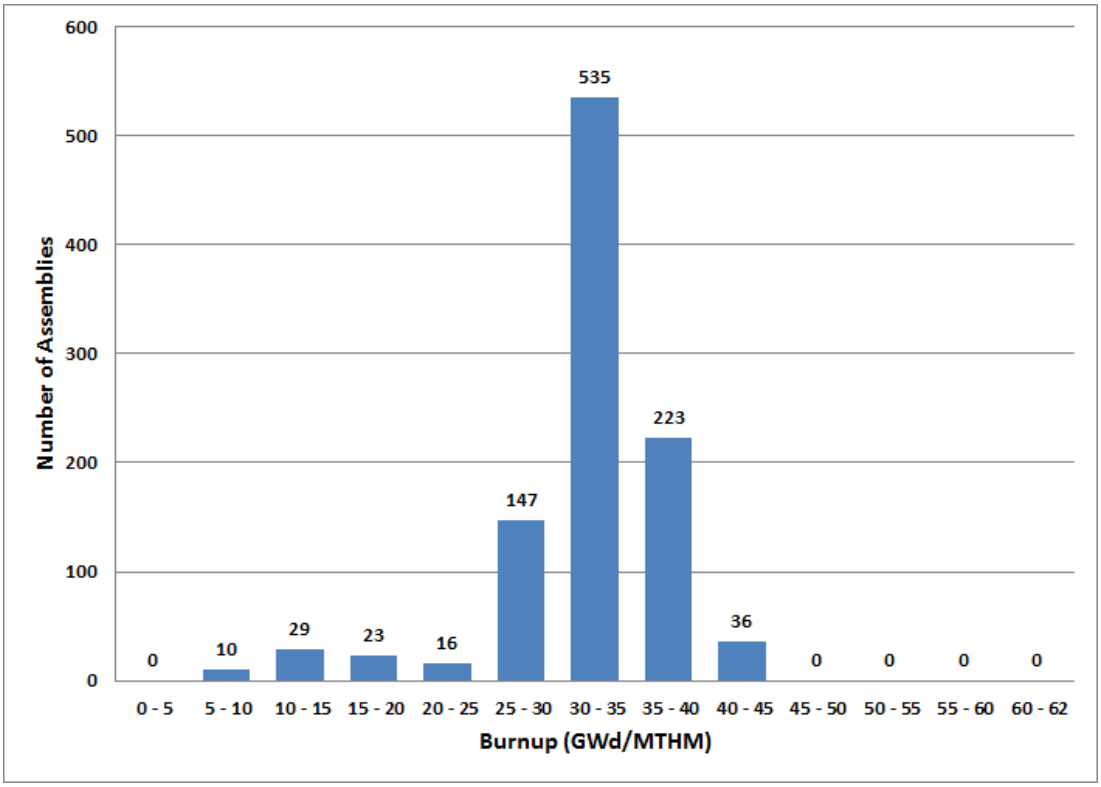


Figure 2-31. Connecticut Yankee Number of Assemblies versus Burnup (EIA 2013)

2.3.2 Site Conditions

Figure 2-32 and Figure 2-33 provide aerial views of the Connecticut Yankee site and ISFSI, where the reactor and associated structures have been removed. Electrical power is available at the Connecticut Yankee ISFSI. However, mobile equipment such as cranes to unload the NAC-MPC vertical concrete storage casks used at Connecticut Yankee and to load the NAC-STC transportation cask that is certified to transport the Connecticut Yankee used nuclear fuel and GTCC low-level radioactive waste is not currently present at the site. Two transfer casks without doors or hydraulic components are stored at the Connecticut Yankee ISFSI. These transfer casks could also be used at the Yankee Rowe site.

There is no on-site rail access at Connecticut Yankee. The nearest rail access is in Portland, Connecticut near Middletown, Connecticut, about 12 miles from the Connecticut Yankee ISFSI. To reach this location, heavy haul truck transport would be required. The rail line at Portland is designated as track class 1 and connects to the Providence and Worcester Railroad in Middletown, Connecticut after crossing the Connecticut River. The condition of this bridge is unknown. The Providence and Worcester rail line in Middletown, Connecticut is designated as track class 2.

An on-site barge slip at Connecticut Yankee is located in an area of the shoreline along the northwest end of the cooling water discharge canal (see Figure 2-34 and Figure 2-35) and is about 0.9 miles from the Connecticut Yankee ISFSI. This slip provides access to the Connecticut River and Atlantic Ocean (TOPO 1993c). The barge slip and cooling water discharge canal were used to ship the reactor pressure vessel, steam generators, and transformer off-site (EPRI 2006, Connecticut Yankee 2012). At the time that the reactor pressure vessel was shipped, the cooling water discharge canal had silted up, and the canal was dredged before the reactor pressure vessel was shipped (EPRI 2006). The on-site barge slip has not been used since decommissioning but remains intact. It is uncertain at this time whether the cooling water discharge canal is deep enough to accommodate barges without dredging.

2.3.3 Near-site Transportation Infrastructure and Experience

Eighty-two stainless steel-clad used nuclear fuel assemblies from Connecticut Yankee are stored at the Morris, Illinois ISFSI. Eighty assemblies were shipped directly from Connecticut Yankee to Morris (SAIC 1991). Three assemblies (G11, H07, and S004) were shipped from Connecticut Yankee to Battelle West Jefferson for examination (EPRI 1996); two of these assemblies (G11 and H07) were subsequently returned to Connecticut Yankee and then shipped to Morris (EPRI 1996). Assembly S004 was shipped to and is currently stored at the Idaho National Laboratory.

The Connecticut Yankee site does not have an on-site rail spur or a railroad that passes near to the site or along the site boundary. For Connecticut Yankee, heavy haul trucks could be used to move transportation casks over public highways to a rail siding or spur that provides access to a railroad that can accommodate the loaded transportation casks.

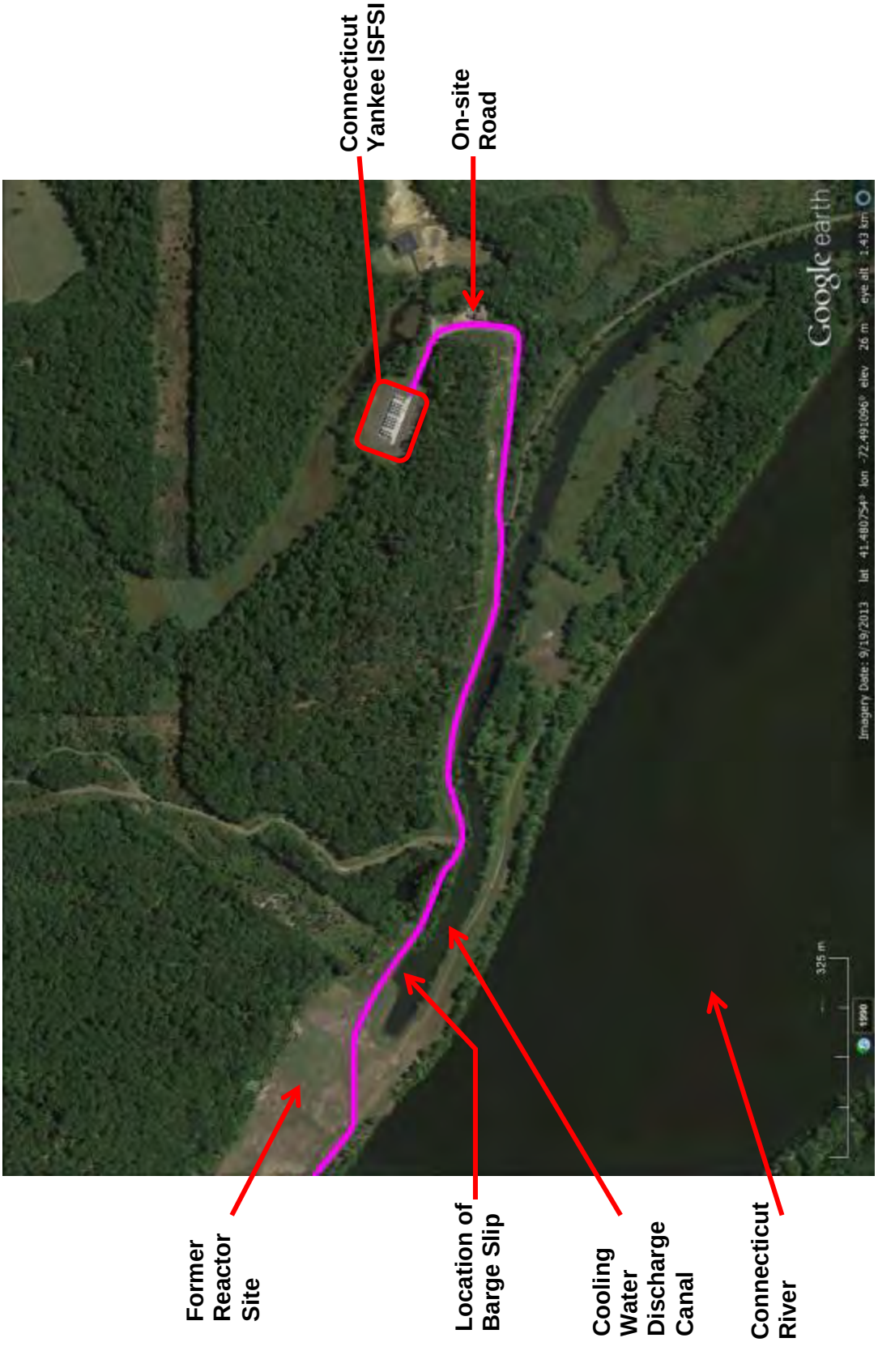


Figure 2-32. Aerial View of the Connecticut Yankee Site (Google 2015)



Photo courtesy of Connecticut Yankee

Figure 2-33. Aerial View of the Connecticut Yankee Independent Spent Fuel Storage Installation (2012)

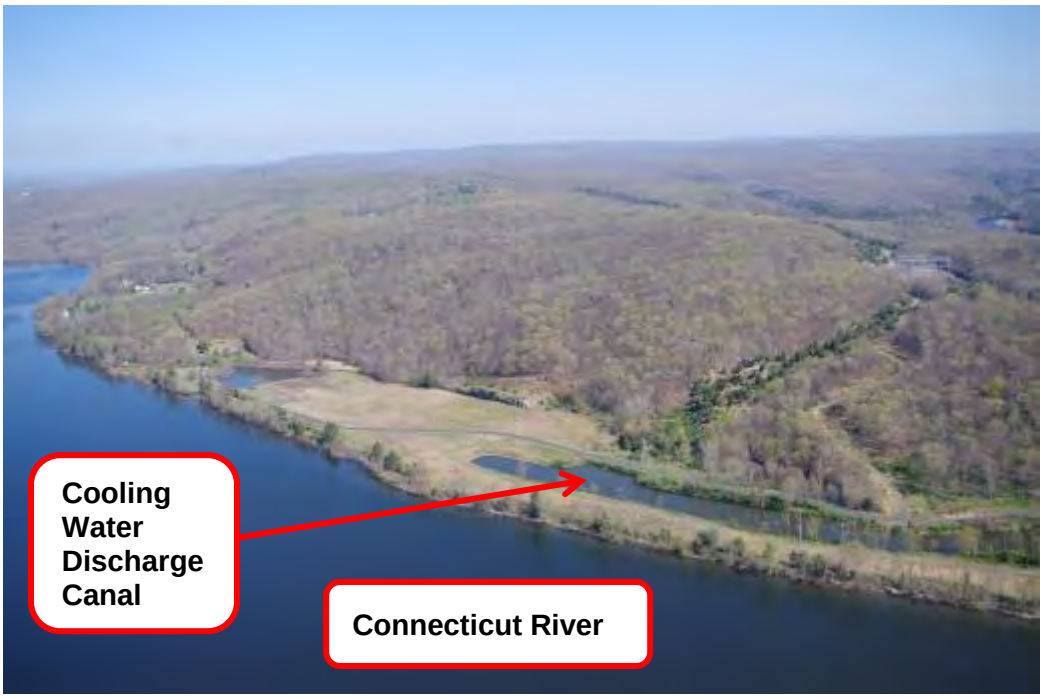


Photo courtesy of Connecticut Yankee

Figure 2-34. Aerial View of the Connecticut Yankee Site and Cooling Water Discharge Canal (2012)



Figure 2-35. Barge Slip at the Connecticut Yankee Site (2012)

For shipments of casks containing used nuclear fuel that require the use of heavy haul trucks, the casks would be prepared for shipment at the Connecticut Yankee ISFSI site and loaded onto a transport cradle that would then be loaded onto the transport trailer of a heavy haul truck. The truck, led and followed by technical and security escorts, would move over an approved, designated highway route to a nearby rail siding or spur. Heavy lift equipment would be used to transfer the cask and its cradle as a unit from the truck to a railcar at the rail siding or spur.

In 1999 and 2001, the steam domes[13] and pressurizer removed during demolition of the Connecticut Yankee (Haddam Neck) nuclear power plant were moved 12 miles from the plant site over local roads to the Portland rail spur near Middletown, Connecticut, transloaded onto railcars, and transported to the EnergySolutions low-level radioactive waste disposal facility in Clive, Utah (EPRI 2006). A total of five heavy haul truck shipments were made. Figure 2-36 shows the pressurizer on its heavy haul truck transporter and Figure 2-37 shows the route taken from the Connecticut Yankee site to the Portland rail spur. Figure 2-38 shows the pressurizer at the end of the Portland rail spur and Figure 2-39 shows the conditions at the end of the Portland rail spur in 2012.

If heavy haul trucks were used to move casks containing used nuclear fuel from the Connecticut Yankee site to the Middletown area rail spur, the P&W Railroad, which is a Class II regional railroad, would then haul the shipments to Hartford, Connecticut. In the Hartford area, the shipments would be switched to the Pan Am Southern Railroad, the same railroad that operates the rail line that passes near the Yankee Rowe site.

[13] The steam dome is the upper portion of the steam generator (EPRI 2006).



Photo courtesy of Connecticut Yankee

Figure 2-36. Connecticut Yankee Pressurizer on Heavy Haul Truck Transporter

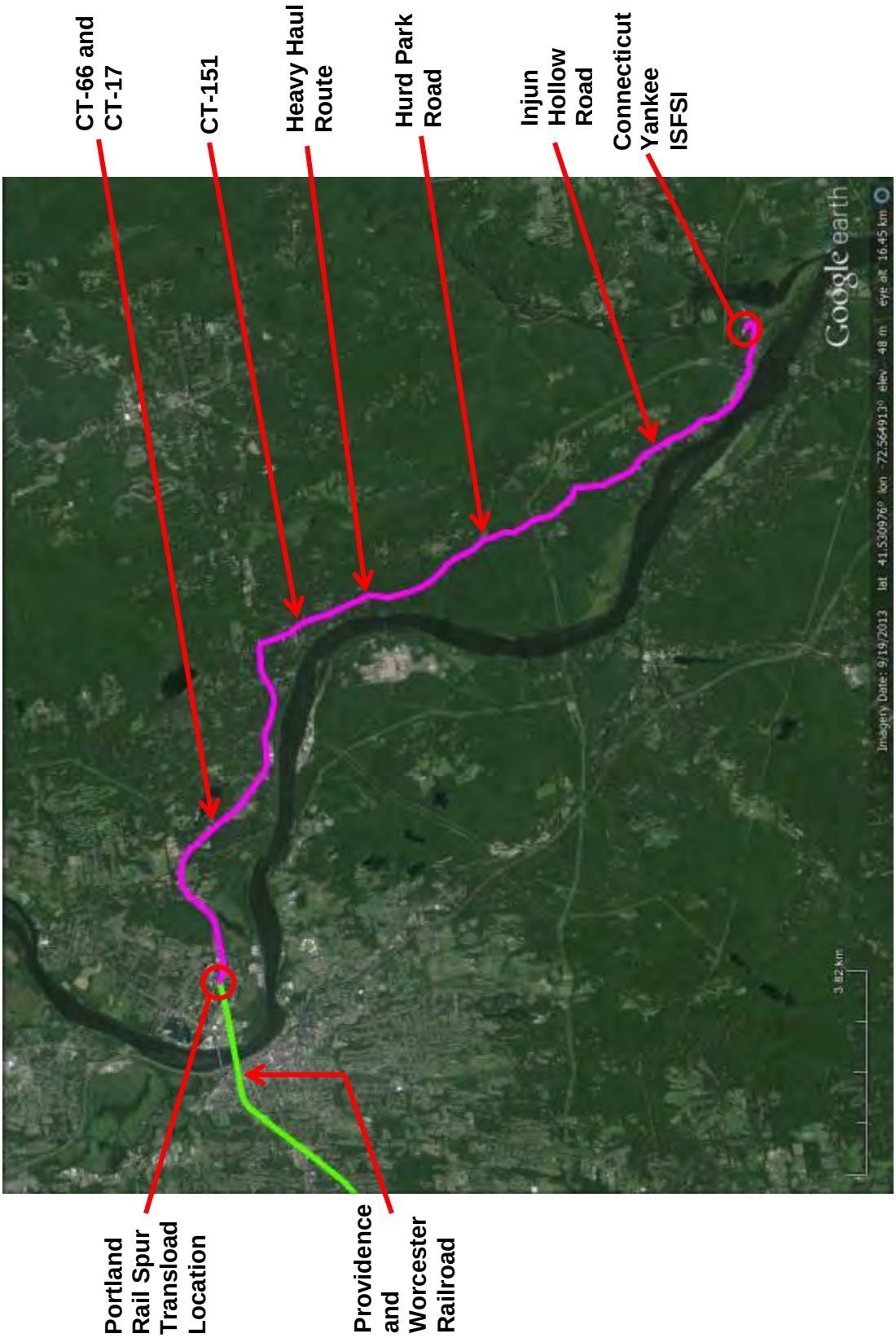


Figure 2-37. Connecticut Yankee Heavy Haul Truck Route (Google 2015)



Photo courtesy of Connecticut Yankee

Figure 2-38. Connecticut Yankee Pressurizer at the End of the Portland Rail Spur



Figure 2-39. Conditions at the End of the Portland Rail Spur (2012)

The Connecticut Yankee site is located on the shores of the Connecticut River and therefore could be accessible by barges that would transport used nuclear fuel transportation casks to nearby ports served by railroads or to barge-accessible rail sidings or spurs. The Connecticut Yankee barge slip is shown in Figure 2-35. The nearest port with rail access is in New Haven, Connecticut (DSI 2004). As discussed in Section 2.3.2, during decommissioning at Connecticut Yankee, the reactor pressure vessel, steam generators, and transformer were transported off-site using barges. Figure 2-40 through Figure 2-42 show the Connecticut Yankee reactor pressure vessel being loaded onto a barge and being transported by barge.



Photo courtesy of Connecticut Yankee

Figure 2-40. Connecticut Yankee Reactor Pressure Vessel Being Loaded onto Barge



Photo courtesy of Connecticut Yankee

Figure 2-41. Connecticut Yankee Reactor Pressure Vessel Being Transported on Barge



Photo courtesy of Connecticut Yankee

Figure 2-42. Connecticut Yankee Reactor Pressure Vessel Being Transported on Barge in the Connecticut River

2.3.4 Gaps in Information

The Connecticut Yankee site managers suggested that shipments of used nuclear fuel casks from the site should use barges. The on-site barge slip at Connecticut Yankee is an area of the shoreline along the cooling water discharge canal and has not been used since decommissioning but remains intact. It is uncertain whether the depth of the cooling water discharge canal remains deep enough to accommodate barges. In addition, the cooling water discharge canal and the Connecticut River can freeze in the winter.

Should it be necessary to use heavy haul trucks to move casks from the site, it would be necessary to work with local authorities to determine local routing and heavy haul truck operations procedures and schedules that would minimize disruption of traffic flow and other community activities in the moderately populated area. In addition, the heavy haul truck route from the Connecticut Yankee site to Portland, Connecticut can be ice covered at times during the winter and could need treatment to prepare it for shipments. An engineering review of the heavy haul route would also be required. It would also be necessary to work with the owners of the rail spur to improve track structures from their current degraded condition to allow the transfer of casks from heavy haul trucks to railcars. The condition of the rail bridge over the Connecticut River that is located west of the Portland rail spur would also need to be evaluated.

2.4 Humboldt Bay

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Humboldt Bay site. The Humboldt Bay site is located on Humboldt Bay near Eureka, California, about 260 miles north of San Francisco (TOPO 1993d).

2.4.1 Site Inventory

The Humboldt Bay ISFSI has a site-specific 10 CFR Part 72 license (License No. SNM-2514). Five canisters containing 390 used nuclear fuel assemblies and one canister containing GTCC low-level radioactive waste are stored at Humboldt Bay. Figure 2-43 shows the Humboldt Bay ISFSI. In contrast to other ISFSIs, the canisters at Humboldt Bay are stored in HI-STAR HB storage overpacks in a below-grade vault.

The storage system used at Humboldt Bay is the Holtec HI-STAR HB system, which is a variation of the HI-STAR 100 system (Docket No. 72-1008). The system consists of a multipurpose canister inside an overpack designed and certified for both storage and transportation. The MPC-HB canister used at Humboldt Bay can hold up to 80 Humboldt Bay boiling water reactor used nuclear fuel assemblies. The fuel assemblies from Humboldt Bay were loaded from August through December 2008 (Leduc 2012). The fuel rods in the fuel assemblies are zirconium alloy-clad. The HI-STAR HB storage overpacks used at Humboldt Bay are also transportable (Docket No. 71-9261); however, impact limiters are required and would need to be fabricated. The HI-STAR HB casks would also have to be leak tested and closure bolts inspected prior to shipping and seals replaced for any casks that failed the leak test or required replacement of closure bolts. The transportation certificate of compliance for the HI-STAR HB cask would need to be revised to allow transport of 44 used nuclear fuel assemblies at the Humboldt Bay site with initial enrichments of 2.08 weight percent, which is less than the minimum initial enrichment of 2.09 weight percent authorized by the transportation certificate of compliance for the HI-STAR HB cask. In addition, the HI-STAR HB cask is not currently certified for the transport of GTCC low-level radioactive waste.



Photo courtesy of Humboldt Bay

Figure 2-43. Humboldt Bay Independent Spent Fuel Storage Installation

Figure 2-44 illustrates the number of used nuclear fuel assemblies at Humboldt Bay based on their discharge year. The oldest fuel was discharged in 1971. The fuel was last critical in 1976 and was removed from the reactor vessel in 1984. The median discharge year of the fuel is 1975.

Figure 2-45 illustrates the number of used nuclear fuel assemblies at Humboldt Bay based on their burnup. The lowest burnup is 1.3 GWd/MTHM and the highest burnup is 22.9 GWd/MTHM. The median burnup is 16.4 GWd/MTHM. No high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) is stored at Humboldt Bay.

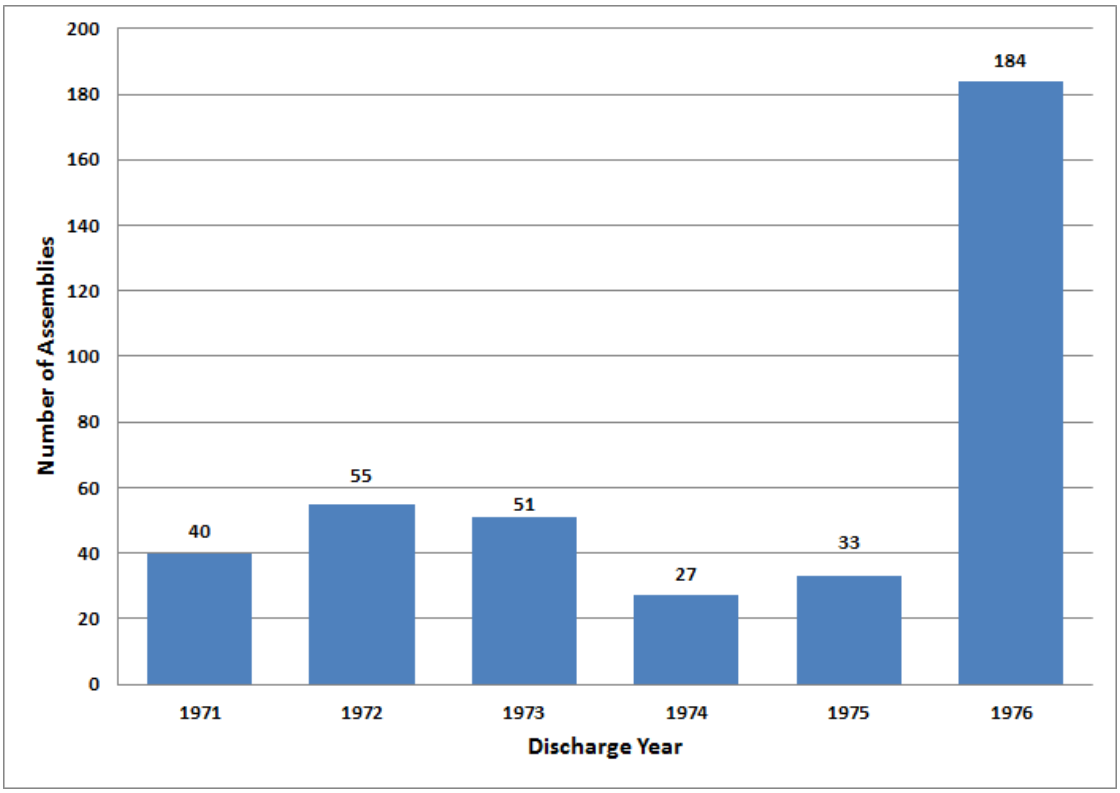


Figure 2-44. Humboldt Bay Number of Assemblies versus Discharge Year (EIA 2013)

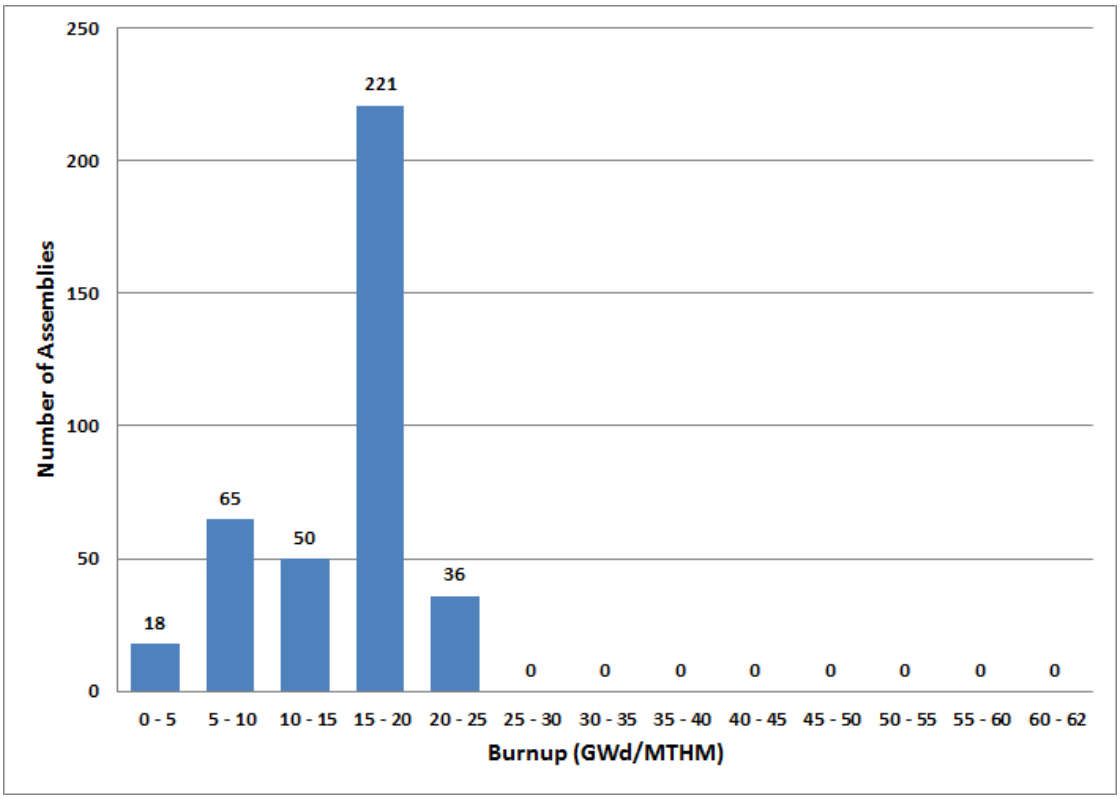


Figure 2-45. Humboldt Bay Number of Assemblies versus Burnup (EIA 2013)

2.4.2 Site Conditions

Figure 2-46 provides an aerial view of the Humboldt Bay site, which is being decommissioned, with completion anticipated in 2019. Electrical power is available at the Humboldt Bay ISFSI. The lifting device shown in Figure 2-43 which is used to remove the HI-STAR HB casks containing the Humboldt Bay used nuclear fuel or GTCC low-level radioactive waste from their below-grade vaults is shared with the Diablo Canyon site; however, mobile equipment such as cranes is not onsite. The HI-STAR HB casks are certified for both the storage and transport of the Humboldt Bay used nuclear fuel. Consequently, a transfer cask is not required at the Humboldt Bay site. The empty HI-STAR HB casks were moved to the Humboldt Bay site using heavy haul trucks (see Figure 2-47).

The Humboldt Bay site has not been served by rail since November 1998, when the Federal Railroad Administration issued Emergency Order 21, which closed the Northwestern Pacific Railroad from Arcata, California (milepost 295.5) to milepost 49.8S (formerly designated milepost 63.4) between Schellville and Napa Junction, California, a distance of 286 miles, for failure to meet federal safety standards (63 FR 67976-67979). In May 2011, the Federal Railroad Administration allowed the Northwestern Pacific Railroad to reopen as far north as milepost 62.9 near Windsor, California (76 FR 27171-27172), about 220 miles south of the Humboldt Bay site. There is also no on-site barge access at the Humboldt Bay site (TriVis Incorporated 2005, TOPO 1993d).

2.4.3 Near-site Transportation Infrastructure and Experience

The Humboldt Bay site does not have an on-site rail spur or an operating railroad that passes near to the site or along the site boundary. For Humboldt Bay, heavy haul trucks could be used to move transportation casks over public highways to a rail siding or spur that provides access to a railroad that can accommodate the loaded transportation casks. Alternatively, heavy haul trucks could be used to move loaded transportation casks from the Humboldt Bay site to a nearby barge facility where the casks would be loaded onto barges.

For shipments of casks containing used nuclear fuel that require the use of heavy haul trucks, the casks would be prepared for shipment at the Humboldt Bay ISFSI site and loaded onto a transport cradle that would then be loaded onto the transport trailer of a heavy haul truck. The heavy haul truck, led and followed by technical and security escorts, would move over an approved, designated highway route to a rail siding or spur or barge facility. Heavy lift equipment would be used to transfer the cask and its cradle as a unit from the heavy haul truck to a railcar at the rail siding or spur, or onto a barge, or the transport trailer carrying the cask could be rolled onto the barge deck.



Photo courtesy of Humboldt Bay

Figure 2-46. Aerial View of Humboldt Bay Site



Photo courtesy of Humboldt Bay

Figure 2-47. Empty HI-STAR HB Cask Being Transported by Heavy Haul Truck

The nearest rail access is located in Redding, California, a distance of about 160 miles from Humboldt Bay. To reach this location, heavy haul truck transport would be required on U.S. Highway 101 and State Route 299. The Union Pacific rail line in the vicinity of Redding is designated as track class 4.

During the decommissioning of Humboldt Bay, several truck routes have been used:[14]

- U.S. Highway 101 south to California State Route 20 to Interstate 5
- U.S. Highway 101 north to U.S. Highway 199 to Interstate 5
- U.S. Highway 101 north to California State Route 299 to Interstate 5.

These routes range in length from about 160 to 240 miles.

[14] Williams JR. 2013. Email message from L Sharp (Pacific Gas and Electric Company) to JR Williams (U.S. Department of Energy), "RE: PG&E Comments to DOE Draft Report," February 25, 2013.

The Humboldt Bay site is located on the Port of Humboldt Bay and therefore could be accessible by barges that would transport used nuclear fuel transportation casks to ports served by railroads or to barge-accessible rail sidings or spurs.

The Port of Humboldt Bay is located on the coast of northern California, approximately 225 nautical miles north of San Francisco, and approximately 156 nautical miles south of Coos Bay, Oregon (USACE 2012). Humboldt Bay is the only harbor between San Francisco and Coos Bay with deep-draft channels large enough to permit the passage of large commercial ocean-going vessels. It is the second largest coastal estuary in California (USACE 2012). Humboldt Bay is reported to have seven shipping terminals: Fairhaven Terminal, Humboldt Bay Forest Products Docks, Fields Landing Terminal, Redwood Marine Terminal, Schneider Dock, Sierra Pacific Eureka Dock, and the Simpson Mill Wharf Port Facility (HBHRCD 2012). The U.S. Army Corps of Engineers dredges shipping channels in and into Humboldt Bay to depths of 35 to 40 feet. DSI (2004) identifies San Francisco Bay and Coos Bay as the closest ports to Humboldt Bay with rail access.

Although there is no on-site barge access at the Humboldt Bay site, in 2010 barges were used to move 10 Wartsila engines weighing 680,000 lb. each and 10 generators weighing 165,000 lb. each to the Fields Landing Terminal (see Figure 2-48 and Figure 2-49), which is about 2 miles from the Humboldt Bay Generating Station[15] (AC&T 2011). The Fields Landing Channel is 12,000 feet long and 300 feet wide, with an 800-foot-long, 600-foot-wide turning basin (USACE 2012). The engines and generators were loaded onto barges at Schneider Dock in Eureka, California, moved by barge to the Fields Landing Terminal, and offloaded. Heavy haul trucks then moved the engines and generators from the Fields Landing Terminal to the Humboldt Bay Generating Station. Figure 2-48 also shows the heavy haul route taken from the Fields Landing Terminal to the Humboldt Bay Generating Station. Figure 2-50 shows the conditions of the Fields Landing Terminal in 2013. Figure 2-51 through Figure 2-55 show a Wartsila engine being loaded on a barge, a barge and Wartsila engine being towed to the Fields Landing Terminal, a barge and Wartsila engine arriving at the Fields Landing Terminal, a Wartsila engine being unloaded from the barge, and a Wartsila engine being transported by heavy haul truck to the Humboldt Bay Generating Station. Figure 2-56 and Figure 2-57 show the location of the Schneider Dock in relation to the Humboldt Bay site.

[15] Maheras SJ. 2012. Email message from A Richards (Senior Project Manager/Special Projects, Bragg Crane & Rigging) to SJ Maheras (Pacific Northwest National Laboratory), "Andy Richards / Bragg Crane & Rigging," October 17, 2012.

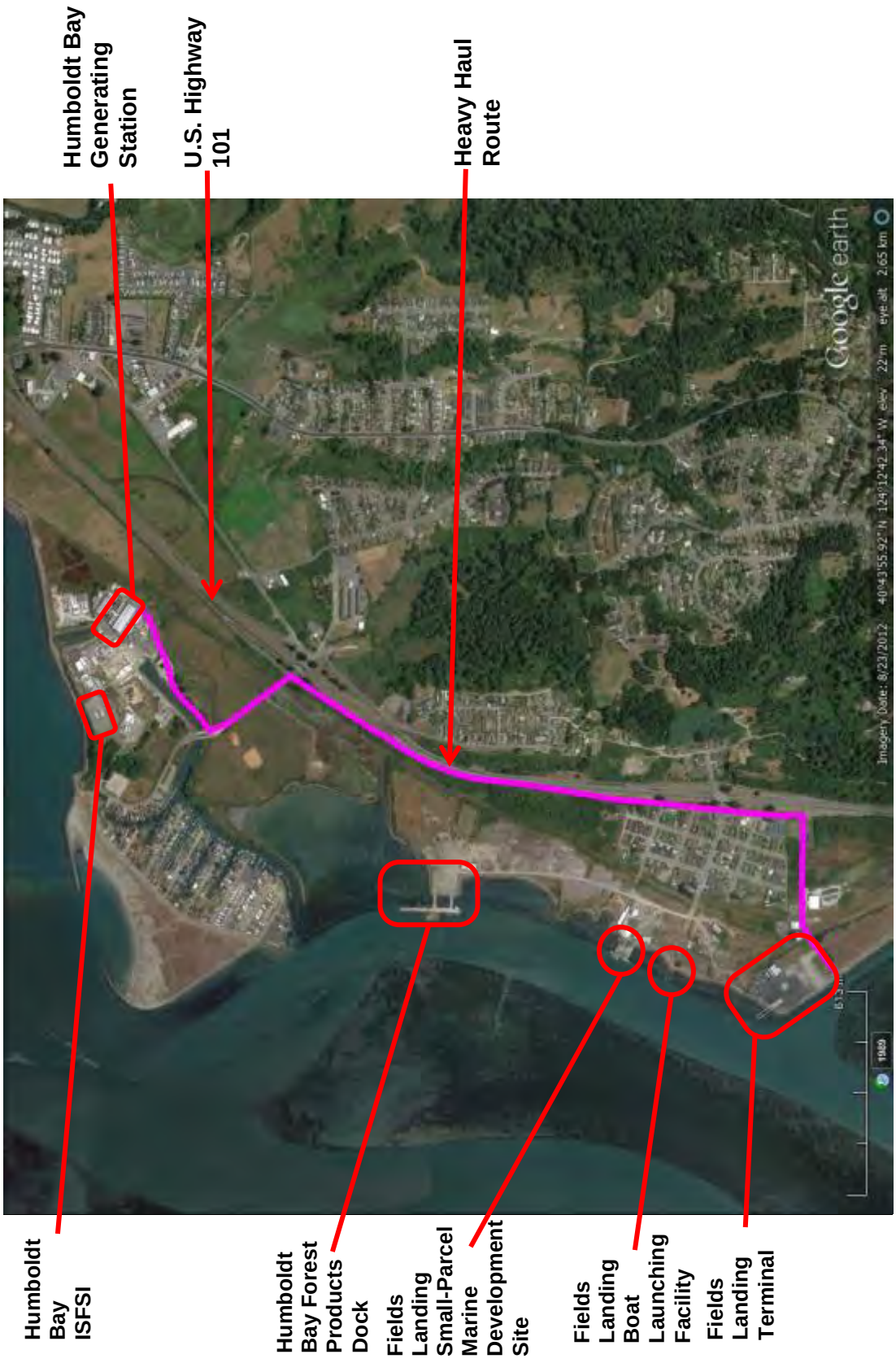


Figure 2-48. Humboldt Bay Independent Spent Fuel Storage Installation and Fields Landing Terminal (Google 2015)



Figure 2-49. Fields Landing Terminal (Google 2015)



Photo courtesy of Federal Railroad Administration

Figure 2-50. Condition of Fields Landing Terminal (2013)



Photo courtesy of Bragg Crane & Rigging Co.

Figure 2-51. Wartsila Engine Being Loaded on a Barge (2010)



Photo courtesy of Bragg Crane & Rigging Co.

Figure 2-52. Wartsila Engine on a Barge Being Towed to Fields Landing Terminal (2010)

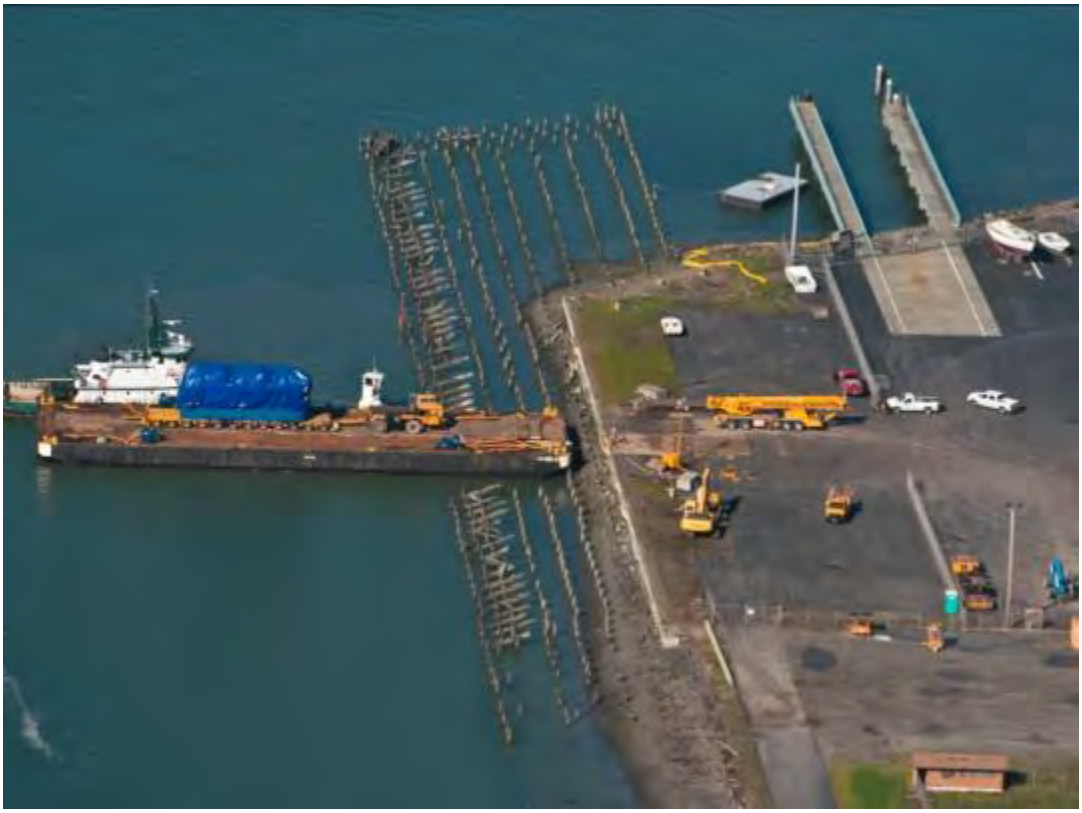


Photo courtesy of Bragg Crane & Rigging Co.

Figure 2-53. Barge with Wartsila Engine Arriving at Fields Landing Terminal (2010)



Photo courtesy of Bragg Crane & Rigging Co.

Figure 2-54. Wartsila Engine Being Unloaded at Fields Landing Terminal (2010)



Photo courtesy of Bragg Crane & Rigging Co.

Figure 2-55. Wartsila Engine Being Transported by Heavy Haul Truck to Humboldt Bay Generating Station (2010)



Figure 2-56. Humboldt Bay Site and Schneider Dock (Google 2015)



Figure 2-57. Schneider Dock (Google 2015)

2.4.4 Gaps in Information

Off-site transportation of HI-STAR HB transportation casks from the Humboldt Bay ISFSI site would require either use of heavy haul trucks for transport over at least 160 miles of mostly two-lane roads that traverse California coastal mountain ranges to a rail siding or spur or use of barges to ship the casks to a port on the western U.S. coast that is served by a railroad.

As discussed in Section 2.4.2, the Humboldt Bay site has not been served by rail since 1998. In 2011, the Northwestern Pacific Railroad reopened as far north as Windsor, California, about 220 miles south of the Humboldt Bay site. The North Coast Railroad Authority hopes to have the rail line open to Willits, California by 2020, which is still about 140 miles south of the Humboldt Bay site. The nearest rail access is located in Redding, California, a distance of about 160 miles from Humboldt Bay (Table 2-3). The 160-mile trip on public highways from the site would entail travel on U.S. Highway 101 through Eureka, connecting to California Highway 299 to travel east across the coastal mountains to Redding, California. This route is illustrated in Figure 2-58. In Redding, heavy-lift equipment would be used to transfer casks from heavy haul trucks onto railcars that would be moved on the Union Pacific mainline that passes through the Redding area. One-way travel time for the heavy haul truck shipments could be greater than one week. It is likely that two of the heavy haul trucks would be moved in convoy in order to limit the overall impact on commuter traffic and business traffic that use the roads. Substantial coordination and planning of the shipments with local and California state officials would be necessary. Prior to the shipments highway engineers would need to survey the roads and road structures (bridges, culverts, and overpasses) to ensure that the shipments could be conducted safely. It is possible that temporary or even permanent improvements, such as adding passing lanes, would need to be made to sections of the roads and structures before the shipments could begin and travel might be limited to late spring through early fall because of weather and frost conditions on roads at higher elevations.

Alternative nearby rail access is located at Grants Pass, Oregon, and Williams, Marysville, and Red Bluff, California. Heavy haul truck routes to these locations are illustrated in Figure 2-58. The distances to these locations range from about 160 to 280 miles (see Table 2-3). Representatives of PG&E have stated that a route using U.S. Highway 101 and State Route 36 would be unacceptable for heavy haul trucks.[16]

Additional heavy haul routes could potentially be used. For example, a heavy haul to Coos Bay, Oregon would be a distance of about 220 miles along U.S. Highway 101, a heavy haul to Windsor, California would be a distance of about 210 miles along U.S. Highway 101, a heavy haul to the San Francisco Bay Area would be a distance of about 240 miles, and a heavy haul to Sacramento, California would be a distance of about 290 miles along U.S. Highway 101, California Highway 20, and Interstate 5. A heavy haul to Willits, California would be a distance of about 130 miles along U.S. Highway 101, but the Northwestern Pacific Railroad is not open to

[16] Williams JR. 2013. Email message from L Sharp (Pacific Gas and Electric Company) to JR Williams (U.S. Department of Energy), "RE: PG&E Comments to DOE Draft Report," February 25, 2013.

Willits. In addition, it is not known if the Northwestern Pacific Railroad will handle hazardous material shipments.[17]

Table 2-3. Alternative Rail Access for Humboldt Bay

Rail Access	Route	Heavy Haul Distance (miles)
Grants Pass, Oregon	U.S. Highway 101 to U.S. Highway 199	180
Redding, California	U.S. Highway 101 to State Route 299	160
Red Bluff, California	U.S. Highway 101 to State Route 36[a]	160
Williams, California	U.S. Highway 101 to State Route 20	240
Marysville, California	U.S. Highway 101 to State Route 20	280

a. Note: Representatives of PG&E have stated that a route using U.S. Highway 101 and State Route 36 would be unacceptable for heavy haul trucks.

Barge transportation of used nuclear fuel casks from the Humboldt Bay site along the Pacific coast to a port facility that is served by a railroad could be an alternative. However, the site does not have a barge siding or dock, and it is uncertain whether barges could be landed at the shoreline of the site to allow roll-on of heavy haul trucks carrying the six HI-STAR HB casks. A marine survey has not been conducted to determine whether the depth of Humboldt Bay waters that approach the site and the bottom conditions near the shore would permit landing and securing a barge to the shoreline, safely loading it, and backing it back into a navigable channel in the bay. In addition, it is possible that approvals would be needed from California state authorities and from the U.S. Army Corps of Engineers before it would be possible to use a landed barge to load transportation casks containing used nuclear fuel.

It may be possible to use heavy haul trucks to transport the casks to a nearby shipping terminal in Humboldt Bay. Humboldt Bay is reported to have seven shipping terminals and it would be necessary to determine which, if any, of the reported shipping terminals in Humboldt Bay could be used for shipments of the casks and what routing would be used by heavy haul trucks. Ten large engines and generators were delivered to Schneider Dock in Eureka, California, transported by barge from Schneider Dock to the Fields Landing Terminal, and transported from Fields Landing Terminal to the Humboldt Bay site using heavy haul trucks (AC&T 2011). Moving casks to the Fields Landing Terminal would involve travel over approximately 2 miles of roadways including about 0.5 mile of U.S. Highway 101 and the remainder on local roadways.

[17] Used nuclear fuel and GTCC low-level radioactive waste would be Class 7 hazardous material.

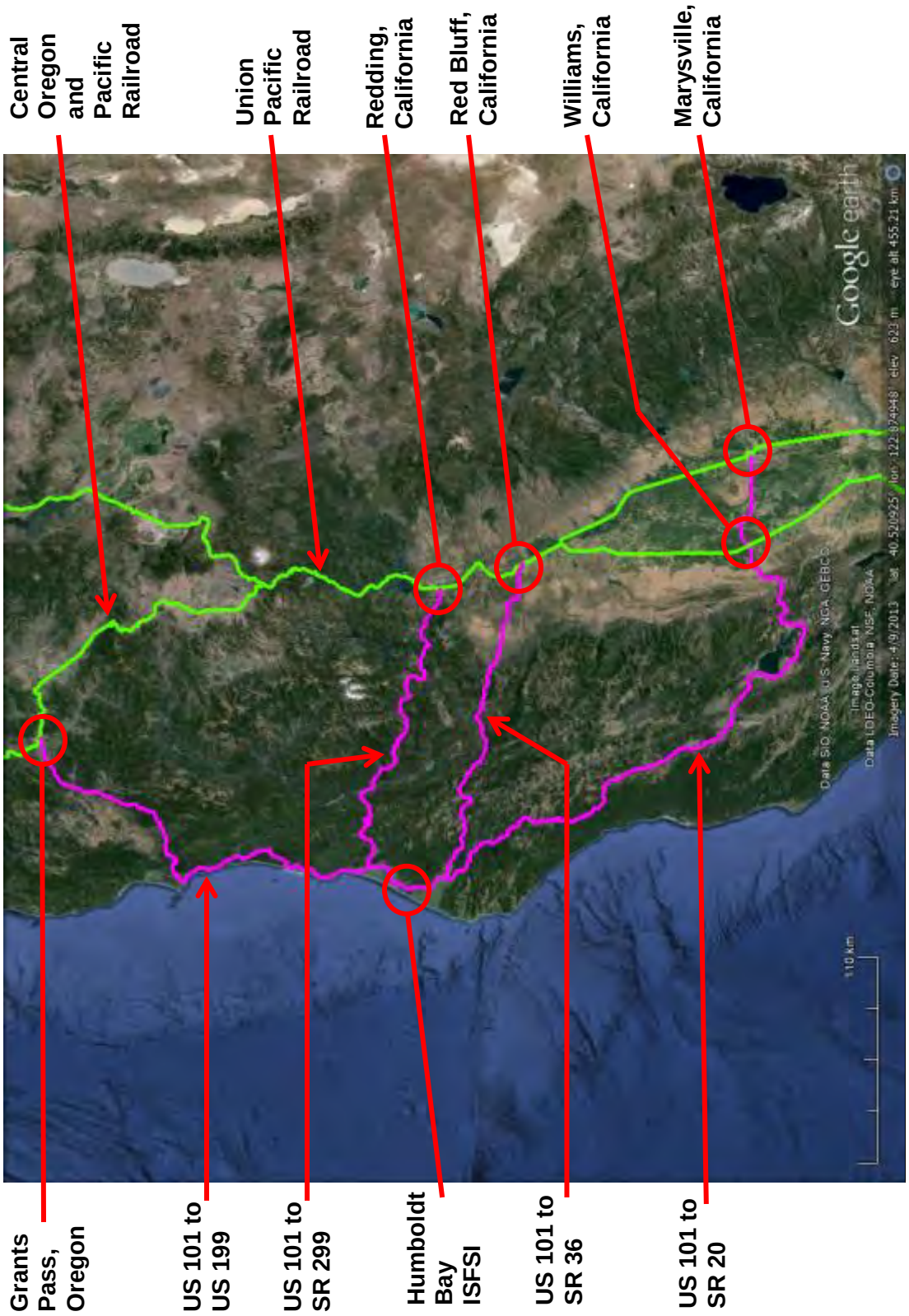


Figure 2-58. Heavy Haul Routes from Humboldt Bay Independent Spent Fuel Storage Installation to Alternative Rail Access Locations (Google 2015)

2.5 Big Rock Point

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Big Rock Point site. The Big Rock Point site is located on the eastern shore of Lake Michigan about 4 miles north of Charlevoix and 10 miles west of Petoskey, Michigan (TOPO 1994a).

2.5.1 Site Inventory

Seven canisters containing 441 used nuclear fuel assemblies and 1 canister of GTCC low-level radioactive waste are stored at the Big Rock Point ISFSI (Docket No. 72-43). The seven canisters contain 50 damaged used nuclear fuel assemblies which have been placed in damaged fuel cans. In addition to uranium dioxide (UO_2) used nuclear fuel assemblies, there are 36 mixed oxide used nuclear fuel assemblies stored at Big Rock Point. Table 2-4 lists the assembly identification numbers for these mixed oxide used nuclear fuel assemblies.

Table 2-4. Assembly Identification Numbers for Mixed Oxide Used Nuclear Fuel Assemblies at Big Rock Point

Fuel Assembly	Fuel Assembly	Fuel Assembly	Fuel Assembly
D72	G04	G13	G204
D73	G05	G14	G205
DA1	G06	G15	G206
DA2	G07	G16	G207
DA3	G08	G17	G208
DA4	G09	G18	G209
G01	G10	G19	G210
G02	G11	G20	E65
G03	G12	G21	E72

a. Source: Maheras SJ. 2014. Email message from LR Potter (Entergy) to SJ Maheras (Pacific Northwest National Laboratory), “RE: mox fuel assemblies at big rock point,” April 2, 2014.

Figure 2-59 shows the Big Rock Point ISFSI. The storage system used at Big Rock Point is the FuelSolutions Storage System which consists of the W74 canister, the W150 storage cask, and the W100 transfer cask (Docket No. 72-1026). The W74 canister holds 64 Big Rock Point boiling water reactor used nuclear fuel assemblies. The fuel assemblies from Big Rock Point were loaded into W74 canisters from December 2002 through March 2003 (Leduc 2012). The fuel rods in the fuel assemblies are zirconium alloy-clad. The TS125 transportation cask (Docket No. 71-9276) is certified to transport the W74 canister. No TS125 transportation casks have been fabricated. In addition, the TS125 transportation cask is not certified for the transport of GTCC low-level radioactive waste.



Photo courtesy of Big Rock Point

Figure 2-59. Big Rock Point Independent Spent Fuel Storage Installation

In October 2012, the NRC issued a renewed certificate of compliance to EnergySolutions for the TS125 transportation cask. The renewed certificate of compliance expires on October 31, 2017 (Waters 2012). The Safety Evaluation Report for the renewal of the certificate of compliance observes that no TS125 transportation casks have been fabricated and states that because the TS125 transportation cask has a -85 designation in its identification number (i.e., USA/9276/B(U)F-85), all fabrication of this package must have been completed by December 31, 2006, as required by 10 CFR 71.19(c). In order to fabricate TS125 transportation casks, EnergySolutions would need to apply for a -96 designation by submitting a revised safety analysis report to demonstrate that the TS125 transportation cask meets the current NRC regulations contained in 10 CFR Part 71. The revisions to the TS125 safety analysis report would include:

- **Revised A_1 and A_2 values.** EnergySolutions would need to update the containment analysis in Chapter 4 of the safety analysis report to incorporate revised A2 values in 10 CFR Part 71, Appendix A, Table A-1. An increase in the maximum allowable leakage rates for the TS125 transportation cask would be expected.
- **Criticality Safety Index (CSI).** EnergySolutions would need to revise Chapters 1, 5, and 6 of the TS125 transportation cask safety analysis report to incorporate the CSI nomenclature and the NRC would need to revise the certificate of compliance to delete references to the Transport Index for criticality control.
- **Expansion of Quality Assurance (QA) Requirements.** EnergySolutions would need to revise the safety analysis report for the TS125 transportation cask to demonstrate how its QA program satisfies the specific requirements of 10 CFR 71.101(a), (b), and (c).

A -96 designation must also be obtained before the TS125 transportation cask is certified for the transport of GTCC low-level radioactive waste. The effort to accomplish these changes and to obtain NRC review and approval is estimated to range from one to three years.

Figure 2-60 illustrates the number of used nuclear fuel assemblies at Big Rock Point based on their discharge year. The oldest fuel was discharged in 1974 and the last fuel was discharged in 1997. The median discharge year of the fuel is 1988.

Figure 2-61 illustrates the number of used nuclear fuel assemblies at Big Rock Point based on their burnup. The lowest burnup is 3.5 GWd/MTHM and the highest burnup is 34.2 GWd/MTHM. The median burnup is 23.7 GWd/MTHM. No high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) is stored at Big Rock Point.

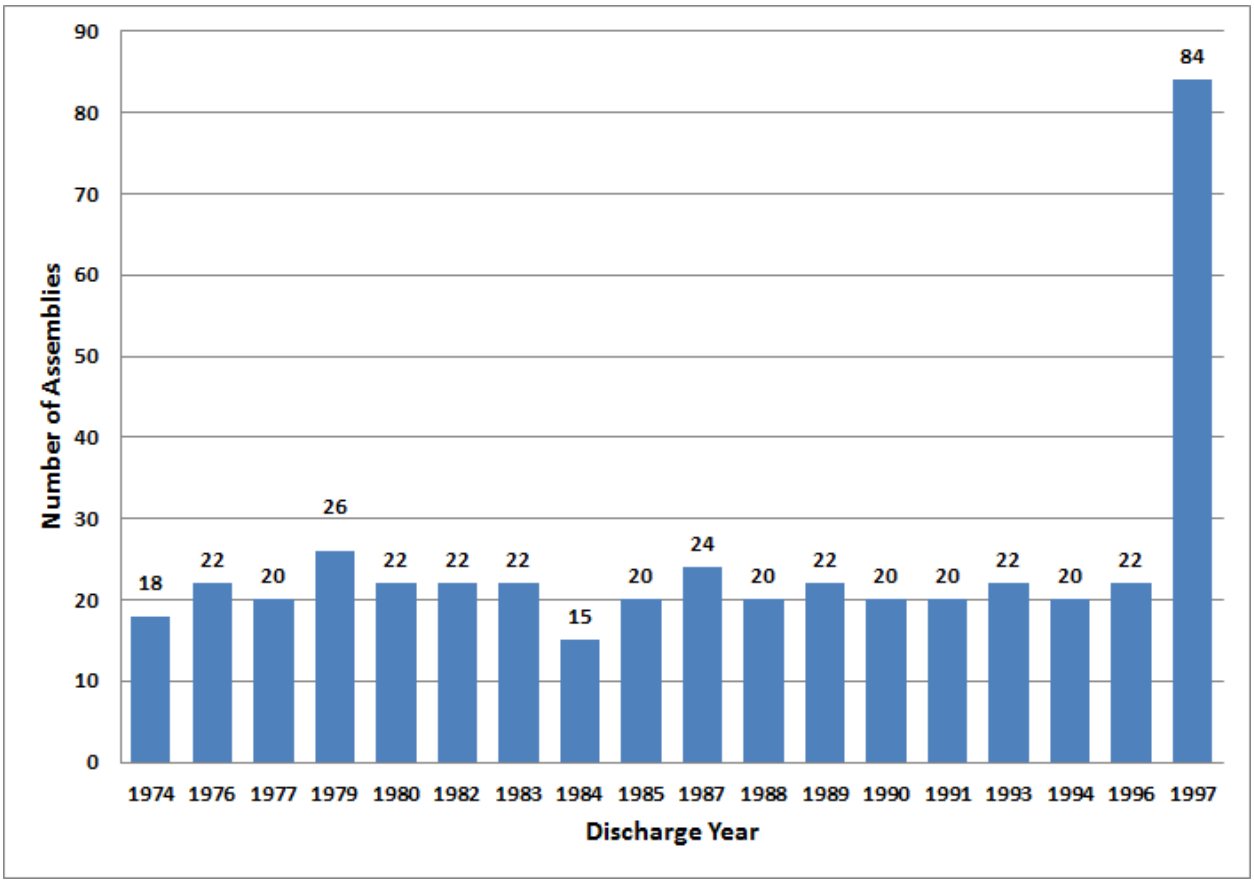


Figure 2-60. Big Rock Point Number of Assemblies versus Discharge Year (EIA 2013)

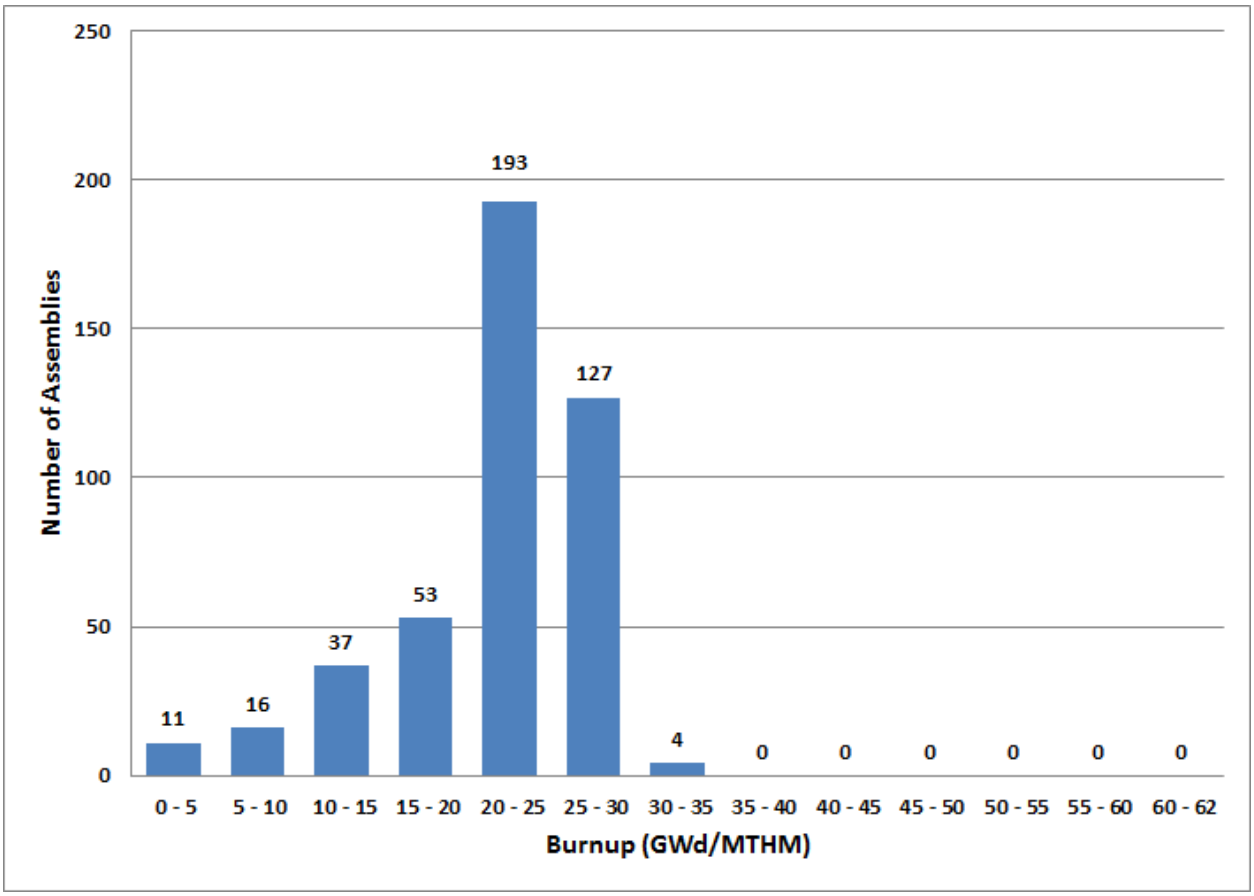


Figure 2-61. Big Rock Point Number of Assemblies versus Burnup (EIA 2013)

2.5.2 Site Conditions

Figure 2-62 provides an aerial view of the Big Rock Point site, where the reactor and associated structures have been removed. Electrical power is available at the Big Rock Point ISFSI; a transfer cask, gantry towers, horizontal transfer system, and J-skid[18] are present at the ISFSI. Herron (2010) stated that the equipment needed to transfer used nuclear fuel and GTCC low-level radioactive waste in W74 canisters from the W150 storage casks to the TS125 transportation cask is in place, is tested on a periodic basis, and preventative maintenance is performed. Figure 2-63 shows the transfer cask and J-skid, Figure 2-64 shows the gantry towers, and Figure 2-65 shows the horizontal transfer system at the Big Rock Point site.

A rail spur that served the Big Rock Point site was removed in 1988 (NAC 1990). This spur was used for nine rail shipments of used nuclear fuel to West Valley, New York between 1970 and 1974 (NAC 1990). There is no on-site rail access at the Big Rock Point site (TriVis Incorporated 2005), and heavy haul truck transport would be necessary to reach nearby rail sidings or spurs. For example, a rail spur in Gaylord, Michigan was used for shipping the reactor pressure vessel

[18] The J-skid is a built-up welded steel frame of heavy wide flange beams and cross members that is used to capture and engage the W150 storage cask for rotation by the gantry towers. This J-skid is also used to support the W150 storage cask in the horizontal orientation during W74 canister transfer.

from Big Rock Point to the Barnwell, South Carolina low-level radioactive waste disposal facility (Petrosky 2004), and a rail siding in Petoskey, Michigan was used for shipping the steam drum to the EnergySolutions low-level radioactive waste disposal facility in Clive, Utah (Tompkins 2006). Herron (2010) states that the heavy haul roadway no longer exists on the site and that the current access road from the ISFSI to the highway was not built to support heavy haul transfers, and may need to be rebuilt or enhanced.

TOPO (1994a) states that an on-site barge facility was used during the construction of Big Rock Point, but its use was discontinued in the early 1960s after Big Rock Point was completed. TOPO (1994a) also identifies a potential barge area at the Big Rock Point site (see Figure 2-62). However, NAC (1990) states that Big Rock Point has never had an on-site barge facility.



Figure 2-62. Aerial View of Big Rock Point Site (Google 2015)



Photo courtesy of Big Rock Point

Figure 2-63. Transfer Cask and J-Skid at Big Rock Big Rock Point Independent Spent Fuel Storage Installation (2013)



Photo courtesy of Big Rock Point

Figure 2-64. Big Rock Point Gantry Towers (2013)



Photo courtesy of Big Rock Point

Figure 2-65. Big Rock Point Horizontal Transfer System (2013)

2.5.3 Near-site Transportation Infrastructure and Experience

The Big Rock Point site does not have an on-site rail spur or a railroad that passes near to the site or along the site boundary. For Big Rock Point, heavy haul trucks could be used to move transportation casks over public highways to a rail siding or spur that provides access to a railroad that can accommodate the loaded transportation casks. Site representatives from Big Rock Point have also stated that seasonal restrictions would likely exist during January through March because of winter conditions, and during July through September because of the large number of tourists in the Big Rock Point area.

For shipments of casks containing used nuclear fuel that require the use of heavy haul trucks, the casks would be prepared for shipment at the Big Rock Point ISFSI site and loaded onto a transport cradle that would be loaded onto the transport trailer of a heavy haul truck. The truck, led and followed by technical and security escorts, would move over an approved, designated highway route to a rail siding or spur. Heavy lift equipment would be used to transload the cask and its cradle as a unit from the truck to a railcar at the rail siding or spur.

During the decommissioning of the Big Rock Point reactor, heavy haul trucks were used to move the reactor pressure vessel and steam drum from the Big Rock Point site to nearby rail sidings or spurs. In 2003, the reactor pressure vessel from the Big Rock Point reactor was moved on a Goldhofer trailer with 36 independently controlled axles and 144 tires propelled by two 1000-horsepower engines (Figure 2-66) about 52 miles to a rail spur near Gaylord, Michigan, transloaded onto an ETMX1001 railcar (Figure 2-67 through Figure 2-69), and then transported by rail to the Barnwell, South Carolina low-level radioactive waste disposal facility (Petrosky 2004, Slimp et al. 2014) (Figure 2-70). The Big Rock Point pressure vessel and its shipping package weighed more than 565,000 lb. Figure 2-71 shows the route taken from the Big Rock Point site to Gaylord, Michigan. The Lake State Railway in the vicinity of Gaylord is designated as track class 2. In the vicinity of Big Rock Point, a detour off of U.S. 31 was required to bypass an abandoned overhead rail bridge with inadequate vertical clearance. Figure 2-72 shows this detour and Figure 2-73 shows the bridge. Figure 2-74 shows the route taken by the reactor pressure vessel in the vicinity of Gaylord, Michigan and Figure 2-75 and Figure 2-76 show the condition in 2013 of the rail crossing and spur used for the Big Rock Point reactor pressure vessel transload. The track class at this crossing and spur appears to be “Excepted” and would likely require refurbishment prior to use for used nuclear fuel shipments.

In 2003, the Big Rock Point steam drum was also moved by heavy haul truck about 13 miles to a rail siding near Petoskey, Michigan, transloaded onto a railcar, and then transported by rail to the EnergySolutions low-level radioactive waste disposal facility in Clive, Utah (Gretzner 2006, Tompkins 2006). The steam drum weighed 200,000 lb. (Figure 2-77 and Figure 2-78). The Great Lakes Central Railroad is designated as track class 1 in the vicinity of Petoskey. The height of the steam drum on its transporter was low enough so that it did not require the same detour as described for the reactor pressure vessel and was able to take U.S. 31 from the Big Rock Point site into Petoskey, Michigan (see Figure 2-71). Figure 2-79 shows the route taken by the reactor pressure vessel in the vicinity of Petoskey, Michigan and Figure 2-80 shows the condition in 2013 of the of rail crossing and siding used for Big Rock Point steam drum transload.



Photo courtesy of Barnhart Crane & Rigging

Figure 2-66. Big Rock Point Reactor Pressure Vessel on Heavy Haul Truck (2003)



Photo courtesy of William J. Trubilowicz

Figure 2-67. ETMX1001 Railcar Staged for Transfer (2003)



Photo courtesy of William J. Trubilowicz

Figure 2-68. Heavy Haul Truck with Reactor Pressure Vessel beside ETMX1001 Railcar (2003)



Photo courtesy of William J. Trubilowicz

Figure 2-69. Transfer of Reactor Pressure Vessel onto ETMX1001 Railcar (2003)



Photo courtesy of Consumers Energy

Figure 2-70. Big Rock Point Reactor Pressure Vessel on ETMX1001 Railcar (2003)

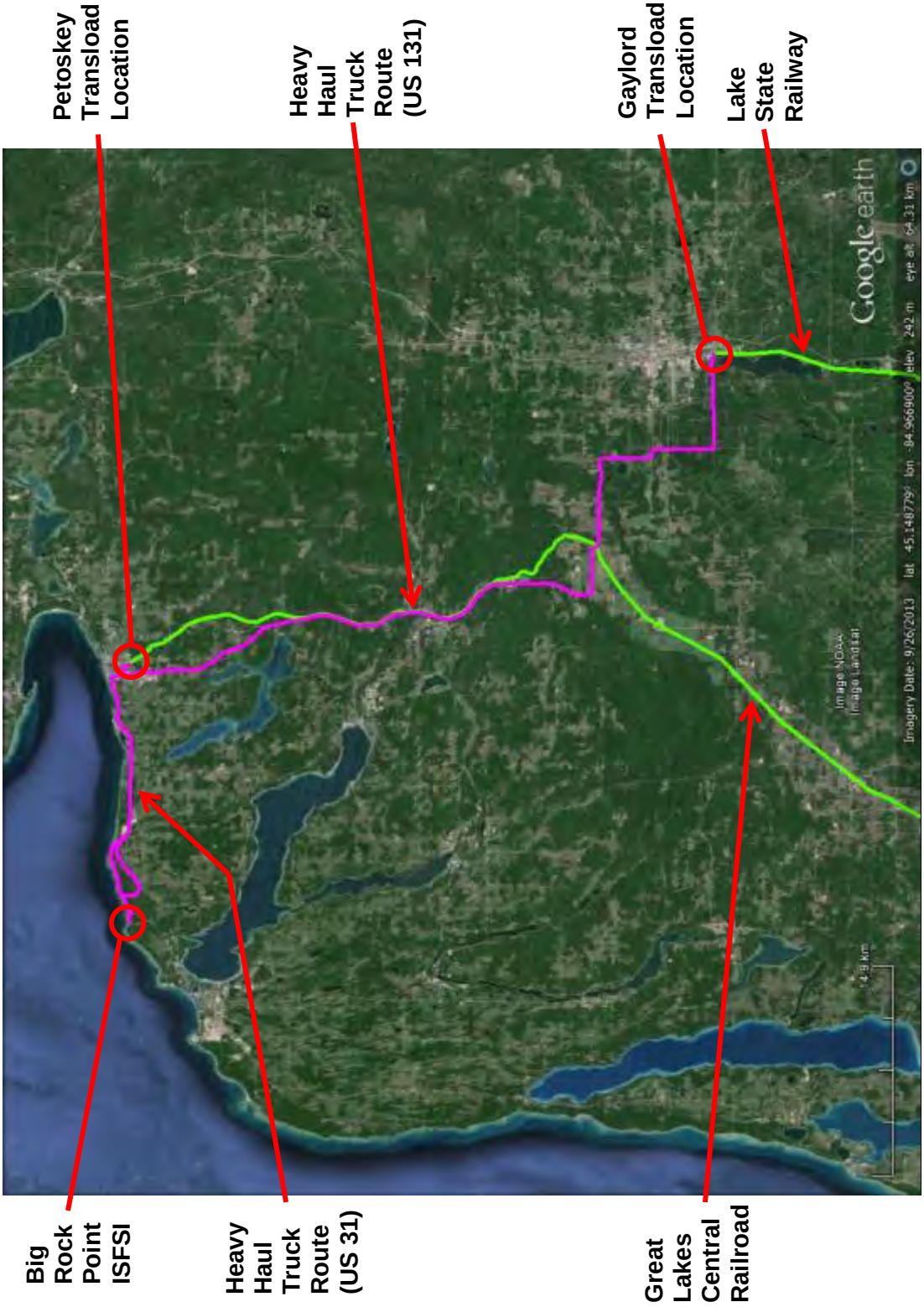


Figure 2-71. Big Rock Point Reactor Pressure Vessel Heavy and Steam Drum Haul Truck Routes (Google 2015)

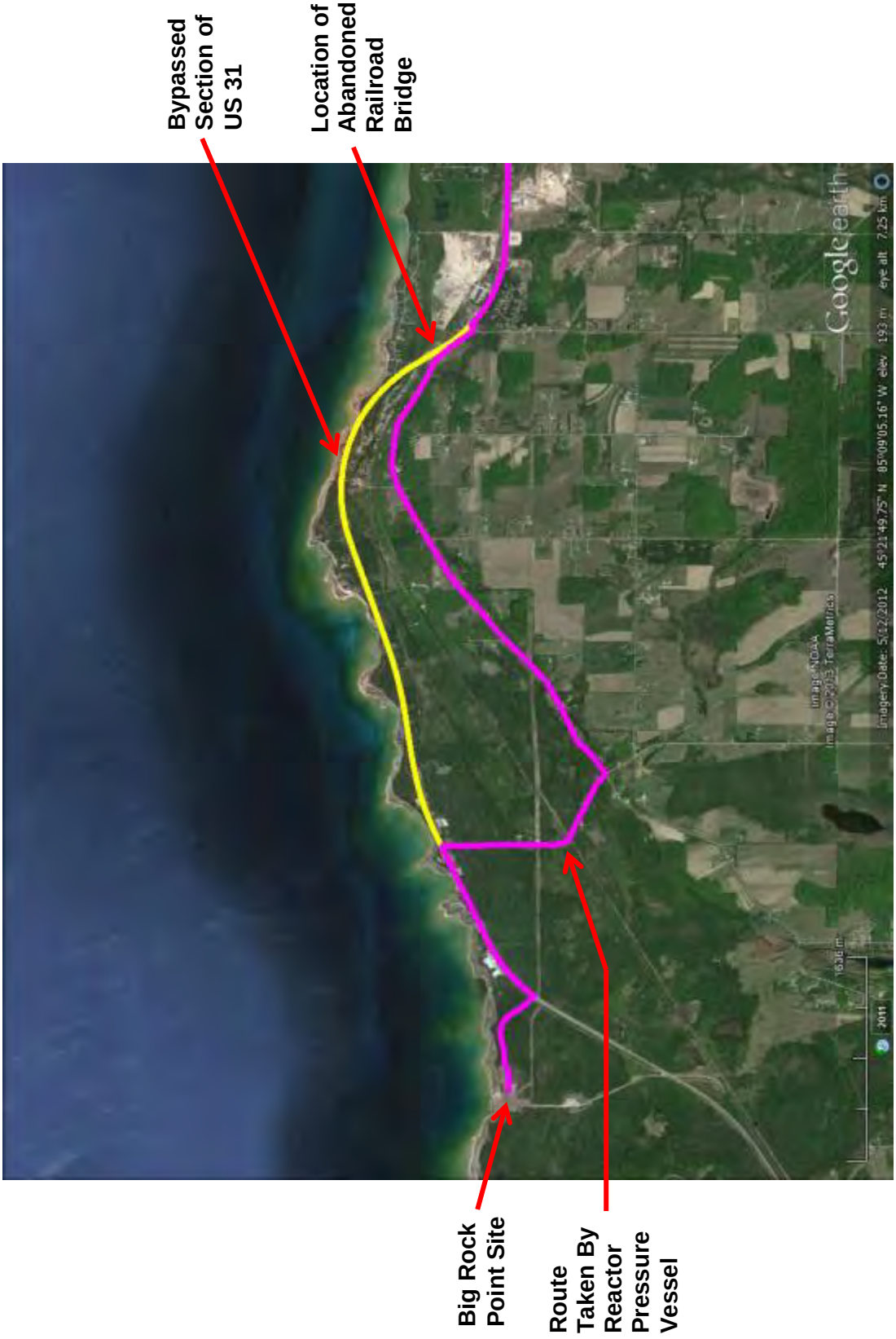


Figure 2-72. Route Taken By Reactor Pressure Vessel to Bypass Low Overhead Clearance Abandoned Railroad Bridge (Google 2015)



Figure 2-73. Low Overhead Clearance Abandoned Railroad Bridge on U.S. 31 (2013)

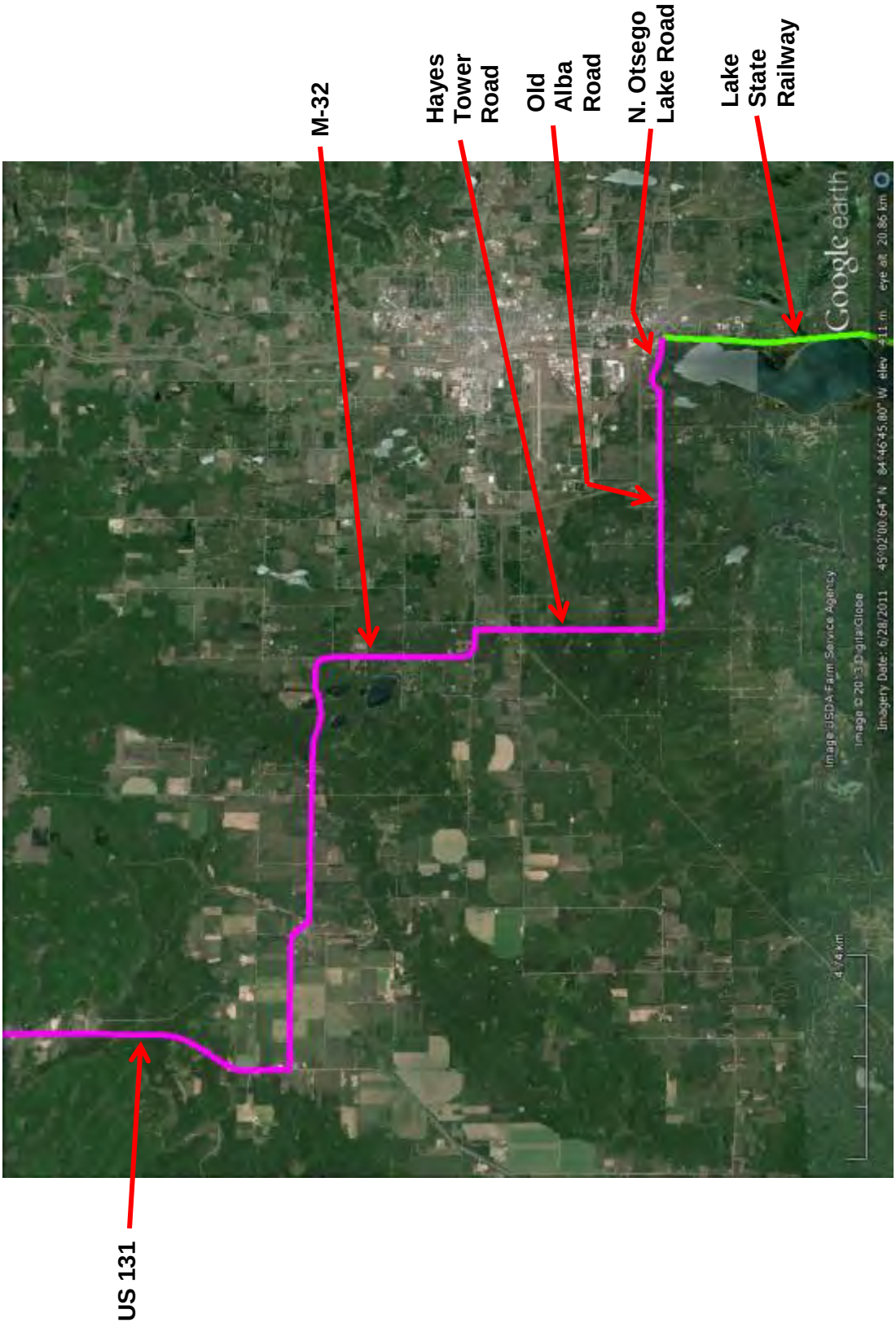


Figure 2-74. Route Taken By Reactor Pressure Vessel in the Vicinity of Gaylord, Michigan (Google 2015)



Figure 2-75. Condition of Rail Crossing Used for Big Rock Point Reactor Pressure Vessel Transload (Looking North) (2013)



Figure 2-76. Condition of Rail Crossing Used for Big Rock Point Reactor Pressure Vessel Transload (Looking South) (2013)



Photo courtesy of Consumers Energy

Figure 2-77. Big Rock Point Steam Drum on Heavy Haul Truck (2003)



Photo courtesy of Consumers Energy

Figure 2-78. Big Rock Point Steam Drum on Railcar (2003)

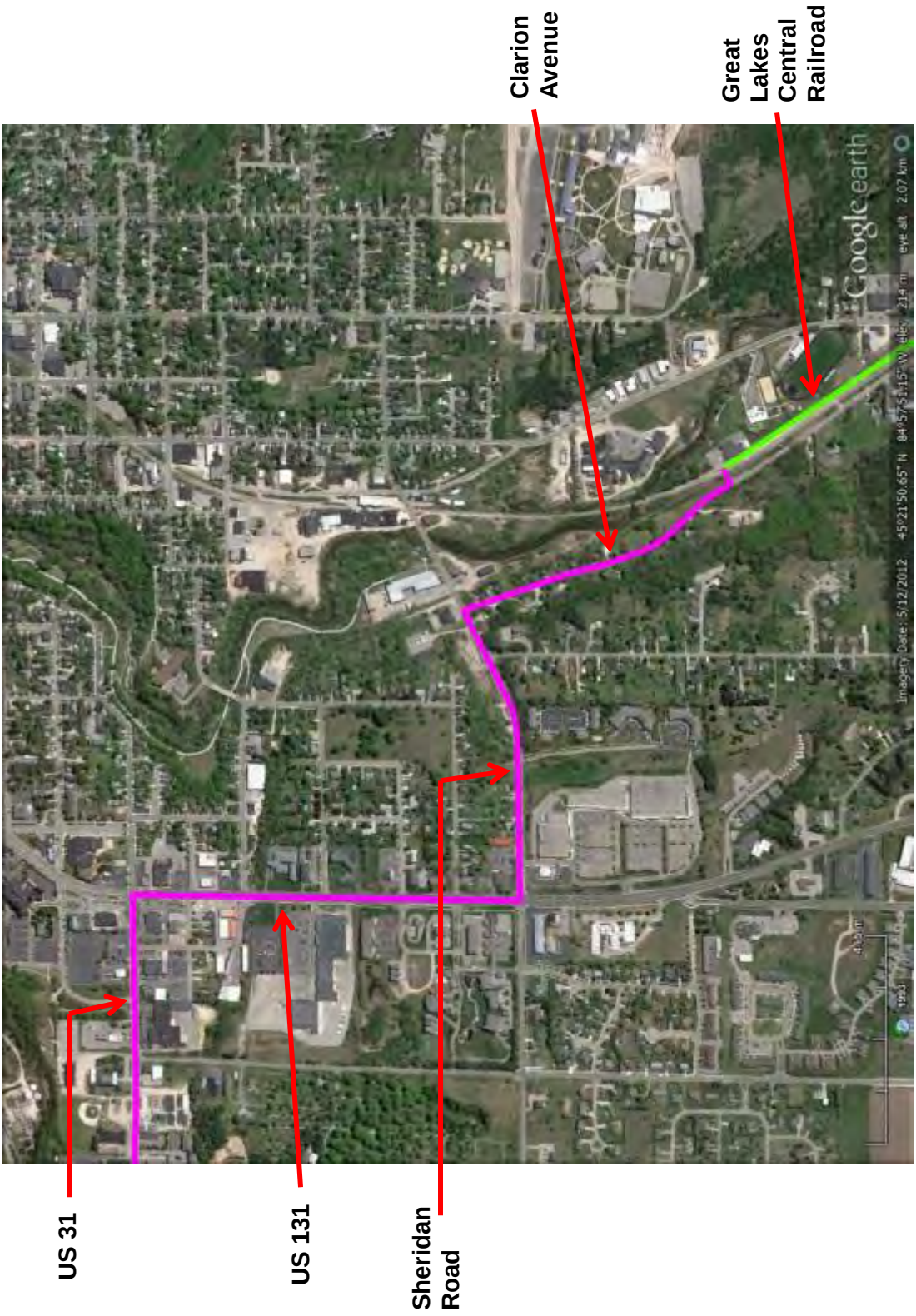


Figure 2-79. Route Taken By Steam Drum in the Vicinity of Petoskey, Michigan (Google 2015)



Photo courtesy of Federal Railroad Administration

Figure 2-80. Condition of Petoskey Rail Siding (2013)

The Big Rock Point site is on the shore of Lake Michigan, and therefore could be accessible by barges that would transport used nuclear fuel transportation casks to nearby ports served by railroads or to barge-accessible rail sidings or spurs. DSI (2004) identifies the following ports with rail access:

- Traverse City, Manistee, Ludington, Muskegon, and Grand Haven as ports with rail access along the eastern shore of Lake Michigan
- Alpena, Bay City, Port Huron, Saint Clair, and Detroit as ports with rail access along the western shore of Lake Huron
- Inland, Escanaba, Green Bay, and Milwaukee as ports with rail access along the western shore of Lake Michigan
- Chicago, Indiana Harbor, Buffington, and Gary as ports with rail access along the southern shore of Lake Michigan.

The capabilities of these ports have not been investigated.

Figure 2-81 shows the condition of the shoreline in 2013 in the vicinity of the potential barge area identified in Figure 2-62.



Photo courtesy of Big Rock Point

Figure 2-81. Condition of Potential Barge Area at Big Rock Point (2013)

2.5.4 Gaps in Information

As discussed in Section 2.5.3, shipments of large reactor components have been made from the Big Rock Point site using heavy haul trucks to carry the components to rail sidings for loading onto railcars. The weight limits associated with the Great Lakes Central Railway and the Lake State Railway track that would be used would need to be evaluated, as well as the current condition of rail sidings or spurs that would be used.

It may also be possible to use barges to transport casks containing used nuclear fuel directly from the Big Rock Point site to a port that is served by a railroad. There is not a barge slip, dock, or landing area on the site's Lake Michigan shoreline. Also, it is unknown whether the depth of water approaching the shore at the site and the bottom conditions near the shore would permit safe operations for barges, and whether extensive grading and spreading of gravel would be required. Barge operations could use either heavy lift equipment to move casks from heavy haul transporters onto barges or the heavy haul transporters might be rolled directly onto barges. Lake Michigan is subject to freezing in the Big Rock Point area (TOPO 1994a), and barge operations would not be conducted on Lake Michigan during winter months.

2.6 Rancho Seco

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Rancho Seco site. The Rancho Seco site is located about 25 miles southeast of Sacramento, California (NAC 1991a).

2.6.1 Site Inventory

The Rancho Seco ISFSI has a site-specific 10 CFR Part 72 license (License No. SNM-2510). Twenty-one canisters containing 493 used nuclear fuel assemblies and 1 canister of GTCC low-level radioactive waste are stored at Rancho Seco. Figure 2-82 shows the Rancho Seco ISFSI. The storage system used at Rancho Seco is a site-specific model of the Standardized NUHOMS-24P system (Docket No. 72-1004), which consists of transportable canisters, reinforced concrete horizontal storage modules, and a transfer cask. The canisters used at Rancho Seco are the fuel-only dry shielded canister (FO-DSC) (2 canisters), fuel with control component dry shielded canister (FC-DSC) (18 canisters), and failed fuel dry shielded canister (FF-DSC) (1 canister). The FO-DSC and FC-DSC hold 24 pressurized water reactor used nuclear fuel assemblies and the FF-DSC holds 13 pressurized water reactor used nuclear fuel assemblies. There are 48 assemblies contained in FO-DSCs, 432 assemblies contained in FC-DSCs, and 13 assemblies contained in FF-DSCs. The fuel assemblies from Rancho Seco were loaded from April 2001 through August 2002 (Leduc 2012). The fuel rods in the fuel assemblies are zirconium alloy-clad. The transfer cask used at Rancho Seco is the MP187 transportation cask (Docket No. 71-9255), which is also certified for off-site transportation of the FO-DSC, FC-DSC, and FF-DSC. The MP187 transportation cask that was used to load the Rancho Seco ISFSI is stored at the Rancho Seco site (see Figure 2-83). The hydraulic ram used to emplace and withdraw canisters from the horizontal storage modules is also stored at the Rancho Seco site (see Figure 2-84). Figure 2-85 shows the MP187 transportation cask and hydraulic ram being used to load a canister into a horizontal storage module. Impact limiters are required for off-site transport of the MP187 transportation cask and would need to be fabricated. The MP187 transportation cask is also not certified for the transport of GTCC low-level radioactive waste.



Photo courtesy of Rancho Seco

Figure 2-82. Rancho Seco Independent Spent Fuel Storage Installation



Figure 2-83. MP187 Transportation Cask at Rancho Seco (2013)



Figure 2-84. Hydraulic Ram Used to Emplace and Withdraw Canisters from Horizontal Storage Modules at Rancho Seco (2013)



Photo courtesy of Rancho Seco

Figure 2-85. MP187 Transportation Cask and Hydraulic Ram Being Used to Load a Canister into a Horizontal Storage Module at Rancho Seco

In August 2013, the NRC issued a renewed certificate of compliance to Transnuclear for the MP187 transportation cask (Sampson 2013).[19] The Safety Evaluation Report for the renewal of the certificate of compliance states that because the MP187 transportation cask has a -85 designation in its identification number (i.e., USA/9255/B(U)F-85), all fabrication of this package must have been completed by December 31, 2006, as required by 10 CFR 71.19(c). To date, one MP187 transportation cask without impact limiters has been fabricated, and before additional MP187 transportation casks are fabricated, Transnuclear/AREVA would need to apply for a -96 designation by submitting a revised safety analysis report to demonstrate that the MP187 transportation cask meets the current NRC regulations contained in 10 CFR Part 71. The revisions to the MP187 safety analysis report would include:

- **Revised A_1 and A_2 values.** Transnuclear would need to update the containment analysis in Chapter 4 of the safety analysis report to incorporate revised A2 values in 10 CFR Part 71, Appendix A, Table A-1. An increase in the maximum allowable leakage rates for the MP187 transportation cask would be expected.

[19] A subsequent update to the MP187 certificate of compliance changed the name of the entity to which the certificate of compliance was issued to from Transnuclear, Inc. to AREVA, Inc. (Sampson 2014).

- **Criticality Safety Index.** Transnuclear would need to revise Chapters 1, 5, and 6 of the MP187 transportation cask safety analysis report to incorporate the CSI nomenclature and the NRC would need to revise the certificate of compliance to delete references to the Transport Index for criticality control.
- **Expansion of QA Requirements.** Transnuclear would need to revise the safety analysis report for the MP187 transportation cask to demonstrate how its QA program satisfies the specific requirements of 10 CFR 71.101(a), (b), and (c).

Representatives of Transnuclear/AREVA have also stated that the -96 designation must be obtained before impact limiters are fabricated for the existing MP187 transportation cask.[20] A -96 designation must also be obtained before the MP187 transportation cask is certified for the transport of GTCC low-level radioactive waste. The effort to accomplish these changes and to obtain NRC review and approval is estimated to range from one to three years.

There are six damaged fuel assemblies stored in five FC-DSCs at Rancho Seco. Table 2-5 lists the details of these damaged fuel assemblies. When this fuel was originally packaged in canisters, the fuel was visually inspected and classified as damaged if cladding failures with breaches greater than 25 percent of the circumference of the fuel pin and at least the length of a fuel pellet were present (Redeker 2006). This equates to a cladding failure that is 0.34 inches across the cladding and 0.7 inches along the cladding. Fuel assemblies not classified as damaged using this definition were classified as intact. The current definition of intact fuel is more restrictive, where fuel assemblies are classified as intact if they contain no cladding breaches (NRC 2007a). Assemblies are classified as undamaged if they have no defects greater than hairline cracks or pinhole leaks (NRC 2007a). This change in the definition of damaged and intact fuel resulted in the six fuel assemblies formerly classified as intact being reclassified as damaged, using the new definition. The Rancho Seco storage license was amended to recognize this situation; however, the certificate of compliance for the MP187 transportation cask requires that damaged fuel assemblies are shipped in FF-DSCs, not in FC-DSCs, so the requirements for transporting the five FC-DSCs containing the six damaged fuel assemblies would need to be determined. In addition, the Safety Evaluation Report for the Rancho Seco ISFSI (NRC 2009) noted that visual examination alone is no longer a sufficient method for classifying assemblies as damaged or intact. NRC (2009) also stated that prior to transporting the used nuclear fuel stored at Rancho Seco, fuel classification may need to be revisited, and the damaged fuel assemblies (and potentially some fuel assemblies currently classified as intact) may need to be placed into damaged fuel cans to be transportable.

[20] Best RE. 2013. Email message from P Murray (AREVA) to RE Best (PNNL Consultant), "MP187 Question," April 2, 2013.

Table 2-5. Details of Damaged Fuel Assemblies at Rancho Seco[a]

Fuel Assembly	Estimated Flaw Size	Canister Number
2G6	0.25 in. × 0.04 in.	FC24P-P16
OEL	0.75 in. long with 0.2 in. hole	FC24P-P10
ODY	0.2 in. hole	FC24P-P10
17G	Unknown	FC24P-P17
1C34	1 in. × 0.1 in.	FC24P-P18
1C04	0.3 in. holes (two)	FC24P-P03

a. Source: Transnuclear (2008)

Figure 2-86 illustrates the number of used nuclear fuel assemblies at Rancho Seco based on their discharge year. The oldest fuel was discharged in 1977 and the last fuel was discharged in 1989. The median discharge year of the fuel is 1983.

Figure 2-87 illustrates the number of used nuclear fuel assemblies at Rancho Seco based on their burnup. The lowest burnup is 10.0 GWd/MTHM and the highest burnup is 38.2 GWd/MTHM. The median burnup is 28.0 GWd/MTHM. No high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) is stored at Rancho Seco.

2.6.2 Site Conditions

Figure 2-88 provides an aerial view of the Rancho Seco site. The reactor building equipment and spent nuclear fuel pool have been decommissioned and removed, but the cooling towers, reactor containment building, and other associated structures remain on-site. In 2014, the remaining low-level radioactive waste that was stored on-site after decommissioning was shipped to Andrews, Texas for disposal. Electrical power is available at the Rancho Seco ISFSI. Also available on-site is the hydraulic ram used to unload the canisters from the NUHOMS reinforced concrete horizontal storage modules and to load the MP187 transportation cask that is certified to transport the Rancho Seco used nuclear fuel. The MP187 transportation cask (without impact limiters) is also stored on-site. The MP187 transportation cask is not certified for the transport of GTCC low-level radioactive waste.

There is no on-site barge access at the Rancho Seco site (TriVis Incorporated 2005). A 1-mile-long on-site rail spur exists at Rancho Seco. A short length of track runs adjacent to the ISFSI and a longer length of track runs into the Rancho Seco reactor site (see Figure 2-88). Figure 2-89 shows the junction of the short track running adjacent to the ISFSI and the longer track running into the Rancho Seco site. Figure 2-90 shows the longer track running into the Rancho Seco site.

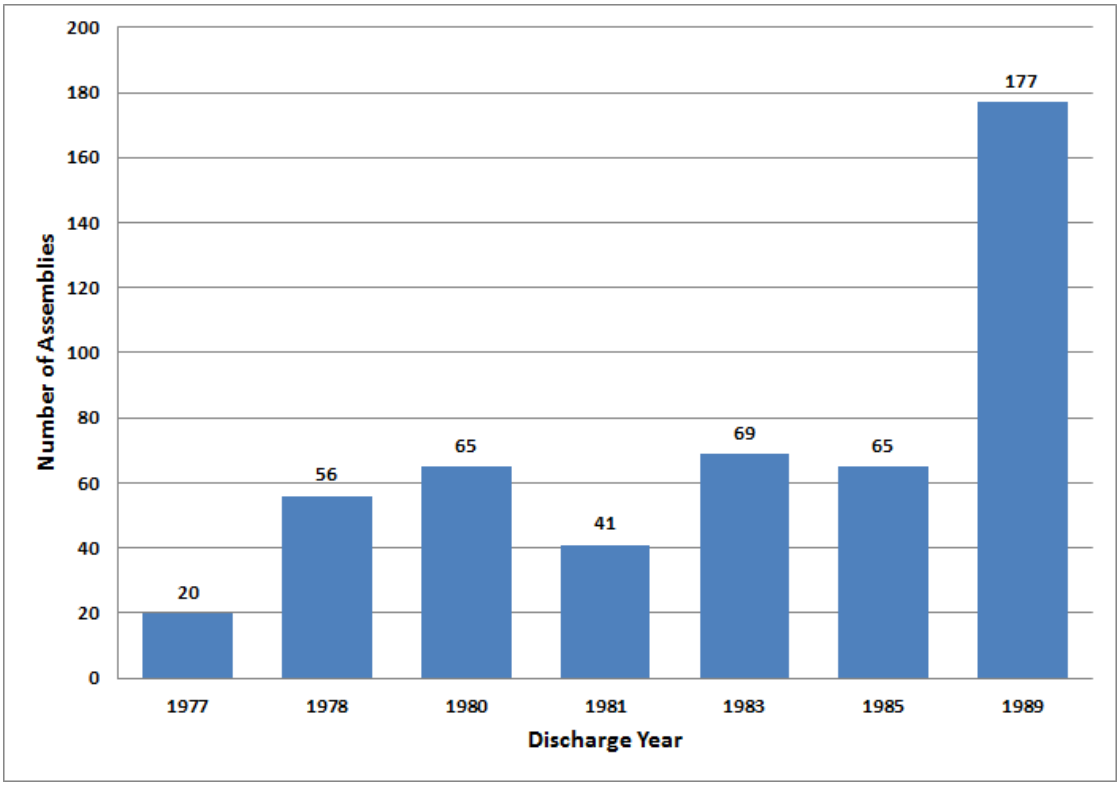


Figure 2-86. Rancho Seco Number of Assemblies versus Discharge Year (EIA 2013)

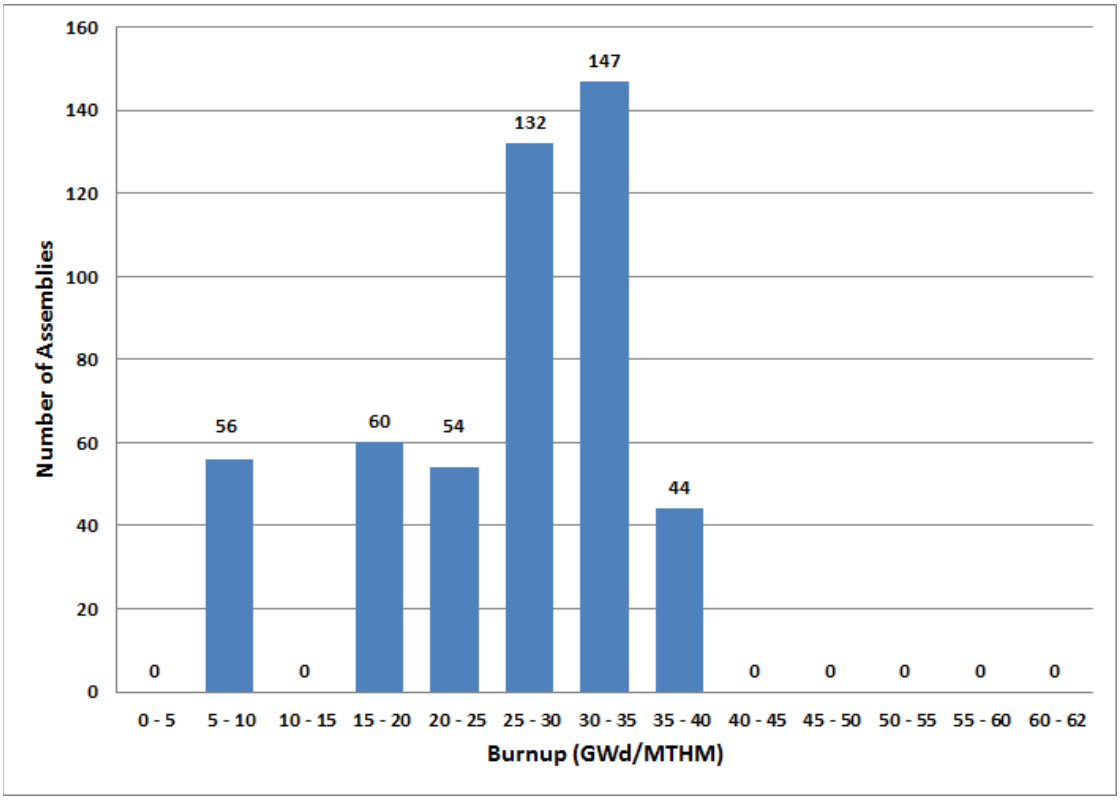


Figure 2-87. Rancho Seco Number of Assemblies versus Burnup (EIA 2013)

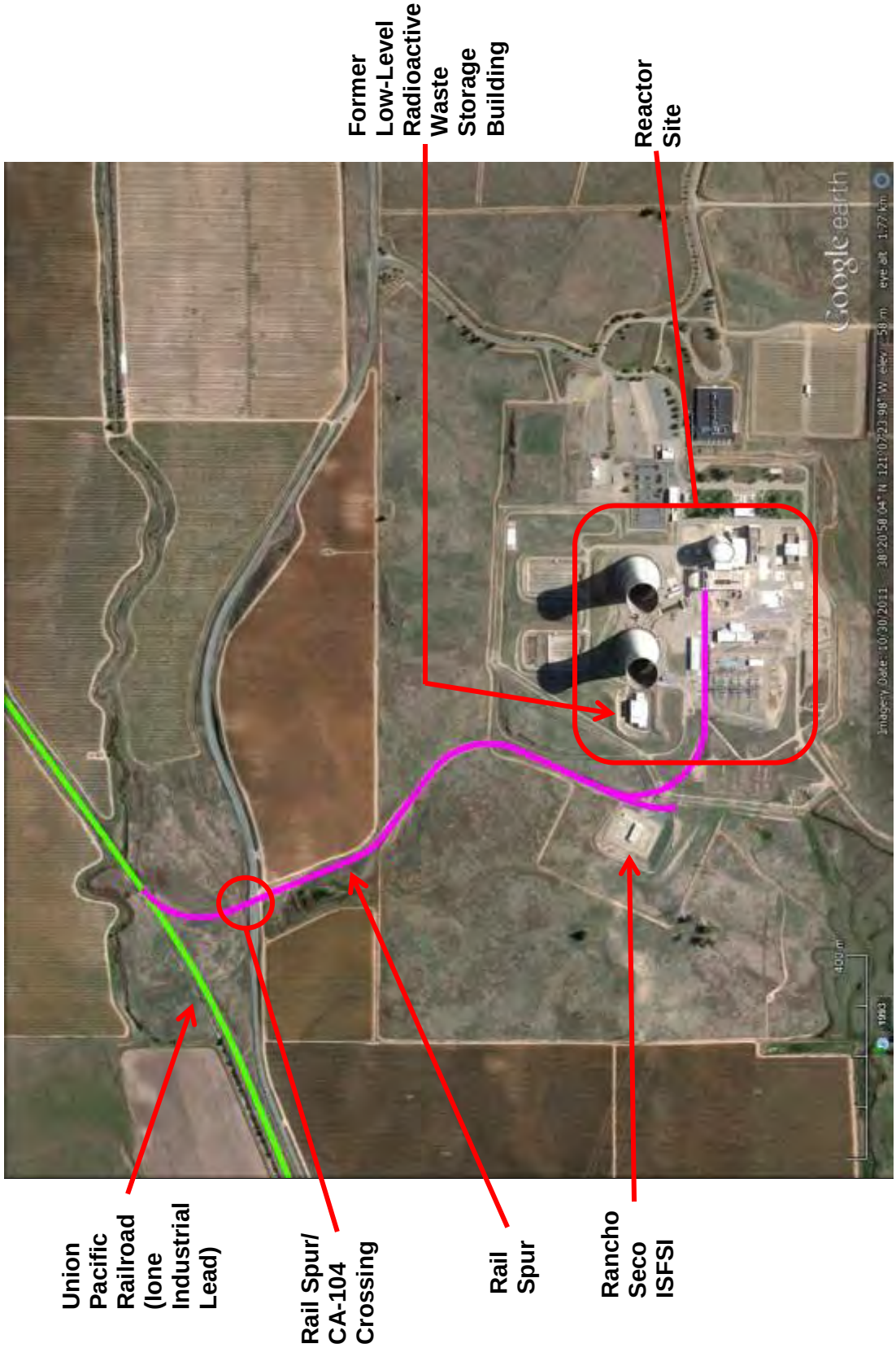


Figure 2-88. Aerial View of Rancho Seco Site (Google 2015)



Figure 2-89. Junction of the On-site Track Spur Running Adjacent to the Independent Spent Fuel Storage Installation (Right) and the Longer Track Running into the Rancho Seco Site (Left) (2013)



Figure 2-90. On-site Rail Spur Running into Rancho Seco Site (2013)

2.6.3 Near-site Transportation Infrastructure and Experience

Rancho Seco owns the rail spur that provides access to the Union Pacific's Ione Industrial Lead, which runs west from the Rancho Seco site to the Union Pacific mainline in Galt, California (see Figure 2-91), a distance of about 15 miles. The distance from Galt to Sacramento, California is about 33 miles and the distance from Galt to Stockton, California is about 28 miles. The Union Pacific mainline is designated as track class 5 and the Ione Industrial Lead is designated as track class 2. The maximum gross weight of railcars on the Ione Industrial Lead between Rancho Seco and Galt is 158 tons, and 6-axle locomotives are prohibited. A loaded MP187 transportation cask would weigh 133 to 136 tons and a cask-carrying railcar would weigh at least 43 tons, so the weight limit of 158 tons is likely to be exceeded, requiring either route clearance or a track upgrade. California State Route 104 crosses the rail spur (see Figure 2-88). The rail spur was not maintained after shutdown in 1989 but was restored to operating condition in the early 2000s to support decommissioning. During decommissioning, this rail spur was used to transport four reactor coolant pumps (50 tons each), the pressurizer (150 tons), and two steam generators (550 tons each) to the EnergySolutions low-level radioactive waste disposal facility in Clive, Utah (Johnson 2006). The two steam generators were approximately 80 feet in length and 12 feet in diameter and were too large to ship in their intact state because of the inability to obtain rail route clearances due to their length (Dempsey and Snyder 2005). Therefore, the steam generators were cut latitudinally into four segments (Dempsey and Snyder 2005) and were transported on 12-axle QTTX railcars. Figure 2-92 and Figure 2-93 show the pressurizer and steam generator segments on railcars prior to shipping, respectively. The segmented Rancho Seco reactor pressure vessel was also shipped by rail to the EnergySolutions low-level radioactive waste disposal facility in Clive, Utah (EPRI 2007, 2008a).

The rail spur was last maintained and certified in 2008; but is not being maintained. Past restoration of the rail spur to pass inspection was a relatively inexpensive, straightforward project.[21]

Although Rancho Seco is not located on a waterway, commercial inland ports suitable for barge traffic are located at the Port of Sacramento, California, about 40 miles from Rancho Seco, and the Port of Stockton, California, about 45 miles from Rancho Seco (NAC 1991a). During decommissioning, a 520-ton generator was transported by heavy haul truck from Rancho Seco to the Port of Stockton, California (see Figure 2-94). At the Port of Stockton, the generator was transloaded onto an ocean-going barge and transported to the Surry Nuclear Power Plant in Virginia for re-use.

Heavy haul trucks have also been used to ship materials to and from the Rancho Seco site. For example, in 2000, Transnuclear, Inc. contracted with a heavy haul truck operator to ship the 100-ton (empty and without impact limiters) MP187 transportation cask from the eastern United States to the Rancho Seco site (see Figure 2-95).

[21] Ross SB. 2012. E-mail from ET Ronningen (Superintendent, Rancho Seco Assets Power Generation, Sacramento Municipal Utility District) to SB Ross (Pacific Northwest National Laboratory), "Re:Request for Info," September 17, 2012.

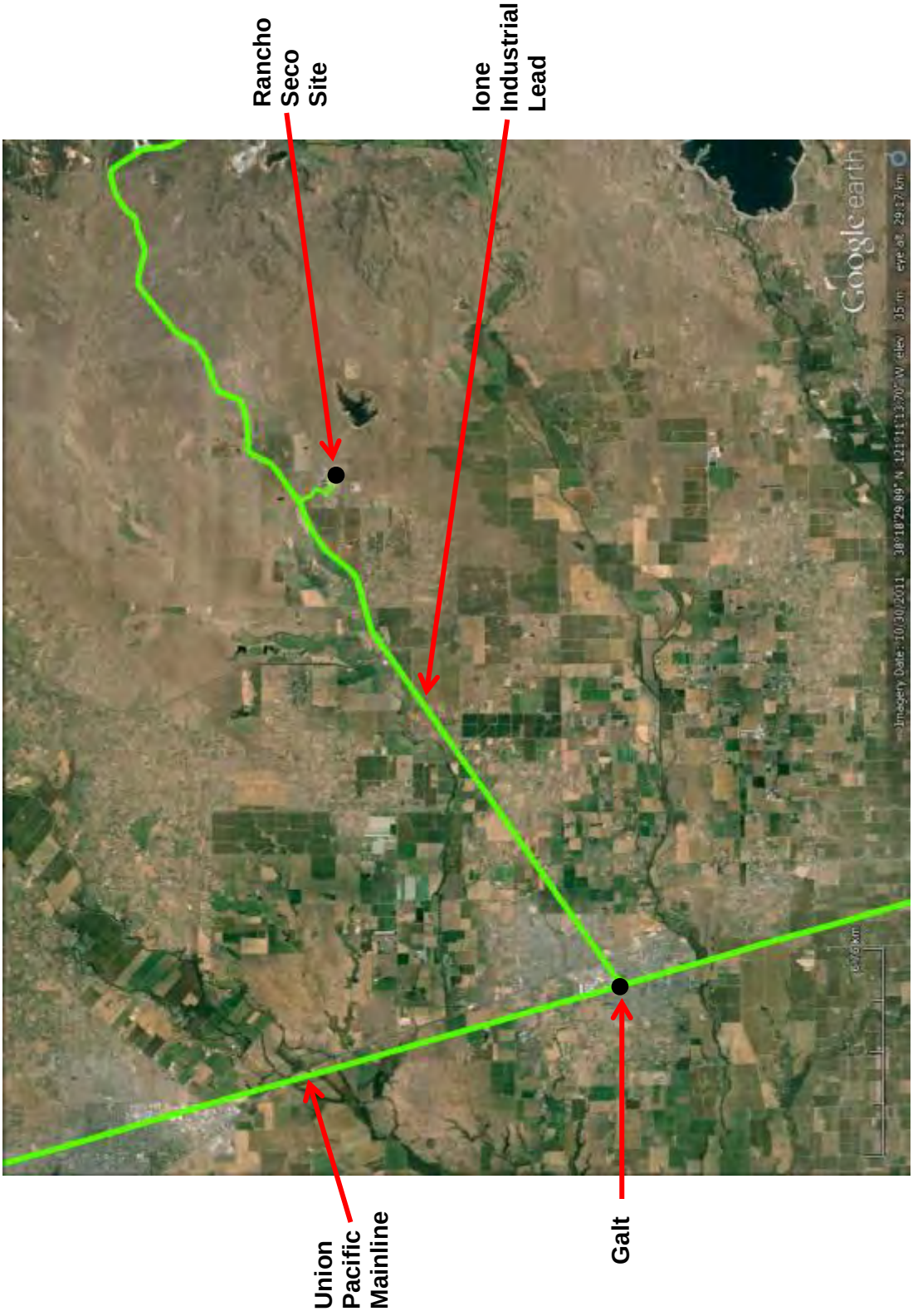


Figure 2-91. Aerial View of Ione Industrial Lead and Union Pacific Mainline (Google 2015)



Photo courtesy of Rancho Seco

Figure 2-92. Rancho Seco Pressurizer on Railcar (2004)



Photo courtesy of Rancho Seco

Figure 2-93. Rancho Seco Steam Generator Segments on Railcars



Photo courtesy of Rancho Seco

Figure 2-94. Rancho Seco Generator on Heavy Haul Truck Being Transported to the Port of Stockton, California (2002)



Photo courtesy of Rancho Seco

Figure 2-95. MP187 Cask Transported by Heavy Haul Truck

2.6.4 Gaps in Information

The principal question for the Rancho Seco site regarding the capability of the off-site transportation infrastructure to accommodate shipments of large transportation casks is the weight limit (158 tons) associated with the Ione Industrial Lead. This weight limit would make it necessary to obtain route clearance from the Union Pacific Railroad or to upgrade the track to allow its use for rail shipments of the MP187 transportation cask. As discussed in Section 2.6.3, during decommissioning loads larger than 158 tons were transported on the Ione Industrial Lead. In addition, it would be necessary to obtain NRC authorization to transport non-failed-fuel canisters containing damaged fuel assemblies in the MP187 transportation cask.

2.7 Trojan

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Trojan site. The Trojan site is located in northwestern Oregon on the Columbia River about 40 miles northwest of Portland, Oregon (NAC 1991b).

2.7.1 Site Inventory

The Trojan ISFSI has a site-specific 10 CFR Part 72 license (License No. SNM-2509). Thirty-four canisters containing used nuclear fuel assemblies and no canisters of GTCC low-level radioactive waste are stored at the Trojan site. The 34 canisters contain 780 intact assemblies, 10 partial assemblies, 8 process can capsules, 1 failed fuel can containing 8 bottom nozzles and 2 process cans, 1 fuel rod storage rack containing 23 ruptured or damaged fuel rods, and 1 assembly skeleton.

Figure 2-96 shows the Trojan ISFSI. The storage system used at Trojan is a hybrid of two storage systems (EPRI 2010), and consists of TranStor concrete storage overpacks and Holtec MPC-24E and MPC-24EF canisters. The MPC-24E and the MPC-24EF canisters hold 24 pressurized water reactor used nuclear fuel assemblies. The fuel assemblies from Trojan were loaded into Holtec canisters from December 2002 through September 2003 (Leduc 2012). The fuel rods in the fuel assemblies are zirconium alloy-clad. The HI-STAR 100 transportation cask (Docket No. 71-9261) is certified to transport the MPC-24E and the MPC-24EF canisters. Although HI-STAR 100 casks have been constructed for use in the United States, these casks are being used as storage casks at the Dresden (4 casks) and Hatch (3 casks) sites (Ux Consulting 2016a). For these HI-STAR 100 casks to be used to ship used nuclear fuel from the Trojan site, they would need to be unloaded, their contents placed in other storage overpacks, and the casks transported to the Trojan site. It would also be necessary to procure impact limiters and spacers for these HI-STAR 100 casks.



Photo courtesy of Trojan

Figure 2-96. Trojan Independent Spent Fuel Storage Installation

Figure 2-97 illustrates the number of used nuclear fuel assemblies at Trojan based on their discharge year. The oldest fuel was discharged in 1978 and the last fuel was discharged in 1992. The median discharge year of the fuel is 1988.

Figure 2-98 illustrates the number of used nuclear fuel assemblies at Trojan based on their burnup. The lowest burnup is 5.1 GWd/MTHM and the highest burnup is 41.9 GWd/MTHM. The median burnup is 33.5 GWd/MTHM. No high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) is stored at Trojan.

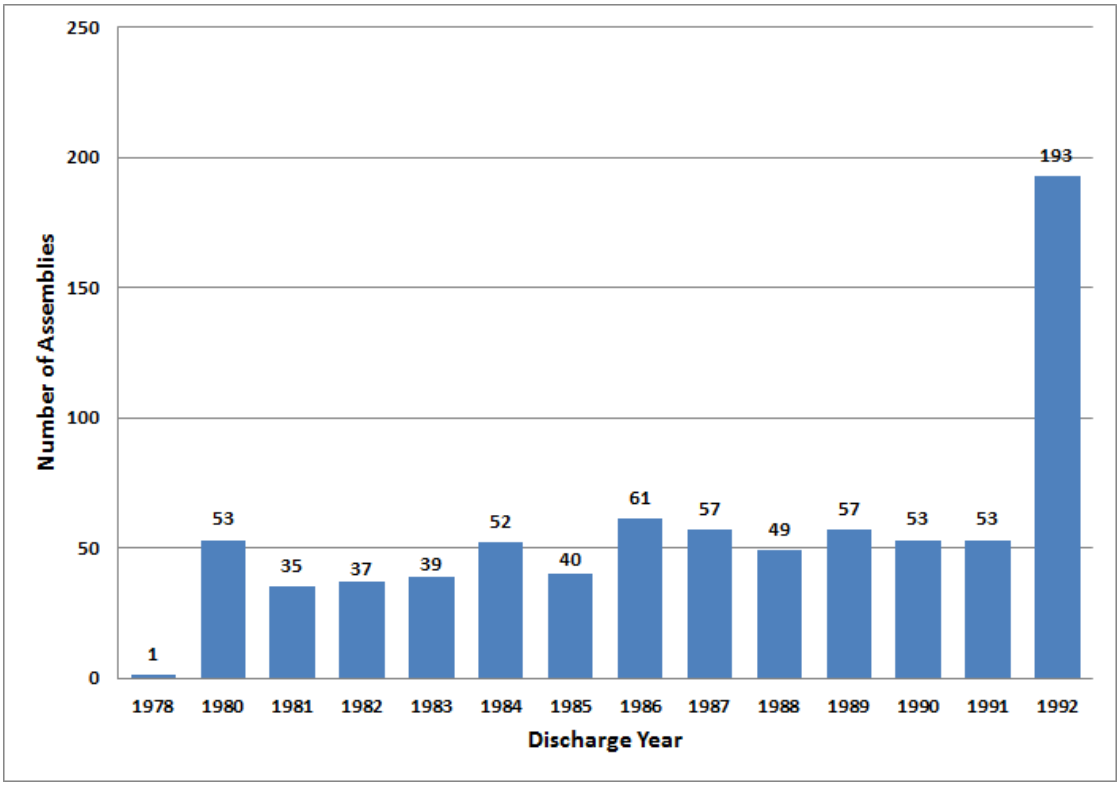


Figure 2-97. Trojan Number of Assemblies versus Discharge Year (EIA 2013)

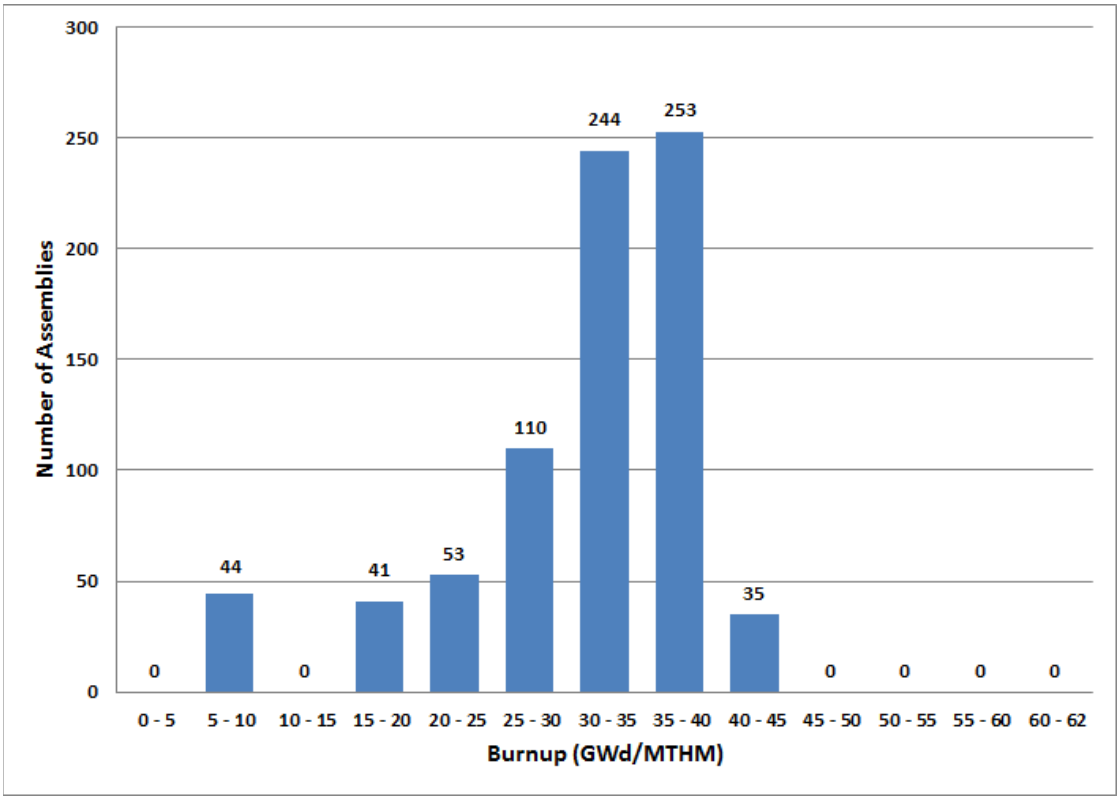


Figure 2-98. Trojan Number of Assemblies versus Burnup (EIA 2013)

2.7.2 Site Conditions

Figure 2-99 provides an aerial view of the Trojan site, where the reactor and associated structures have been removed. Electrical power is available at the Trojan ISFSI. However, mobile equipment such as cranes to unload the TranStor vertical concrete storage overpacks containing the Holtec multipurpose canisters used at Trojan, and to load the HI-STAR 100 transportation casks is not present at the site. The HI-STAR 100 transportation cask is certified to transport the Trojan used nuclear fuel contained in the MPC-24E and the MPC-24EF canisters. A transfer cask, transfer station, and air pad system are also located at the Trojan ISFSI. Figure 2-100 shows the transfer cask, Figure 2-101 shows the transfer station, Figure 2-102 shows the transfer station with the transfer cask and mobile crane, and Figure 2-103 shows the transfer station with the transfer cask and a TranStor vertical concrete storage overpack.

The Portland and Western Railroad rail line passes through the Trojan site approximately 700 feet from the Trojan ISFSI (TriVis Incorporated 2005). This rail line is designated as track class 2 and connects to the Union Pacific and BNSF Railroads near Portland, Oregon, a distance of about 60 miles. A rail spur formerly entered the protected area (NAC 1991b). This spur has been removed, but could be rebuilt in preparation for shipping used nuclear fuel.[22]

A barge slip is located on the Trojan site about 3000 feet south of the Trojan ISFSI. The barge slip is located at Columbia River Mile 72.5 and provides for roll-on/roll-off capability. The barge slip is not being maintained and dredging is usually required prior to use. There is no crane or other permanently installed handling or lifting equipment at the barge slip.

2.7.3 Near-site Transportation Infrastructure and Experience

At the Trojan site, a rail spur used to run from the Portland and Western Railroad to the site (see Figure 2-104). The rail spur was located at milepost 40.8 on the Astoria District of the Portland and Western Railroad and has been removed. In addition, during decommissioning a short spur was installed for rail shipments of waste from the site. This spur has also been removed.

Figure 2-105 shows the Portland and Western Railroad in the vicinity of the Trojan site, Figure 2-106 shows the location of the former junction of the rail spur with the Portland and Western Railroad, and Figure 2-107 shows the railbed of the former rail spur. Remnants of this spur exist on-site (see Figure 2-108). There appears to be sufficient room at the Trojan site for additional track to accommodate trains having eight or more railcars (two buffer cars, a security escort car, and five or more cask cars).

As discussed in Section 2.7.2, a barge slip is also present at the Trojan site and provides access to the Columbia River. Figure 2-99 shows the location of the barge slip. Figure 2-109 shows the access road to the barge slip, and Figure 2-110 shows the condition of the barge slip in 2013.

[22] Ross SB. 2012. Email message from JP Fischer (Trojan ISFSI Manager, Portland General Electric Company) to SB Ross (Pacific Northwest National Laboratory), "Re: Request for Info," September 17, 2012.

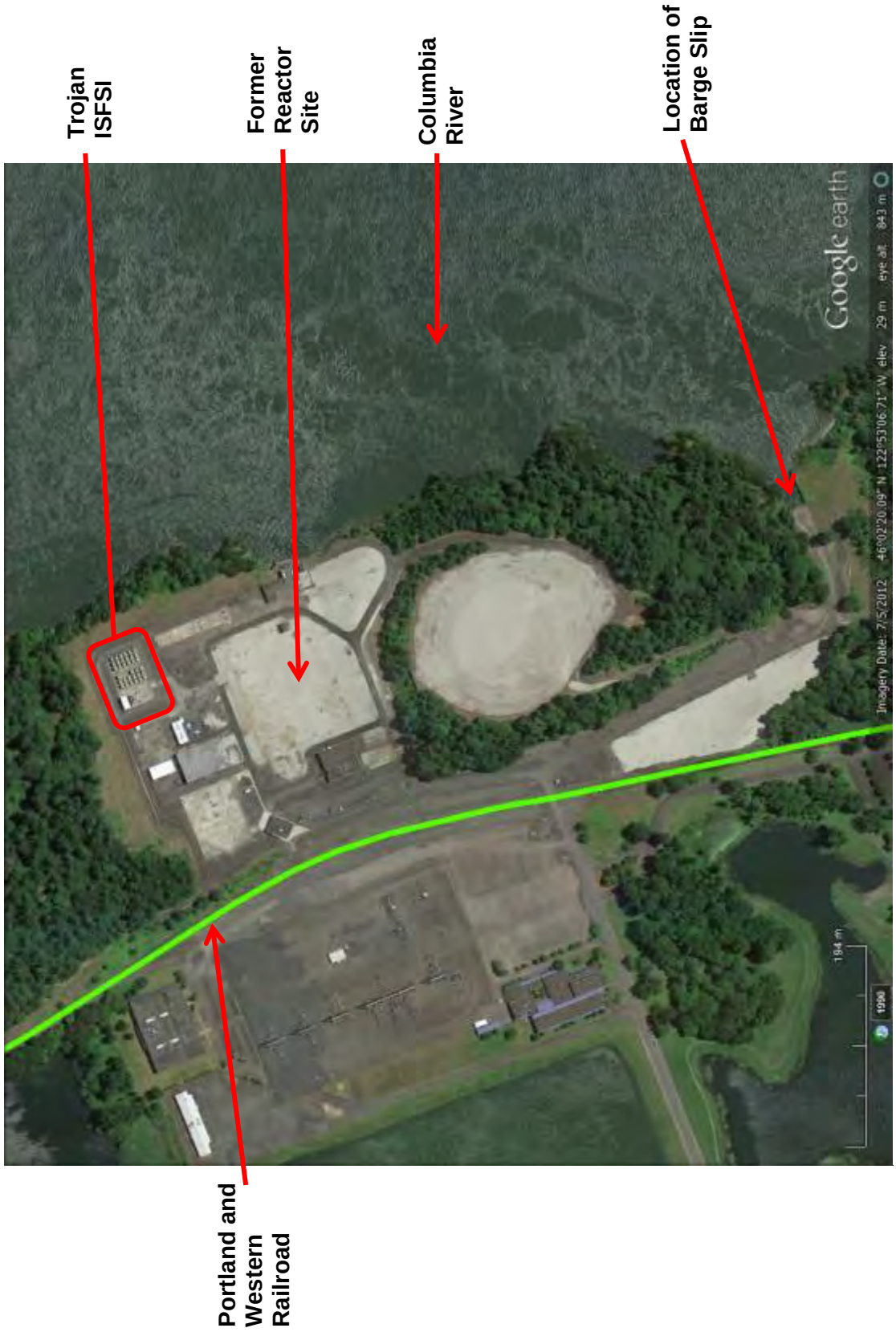


Figure 2-99. Aerial View of Trojan Site (Google 2015)



Photo courtesy of Trojan

Figure 2-100. Trojan Transfer Cask



Photo courtesy of Trojan

Figure 2-101. Trojan Transfer Station



Photo courtesy of Trojan

Figure 2-102. Trojan Transfer Station with Transfer Cask and Mobile Crane



Photo courtesy of Oregon Department of Energy

Figure 2-103. Trojan Transfer Station with Transfer Cask and TranStor Vertical Concrete Storage Overpack



Figure 2-104. Rail Interface at Trojan (Google 2015)



Figure 2-105. Portland and Western Railroad in the Vicinity of the Trojan Site (2013)



Figure 2-106. Location of Former Junction of Portland and Western Railroad and Trojan Rail Spur (2013)



Figure 2-107. Former Trojan Rail Spur Railbed (2013)



Figure 2-108. Remnants of On-site Rail Spur at Trojan (2013)



Photo courtesy of Federal Railroad Administration

Figure 2-109. Trojan Barge Slip Access Road (2013)



Photo courtesy of Federal Railroad Administration

Figure 2-110. Trojan Barge Slip (2013)

During decommissioning, Trojan shipped four steam generators, the pressurizer, and the reactor pressure vessel from this barge slip to the US Ecology low-level radioactive waste disposal facility near Richland, Washington. The steam generator packages weighed 450 tons each and the pressurizer package weighed 125 tons (Lackey and Kelly 1996, 1997). The four steam generators had diameters of 14.5 feet and a length of 68 feet. The pressurizer had a diameter of 8.5 feet and a length of 53 feet. The four steam generators and pressurizer were transported from the Trojan site to the barge slip using a hydraulically-leveled 16-line Goldhofer transporter. The transporter was also used to support the four steam generators and pressurizer while on the barge, and to move the four steam generators and pressurizer from the barge slip at the Port of Benton, Washington (Columbia River Mile 342.8), to the US Ecology low-level radioactive waste disposal facility. A total of five barge shipments were made (EPRI 1997b).

The barge was 180 feet long, 50 feet wide, and 14 feet deep. Prior to transporting the four steam generators and pressurizer, the Trojan barge slip was dredged. The sediments in the barge slip were analyzed to assure that there were no contaminants that would require special handling. Approximately 2750 cubic yards of material were removed from the barge slip. After dredging, the barge slip was graded. Because the barge was grounded for loading and unloading, the barge slip bottoms at the Trojan site and at the Port of Benton were leveled and inspected by divers, who removed any large objects and debris and corrected any out-of-specification unevenness. After the barge was loaded, the barge was deballasted. Inspections were performed prior to ballasting and after deballasting to ensure that no damage was done during loading. The Trojan barge slip is also significantly affected by tides, so departure had to take place during high tide to have sufficient water depth to float the loaded barge (EPRI 1997b).

The reactor pressure vessel package weighed 1000 tons (Radwaste Magazine 1999), had a diameter of 28 feet, and was 42.5 feet long (EPRI 2000). The reactor pressure vessel was transported from the Trojan site to the barge slip using a hydraulically-leveled 4-file, 20-line Scheuerle transport trailer. Each line consisted of 16 tires, which resulted in a total of 320 tires. The transporter was also used to support the reactor pressure vessel package while on the barge, and to move the reactor pressure vessel package from the barge slip at the Port of Benton, Washington (Columbia River Mile 342.8), to the US Ecology low-level radioactive waste disposal facility (EPRI 2000).

The barge was specifically designed and built to transport the reactor pressure vessel package, and was 240 feet long, 55 feet wide, and 15 feet deep. Because the barge was grounded for loading and unloading, the barge slip bottoms at the Trojan site and at the Port of Benton were leveled and inspected by divers, who removed any large objects and debris and corrected any out-of-specification unevenness. After the barge was loaded, the barge was deballasted. Inspections were performed prior to ballasting and after deballasting to ensure that no damage was done during loading. The Trojan barge slip is also significantly affected by tides, so departure had to take place during high tide to have sufficient water depth to float the loaded barge (EPRI 2000).

Figure 2-111 through Figure 2-115 show a steam generator being loaded at the Trojan barge slip, and the Trojan reactor pressure vessel in its transport cradle, the reactor pressure vessel being transported by barge, passing through locks on the Columbia River, and being transported by heavy haul truck to the US Ecology low-level radioactive waste disposal facility.



Photo courtesy of Trojan

Figure 2-111. Trojan Steam Generator Being Loaded at Barge Slip (1995)



Photo courtesy of Oregon Department of Energy

Figure 2-112. Trojan Reactor Pressure Vessel on Transport Cradle (1999)



Photo courtesy of Trojan

Figure 2-113. Trojan Reactor Pressure Vessel Being Transported by Barge (1999)



Photo courtesy of Trojan

Figure 2-114. Trojan Reactor Pressure Vessel Passing Through Locks on the Columbia River (1999)



Photo courtesy of Trojan

Figure 2-115. Trojan Reactor Pressure Vessel Being Transported by Heavy Haul Truck (1999)

2.7.4 Gaps in Information

Both rail and barge modes are feasible for transporting used nuclear fuel from the Trojan site. The Portland and Western Railroad rail line passes through the Trojan site approximately 700 feet from the Trojan ISFSI. In the past, a rail spur entered the protected area. The spur was disconnected, but according to site representatives, could be rebuilt in preparation for shipping used nuclear fuel. The Portland and Western Railroad is a Class II regional railroad whose track is expected to be capable of accommodating shipments of HI-STAR 100 casks from the Trojan site. The Trojan site also has an on-site barge slip, and it is likely the barge slip could be used for shipping used nuclear fuel transportation casks on barges.

2.8 La Crosse

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the La Crosse site. The La Crosse site is located in western Wisconsin on the east bank of the Mississippi River, about 1 mile south of Genoa and 17 miles south of La Crosse, Wisconsin (TOPO 1993e).

2.8.1 Site Inventory

Five canisters containing 333 used nuclear fuel assemblies are stored at the La Crosse ISFSI (Docket No. 72-46). The five canisters contain 176 intact used nuclear fuel assemblies, 157 damaged used nuclear fuel assemblies, and 1 fuel debris can. The 157 damaged assemblies have been placed in damaged fuel cans. La Crosse is undergoing decommissioning; however, because the La Crosse reactor pressure vessel with its internal components has been shipped off-site for disposal (Radwaste Solutions 2007), GTCC low-level radioactive waste would not be generated.

Figure 2-116 shows the La Crosse ISFSI. The storage system used at La Crosse is the NAC Multi-Purpose Canister system (NAC-MPC) (Docket No. 72-1025), which consists of a transportable storage canister, a vertical concrete storage cask, and a transfer cask. The transportable storage canister used for the La Crosse used nuclear fuel is the MPC-LACBWR. This canister holds 68 La Crosse boiling water reactor used nuclear fuel assemblies. The fuel assemblies from La Crosse were loaded into MPC-LACBWR canisters from July through September 2012. The fuel rods in the fuel assemblies are stainless steel-clad. The NAC-STC transportation cask (Docket No. 71-9235) is certified to transport the MPC-LACBWR canister. No NAC-STC transportation casks have been fabricated for use in the United States. Two NAC-STC transportation casks have been fabricated for use in China (Washington Nuclear Corporation 2003).

Figure 2-117 illustrates the number of used nuclear fuel assemblies at La Crosse, based on their discharge year. The oldest fuel was discharged in 1972 and the last fuel was discharged in 1987. The median discharge year of the fuel is 1982.

Figure 2-118 illustrates the number of used nuclear fuel assemblies at La Crosse based on their burnup. The lowest burnup is 4.7 GWd/MTHM and the highest burnup is 21.5 GWd/MTHM. The median burnup is 15.7 GWd/MTHM. No high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) is stored at La Crosse.



Photo courtesy of La Crosse

Figure 2-116. La Crosse Independent Spent Fuel Storage Installation

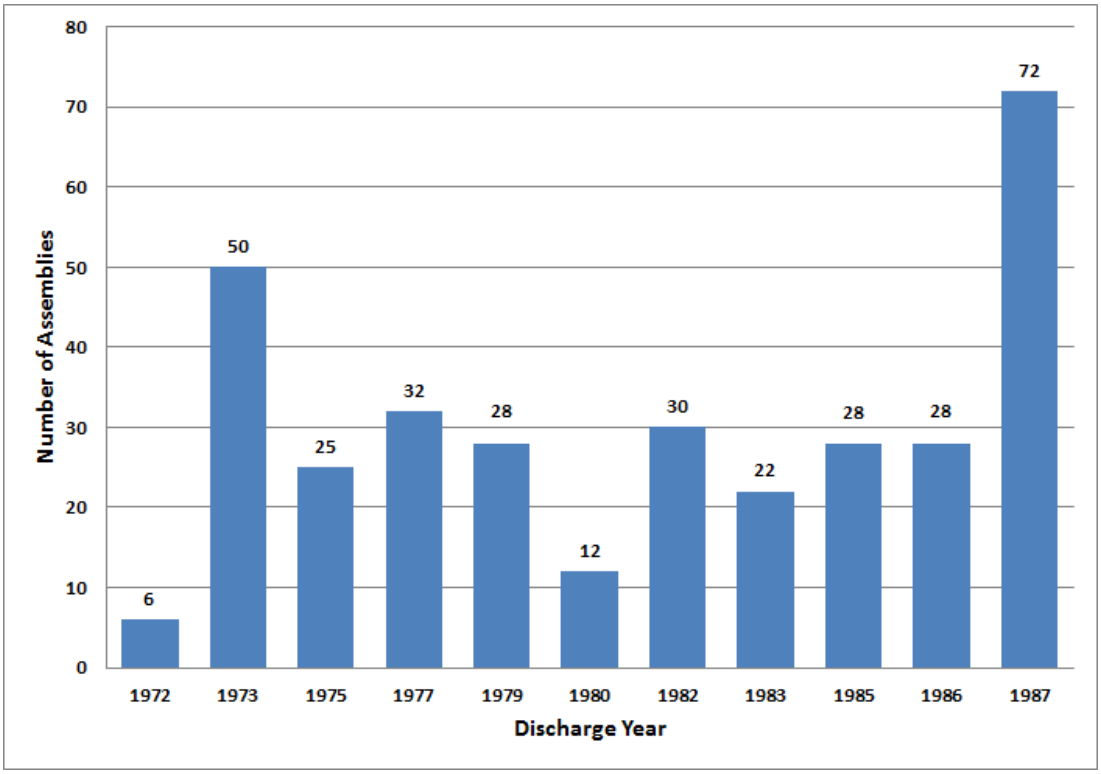


Figure 2-117. La Crosse Number of Assemblies versus Discharge Year (EIA 2013)

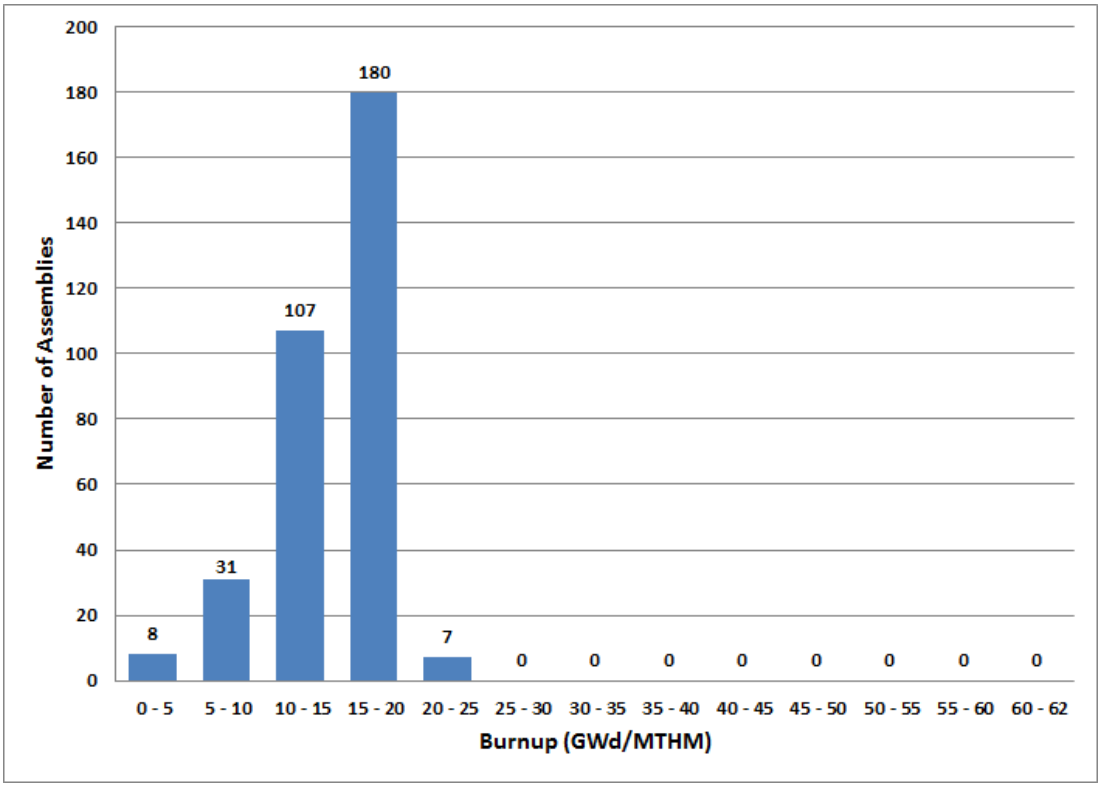


Figure 2-118. La Crosse Number of Assemblies versus Burnup (EIA 2013)

2.8.2 Site Conditions

Figure 2-119 through Figure 2-121 provide aerial views of the La Crosse site, barge facility and on-site rail spur, and ISFSI and boat ramp. As seen in Figure 2-119, the La Crosse ISFSI is located south of the La Crosse reactor site and the Genoa #3 coal-fired power plant. Electrical power is available at the La Crosse ISFSI. However, mobile equipment such as cranes or a gantry system to unload the NAC-MPC vertical concrete storage casks used at La Crosse and to load the NAC-STC transportation cask that is certified to transport the La Crosse used nuclear fuel is not present at the site. A transfer cask is available on-site and is owned by the Dairyland Power Cooperative. This transfer cask could also be used at the Yankee Rowe and Connecticut Yankee sites.

Rail service to the La Crosse site is provided by the BNSF Railroad. The BNSF rail line runs along the eastern boundary of the site about 800 feet from the La Crosse ISFSI. About 86 trains per day use this mainline and the rail line is designated as track class 4. La Crosse does not have an active on-site rail system;[23] however, remnants of an on-site rail system exist at the site (see Figure 2-122). There is a short on-site spur at the north end of the La Crosse site (see Figure 2-123). Figure 2-124 shows the junction of the on-site rail spur with the BNSF Railroad. In 2007, this on-site rail spur was used during the transport of the La Crosse reactor pressure vessel to the Barnwell, South Carolina low-level radioactive waste disposal facility (Radwaste Solutions 2007). The reactor pressure vessel was transported on a specially designed 20-axle railcar and the shipment weighed 310 tons.

The La Crosse site is located on the Upper Mississippi River at Mississippi River Mile 678.7, 0.5 miles south of Lock and Dam 8 (located at Mississippi River Mile 679.2) and 30.8 miles north of Lock and Dam 9 (located at Mississippi River Mile 647.9). On-site barge access is available about 0.2 miles north of the La Crosse reactor site (see Figure 2-125). The dock area is approximately 500 feet long by 100 feet wide with a minimum 9-foot water depth (TOPO 1993e). The barge facility has direct access to the shipping channel and receives between 450 and 500 barges annually. The barge facility is routinely used for the removal of covers from coal barges using a portable crane and for cleaning out the empty barges after the coal has been unloaded. The coal is unloaded several hundred yards downstream adjacent to the Genoa #3 coal-fired power plant. A large number of barge mooring/securing posts are available. Since the Upper Mississippi River usually freezes in the winter, the typical barge delivery season is from March through October, 30 to 35 weeks. Mobile rental cranes of the required capacity are available (TriVis Incorporated 2005). TOPO (1993e) reports that dredging or other dock area refurbishment is likely to be required.

[23] Ross SB. 2012. Email message from DG Egge (Plant Manager, LACBWR, Dairyland Power Cooperative) to SB Ross (Pacific Northwest National Laboratory), "Re: La Crosse Information," October 17, 2012.



Figure 2-119. Aerial View of La Crosse Site (Google 2015)



Figure 2-120. Aerial View of La Crosse Barge Facility and On-site Rail Spur (Google 2015)



Figure 2-121. Aerial View of La Crosse Independent Spent Fuel Storage Installation and Boat Ramp (Google 2015)



Photo courtesy of La Crosse

Figure 2-122. Remnants of the On-site Rail System at La Crosse Site (2013)



Photo courtesy of La Crosse

Figure 2-123. On-site Rail Spur at Northern End of La Crosse Site (2013)



Photo courtesy of La Crosse

Figure 2-124. Junction of On-site Rail Spur with BNSF Railroad at La Crosse Site (2013)



Figure 2-125. Coal Barge at Barge Dock Area at La Crosse Site (2013)

2.8.3 Near-site Transportation Infrastructure and Experience

At the La Crosse site, a short on-site rail spur exists that provides direct rail access to the BNSF Railroad. There appears to be adequate room at the La Crosse site to extend this spur to accommodate trains having eight or more railcars (two buffer cars, a security escort car, and five or more cask cars). As discussed in Section 2.8.2, in 2007, this on-site rail spur was used to transport the La Crosse reactor pressure vessel to the Barnwell, South Carolina low-level radioactive waste disposal facility. Figure 2-126 and Figure 2-127 show the La Crosse reactor pressure vessel on the on-site spur and on the BNSF Railroad. The La Crosse site is also on the Mississippi River and has on-site barge access. However, barges have not been used for radioactive waste shipments from La Crosse.

In 2016, Lacrosse Solutions[24] is planning to start transporting low-level radioactive waste in an estimated 1100 intermodal containers approximately 50 miles by truck to the Seven Rivers Intermodal Terminal in Winona, Minnesota. This is being done to avoid blockage of the BNSF mainline which runs along the eastern boundary of the La Crosse site. The intermodal containers will be transferred to approximately 200 flat cars and transported by rail to Clive, Utah for disposal.

2.8.4 Gaps in Information

Rail service to the La Crosse site is provided by the BNSF Railroad that is east of the La Crosse ISFSI using a short on-site rail spur and there appears to be adequate room at the La Crosse site to extend this spur to accommodate trains having eight or more railcars (two buffer cars, a security escort car, and five or more cask cars). The location and method for loading the transportation cask and moving the transportation cask to a rail spur is uncertain.

On-site barge access is available about 0.2 miles north of the La Crosse reactor site. It is uncertain whether the on-site barge facility could accommodate used nuclear fuel transportation casks.

Assuming that the on-site rail spur into the La Crosse site is maintained or refurbished as may be needed, it is unlikely that heavy haul trucks would be used to remove transportation casks containing used nuclear fuel from the site.

[24] Lacrosse Solutions is the decommissioning contractor for the La Crosse site.



Photo courtesy of La Crosse

Figure 2-126. La Crosse Reactor Pressure Vessel on Rail Spur (2007)



Photo courtesy of La Crosse

Figure 2-127. La Crosse Reactor Pressure Vessel on BNSF Railroad (2007)

2.9 Zion

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Zion site. The Zion site is located in the northeastern corner of Illinois on the western shore of Lake Michigan, about 40 miles north of Chicago (TOPO 1994b).

2.9.1 Site Inventory

Sixty-one canisters containing used nuclear fuel assemblies and four canisters of GTCC low-level radioactive waste are stored at the Zion ISFSI (Docket No. 72-1037). The 61 canisters contain 2226 used nuclear fuel assemblies that were discharged from the Zion 1 and Zion 2 reactors. Figure 2-128 shows the Zion ISFSI. The storage system used at Zion is the NAC MAGNASTOR system (Docket No. 72-1031), which consists of a transportable storage canister (see Figure 2-129), a vertical concrete storage cask, and a transfer cask (see Figure 2-130). At Zion, the TSC-37[25] transportable storage canister is being used, which holds 37 pressurized water reactor used nuclear fuel assemblies. Figure 2-131 shows the TSC-37 canister inside the transfer cask and Figure 2-132 shows a damaged fuel can being installed inside a TSC-37 canister. The fuel rods in the fuel assemblies at Zion are all zirconium alloy-clad. The transportation cask that will be certified to transport this used nuclear fuel is the NAC MAGNATRAN (Docket No. 71-9356). The application for a certificate of compliance for the MAGNATRAN is currently under review by the NRC.

[25] The TSC-37 canister is also referred to as the TSC or TSCDF. The TSCDF may contain damaged fuel.



Photo courtesy of EnergySolutions

Figure 2-128. Zion Independent Spent Fuel Storage Installation

Figure 2-133 illustrates the number of used nuclear fuel assemblies at Zion, based on their discharge year. The oldest fuel was discharged in 1976 and the last fuel was discharged in 1997. The median discharge year of the fuel is 1987.

Figure 2-134 illustrates the number of used nuclear fuel assemblies at Zion based on their burnup. The lowest burnup is 14.2 GWd/MTHM and the highest burnup is 55.4 GWd/MTHM. The median burnup is 33.1 GWd/MTHM. There are 36 used nuclear fuel assemblies at Zion with burnups greater than 45 GWd/MTHM. These 36 fuel assemblies are classified by the NRC as high burnup used nuclear fuel. At the Zion site, all fuel with a burnup greater than 45 GWd/MTHM was placed in damaged fuel cans. Each TSCDF canister can accommodate up to four damaged fuel cans. An additional assembly (J47B) with a burnup of 44.945 GWd/MTHM was also treated as high burnup used nuclear fuel and was placed in a damaged fuel can.

In addition to the 37 used nuclear fuel assemblies discussed above, 57 used nuclear fuel assemblies identified as damaged, 2 loose fuel rod storage containers (ZFRSB1 and Y48B) holding 28 fuel rods, and 1 used nuclear fuel assembly (C15R) containing a stainless steel fuel rod of unconfirmed dimensions were placed in damaged fuel cans. Assembly N47B was also canned to meet MAGNATRAN burnup credit requirements. In total, 98 assemblies/fuel rod storage containers are contained in damaged fuel cans. A total of 25 TSCDF canisters contain a combination of high burnup fuel (12 canisters), damaged fuel (20 canisters), or fuel debris (2 canisters).

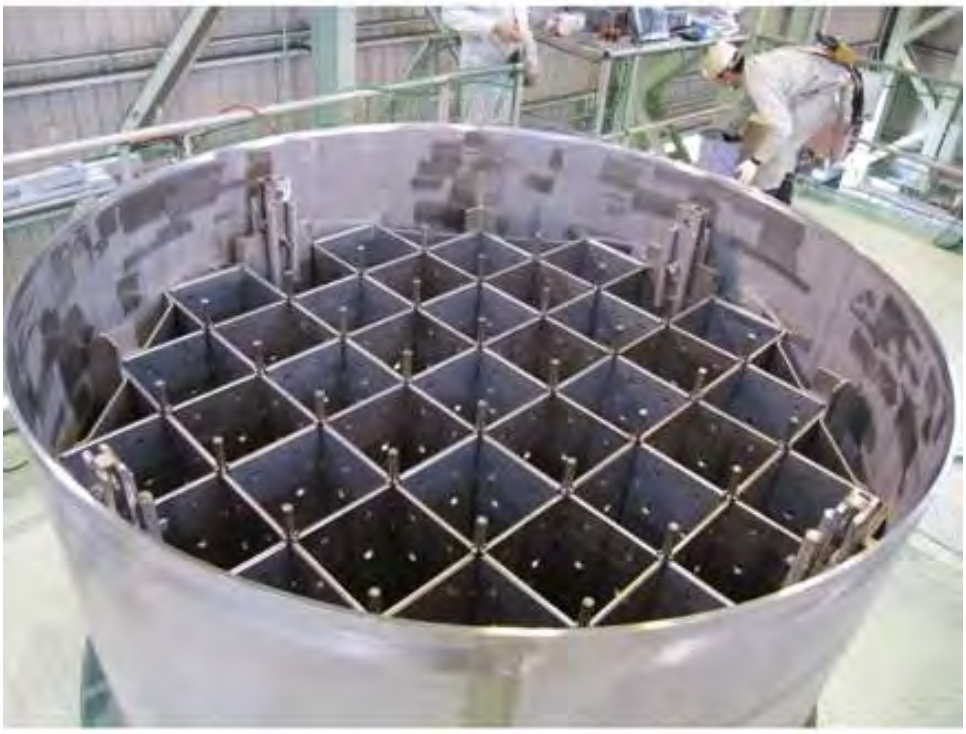


Photo courtesy of NAC International

Figure 2-129. TSC-37 Canister Showing Internal Baskets Which Hold Used Nuclear Fuel Assemblies



Photo courtesy of ZionSolutions

Figure 2-130. Transfer Cask

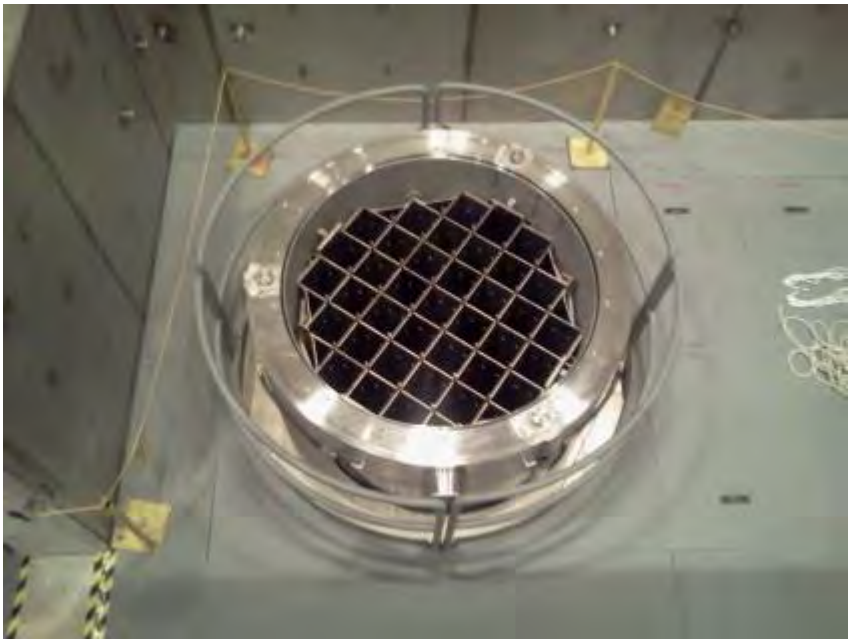


Photo courtesy of ZionSolutions

Figure 2-131. TSC-37 Canister Inside Transfer Cask



Photo courtesy of ZionSolutions

Figure 2-132. Damaged Fuel Can Being Installed in TSC-37 Canister

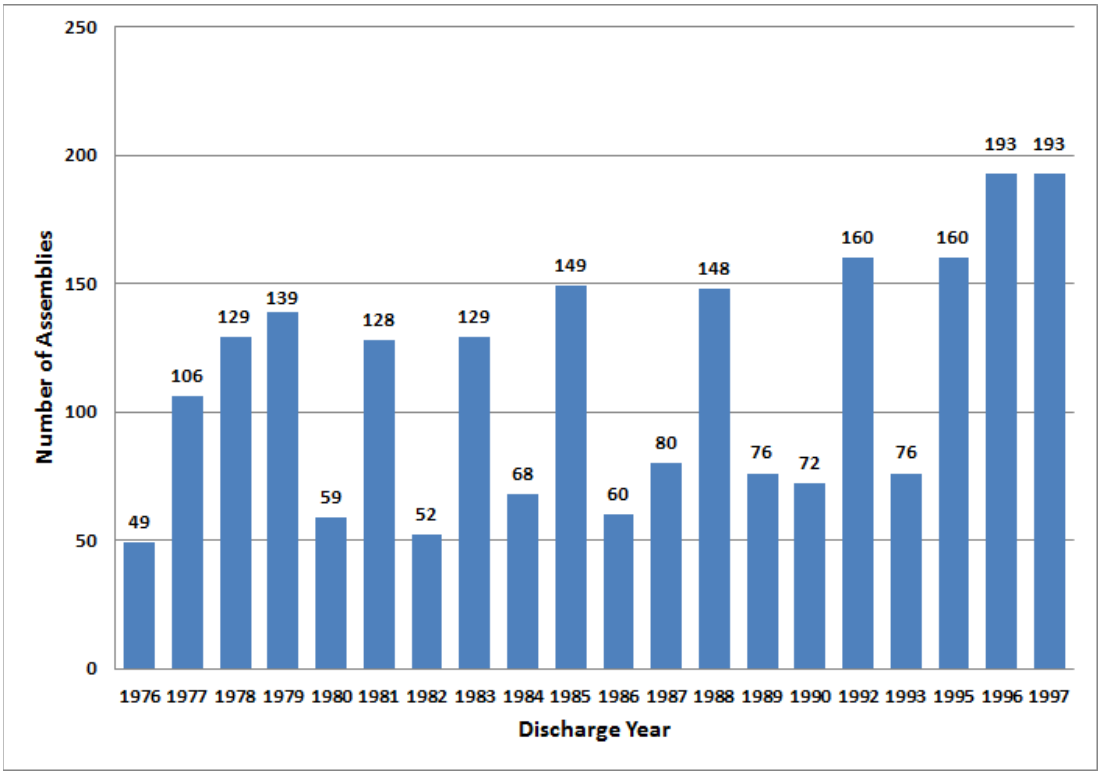


Figure 2-133. Zion Number of Assemblies versus Discharge Year (EIA 2013)

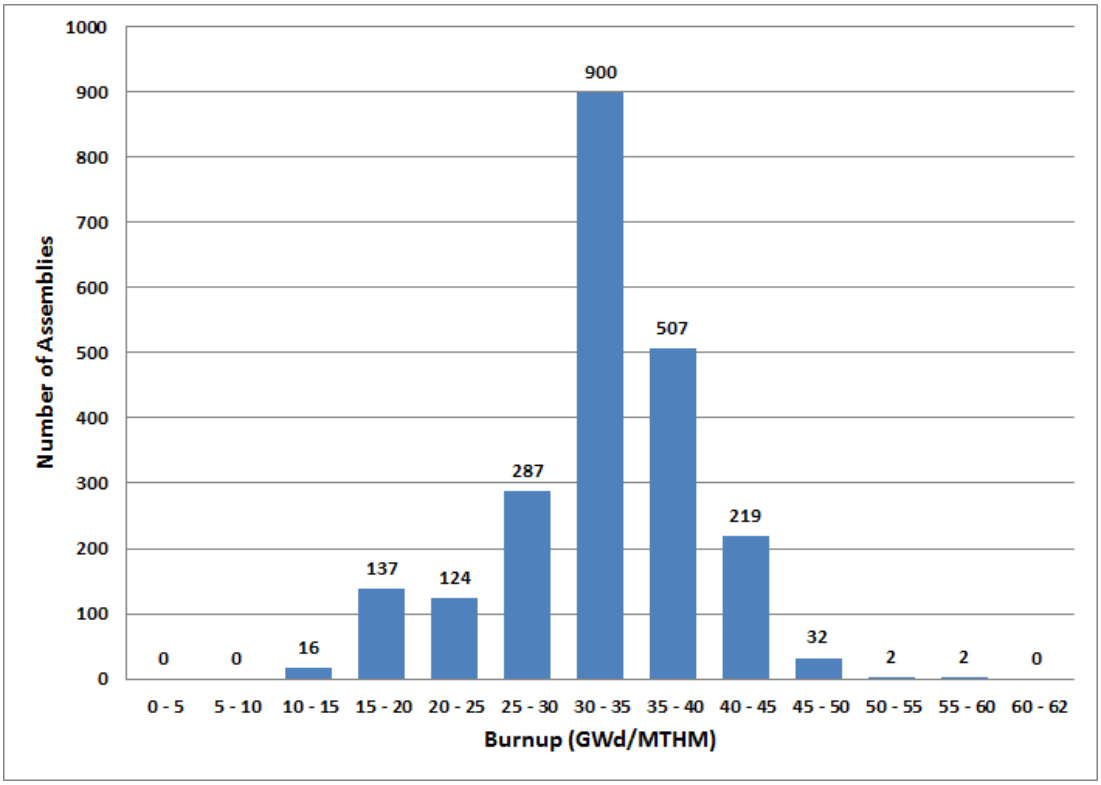


Figure 2-134. Zion Number of Assemblies versus Burnup (EIA 2013)

2.9.2 Site Conditions

Figure 2-135 provides an aerial view of the Zion site, which is being decommissioned. The Zion ISFSI is located at the southern end of the Zion site (see Figure 2-136). At the northern end of the Zion site, 65 vertical concrete storage casks were staged prior to being loaded. Figure 2-137 provides a close-up view of these vertical concrete storage casks. Figure 2-138 shows the TSC-37 transportable storage canisters into which the used nuclear fuel was placed. These canisters were then placed inside vertical concrete storage casks and moved to the Zion ISFSI. Figure 2-139 shows the transporter used to move the loaded vertical concrete storage casks to the ISFSI.

Figure 2-135 also shows the Zion on-site rail spur which was recently refurbished and which is being used for low-level radioactive waste shipments from the site. This refurbishment included installing concrete ties with Pandrol clips on the curves. A 4-inch ballast lift was also performed over the length of the spur and on the east-west portion of the spur every other wooden tie was replaced. This rail spur provides access to the Union Pacific Railroad. The Union Pacific rail line in the vicinity of the Zion site is designated as track class 4.

During construction of the Zion site, barges were used to move materials and components to the site (see Figure 2-140). The barge facility was located at the northern end of the Zion site and has been abandoned, and the land on which it was located was donated to the Illinois Beach State Park (TOPO 1994b). However, the barge pilings (see Figure 2-141) remain and could be reused to refurbish the barge facility.



Figure 2-135. Aerial View of Zion Site (Google 2015)



Figure 2-136. Aerial View of Zion Independent Spent Fuel Storage Installation (Google 2015)



Figure 2-137. Vertical Concrete Storage Casks Staged at Zion (2013)



Figure 2-138. Used Nuclear Fuel Transportable Storage Canisters Staged at Zion (2013)



Figure 2-139. Transporter Used to Move Vertical Concrete Storage Casks (2013)



Photo courtesy of ZionSolutions

Figure 2-140. Steam Generators Being Delivered to Zion Site by Barge during Construction



Figure 2-141. Barge Pilings at the North End of the Zion Site (Google 2015)

2.9.3 Near-site Transportation Infrastructure and Experience

At the Zion site, an on-site rail spur provides direct rail access to the Union Pacific Railroad (see Figure 2-142). The Northeast Illinois Regional Commuter Rail Corporation operates commuter service over this same track and there is a commuter rail stop located approximately 4,000 feet from the Zion site entrance.

There is currently enough room on the Zion site to accommodate trains having eight or more railcars (two buffer cars, a security escort car, and five or more cask cars). Figure 2-143 shows the Trackmobile that is being used to move railcars on-site. Figure 2-144 shows the rail spur entering the Zion site and Figure 2-145 shows the junction of the Zion on-site rail spur with the Union Pacific Railroad. Figure 2-145 also shows the concrete rail ties that were used in the reconstructing the curves of the on-site rail spur.

As mentioned in Section 2.9.2, the Zion site was served by barges during construction. The barge facility was abandoned; however, the barge pilings remain and could be reused to refurbish the barge facility.

In addition to rail, Zion has used heavy haul trucks to ship radioactive waste off-site for disposal. For example, in 2011, ZionSolutions, which is decommissioning the Zion reactors, shipped the Zion Unit 2 reactor head from the Zion site to Clive, Utah for disposal. The reactor head was approximately 17 feet in diameter and weighed 225,000 lb. (Troher 2011). A heavy haul truck was used for this shipment because the Zion Unit 2 reactor head was too large for shipment by rail. The heavy haul truck travelled 1,500 miles from the Zion site north of Chicago, Illinois to the EnergySolutions low-level radioactive waste disposal facility in Clive, Utah. Figure 2-146 shows the Zion reactor head on its heavy haul truck transporter.

2.9.4 Gaps in Information

At the Zion site, a rail spur connects to the Union Pacific Railroad mainline that runs between Milwaukee, Wisconsin, and Chicago, Illinois. The Union Pacific Railroad is a Class I railroad that is expected to have the capability to move shipments of used nuclear fuel in NAC MAGNATRAN transportation casks. However, the status and maintaining of this rail spur after decommissioning of the Zion site has been completed has not been determined.

The Zion barge facility used during plant construction was abandoned and the land on which it was located was donated to the Illinois Beach State Park. However, the barge pilings remain and could be reused to refurbish the barge facility.

The application for a certificate of compliance for the MAGNATRAN transportation cask is currently under review by the NRC and has not been issued.



Figure 2-142. Rail Interface at Zion (Google 2015)



Figure 2-143. Trackmobile Used to Move Railcars On-site (2013)



Photo courtesy of Federal Railroad Administration

Figure 2-144. On-site Rail Spur Entering Zion Site (2013)



Figure 2-145. Junction of Zion On-site Rail Spur with Union Pacific Railroad Showing Concrete Rail Ties (2013)



Photo courtesy of ZionSolutions

Figure 2-146. Zion Reactor Head on Heavy Haul Truck Transporter (2011)

2.10 Crystal River

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Crystal River site. The Crystal River site is located in northwestern Florida near the Gulf of Mexico on the Crystal River about 46 miles south-southwest of Gainesville, Florida, and 70 miles north of Tampa, Florida (TOPO 1994c).

2.10.1 Site Inventory

The Crystal River Unit 3 Nuclear Generating Plant (CR-3) has been shut down since September 26, 2009 and the final removal of used nuclear fuel from the reactor vessel was completed on May 28, 2011 (Franke 2013). There are 1244 pressurized water reactor used nuclear fuel assemblies (582.2 MTHM) stored in the spent fuel pool and there is no used nuclear fuel in dry storage at Crystal River.[26] This total includes an assembly that was created by

[26] Fata A. 2014. Email message from A Fata (Duke Energy Corporation) to SJ Maheras (Pacific Northwest National Laboratory), "Re: CR3 input to DOE report," September 30, 2014.

combining failed fuel rods from other assemblies, and does not include 76 assemblies that were loaded into the reactor for restart but not brought to critical. These assemblies are being sold for reuse.

The fuel rods in the fuel assemblies are zirconium alloy-clad. Crystal River is planning on using the Standardized NUHOMS System (Docket No. 72-1004) with the 32PTH1 dry shielded canister for dry storage of used nuclear fuel at an ISFSI. This system consists of transportable 32PTH1 dry shielded canisters, reinforced concrete horizontal storage modules, and a transfer cask. Figure 2-147 shows a transfer cask being used to load a canister into a horizontal storage module.

The 32PTH1 dry shielded canister holds 32 pressurized water reactor used nuclear fuel assemblies. Thirty-nine 32PTH1 canisters would be required to store the 1244 used nuclear fuel assemblies at Crystal River. Elnitsky (2013) estimated that 5 canisters containing GTCC low-level radioactive waste will be generated during decommissioning, and that GTCC low-level radioactive waste would not be packaged until 2068-2070. In addition, Elnitsky (2013) also states that the spent fuel pool will be maintained in a recoverable condition until all fuel has been removed from the Crystal River site unless contingency plans are put in place for offload of the canisters if needed.

The MP197HB transportation cask (Docket No. 71-9302) is certified to transport the 32PTH1 canister and also canisters containing GTCC low-level radioactive waste. In addition, the MP197HB transportation cask is certified to transport high burnup (> 45 GWd/MTHM) used nuclear fuel in the 32PTH1 canister. An MP197HB transportation cask is being fabricated in Japan (Vanderniet 2012). Fabrication is currently on hold.[27]

Figure 2-148 illustrates the number of used nuclear fuel assemblies at Crystal River, based on their discharge year. The oldest fuel was discharged in 1978 and the last fuel was discharged in 2009. The median discharge year of the fuel is 1996.

Figure 2-149 illustrates the number of used nuclear fuel assemblies at Crystal River based on their burnup. The lowest burnup is 8.7 GWd/MTHM and the highest burnup is 54.9 GWd/MTHM. The median burnup is 38.2 GWd/MTHM. There are 428 used nuclear fuel assemblies at Crystal River that have burnups greater than 45 GWd/MTHM. These 428 fuel assemblies are classified by the NRC as high burnup used nuclear fuel.

[27] Guibert N. 2016. Personal communication between N Guibert (AREVA TN) and SJ Maheras (PNNL), August 4, 2016.



Photo courtesy of AREVA TN

Figure 2-147. Transfer Cask Being Used to Load Canister into Horizontal Storage Module

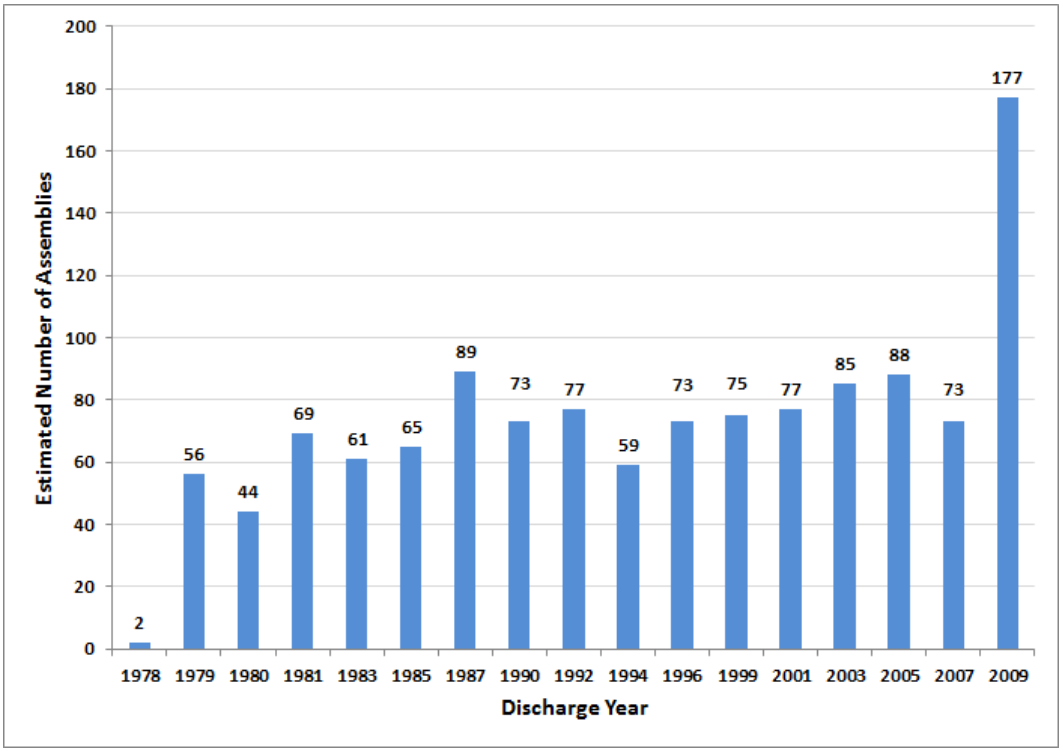


Figure 2-148. Crystal River Number of Assemblies versus Discharge Year (EIA 2013)

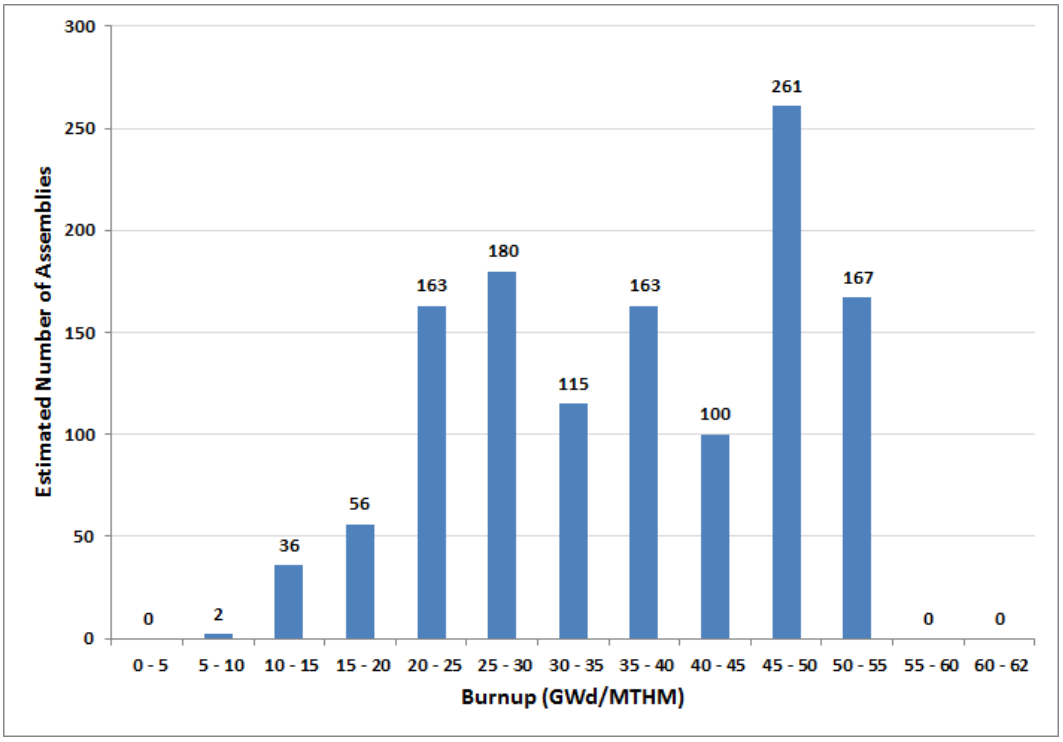


Figure 2-149. Crystal River Number of Assemblies versus Burnup (EIA 2013)

2.10.2 Site Conditions

The Crystal River Unit 3 Nuclear Generating Plant (CR-3) is part of the larger Crystal River Energy Complex (CREC), which includes the single nuclear unit and four fossil fueled units, Crystal River Units 1, 2, 4, and 5 (CR-1, CR-2, CR-4, and CR-5). Figure 2-150 shows the future site of the Crystal River ISFSI. This area will be built up approximately 20 feet to be above flood level. Figure 2-151 shows an artist's conception of the future Crystal River ISFSI. Figure 2-152 provides an aerial view of the Crystal River Energy Complex showing the location of CR-1 through CR-5, the on-site rail system including the nuclear spur and coal receiving loop, the coal barge unloading area, the barge turning basin, an area used to unload roll-on/roll-off barges, and the intake and discharge canals. Figure 2-153 shows the location of the future ISFSI at the Crystal River site discussed in Section 2.10.1.

Crystal River has an extensive on-site rail system used for coal shipments to the 4 fossil fueled units with service provided by the Florida Northern Railroad. The Crystal River site currently receives 5 coal trains per month but has received 30 to 40 trains per month. The weight of each car is in the range of 100 to 110 tons and coal trains weigh about 11,000 tons. In general, the on-site rail system is built using 132 to 136 lb. rail. A nuclear spur previously extended into the Crystal River reactor cask receiving area; the nuclear spur now terminates about 0.22 miles east of the cask receiving area and does not extend into the future ISFSI.

Figure 2-154 and Figure 2-155 show the nuclear spur and the junction of the onsite industrial spur and the nuclear spur. Figure 2-156 and Figure 2-157 show the onsite industrial spur in front

of the future ISFSI site. Figure 2-158 and Figure 2-159 show the onsite industrial spur at the junction with the coal receiving loop and approaching U.S. Highway 19 from the west. There is sufficient track outside of the Crystal River protected area to assemble or store more than 20 railcars, but use of the on-site track would not be allowed to interfere with coal shipments for the fossil fueled units.

Intake and discharge canals at the Crystal River site withdraw water from and discharge water to the Gulf of Mexico (see Figure 2-160). The Crystal River site has on-site barge access through the intake canal but loading a transportation cask onto a barge would require a crane to boom out over 30 feet to avoid a coal conveyer. The intake canal, which extends into the Gulf of Mexico, is 14 miles long. It has a minimum depth of 20 feet to accommodate barge traffic used to deliver coal for the fossil fuel units. Southern and northern dikes parallel the intake canal for about 3.4 miles offshore. The southern dike terminates at this point, while the northern dike extends an additional 5.3 miles into the Gulf of Mexico. The dikes are about 50 to 100 feet wide on top and are elevated about 10 feet above the water surface at mean low tide. Starting at the east end, the intake canal is 150 feet wide for 2.8 miles; 225 feet wide for the next 6.3 miles; and 300 feet wide for the last 4.9 miles. Dredging occurs in the intake canal every 5 to 7 years (NRC 2011).

Figure 2-161 shows the coal barge unloading area at the Crystal River site. The Crystal River site currently receives about 20 barges per month and each barge has a capacity of 20,000 tons. Figure 2-162 shows the barge turning basin. This area has been used to unload roll-on/roll-off barges at the Crystal River site.



Photo courtesy of Crystal River

Figure 2-150. Future Site of Crystal River Independent Spent Fuel Storage Installation (2015)



Photo courtesy of Crystal River

Figure 2-151. Artist's Conception of the Future Crystal River Independent Spent Fuel Storage Installation



Figure 2-152. Aerial View of the Crystal River Energy Complex (Google 2015)



Figure 2-153. Location of Future Crystal River Independent Spent Fuel Storage Installation (Google 2015)



Figure 2-154. Nuclear Spur (2015)



Figure 2-155. Junction of Onsite Industrial Spur (Left) and Nuclear Spur (Right) (2015)



Figure 2-156. Onsite Industrial Rail Spur in Front of the Future Independent Spent Fuel Storage Installation Site (Facing East) (2015)



Figure 2-157. Onsite Industrial Rail Spur in Front of Future Independent Spent Fuel Storage Installation Site (Facing West) (2015)



Figure 2-158. Onsite Industrial Rail Spur at the Coal Loop Junction (2015)



Figure 2-159. Onsite Industrial Rail Spur Approaching U.S. Highway 19 from the West (2015)



Figure 2-160. Aerial View of the Crystal River Intake and Discharge Canals (Google 2015)



Figure 2-161. Current Barge Area Used for Unloading Coal Barges (2015)



Figure 2-162. Barge Turning Basin (2015)

2.10.3 Near-site Transportation Infrastructure and Experience

At the Crystal River site, a 7-mile industrial rail spur provides direct rail access to the Florida Northern Railroad at Red Level Junction (see Figure 2-163). This spur is used to receive coal shipments for CR-1, CR-2, CR-4, and CR-5. The track south of Red Level Junction has been abandoned. In Newberry, Florida, about 60 miles from the Crystal River site, the Florida Northern Railroad interchanges with the CSXT Railroad at the Newberry wye (see Figure 2-164 and Figure 2-165). The Crystal River industrial spur (milepost 793.1 to 785.7) has a speed limit of 10 mph and is designated as track class 1. The Florida Northern Railroad speed limit from milepost 785.7 and 732.0 is 25 mph and is designated as track class 2. At milepost 789.27, the Florida Northern Railroad crosses U.S. Highway 19. At the Newberry wye (milepost 732.0 to 729.9), the speed limit is 10 mph and the track is designated as track class 1. To the northeast of the Newberry wye (milepost 718.7 to 717.0), the speed limit is also 10 mph and the track is designated as track class 1. At milepost 718.34, the Florida Northern Railroad crosses U.S. Highway 41/Main Street. In general, the Florida Northern Railroad is built using 115 lb. rail.

The CSXT track begins at milepost 717.0 and is track class 3. The CSXT also has trackage rights over the Florida Northern Railroad between milepost 718.7 and 717.0, enabling the CSXT to interchange with the Florida Northern Railroad at the Newberry wye, and between milepost 730.0 and 732.0, which is where inbound and outbound trains are staged. Figure 2-166 through Figure 2-169 show the Florida Northern Railroad near Dunnellon, Florida, a highway bridge over the Florida Northern Railroad, a grade crossing on the Florida Northern Railroad, and a bridge on the Florida Northern Railroad, respectively. Figure 2-170 through Figure 2-172 show wheel detectors, a hot bearing detector, and a dragging equipment detector on the Florida Northern Railroad at milepost 759.6. Figure 2-173 shows track maintenance equipment staged at the mine spur, just off the industrial spur, and Figure 2-174 shows a Florida Northern Railroad Hi-Rail vehicle used for track inspections.

In 2009, four moisture separator reheaters and a generator rotor were shipped to the Crystal River site by rail. The moisture separator reheaters weighed 300,000 lb. each, and had a length of 51 feet and a diameter of 14 feet (see Figure 2-175 and Figure 2-176). The generator rotor weighed 395,000 lb., and had a length of 50 feet and a diameter of 8 feet (see Figure 2-177 and Figure 2-178). The moisture separator reheaters and a generator rotor were unloaded at the Crystal River site nuclear spur. The old moisture separator reheaters were also loaded at the nuclear spur and shipped offsite by rail (see Figure 2-179 and Figure 2-180).

In 2015, twelve horizontal storage modules were shipped to the Crystal River site by rail. The horizontal storage modules were transported using 230-ton, 27-foot deck, 8-axle depressed center railcars. Each horizontal storage module weighed 189,000 lb., and had a length of 20.7 feet, a width of 9.7 feet, and a height of 14.8 feet. As with the moisture separator reheaters and the generator rotor, the horizontal storage modules were unloaded at the nuclear spur. Figure 2-181 shows two horizontal storage modules loaded on railcars, Figure 2-182 shows a horizontal storage module staged for unloading, Figure 2-183 shows a horizontal storage module being unloaded from a railcar, and Figure 2-184 shows the twelve horizontal storage modules at the nuclear spur after unloading.

As discussed in Section 2.10.2, Crystal River also has barge access to the Gulf of Mexico through the intake canal at the site. In 2012, the Crystal River site received low pressure turbine components by barge. These components consisted of two low pressure rotors (353,000 lb. each), two low pressure upper casings (117,000 lb. each), and two low pressure lower casings (200,000 lb. each). The components were unloaded at an area adjacent to the coal barge unloading area (see Figure 2-185), which also shows the barge turning basin. A ramp was constructed in the bank of the barge turning basin, the barge grounded, and the components rolled off the barge. Figure 2-186 through Figure 2-193 show the sequence of operations used to offload the components from the barge.

The Crystal River site has also received components by heavy haul truck. For example, in 2011, a high pressure turbine rotor was received by the Crystal River site (see Figure 2-194). The high pressure turbine weighed 150,000 lb., and had a length of 28 feet and a diameter of 7 feet.

2.10.4 Gaps in Information

At the Crystal River site, an on-site rail spur provides direct access to the Florida Northern Railroad which interchanges with the CSXT Railroad and consequently, barge or heavy haul truck transport of used nuclear fuel and GTCC low-level radioactive waste would be unlikely from the Crystal River site.

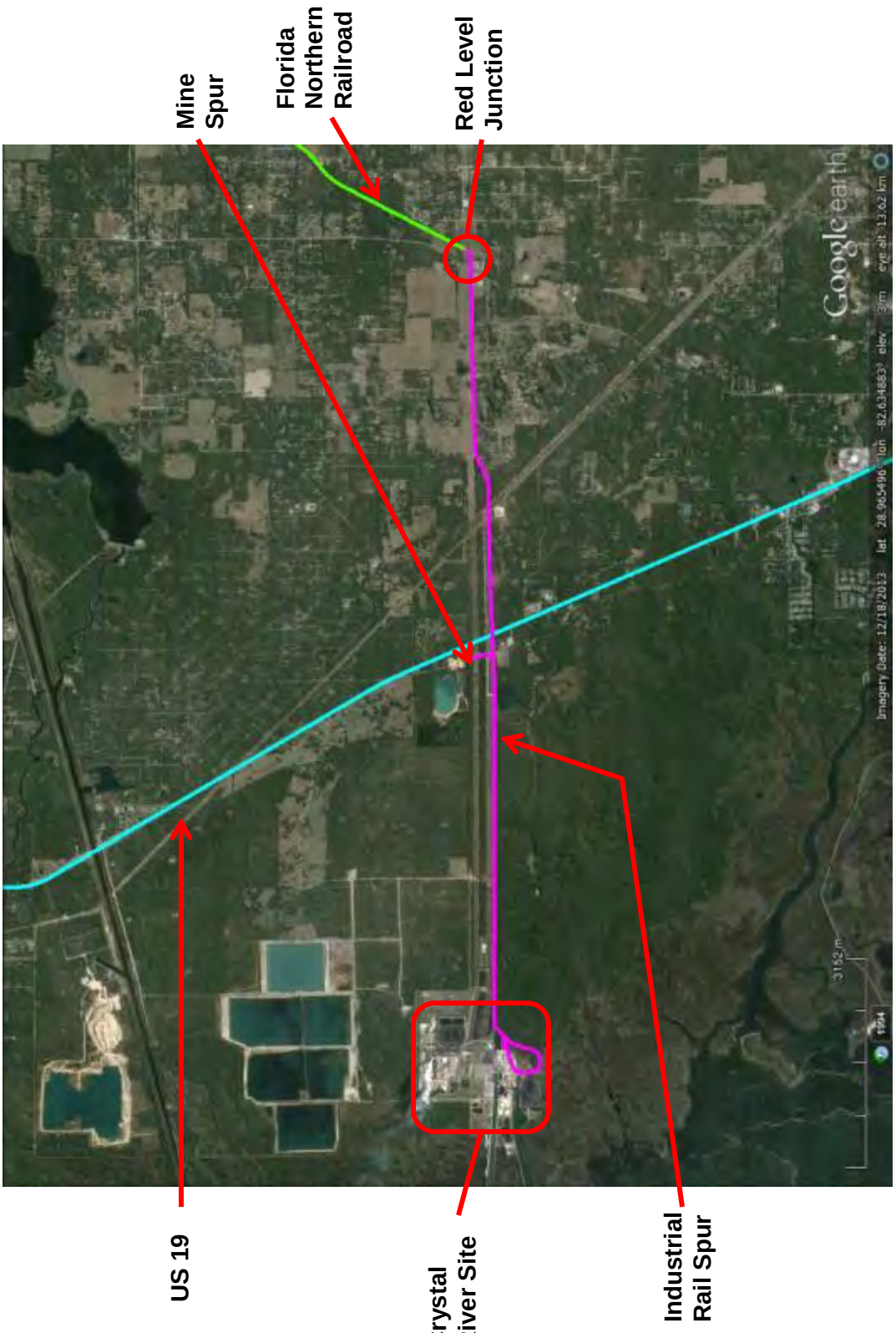


Figure 2-163. Aerial View of the Crystal River Industrial Rail Spur and Florida Northern Railroad (Google 2015)

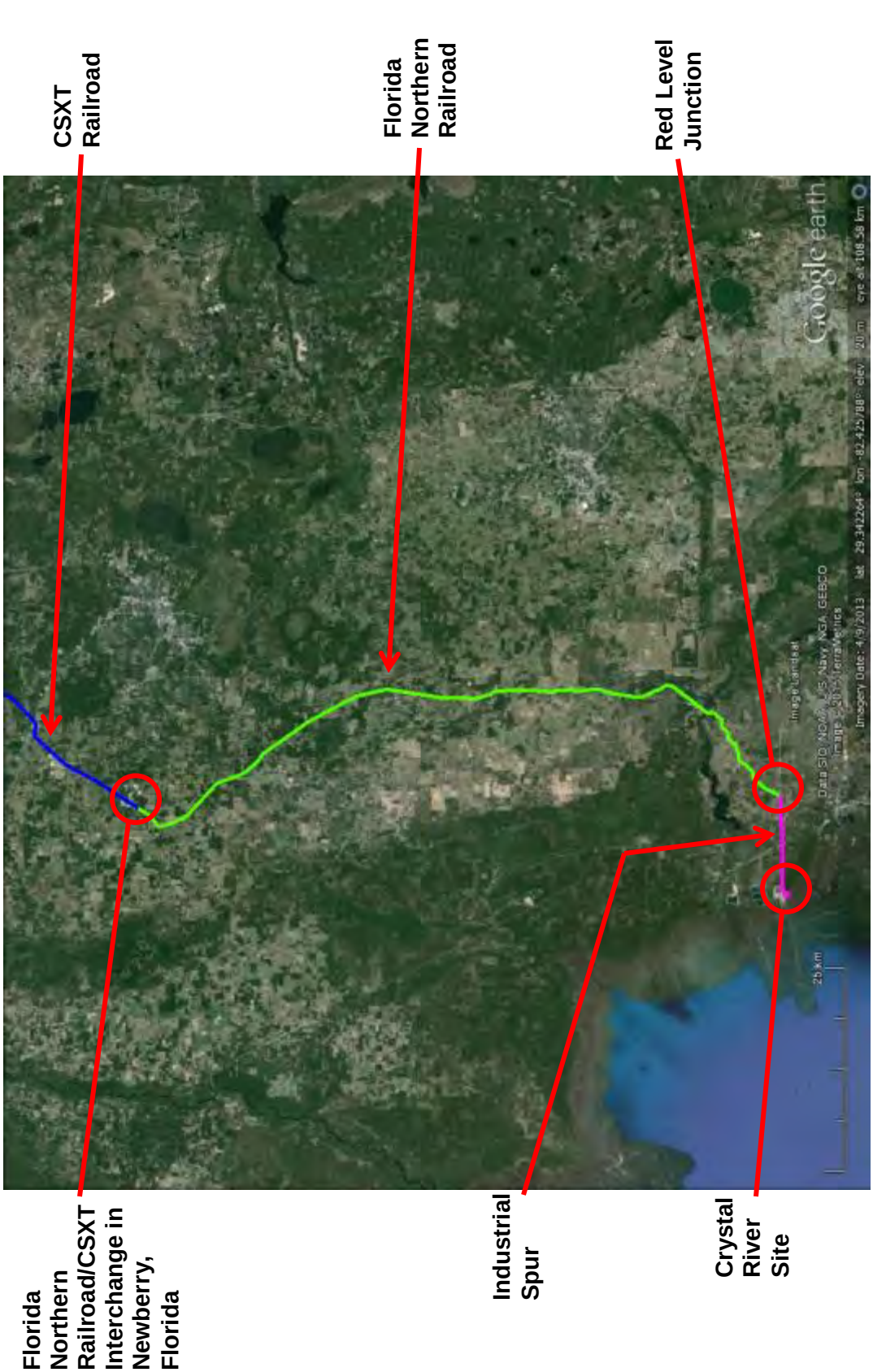


Figure 2-164. Aerial View of the Crystal River Industrial Rail Spur, Florida Northern Railroad, and CSXT Railroad (Google 2015)



Figure 2-165. Newberry Wye (Google 2015)



Figure 2-166. Florida Northern Railroad near Dunnellon, Florida (2015)



Figure 2-167. Highway Bridge over Florida Northern Railroad (2015)



Figure 2-168. Florida Northern Railroad Grade Crossing (2015)



Figure 2-169. Florida Northern Railroad Bridge (2015)



Figure 2-170. Wheel Detectors on Florida Northern Railroad (2015)



Figure 2-171. Hot Bearing Detector on Florida Northern Railroad (2015)



Figure 2-172. Dragging Equipment Detector on Florida Northern Railroad (2015)



Figure 2-173. Track Maintenance Equipment Staged at the Mine Spur (2015)



Figure 2-174. Hi-Rail Vehicle Used for Track Inspections (2015)



Photo courtesy of Crystal River

Figure 2-175. Moisture Separator Reheaters Being Shipped by Rail to the Crystal River Site (2009)



Photo courtesy of Crystal River

Figure 2-176. Moisture Separator Reheaters Being Unloaded at the Crystal River Site (2009)



Photo courtesy of Crystal River

Figure 2-177. Generator Rotor Being Shipped by Rail to the Crystal River Site (2009)



Photo courtesy of Crystal River

Figure 2-178. Generator Rotor Being Unloaded at the Crystal River Site (2009)



Photo courtesy of Crystal River

Figure 2-179. Old Moisture Separator Reheaters Being Shipped Offsite by Rail (2009)



Photo courtesy of Crystal River

Figure 2-180. Locomotive Picking Up Old Moisture Separator Reheaters (2009)



Photo courtesy of Crystal River

Figure 2-181. Two Horizontal Storage Modules Loaded on Railcars (2015)



Photo courtesy of Crystal River

Figure 2-182. Horizontal Storage Module Staged for Unloading (2015)



Photo courtesy of Crystal River

Figure 2-183. Horizontal Storage Module Being Unloaded from Railcar (2015)



Photo courtesy of Crystal River

Figure 2-184. Horizontal Storage Modules at Nuclear Spur after Unloading (2015)



Figure 2-185. Crystal River Site Barge Area (Google 2015)



Photo courtesy of Crystal River

Figure 2-186. Crystal River Turbine Components on Barge (2012)



Photo courtesy of Argonautics Marine Engineering, Inc.

Figure 2-187. Barge with Turbine Components Approaching Ramp (2012)



Photo courtesy of Crystal River

Figure 2-188. Barge with Turbine Components Just Before Grounding at Ramp (2012)



Photo courtesy of Argonautics Marine Engineering, Inc.

Figure 2-189. Barge with Turbine Components Grounded at Ramp (2012)



Photo courtesy of Argonautics Marine Engineering, Inc.

Figure 2-190. Turbine Components Being Unloaded Using Self-Propelled Modular Transporter (2012)



Photo courtesy of Argonautics Marine Engineering, Inc.

Figure 2-191. Turbine Components Driving Off of Unloading Ramp (2012)



Photo courtesy of Argonautics Marine Engineering, Inc.

Figure 2-192. Turbine Components Fully Unloaded from Barge (2012)



Photo courtesy of Argonautics Marine Engineering, Inc.

Figure 2-193. Self-Propelled Modular Transporter Turning with Turbine Components (2012)



Photo courtesy of Crystal River

Figure 2-194. High Pressure Turbine Rotor Delivered to Crystal River Site by Heavy Haul Truck (2011)

2.11 Kewaunee

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Kewaunee site. The Kewaunee site is located on the western shore of Lake Michigan between the towns of Manitowoc and Kewaunee about 30 miles southeast of Green Bay and 98 miles north of Milwaukee, Wisconsin (TOPO 1994d).

2.11.1 Site Inventory

Kewaunee has been shut down since May 7, 2013 and final removal of used nuclear fuel from the reactor vessel was completed on May 14, 2013 (Stoddard 2013a, 2013b). A total of 1335 used nuclear fuel assemblies (518.7 MTHM) are stored at Kewaunee (Sartain 2014a), of which 887 pressurized water reactor used nuclear fuel assemblies (348.4 MTHM) are stored in the spent fuel pool and 448 pressurized water reactor used nuclear fuel assemblies (170.3 MTHM) are in dry storage at the Kewaunee ISFSI (Docket No. 72-64). The fuel rods in the fuel assemblies are zirconium alloy-clad. The 448 fuel assemblies are stored in 14 32PT dry shielded canisters. The 32PT dry shielded canister holds 32 pressurized water reactor used nuclear fuel assemblies and is part of the Standardized NUHOMS System (Docket No. 72-1004).

This system consists of transportable dry shielded canisters, reinforced concrete horizontal storage modules, and a transfer cask.

The MP197HB transportation cask (Docket No. 71-9302) is certified to transport the 32PT canister and also canisters containing GTCC low-level radioactive waste. Transport of high burnup (> 45 GWd/MTHM) used nuclear fuel in the 32PT canister is not authorized in Revision 7 of the certificate of compliance for the MP197HB. An MP197HB transportation cask is being fabricated in Japan (Vanderniet 2012). Fabrication is currently on hold.[28]

After 2014, Kewaunee plans to load used nuclear fuel into the NAC MAGNASTOR system (Docket No. 72-1031). The MAGNASTOR system consists of transportable storage canisters, vertical concrete storage casks, and a transfer cask. At Kewaunee, the TSC-37 transportable storage canister, which holds 37 pressurized water reactor used nuclear fuel assemblies, will be used. Twenty-four TSC-37 canisters would be required and it is expected that the loading of the canisters and the MAGNASTOR system will start in late 2016 or early 2017 (Ux Consulting 2016b). The transportation cask that will be certified to transport the TSC-37 canister is the NAC MAGNATRAN (Docket No. 71-9356). The application for a certificate of compliance for the MAGNATRAN is currently under review by the NRC.

Three damaged fuel assemblies (A15, C02, and N11) have been identified at the Kewaunee site. These assemblies will be placed in damaged fuel cans (Ridder 2016). In addition, 241 assemblies were identified as susceptible to bulge joint corrosion of the top nozzle sleeves and were repaired to allow inspection and movement into dry storage (Ridder 2016).

At the Kewaunee site, it is estimated that a total of 38 canisters containing used nuclear fuel and 2 canisters containing GTCC low-level radioactive waste will be stored. Sartain (2014b) states that GTCC low-level radioactive waste would not be packaged until 2070.

Figure 2-195 illustrates the number of used nuclear fuel assemblies at Kewaunee based on their discharge year. The oldest fuel was discharged in 1976 and the last fuel was discharged in 2013. The median discharge year of the fuel is 1994.

Figure 2-196 illustrates the number of used nuclear fuel assemblies at Kewaunee based on their burnup. The lowest burnup is 14.7 GWd/MTHM and the highest burnup is 56.3 GWd/MTHM. The median burnup is 37.2 GWd/MTHM. There are 264 used nuclear fuel assemblies at Kewaunee that have burnups greater than 45 GWd/MTHM. These 264 fuel assemblies are classified by the NRC as high burnup used nuclear fuel.

As mentioned previously, Kewaunee has 448 used nuclear fuel assemblies stored in 14 dry storage canisters. Figure 2-197 and Figure 2-198 illustrate the number of canistered fuel assemblies based on their discharge year and burnup. The oldest canistered fuel was discharged in 1982 and the last fuel was discharged in 2004. The median discharge year of the canistered fuel is 1992. The lowest burnup is 25.0 GWd/MTHM and the highest burnup is 43.1 GWd/MTHM. The median burnup is 36.9 GWd/MTHM. There are no canistered fuel assemblies at Kewaunee that have burnups greater than 45 GWd/MTHM.

[28] Guibert N. 2016. Personal communication between N Guibert (AREVA TN) and SJ Maheras (PNNL), August 4, 2016.

Figure 2-199 and Figure 2-200 illustrate the number of fuel assemblies based on their discharge year and burnup for the 887 uncanistered fuel assemblies at Kewaunee. The oldest uncanistered fuel was discharged in 1976 and the last fuel was discharged in 2013. The median discharge year of the uncanistered fuel is 2001. The lowest burnup is 14.7 GWd/MTHM and the highest burnup is 56.3 GWd/MTHM. The median burnup is 37.6 GWd/MTHM. There are 264 uncanistered fuel assemblies at Kewaunee that have burnups greater than 45 GWd/MTHM. These assemblies will not be placed in damaged fuel cans (Ridder 2016).

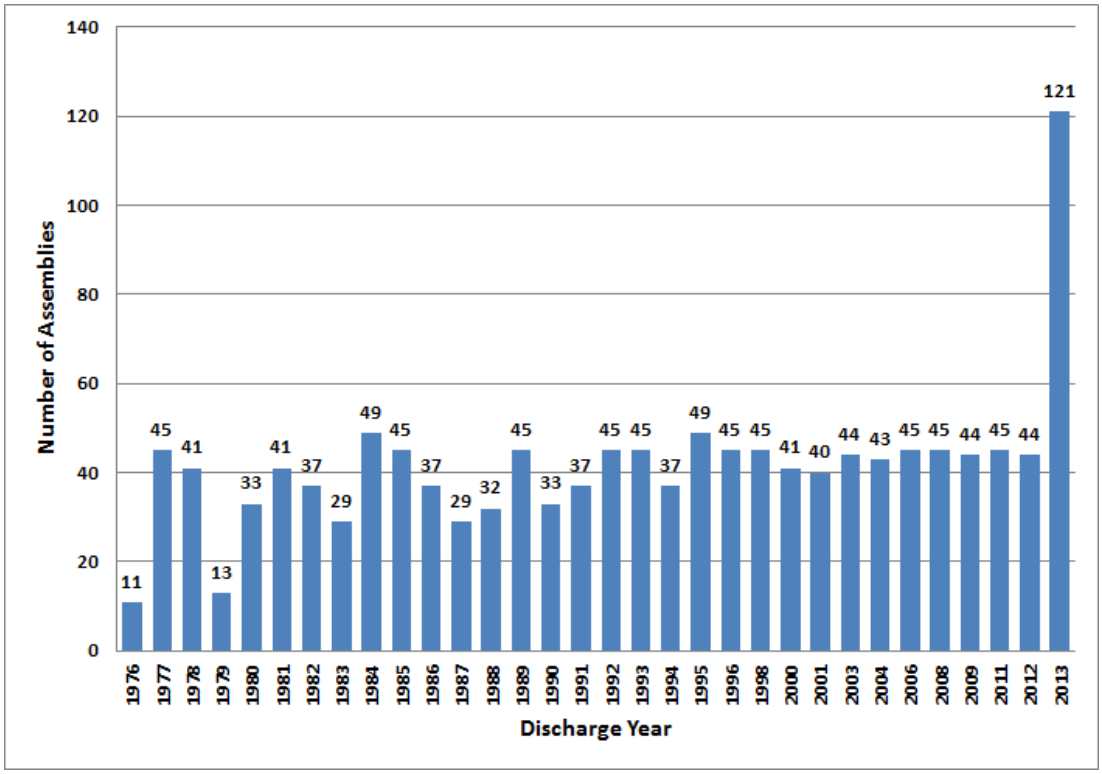


Figure 2-195. Kewaunee Number of Assemblies versus Discharge Year (EIA 2013)

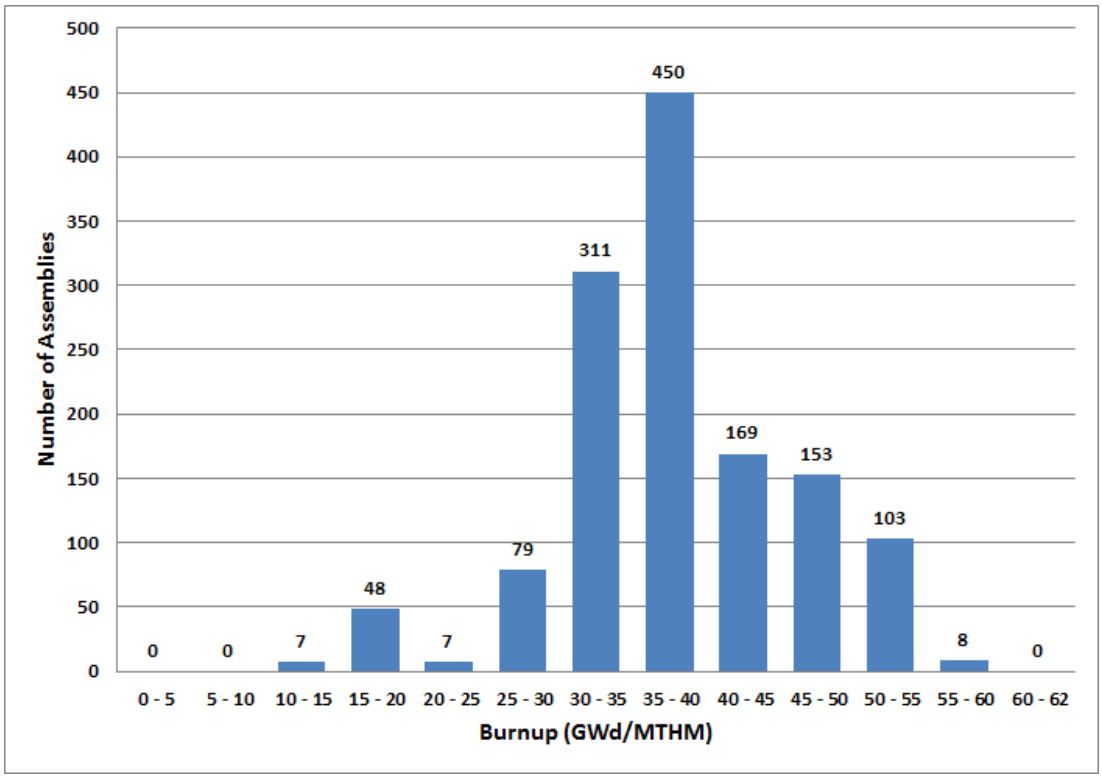


Figure 2-196. Kewaunee Number of Assemblies versus Burnup (EIA 2013)

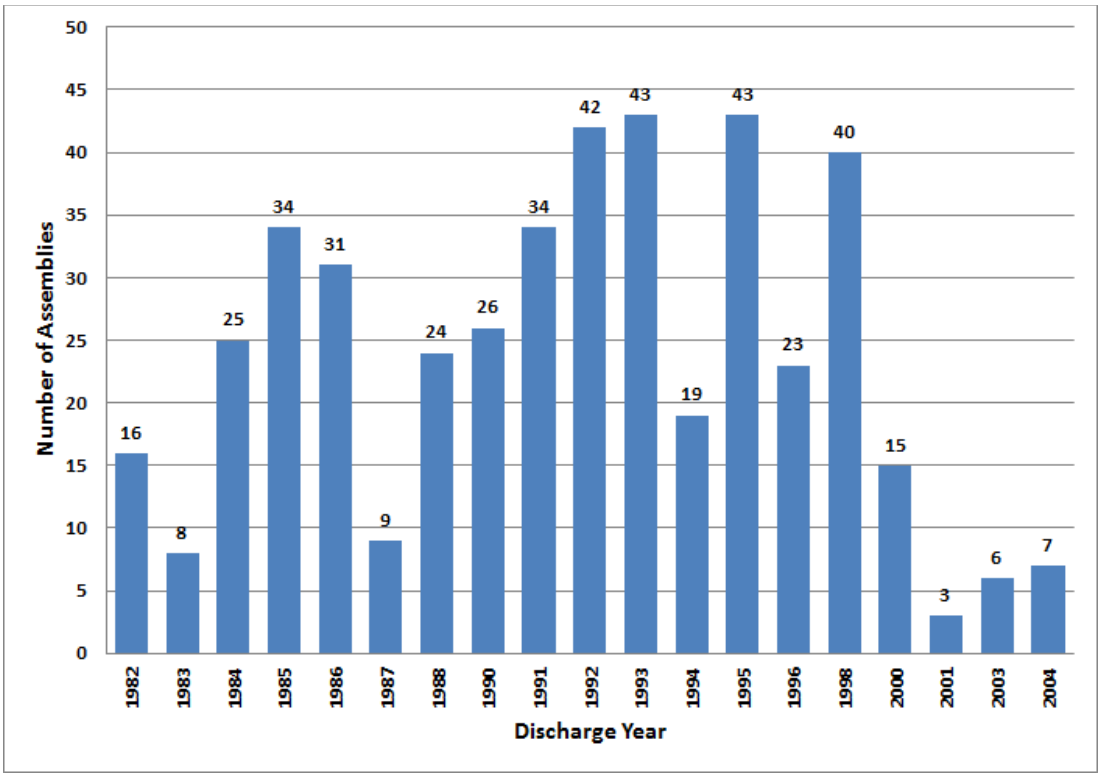


Figure 2-197. Kewaunee Number of Canistered Assemblies versus Discharge Year (EIA 2013)

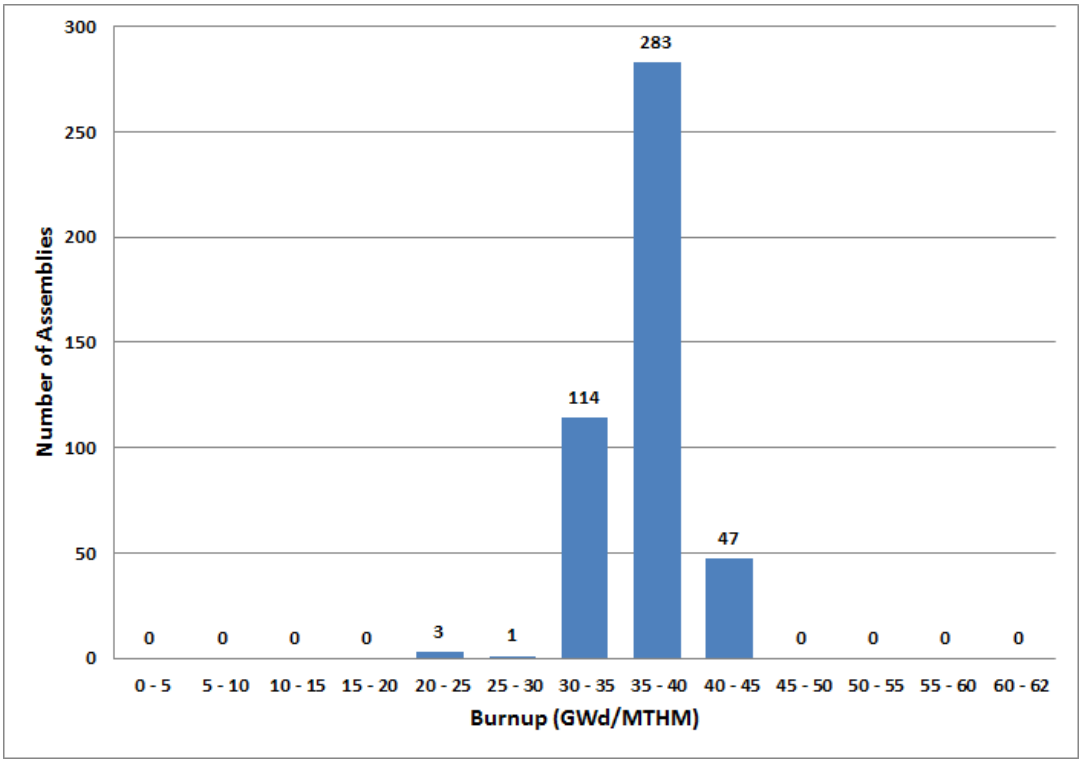


Figure 2-198. Kewaunee Number of Canistered Assemblies versus Burnup (EIA 2013)

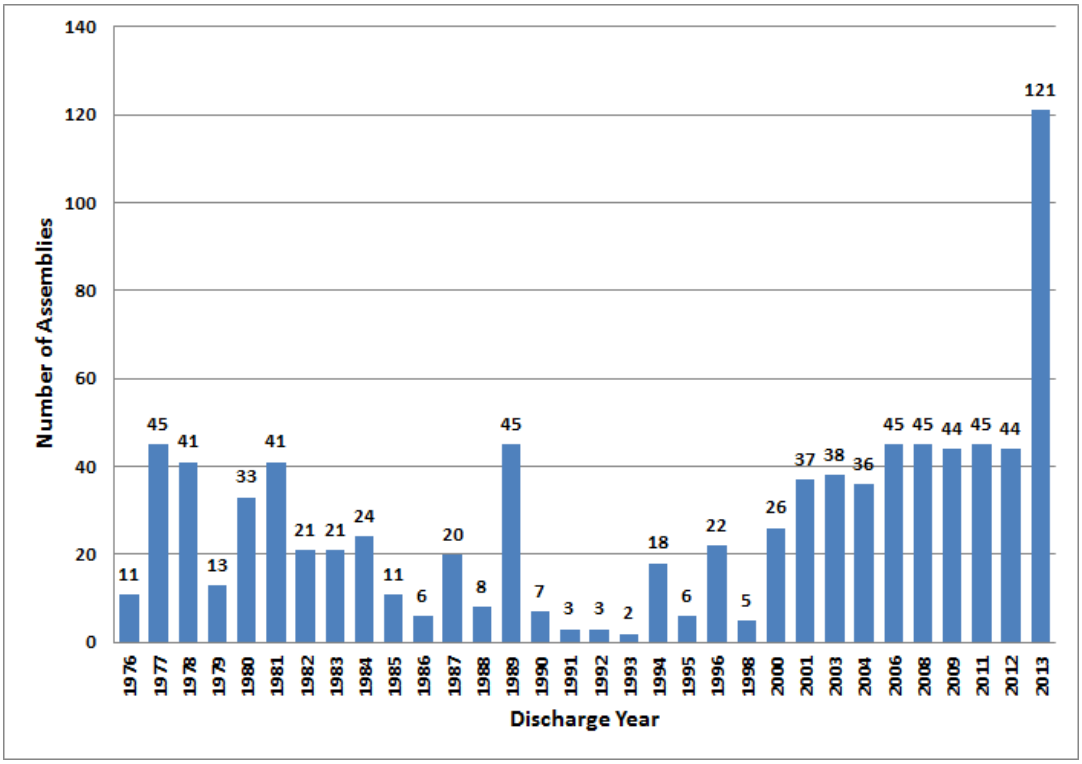


Figure 2-199. Kewaunee Number of Uncanistered Assemblies versus Discharge Year (EIA 2013)

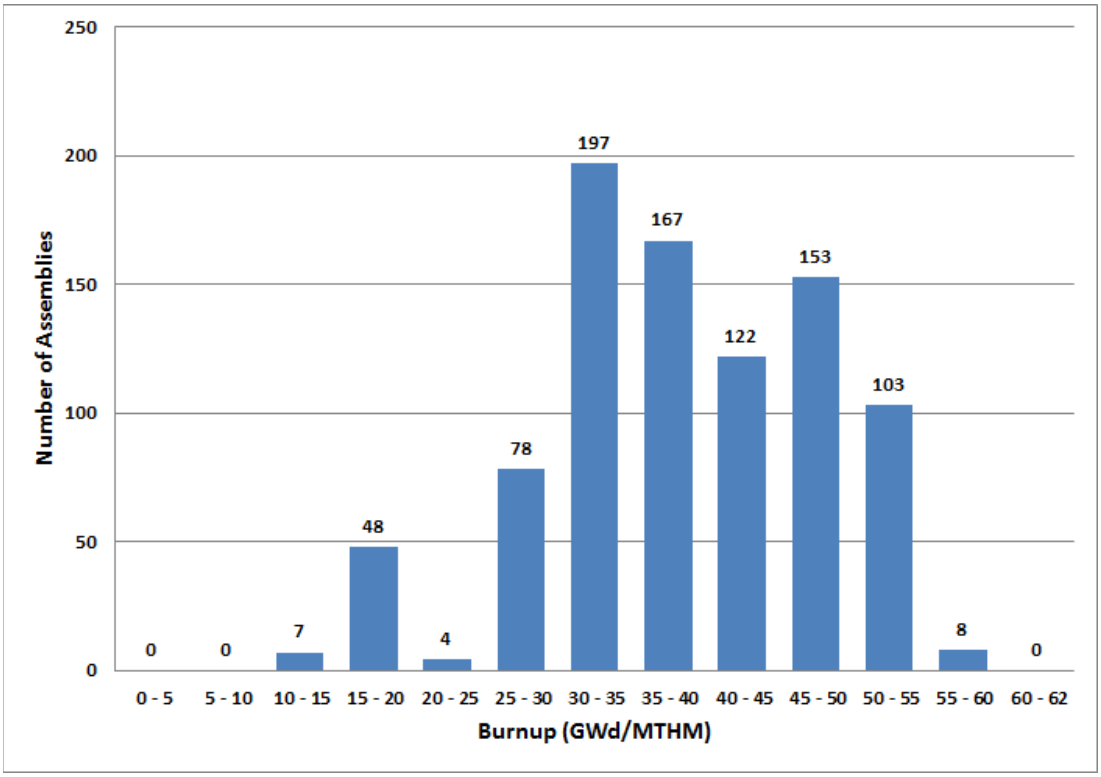


Figure 2-200. Kewaunee Number of Uncanistered Assemblies versus Burnup (EIA 2013)

2.11.2 Site Conditions

The Kewaunee site is located on the western shore of Lake Michigan and the Kewaunee ISFSI (see Figure 2-201) is located at the northern end of the site (see Figure 2-202). There is no direct rail or barge service to the site (TOPO 1994d). The nearest rail access is in Denmark, Wisconsin, about 16 miles from the site, and the nearest barge terminal is in Kewaunee, Wisconsin, about 10 miles from the site. There was an on-site barge facility during plant construction, but it was disassembled, and reestablishment would require a major restoration (TriVis Incorporated 2005).



Photo courtesy of Kewaunee

Figure 2-201. Kewaunee Independent Spent Fuel Storage Installation



Figure 2-202. Aerial View of Kewaunee Site (Google 2015)

2.11.3 Near-site Transportation Infrastructure and Experience

The Kewaunee site does not have an on-site rail spur or a railroad that passes near to the site or along the site boundary. For Kewaunee, heavy haul trucks could be used to move transportation casks over public highways to a rail siding or spur that provides access to a railroad that can accommodate the loaded transportation casks.

For shipments of casks containing used nuclear fuel that require the use of heavy haul trucks, the casks would be prepared for shipment at the Kewaunee ISFSI site and loaded onto a transport cradle that would be loaded onto the transport trailer of a heavy haul truck. The truck, led and followed by technical and security escorts, would move over an approved, designated highway route to a nearby rail siding or spur. Heavy lift equipment would be used to transload the cask and its cradle as a unit from the truck to a railcar at the rail siding or spur.

Table 2-6 lists distances from the Kewaunee site to potential transload locations at Luxemburg, Bellevue, Denmark, Rockwood, and Manitowoc, Wisconsin (see Figure 2-203). Figure 2-203 also shows the location of the Point Beach Nuclear Plant, which is about 4.5 miles south of the Kewaunee site. The rail lines in the vicinity of Luxemburg, Bellevue, and Denmark are designated as track class 1. These rail lines connect to the Fox River Subdivision of the Canadian National Railroad which is designated as track class 2. The rail line in the vicinity of Rockwood is designated as track class 1. After merging with the mainline at Manitowoc, the rail line is designated as track class 2.

Table 2-6 also provides potential routes that heavy haul trucks might use to get to the rail transload locations. These routes have not been evaluated for attributes such as weight limitations, bridge and tunnel limitations, turning radii, vertical or horizontal clearances, seasonal restrictions, presence of culverts, etc.

Table 2-6. Potential Kewaunee Rail Transload Locations

Rail Transload Location	Distance From Kewaunee Site (mile)	Potential Route
Luxemburg	23.5	WI-42 North to County Road C North to WI-29 West to County Road AB North
Bellevue	27.9	WI-42 North to County Road C North to WI-29 West
Denmark	16.7–17.4	WI-42 South to County Road BB West to County Road R North WI-42 South to County Road BB West to County Road R North to County Road T North
Rockwood Spur at WI-310	21.0–22.7	WI-42 South to WI-310 West WI-42 South to County Road BB West to County Road Q South to WI-310 West
Rockwood Spur at Manitowoc Airport	21.5	WI-42 South to WI-42 West
Manitowoc (waterfront area)	21.3	WI-42 South

Figure 2-204 shows an aerial view of a potential transload location at Luxemburg, Wisconsin, and Figure 2-205 shows a potential heavy haul truck route from the Kewaunee site to the Luxemburg transload location. Figure 2-206 through Figure 2-208 show the current condition of the potential Luxemburg transload location. In 2008, the Luxemburg transload location was used to transload four 160-ton transformers from railcars to 15-axle Goldhofer trailers using a gantry system, which were then moved to the Kewaunee site. Figure 2-209 shows the gantry system used to transfer the transformers from the railcars to Goldhofer trailer and Figure 2-210 shows a transformer on a heavy haul truck being moved from Luxemburg to the Kewaunee site.

Figure 2-211 shows an aerial view of a potential transload location at Bellevue, Wisconsin, and Figure 2-212 shows a potential heavy haul truck route from the Kewaunee site to the Bellevue transload location. Figure 2-213 through Figure 2-216 show the current condition of the potential Bellevue transload location. In 2008, the Bellevue transload location was used to transload ten 82-ton NUHOMS horizontal storage modules from railcars to 6-axle Goldhofer trailers using a 550-ton crane. Figure 2-217 shows horizontal storage modules on railcars and Figure 2-218 shows a horizontal storage module on a heavy haul truck being moved from Bellevue to the Kewaunee site.

Figure 2-219 shows an aerial view of a potential transload location at Denmark, Wisconsin, and Figure 2-220 shows a potential heavy haul truck route from the Kewaunee site to the potential Denmark transload location. Figure 2-221 through Figure 2-224 show the current condition of the potential Denmark transload location.

Figure 2-225 shows an aerial view of a potential transload location at the junction of the Rockwood Spur and WI-310, located near Manitowoc, Wisconsin, and Figure 2-226 shows potential heavy haul truck routes from the Kewaunee site to the potential Rockwood Spur and WI-310 transload location. Figure 2-227 through Figure 2-230 show the current condition of the potential Rockwood Spur and WI-310 transload location. Figure 2-231 shows a traffic circle on WI-310 that a transportation cask would have to pass through to approach the potential transload location from the east.

Figure 2-232 shows an aerial view of a potential transload location on the Rockwood Spur near the Manitowoc, Wisconsin airport, and Figure 2-233 shows a potential heavy haul truck route from the Kewaunee site to the Rockwood Spur near the Manitowoc, Wisconsin airport. Figure 2-234 through Figure 2-236 show the current condition of this potential transload location.

Figure 2-237 shows an aerial view of a potential transload location in Manitowoc, Wisconsin, and Figure 2-238 shows potential heavy haul truck routes from the Kewaunee site to the potential Manitowoc transload location. Figure 2-239 through Figure 2-241 show the current condition of the potential Manitowoc transload location.

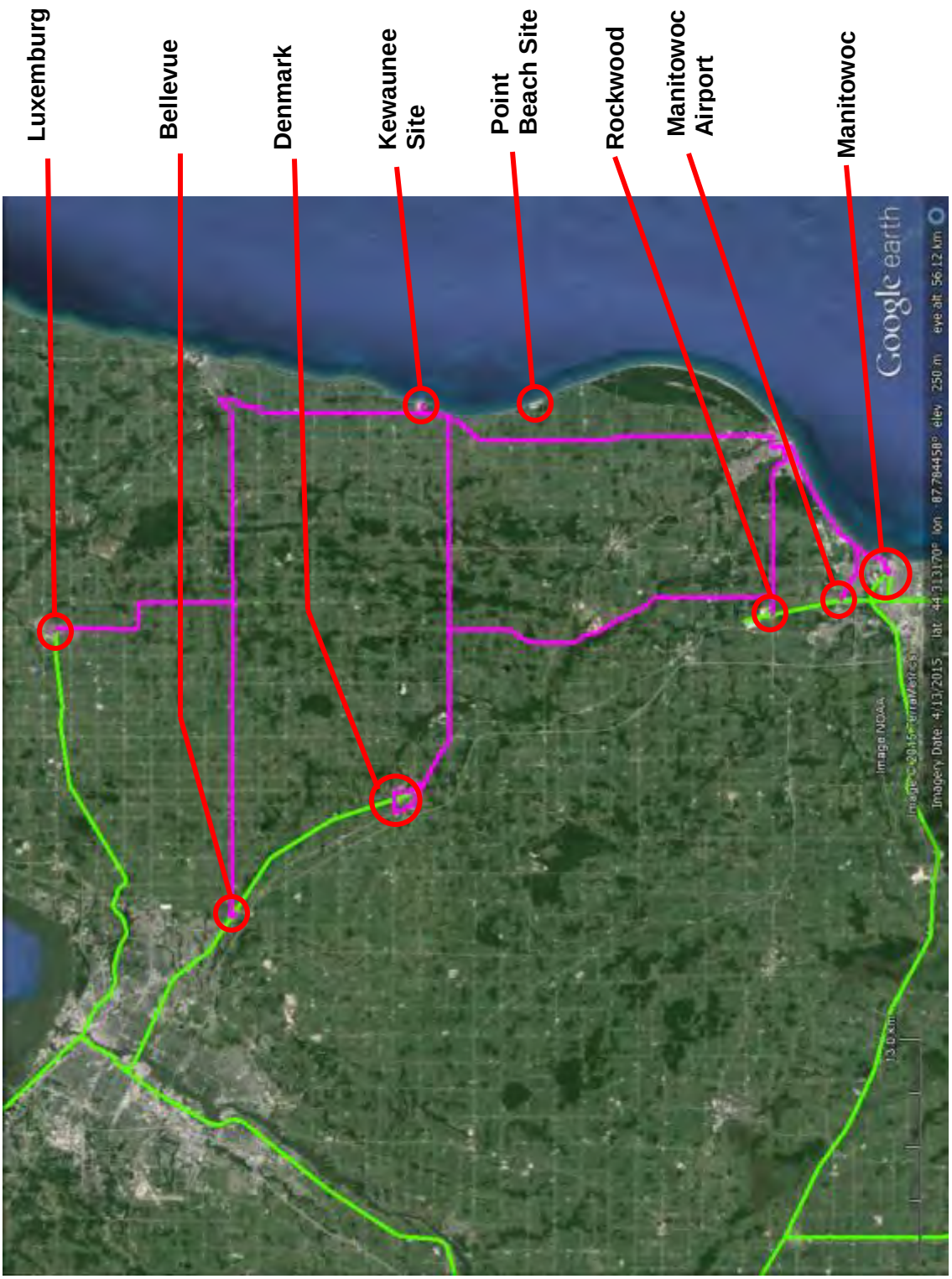


Figure 2-203. Potential Rail Transload Locations and Heavy Haul Truck Routes for the Kewaunee Site (Google 2015)

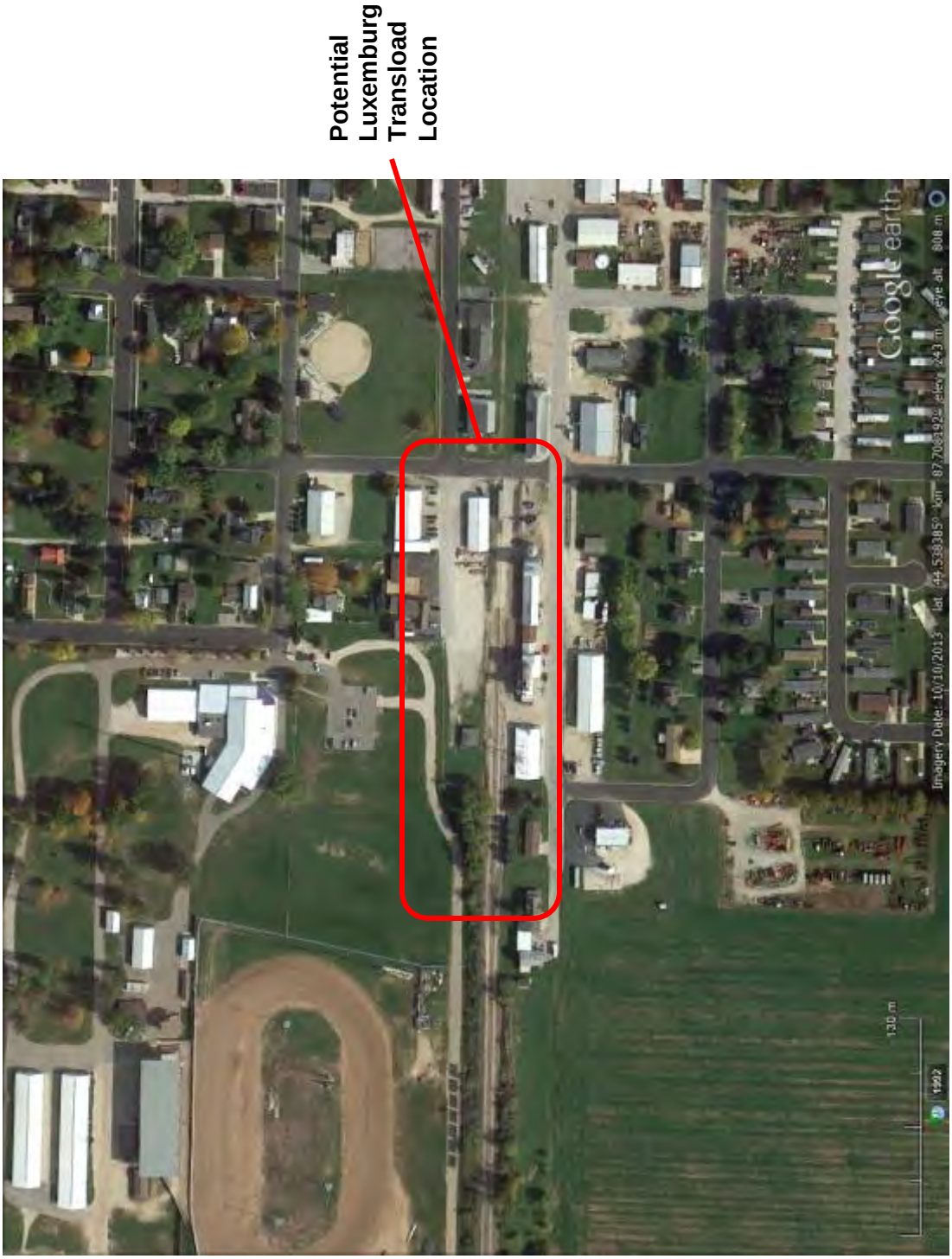


Figure 2-204. Potential Luxemburg Transload Location (Google 2015)



Figure 2-205. Potential Luxemburg Heavy Haul Route (Google 2015)



Figure 2-206. Potential Luxemburg Transload Location (Looking West) (2014)



Figure 2-207. Potential Luxemburg Transload Location Further Down Track (Looking West) (2014)



Figure 2-208. Potential Luxemburg Transload Location (Looking East) (2014)



Photo courtesy of Kewaunee

Figure 2-209. Gantry System Used to Transfer Transformers from Railcars to Goldhofer Trailers (2008)



Photo courtesy of Kewaunee

Figure 2-210. Transformer on 15-axle Goldhofer Trailer (2008)



Figure 2-211. Potential Bellevue Transload Location (Google 2015)

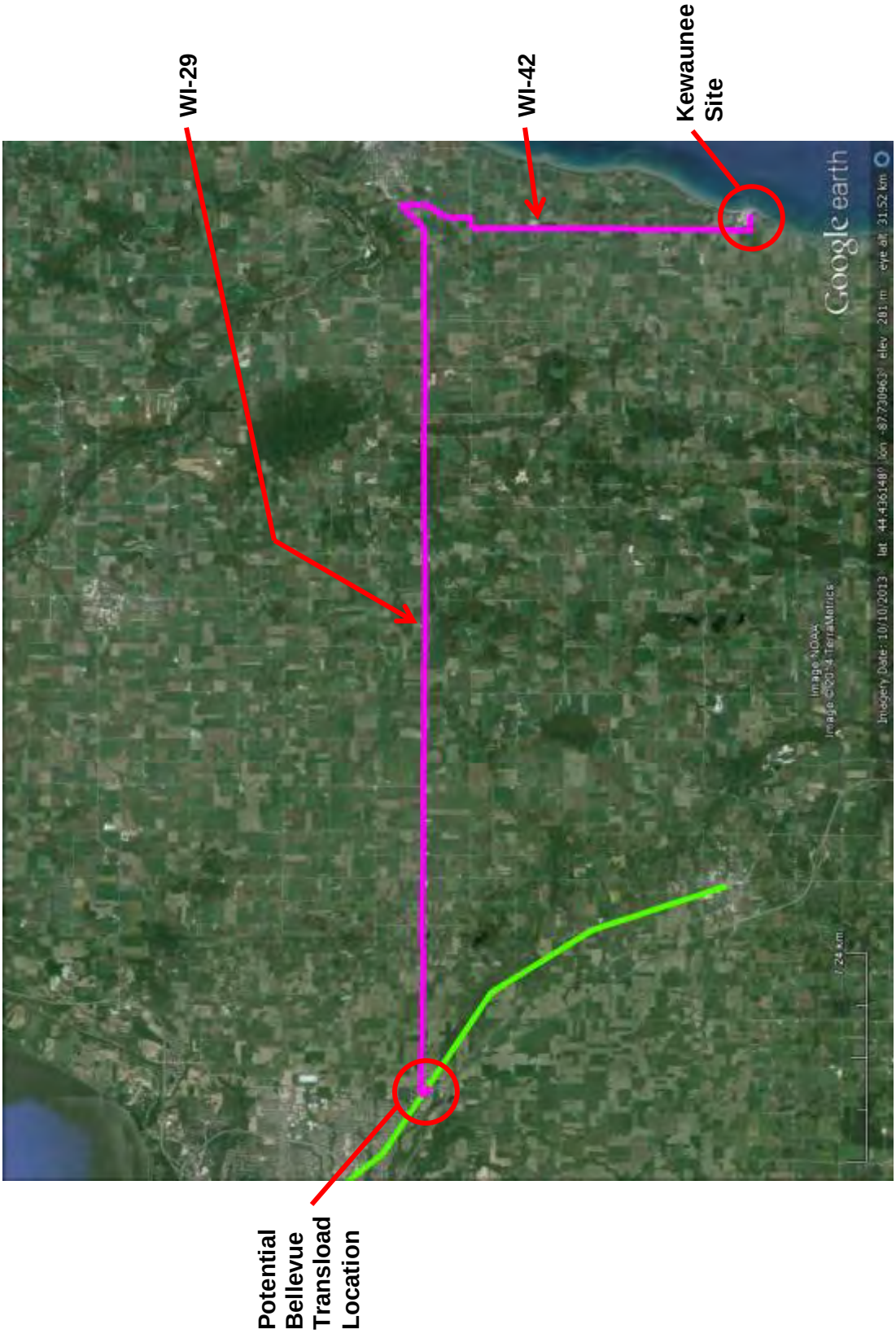


Figure 2-212. Potential Bellevue Heavy Haul Route (Google 2015)



Figure 2-213. Potential Bellevue Transload Location (Looking North) (2014)



Figure 2-214. Potential Bellevue Transload Location (Looking South) (2014)



Figure 2-215. Potential Bellevue Transload Location at WI-29 (2014)



Figure 2-216. Approaching Potential Bellevue Transload Location on WI-29 (Looking West) (2014)



Photo courtesy of Kewaunee

Figure 2-217. Horizontal Storage Module Transloading at Bellevue Location (2008)



Photo courtesy of Kewaunee

Figure 2-218. Horizontal Storage Module on 6-axle Goldhofer Trailer (2008)

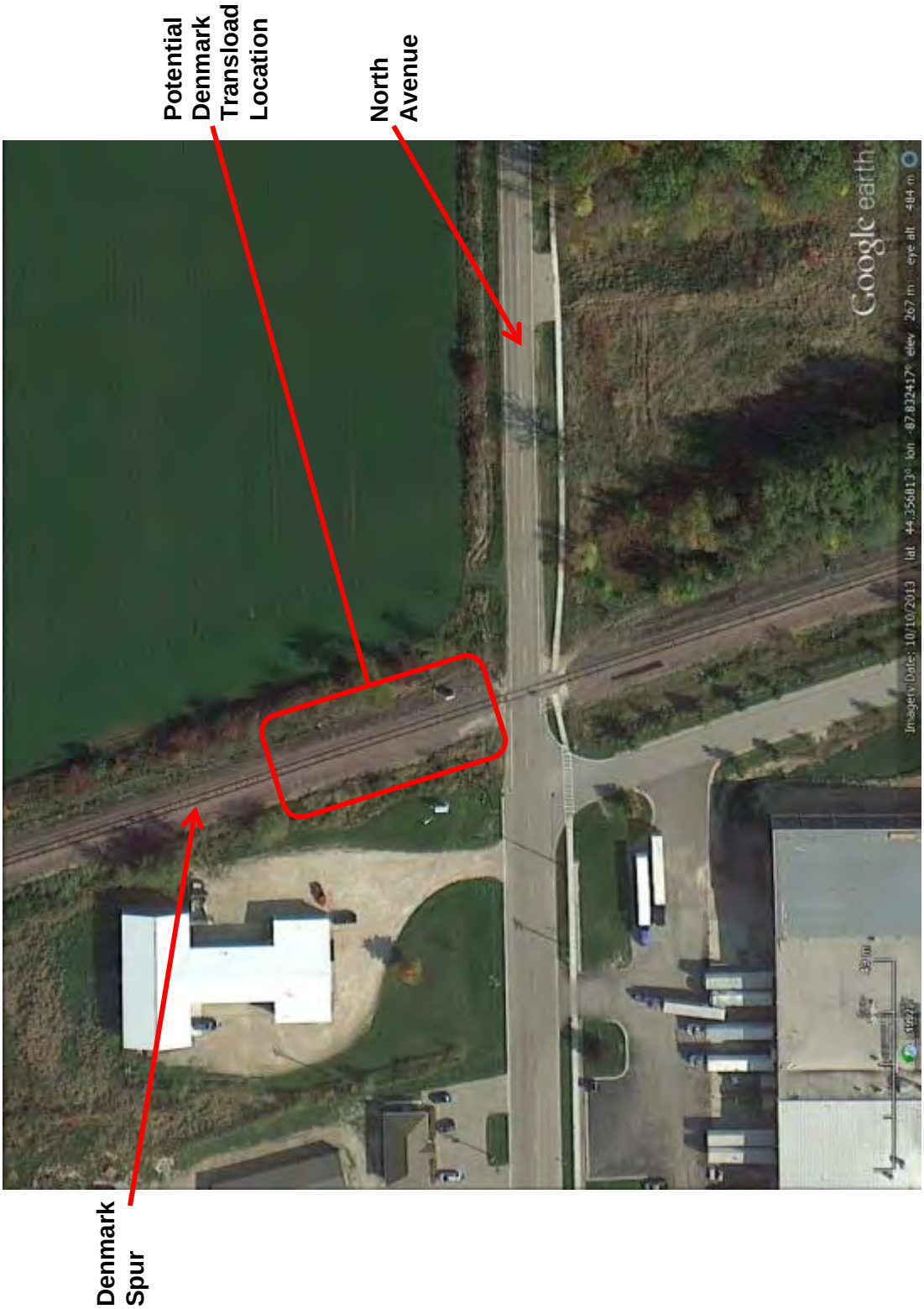


Figure 2-219. Potential Denmark Transload Location (Google 2015)

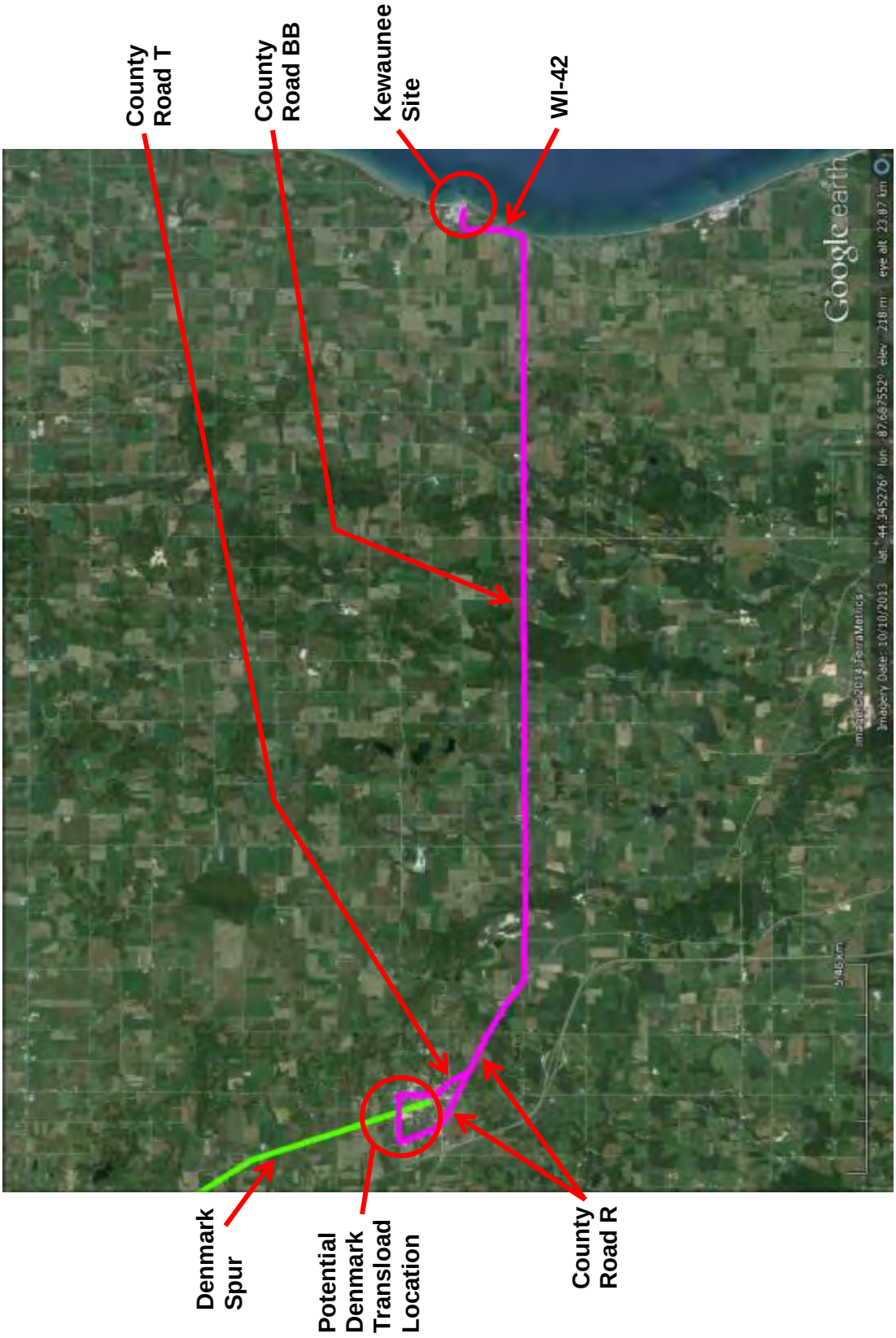


Figure 2-220. Potential Denmark Heavy Haul Route (Google 2015)



Figure 2-221. Potential Denmark Transload Location (Looking South) (2014)



Figure 2-222. Potential Denmark Transload Location (Looking North) (2014)



Figure 2-223. Potential Denmark Transload Location (Looking West) (2014)



Figure 2-224. Potential Denmark Transload Location (Looking East) (2014)

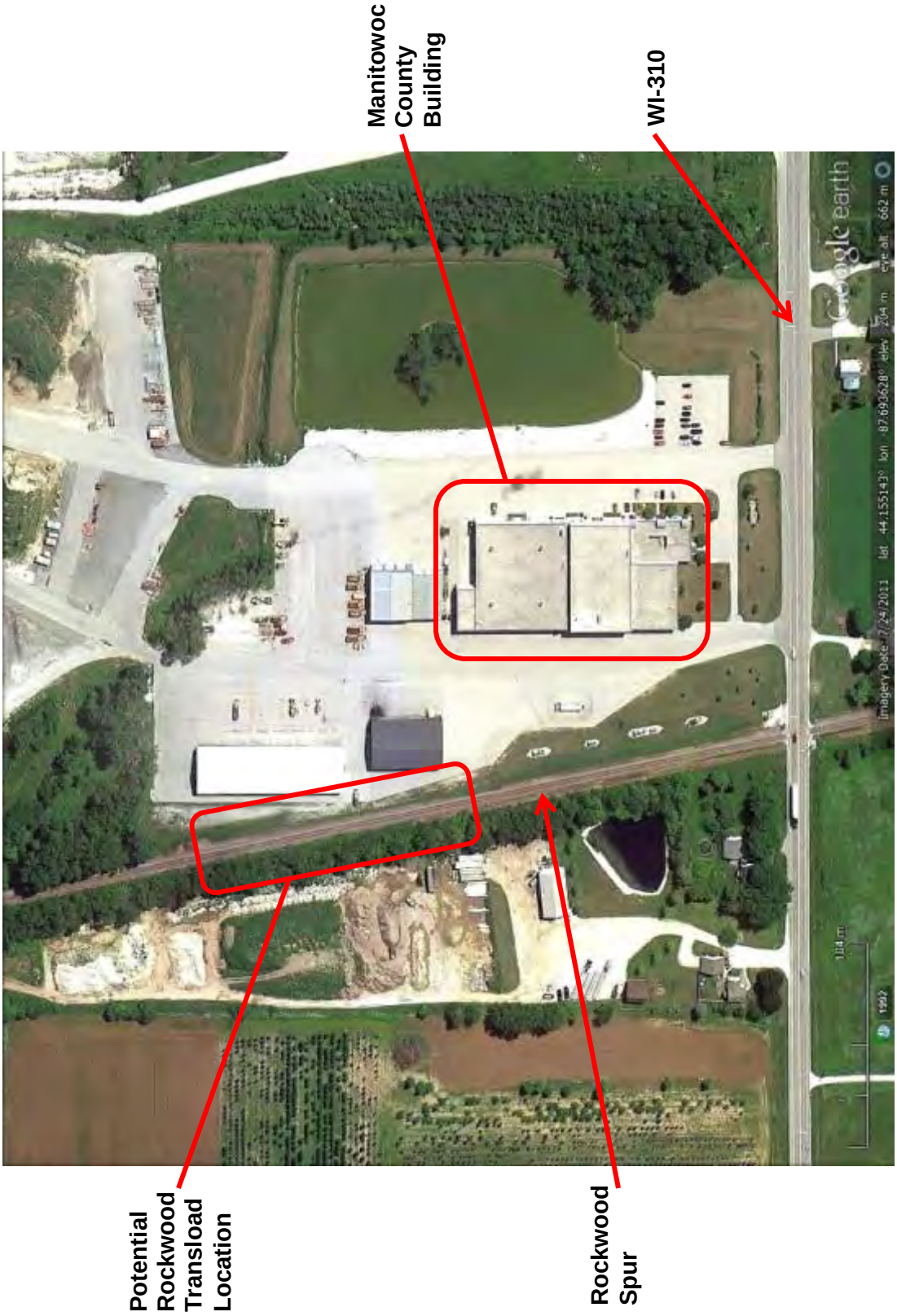


Figure 2-225. Potential Rockwood Spur at WI-310 Transload Location (Google 2015)

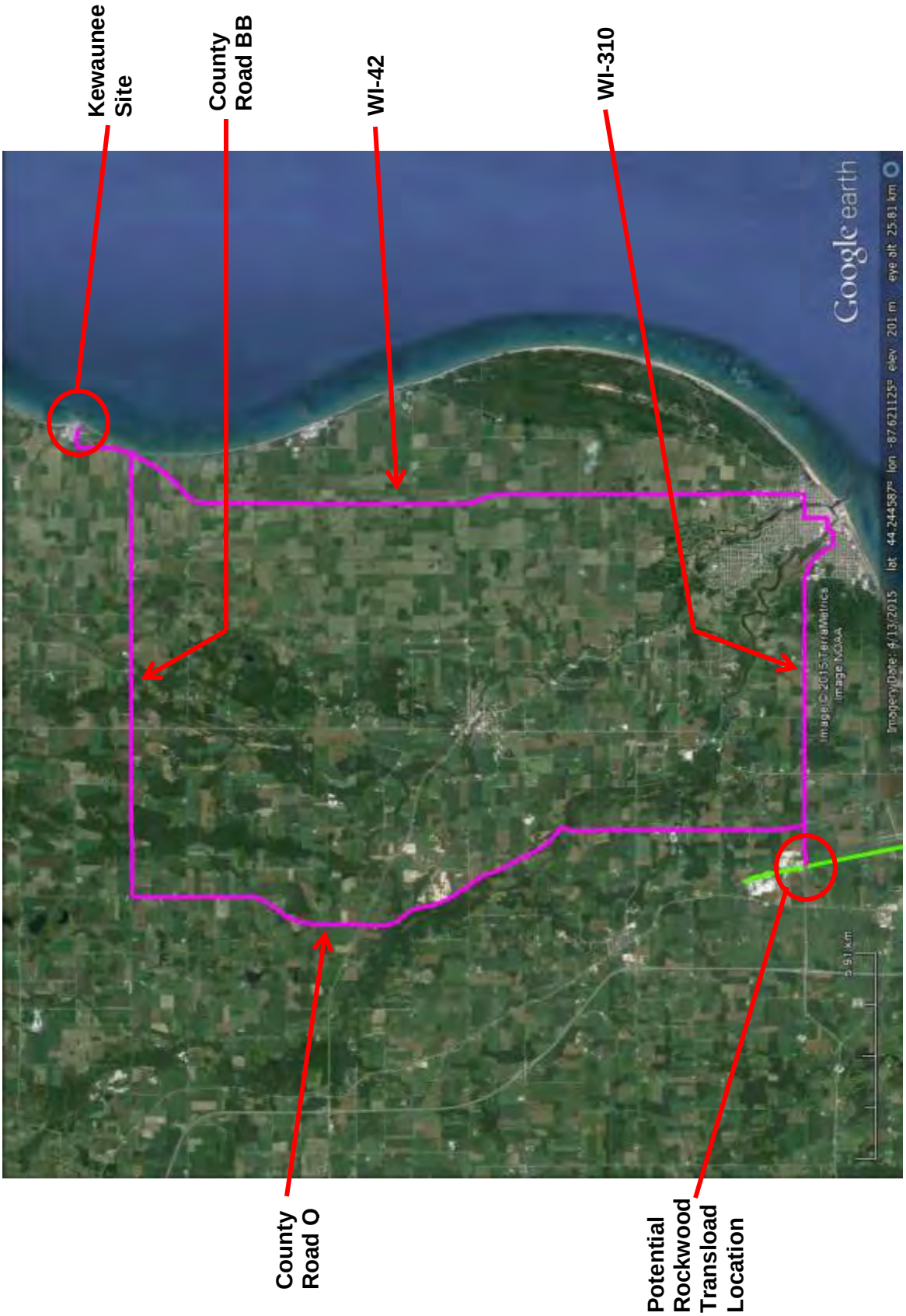


Figure 2-226. Potential Rockwood Spur at WI-310 Heavy Haul Routes (Google 2015)



Figure 2-227. Potential Rockwood Spur at WI-310 Transload Location (Looking North) (2014)



Figure 2-228. Potential Rockwood Spur at WI-310 Transload Location (Looking South) (2014)



Figure 2-229. Approaching Rockwood Spur at WI-310 from the East (2014)



Figure 2-230. Turning into Parking Lot at Rockwood Spur at WI-310 (2014)



Figure 2-231. Traffic Circle on WI-310 (Looking East) (2014)



Figure 2-232. Potential Rockwood Spur at the Manitowoc Airport Transload Location (Google 2015)

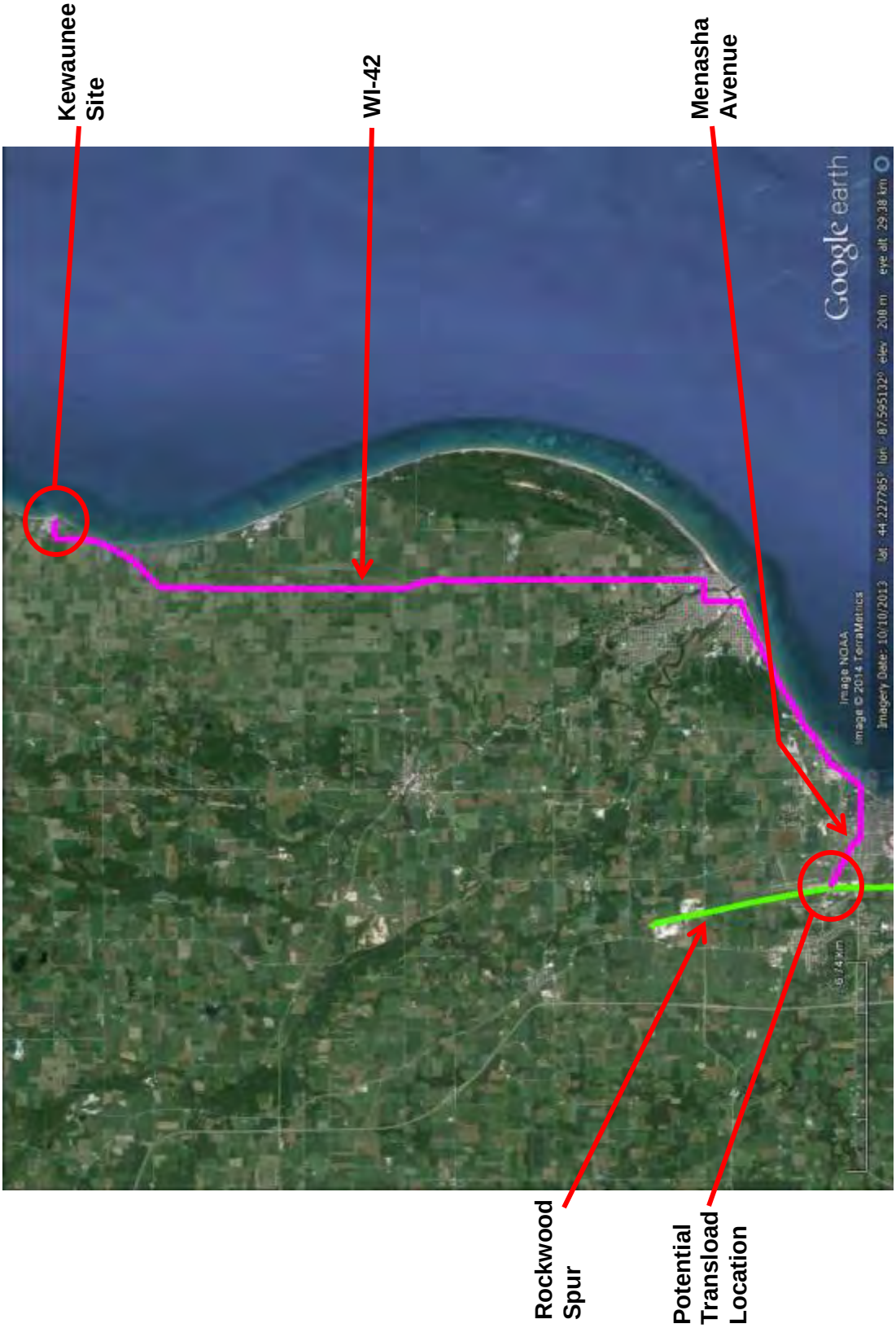


Figure 2-233. Potential Rockwood Spur at the Manitowoc Airport Heavy Haul Route (Google 2015)



Figure 2-234. Potential Rockwood Spur at the Manitowoc Airport Transload Location (Looking North) (2014)



Figure 2-235. Potential Rockwood Spur at the Manitowoc Airport Transload Location (Looking South) (2014)



Figure 2-236. Access Road at Potential Rockwood Spur at the Manitowoc Airport Transload Location (Looking North) (2014)



Figure 2-237. Potential Manitowoc Transload Location (Google 2015)

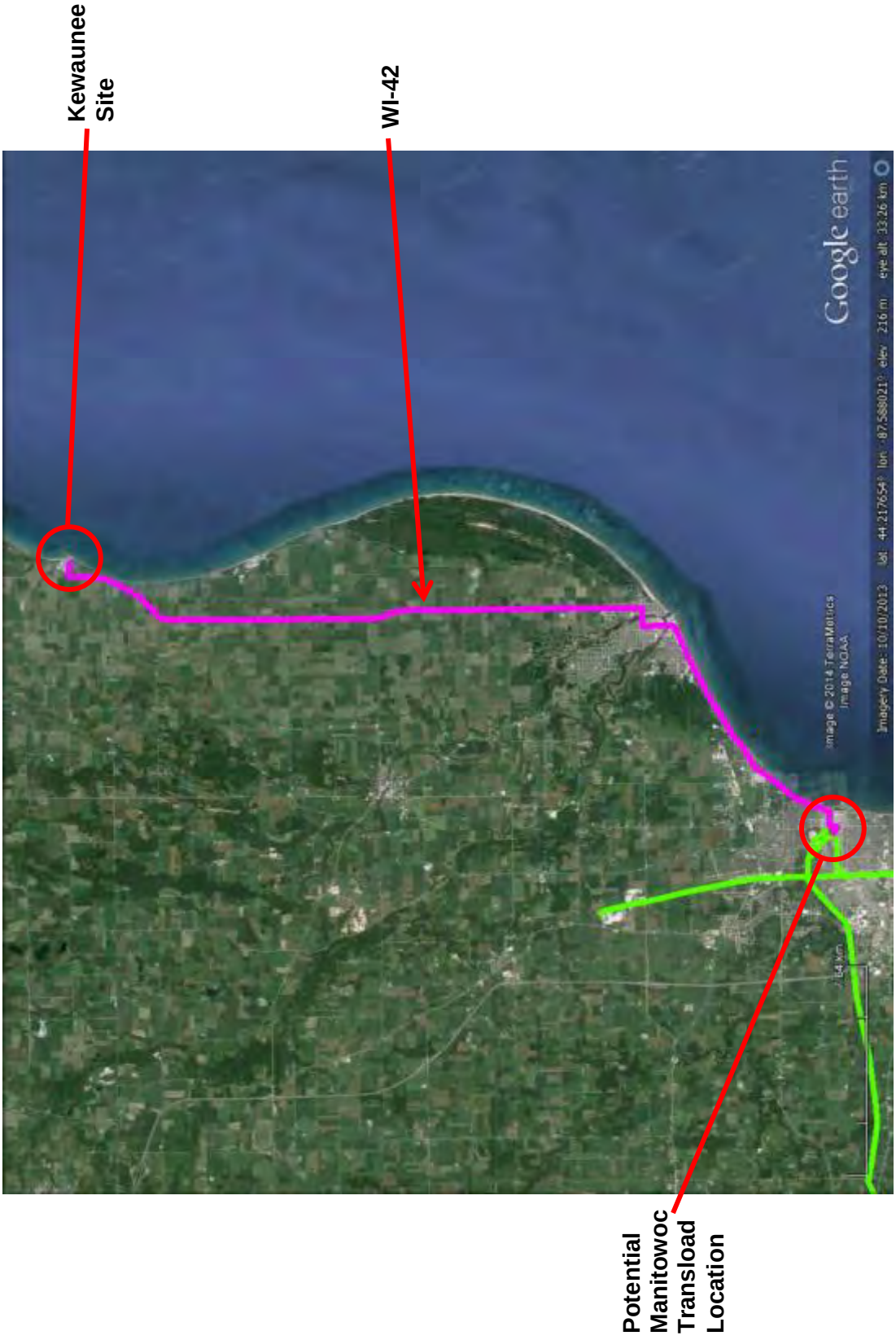


Figure 2-238. Potential Manitowoc Heavy Haul Routes (Google 2015)



Figure 2-239. Potential Manitowoc Transload Location (Looking Northwest) (2014)



Figure 2-240. Potential Manitowoc Transload Location (Looking Southeast) (2014)



Figure 2-241. Potential Manitowoc Transload Location (Looking South) (2014)

The closest barge terminal to the Kewaunee site is located in the city of Kewaunee, about 10 miles from the Kewaunee site. The city of Kewaunee is located on the west shore of Lake Michigan about 105 miles north of Milwaukee, Wisconsin and about 32 miles east of Green Bay. Kewaunee Harbor is a commercial harbor that currently serves primarily recreational boat traffic. The harbor also supports transitory barge traffic. There are approximately 6,500 feet of breakwater and pier structures and approximately 5,500 feet of maintained channel (USACE 2014).

Figure 2-242 shows an aerial view of a potential barge transload location in the city of Kewaunee. Figure 2-243 shows a potential heavy haul truck route from the Kewaunee site to the barge transload location. As with the routes to the rail access locations, this route has not been evaluated for attributes such as weight limitations, bridge or tunnel limitations, turning radii, vertical or horizontal clearances, seasonal restrictions, presence of culverts, etc. Figure 2-244 and Figure 2-245 show the current condition of the transload location.

In 2013, the Kewaunee barge transload location was used to transload ten 82-ton NUHOMS horizontal storage modules from railcars to 6-axle Goldhofer trailers using a 550-ton crane. Figure 2-246 shows horizontal storage modules being unloaded from a barge and Figure 2-247 shows a horizontal storage module on a 6-axle Goldhofer trailer.

In 2000, replacement steam generators were shipped from Milan, Italy to the Kewaunee barge transload location via the Atlantic Ocean, Saint Lawrence Seaway, and the Great Lakes. At the Kewaunee transload location, the replacement steam generators were transloaded from barge to a

14-axle transporter and moved to the Kewaunee site by road. In 2001, the old steam generators were moved from the Kewaunee site to the Kewaunee barge transload location using a 14-axle transporter, transloaded to barge and shipped to Memphis, Tennessee for decontamination via Lake Michigan, the Illinois Waterway System, and the Mississippi River. Speeds during barge transport were limited to 10 knots.

In 2014, four old steam generators from the Point Beach Nuclear Power Plant (located about 4 miles south of the Kewaunee site) were shipped to the Waste Control Specialists low-level radioactive waste disposal facility located in Andrews, Texas. The steam generators were transported from the Point Beach site using Goldhofer trailers (see Figure 2-248) and transloaded onto a barge at the Kewaunee barge transload location (see Figure 2-249 through Figure 2-252). The steam generators were transported on Lake Michigan, through Chicago, Illinois to the Mississippi River to the Intracoastal Waterway to Houston, Texas, where the steam generators were transloaded to railcars (see Figure 2-253) and transported through Texas to the Waste Control Specialists low-level radioactive waste disposal facility in Andrews, Texas (see Figure 2-254).

Heavy haul truck transport has been used to move large components to and from the Kewaunee site. For example, in 2004, the replacement Kewaunee site reactor pressure vessel head was shipped from Houston, Texas to the Kewaunee site using a heavy haul truck (see Figure 2-255), and the old Kewaunee site reactor pressure vessel head was shipped to Clive, Utah for disposal using a heavy haul truck (see Figure 2-256).



Figure 2-242. Aerial View of Potential Kewaunee Barge Transload Location (Google 2015)

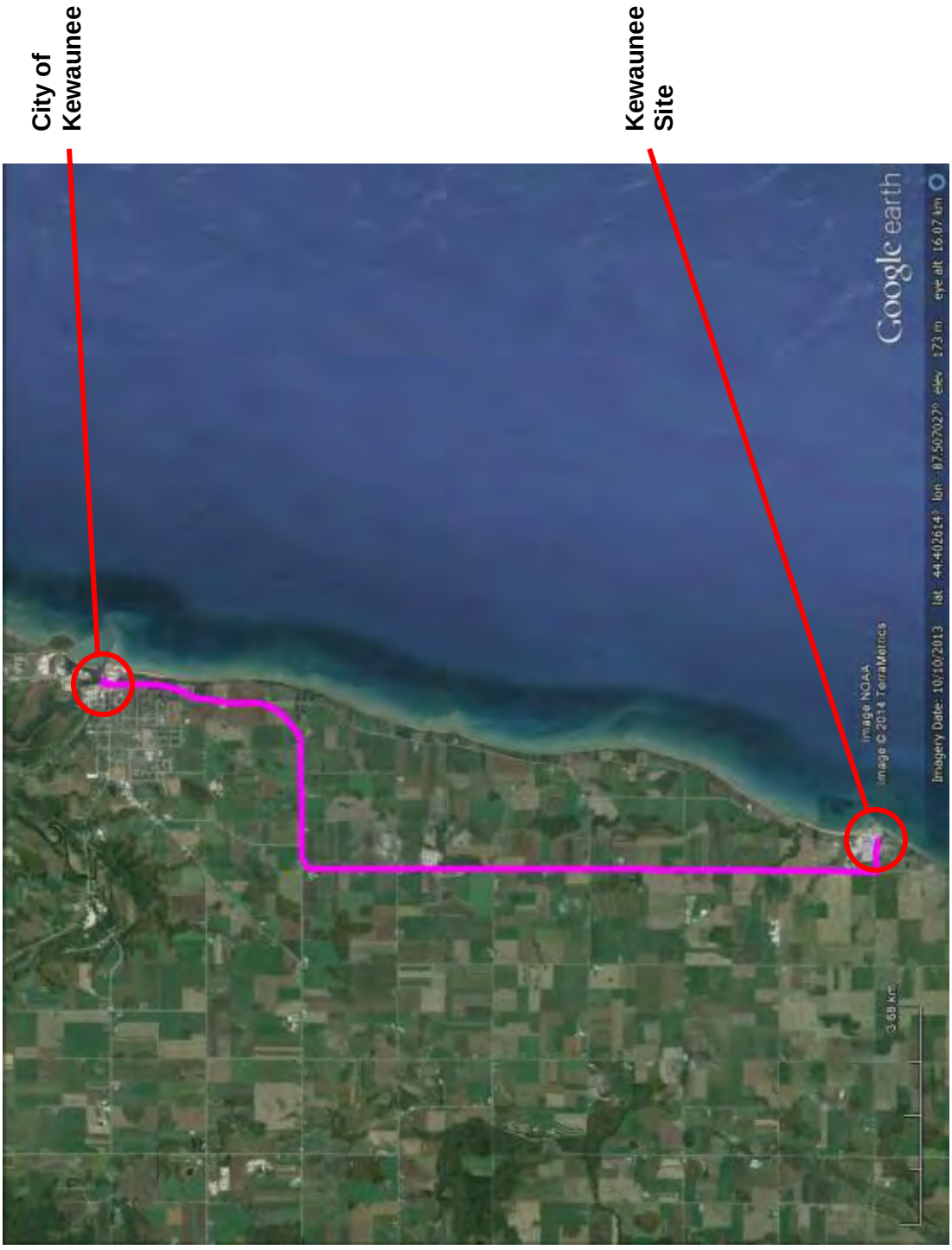


Figure 2-243. Potential Heavy Haul Truck Route to City Of Kewaunee Dock Facilities (Google 2015)



Figure 2-244. Potential Kewaunee Barge Transload Location Parking Lot (2014)



Figure 2-245. Potential Kewaunee Barge Transload Location Water Front (2014)



Photo courtesy of Kewaunee

Figure 2-246. Horizontal Storage Modules Being Unloaded from a Barge (2013)



Photo courtesy of Kewaunee

Figure 2-247. Horizontal Storage Module on 6-axle Goldhofer Trailer (2013)



Photo courtesy of Point Beach

Figure 2-248. Steam Generator on Goldhofer Trailer (2014)



Photo courtesy of Point Beach

Figure 2-249. First Steam Generator on Goldhofer Trailer Moving onto Barge (2014)



Photo courtesy of Point Beach

Figure 2-250. Barge with Two Steam Generators at Kewaunee Barge Transload Location (2014)



Photo courtesy of Point Beach

Figure 2-251. Fourth Steam Generator Moving onto Barge (2014)



Photo courtesy of Point Beach

Figure 2-252. Barge with Four Steam Generators at Kewaunee Barge Transload Location (2014)



Photo courtesy of Point Beach

Figure 2-253. Transloading of Steam Generator from Barge to Railcar in Houston, Texas (2014)



Photo courtesy of Point Beach

Figure 2-254. Steam Generators Arriving at Waste Control Specialists Low-Level Radioactive Waste Disposal Facility (2014)



Photo courtesy of Kewaunee

Figure 2-255. Replacement Reactor Pressure Vessel Head on Heavy Haul Truck (2004)



Photo courtesy of Kewaunee

Figure 2-256. Old Reactor Pressure Vessel Head on Heavy Haul Truck (2004)

2.11.4 Gaps in Information

The Kewaunee site does not have direct rail access or an on-site barge facility. Off-site shipment of transportation casks from the Kewaunee site would require either the use of heavy haul trucks for transport of casks to nearby rail sidings or spurs, or the use of heavy haul trucks for transport of casks to a nearby barge facility, likely followed by barge transport to a port on the Great Lakes that is served by a railroad. Potential nearby rail transload locations include Luxemburg, Bellevue, Denmark, Rockwood, and Manitowoc, Wisconsin; these locations are 16.7 to 27.9 miles from the Kewaunee site. At Luxemburg, the track is built using 80 lb. rail, while at Bellevue, Denmark, and Rockwood, the track is built using 110 to 115 lb. rail. The track at these locations is track class 1. Canadian National Railroad staff stated that to rehabilitate the track to track class 2 would require replacing every third or fourth tie at a cost of about $90,000 per mile. At Manitowoc, the track is track class 2.

The city of Kewaunee dock facilities are located 10 miles from the Kewaunee site. The roads to these rail or barge locations have not been evaluated for attributes such as weight limitations, bridge or tunnel limitations, turning radii, vertical or horizontal clearances, seasonal restrictions, presence of culverts, etc.

High burnup (> 45 GWd/MTHM) used nuclear fuel is not stored in 32PT canisters so the certificate of compliance for the MP197HB transportation cask would not have to be revised before transport of 32PT canisters. However, the application for a certificate of compliance for the MAGNATRAN transportation cask is currently under review by the NRC and has not been issued.

2.12 San Onofre

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the San Onofre site. The San Onofre site is located on California's Pacific coast, about 70 miles southeast of Los Angeles and about 60 miles northwest of San Diego, near the town of San Clemente, California (TOPO 1993f, 1994e; Google 2015).

2.12.1 Site Inventory

San Onofre Unit 1 (San Onofre-1) ceased operation in 1992 and San Onofre Units 2 and 3 (San Onofre-2 and -3) ceased operation on June 7, 2013 (Dietrich 2013a), although the reactors did not operate after January 2012. The final removal of used nuclear fuel from the San Onofre-2 reactor vessel was completed on July 18, 2013 (Dietrich 2013b). Final removal of used nuclear fuel from the San Onofre-3 reactor vessel was completed on October 5, 2012 (Dietrich 2013c).

For used nuclear fuel already in dry storage, San Onofre has used the Standardized Advanced NUHOMS System (Docket No. 72-1029). This system consists of transportable dry shielded canisters, reinforced concrete horizontal storage modules, and a transfer cask. The specific dry shielded canisters that have been used at San Onofre are the 24PT1 and 24PT4, which each hold 24 pressurized water reactor used nuclear fuel assemblies.

San Onofre has announced that the HI-STORM UMAX System (Docket No. 72-1040) will be used for future dry storage of used nuclear fuel. This system consists of transportable multipurpose canisters, which contain the fuel; underground vertical ventilated modules, which contain the multipurpose canisters during storage; and a transfer cask (HI-TRAC VW), which contains the multipurpose canister during loading, unloading and transfer operations. The multipurpose canister (MPC-37) stores up to 37 pressurized water reactor used nuclear fuel assemblies. An application for a certificate of compliance for the HI-STAR 190 transportation cask (Docket No. 71-9373) that would be used to transport the MPC-37 multipurpose canister has been submitted to the NRC (Manzione 2015). Figure 2-257 shows a representation of the San Onofre HI-STORM UMAX ISFSI and Figure 2-258 shows a cutaway view of the HI-STORM UMAX dry storage system.

At the San Onofre site, there are also 12 additional unused 24PT4 dry shielded canisters and 12 reinforced concrete horizontal storage modules, and in the future there will be up to six 32PTH2 unused dry shielded canisters and eight additional reinforced concrete horizontal storage modules at the site. The 32PTH2 canister is not certified for use in transportation. Figure 2-259 through Figure 2-262 show 24PT4 and 32PTH2 dry storage canisters, a transfer cask, and horizontal storage modules, respectively. The San Onofre site has not decided whether to use these unused canisters for storage of used nuclear fuel or GTCC low-level radioactive waste.

There are 395 pressurized water reactor used nuclear fuel assemblies in 17 24PT1 dry shielded canisters from San Onofre-1 in dry storage at the San Onofre site. Four of these assemblies (D049, D050, D051, and D052) are mixed oxide used nuclear fuel assemblies. There is also one

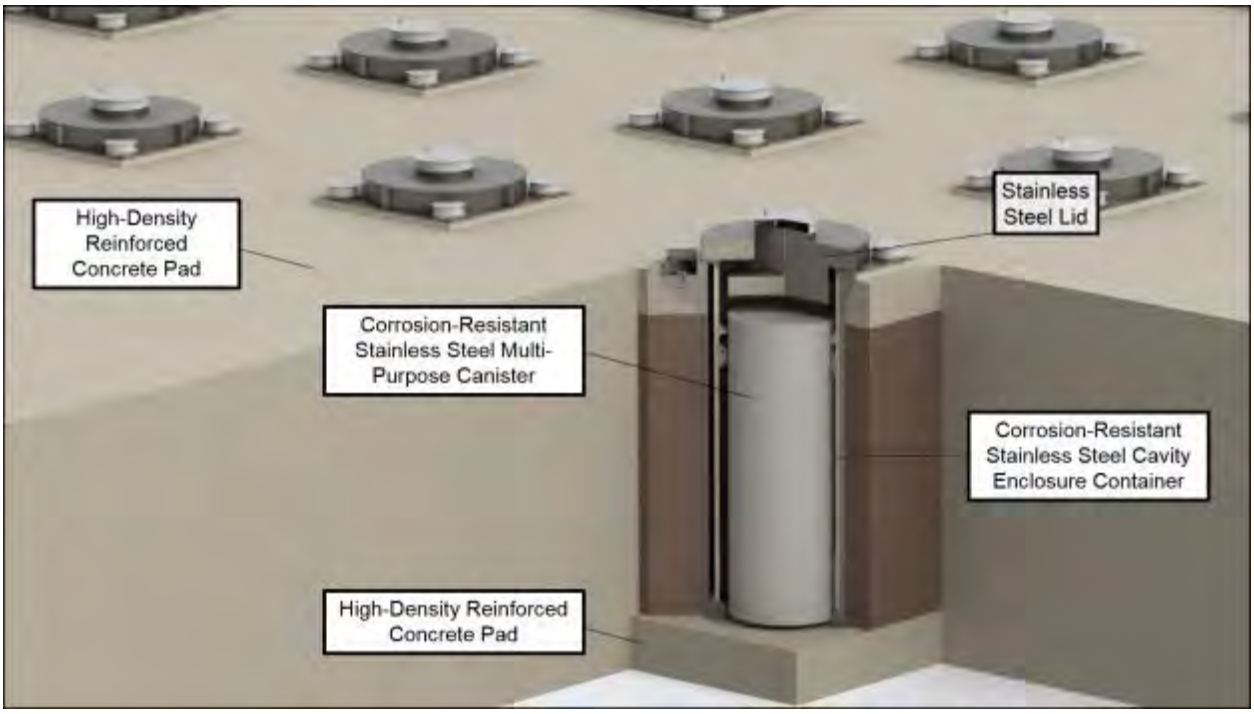
24PT1 dry shielded canister containing GTCC low-level radioactive waste from the segmentation of reactor vessel internals during the decommissioning of San Onofre-1 stored at the San Onofre site. It was initially estimated that two canisters would be required; however, due to packaging efficiencies, only one canister was required (EPRI 2005, 2008b).

The MP187 transportation cask (Docket No. 71-9255) is certified to ship used nuclear fuel in the 24PT1 canister. However, the MP187 transportation cask is not certified for the transport of GTCC low-level radioactive waste. As discussed in Section 2.6.1, a single MP187 transportation cask is stored at the Rancho Seco site, but impact limiters would need to be fabricated before this MP187 transportation cask could be used to ship used nuclear fuel or GTCC low-level radioactive waste. A -96 designation must be obtained before impact limiters are fabricated for the existing MP187 transportation cask. A -96 designation must also be obtained before the MP187 transportation cask is certified for the transport of GTCC low-level radioactive waste. The effort to accomplish these changes and to obtain NRC review and approval is estimated to range from one to three years. It may also be possible to transport the 24PT1 canister containing GTCC low-level radioactive waste using the MP197HB transportation cask.



Graphic courtesy of San Onofre

Figure 2-257. Representation of the San Onofre HI-STORM UMAX Independent Spent Fuel Storage Installation (Looking Towards Southwest)



Graphic courtesy of San Onofre

Figure 2-258. Cutaway View of the HI-STORM UMAX Dry Storage System



Photo courtesy of San Onofre

Figure 2-259. 24PT4 Dry Storage Canisters



Figure 2-260. 32PTH2 Dry Storage Canisters (On Left) (2015)



Figure 2-261. Transfer Cask for 32PTH2 Canisters (2015)



Figure 2-262. Horizontal Storage Modules (2015)

There are also 792 pressurized water reactor used nuclear fuel assemblies in 33 24PT4 dry shielded canisters from San Onofre-2 and -3 stored at the San Onofre site. The MP197HB transportation cask (Docket No. 71-9302) is certified to ship used nuclear fuel in the 24PT4 canister. The MP197HB is also certified to ship GTCC low-level radioactive waste. An MP197HB transportation cask is being fabricated in Japan (Vanderniet 2012). Fabrication is currently on hold.[29]

The fuel rods in the 395 used nuclear fuel assemblies (146.2 MTHM) from San Onofre-1 stored at the San Onofre site are stainless steel-clad. There are also an additional 270 stainless steel-clad used nuclear fuel assemblies from San Onofre-1 that are stored at the Morris, Illinois ISFSI. Figure 2-263 illustrates the number of used nuclear fuel assemblies from San Onofre-1 stored at the San Onofre site, based on their discharge year. The oldest fuel was discharged in 1971 and the last fuel was discharged in 1992. The median discharge year of the fuel is 1988.

Figure 2-264 illustrates the number of used nuclear fuel assemblies from San Onofre-1 stored at the San Onofre site based on their burnup. The lowest burnup is 6.8 GWd/MTHM and the highest burnup is 39.3 GWd/MTHM. The median burnup is 30.0 GWd/MTHM. No high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) from San Onofre-1 is stored at the San Onofre site.

[29] Guibert N. 2016. Personal communication between N Guibert (AREVA TN) and SJ Maheras (PNNL), August 4, 2016.

There are a total of 3460 used nuclear fuel assemblies (1462.6 MTHM) from San Onofre-2 and -3 stored at the San Onofre site.[30] This total includes the 792 assemblies (330.4 MTHM) in dry storage and 2668 assemblies (1132.2 MTHM) stored in the spent fuel pools at the San Onofre site. The fuel rods in these fuel assemblies are zirconium alloy-clad. There is also one rod storage basket containing rods from reconstituted fuel assemblies in each San Onofre -2 and -3 spent fuel pool. The 2668 used nuclear fuel assemblies in the spent fuel pools do not include 108 fuel assemblies that were inserted into the San Onofre-2 reactor but that were not made critical. These assemblies were transported off-site to a fuel fabricator for uranium recovery.

As mentioned previously, the San Onofre site has not decided whether to use the unused 24PT4 or 32PTH2 canisters for storage of used nuclear fuel or GTCC low-level radioactive waste. If these canisters are not used, 73 MPC-37 canisters would be required to store the 2668 assemblies that are currently stored in the spent fuel pools at the San Onofre site. If these canisters are used, a maximum of 79 canisters would be required to store the 2668 assemblies. The San Onofre site also estimates that 10 canisters would be required to store the GTCC low-level radioactive waste from decommissioning of San Onofre-2 and -3. A total of 123 to 129 canisters containing used nuclear fuel from San Onofre-1, -2, and -3, and 11 canisters containing GTCC low-level radioactive waste would be required to store the entire inventory of used nuclear fuel and GTCC low-level radioactive waste at the San Onofre site.

High burnup used nuclear fuel stored in 24PT4 canisters at San Onofre would be transportable in the MP197HB transportation cask; as mentioned previously, an application for a certificate of compliance for the HI-STAR 190 that would be used to transport the MPC-37 canisters has been submitted to the NRC (Manzione 2015). If used for storage of used nuclear fuel or GTCC low-level radioactive waste, the 32PTH2 canisters would not be transportable without changes to the list of approved contents in the certificate of compliance for the MP197HB transportation cask.

There are 94 damaged used nuclear fuel assemblies from San Onofre-1, -2, and -3 in dry storage. There are 27 assemblies from San Onofre-1 stored in 9 canisters, 46 assemblies from San Onofre-2 stored in 4 canisters, and 21 assemblies from San Onofre-3 stored in 2 canisters. These assemblies are packaged in damaged fuel cans. There are also 32 known or suspect damaged assemblies from San Onofre-2 and 27 known or suspect damaged assemblies from San Onofre-3 stored in the spent fuel pools.

Figure 2-265 illustrates the number of used nuclear fuel assemblies from San Onofre-2 and -3, based on their discharge year. The oldest fuel was discharged in 1984 and the last fuel was discharged in 2012. The median discharge year of the fuel is 1999.

Figure 2-266 illustrates the number of used nuclear fuel assemblies from San Onofre-2 and -3 based on their burnup. The lowest burnup is 9.3 GWd/MTHM and the highest burnup is 55.1 GWd/MTHM. The median burnup is 40.7 GWd/MTHM. There are 1123 used nuclear fuel assemblies from San Onofre-2 and -3 that have burnups greater than 45 GWd/MTHM. These 1123 fuel assemblies are classified by the NRC as high burnup used nuclear fuel.

[30] Granaas R. 2013. Email messages from R Granaas (San Onofre Nuclear Generating Station) to SJ Maheras (Pacific Northwest National Laboratory), "RE: san onofre sections of draft shutdown sites report," September 11-24, 2013.

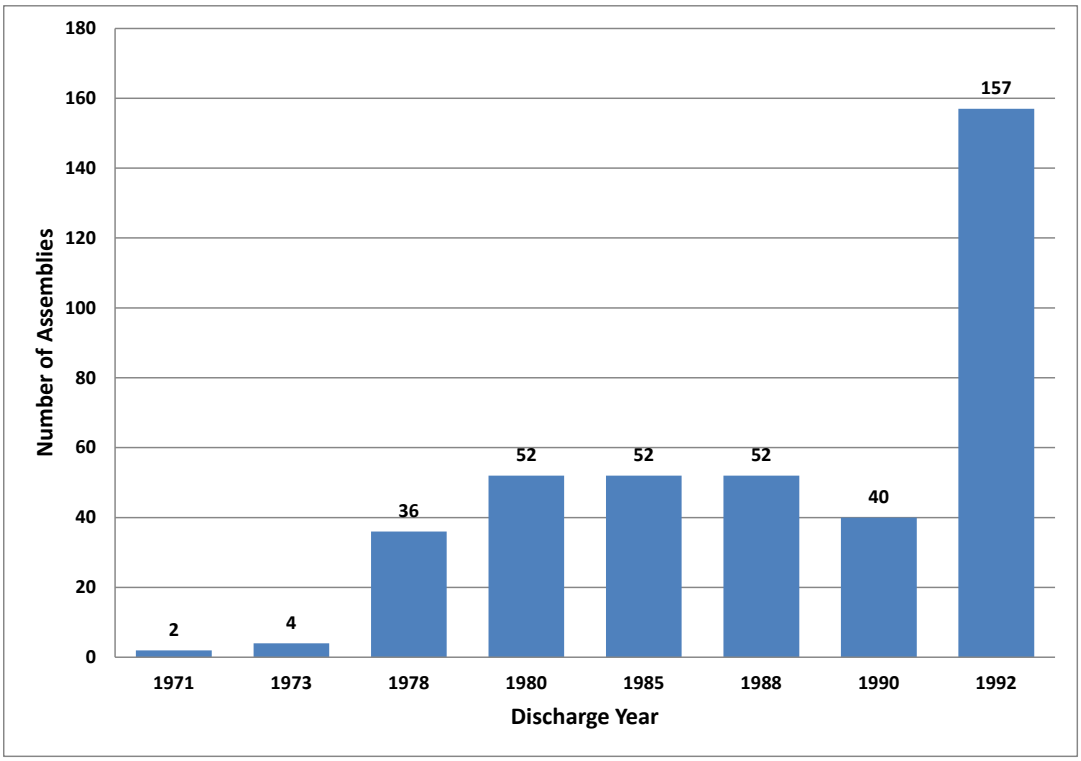


Figure 2-263. San Onofre-1 Number of Onsite Assemblies versus Discharge Year (EIA 2013)

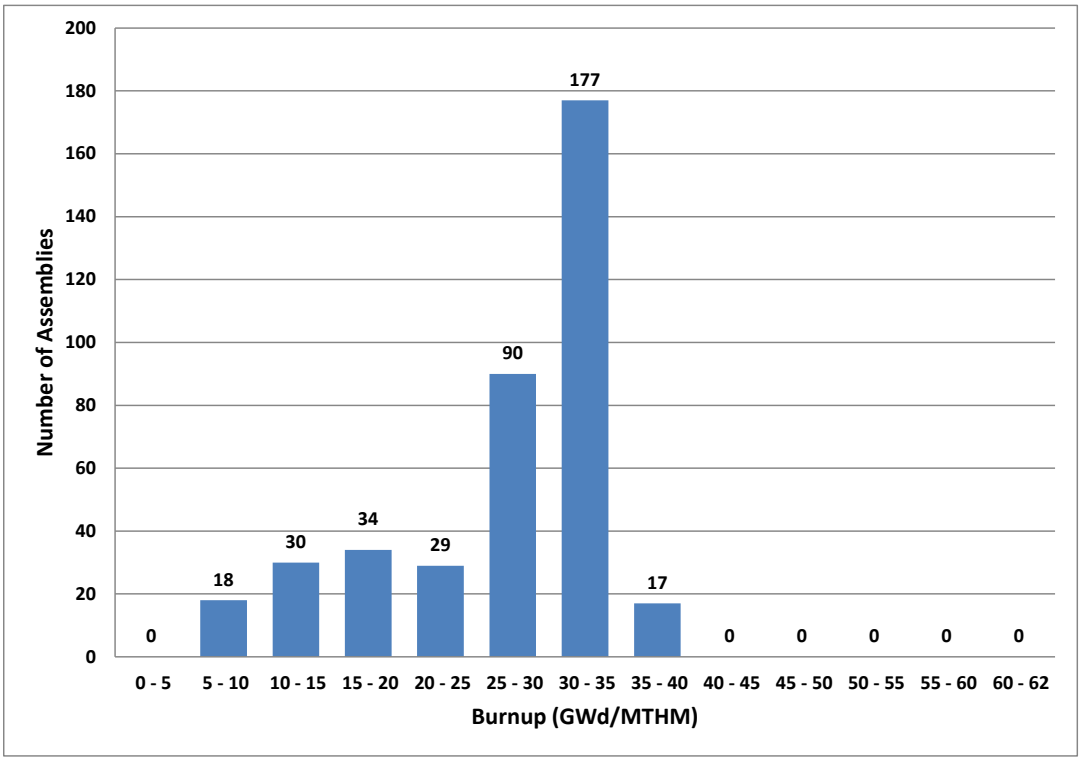


Figure 2-264. San Onofre-1 Number of Onsite Assemblies versus Burnup (EIA 2013)

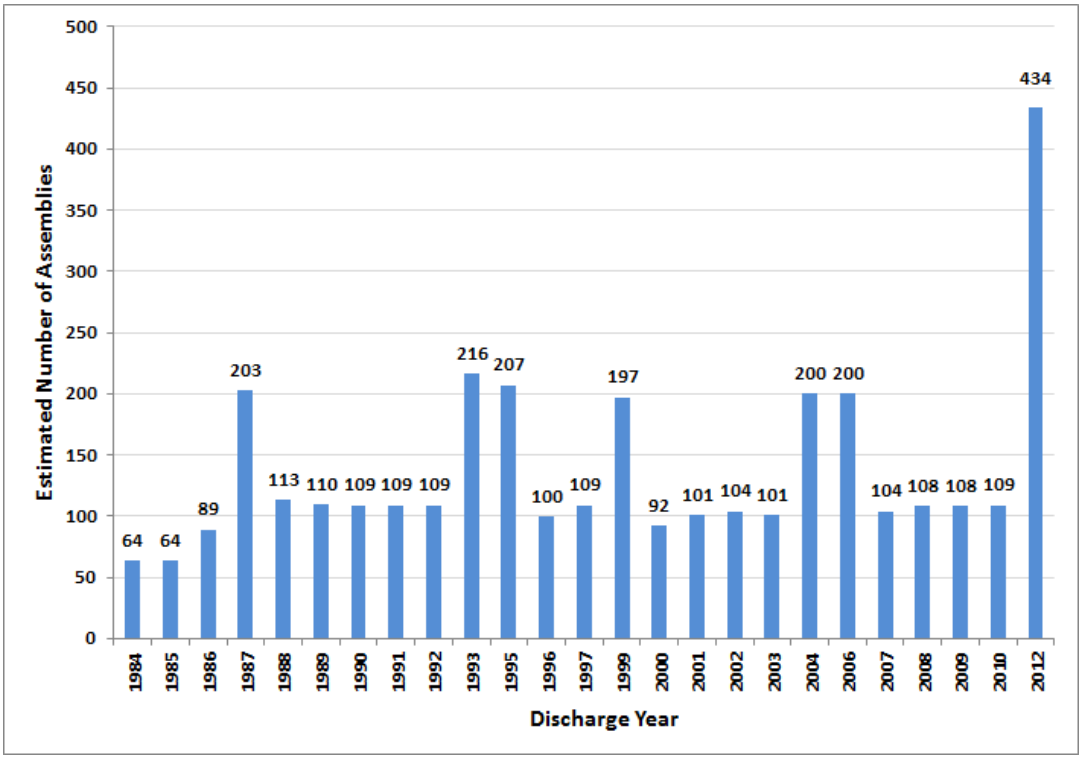


Figure 2-265. San Onofre-2 and -3 Number of Assemblies versus Discharge Year (EIA 2013)

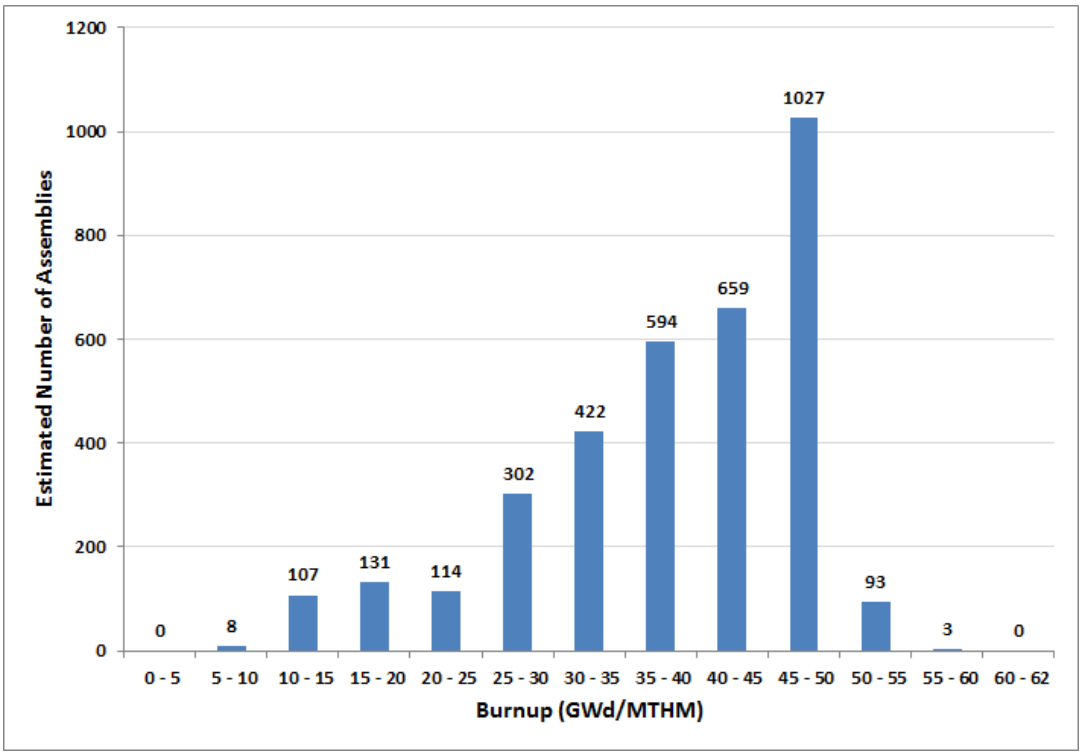


Figure 2-266. San Onofre-2 and -3 Number of Assemblies versus Burnup (EIA 2013)

As mentioned previously, there are 792 used nuclear fuel assemblies from San Onofre-2 and -3 stored in 33 dry storage canisters. Figure 2-267 and Figure 2-268 illustrate the number of canistered fuel assemblies based on their discharge year and burnup. The oldest canistered fuel was discharged in 1984 and the last fuel was discharged in 2004. The median discharge year of the canistered fuel is 1993. The lowest burnup is 11.1 GWd/MTHM and the highest burnup is 48.0 GWd/MTHM. The median burnup is 34.2 GWd/MTHM. There are 8 canistered fuel assemblies from San Onofre-2 and -3 that have burnups greater than 45 GWd/MTHM. These 8 assemblies are not packaged in damaged fuel cans.

Figure 2-269 and Figure 2-270 illustrate the number of fuel assemblies based on their discharge year and burnup for the 2668 uncanistered fuel assemblies from San Onofre-2 and -3. The oldest uncanistered fuel was discharged in 1984 and the last fuel was discharged in 2012. The median discharge year of the uncanistered fuel is 2002. The lowest burnup is 9.3 GWd/MTHM and the highest burnup is 55.1 GWd/MTHM. The median burnup is 43.1 GWd/MTHM. There are 1115 uncanistered fuel assemblies from San Onofre-2 and -3 that have burnups greater than 45 GWd/MTHM. The San Onofre site has decided not to package these assemblies in damaged fuel cans.

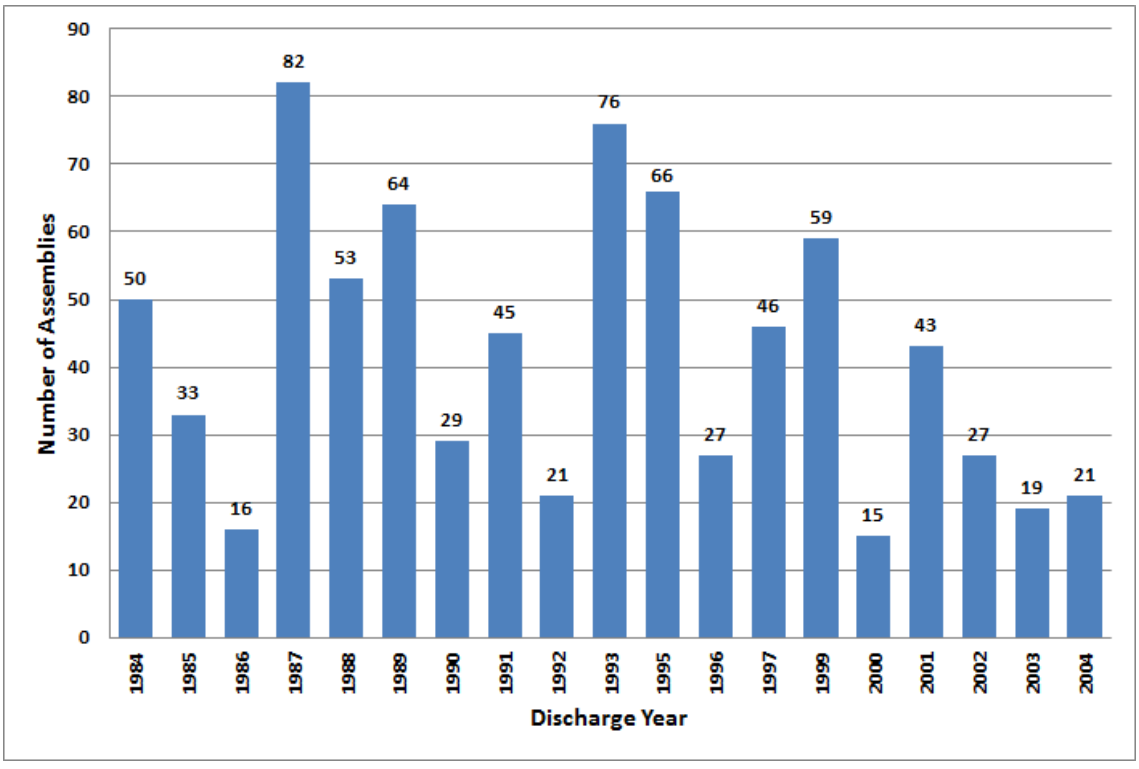


Figure 2-267. San Onofre-2 and -3 Number of Canistered Assemblies versus Discharge Year (EIA 2013)

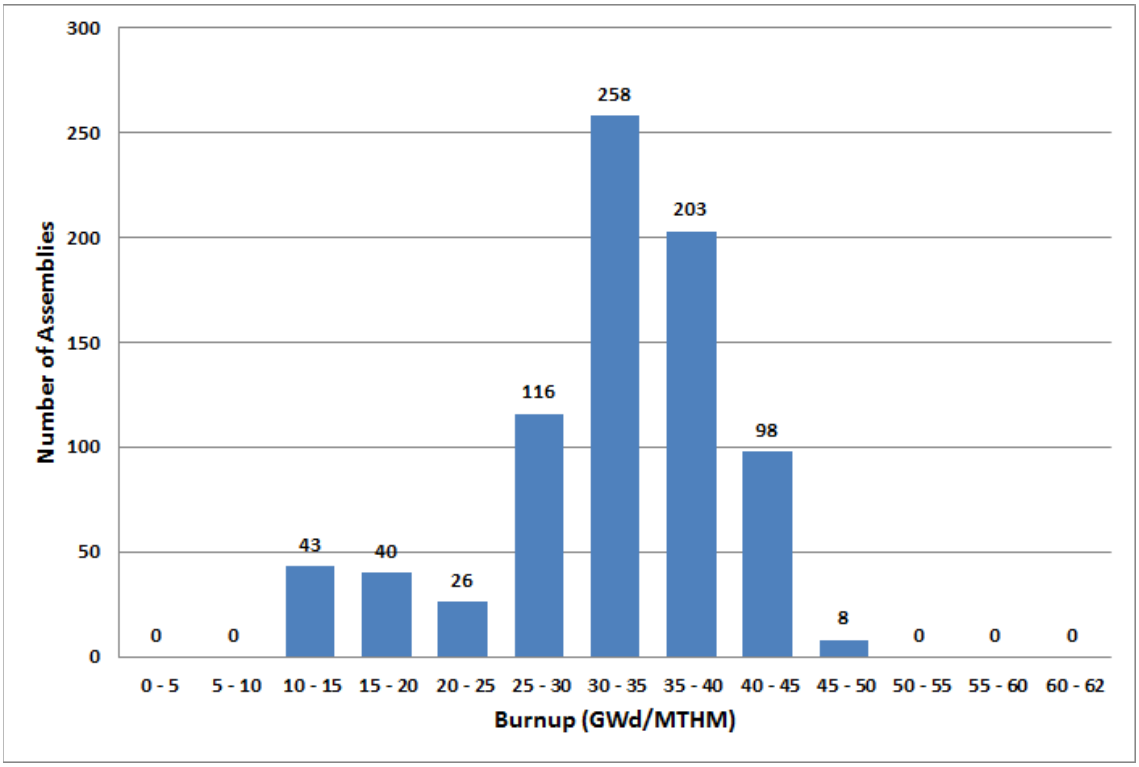


Figure 2-268. San Onofre-2 and -3 Number of Canistered Assemblies versus Burnup (EIA 2013)

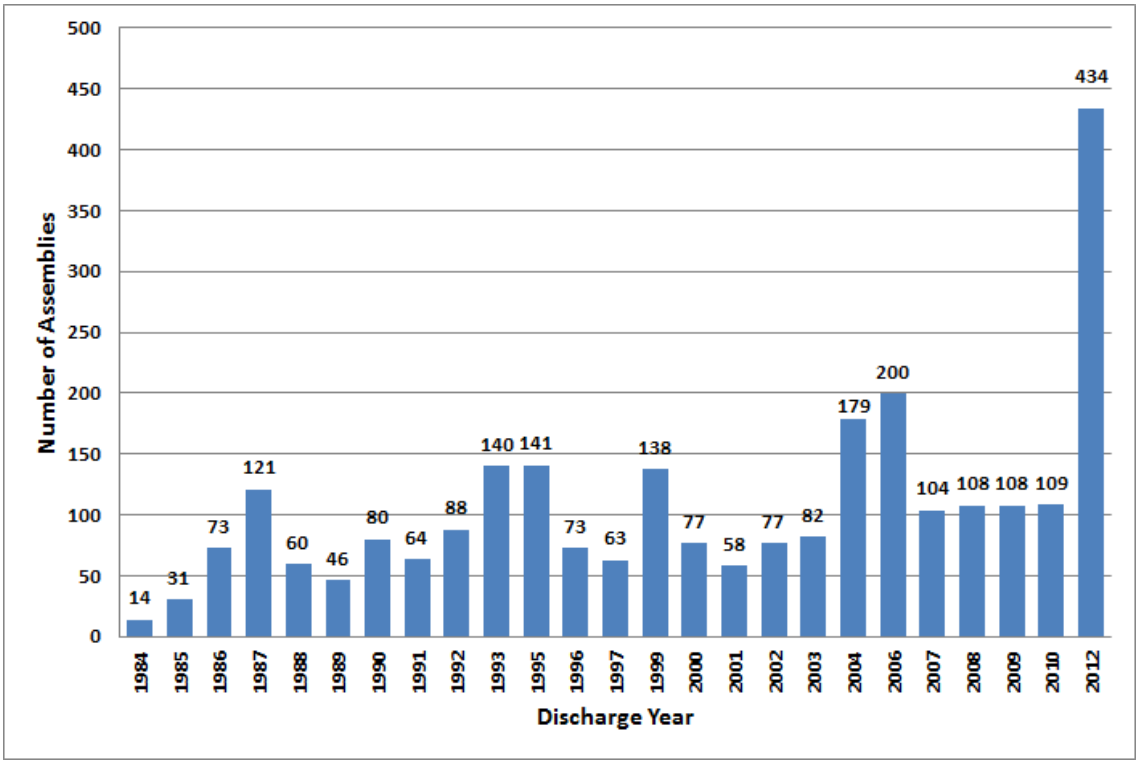


Figure 2-269. San Onofre-2 and -3 Number of Uncanistered Assemblies versus Discharge Year (EIA 2013)

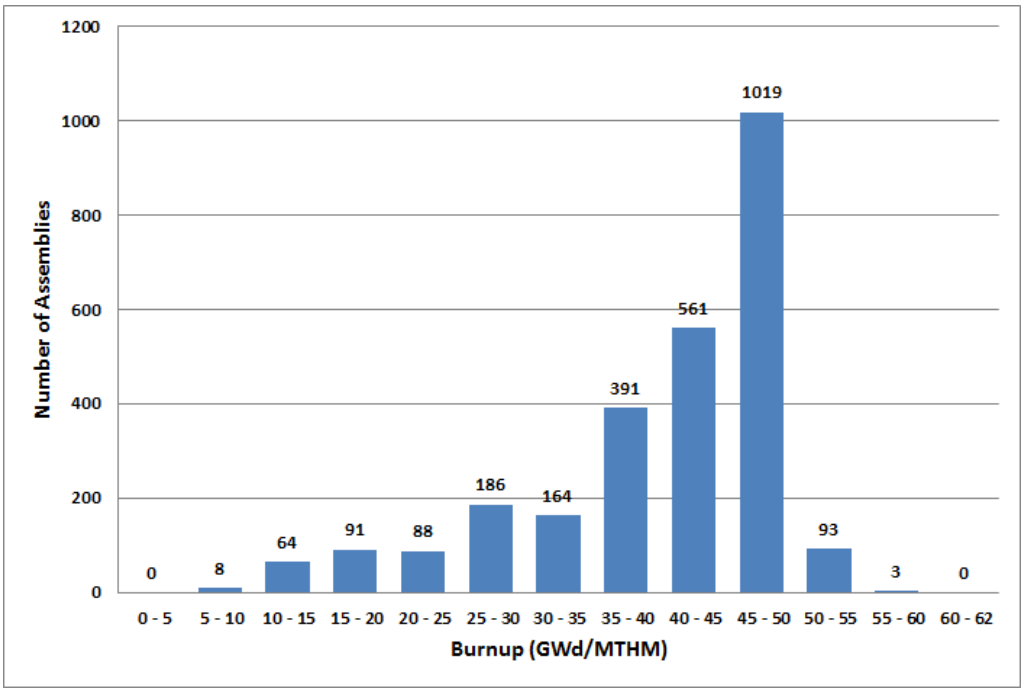


Figure 2-270. San Onofre-2 and -3 Number of Uncanistered Assemblies versus Burnup (EIA 2013)

2.12.2 Site Conditions

The San Onofre site is located on the Pacific coast in southern California. The San Onofre ISFSI (Docket No. 72-41) (see Figure 2-271 and Figure 2-272) is located at the northwestern end of the site. Figure 2-273 provides an aerial view of the San Onofre site.

The San Onofre ISFSI will be expanded to accommodate additional dry storage in HI-STORM UMAX underground vertical storage modules. The proposed expansion will be in an area adjacent to the current ISFSI (see Figure 2-274 and Figure 2-275). This area will be excavated to a depth of approximately 12 feet to install the underground vertical storage modules. Following installation of the modules, the area will be built up approximately 12 feet from the current ground level.

The San Onofre site is served by the Pacific Sun Railroad and has an on-site rail spur (TOPO 1993f, 1994e; TriVis Incorporated 2005). The rail spur is about 0.8 mile long and was originally built in the 1960s to support construction of San Onofre-1 and was subsequently used to support construction of San Onofre-2 and -3 in the 1970s (Gilson 2005, Gilson and Blythe 2005). The rail spur connects with the Pacific Sun Railroad mainline about 0.6 mile northwest of the site. The rail spur was reactivated in 2000 to support the decommissioning of San Onofre-1 (Gilson 2005, Gilson and Blythe 2005). Figure 2-276 through Figure 2-280 show the onsite rail system at San Onofre, the onsite spur, and the junction of the rail spur with the mainline. San Onofre staff stated that use of the onsite rail spur would require removal or modification of the vehicle barrier and maintenance of the rail.

The San Onofre site has no on-site barge facilities (TOPO 1993f, 1994e; TriVis Incorporated 2005). Construction of an on-site barge facility was attempted during construction of the San Onofre site, but this effort was unsuccessful because of currents and wave activity.

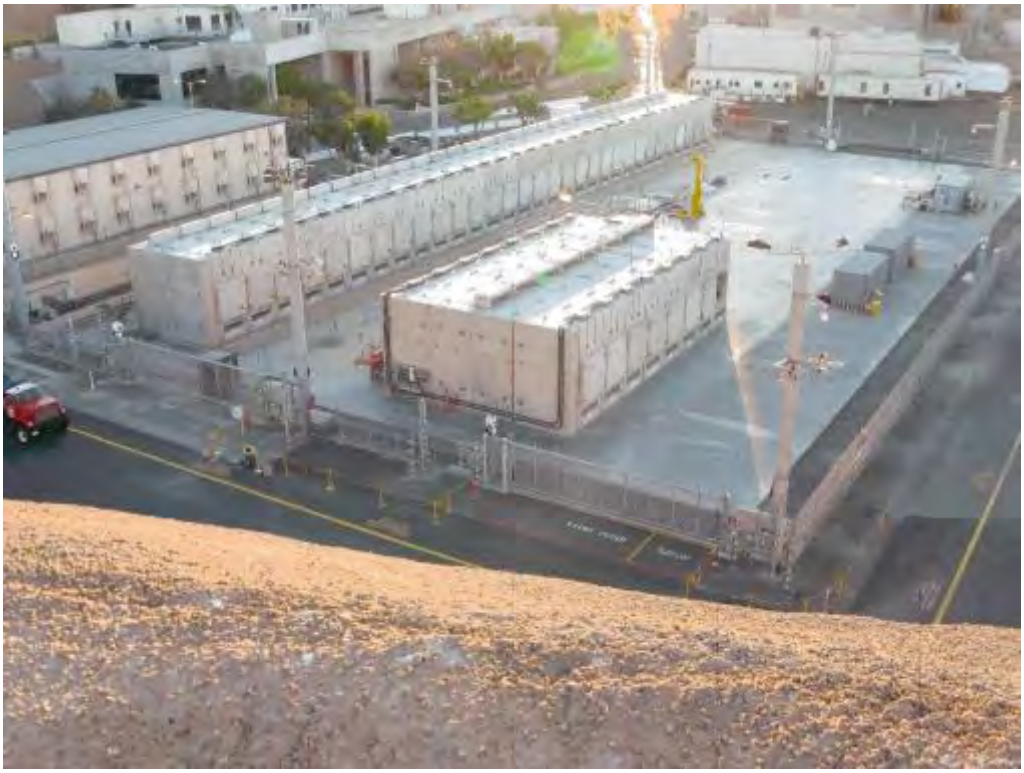


Photo courtesy of San Onofre

Figure 2-271. San Onofre Independent Spent Fuel Storage Installation (2009)



Figure 2-272. Close-up View of San Onofre Independent Spent Fuel Storage Installation (2015)



Figure 2-273. Aerial View of San Onofre Site (Google 2015)



Figure 2-274. Aerial View of Area of Proposed San Onofre Independent Spent Fuel Storage Installation Expansion (Google 2015)



Figure 2-275. Future Expanded San Onofre Independent Spent Fuel Storage Installation Location (2015)

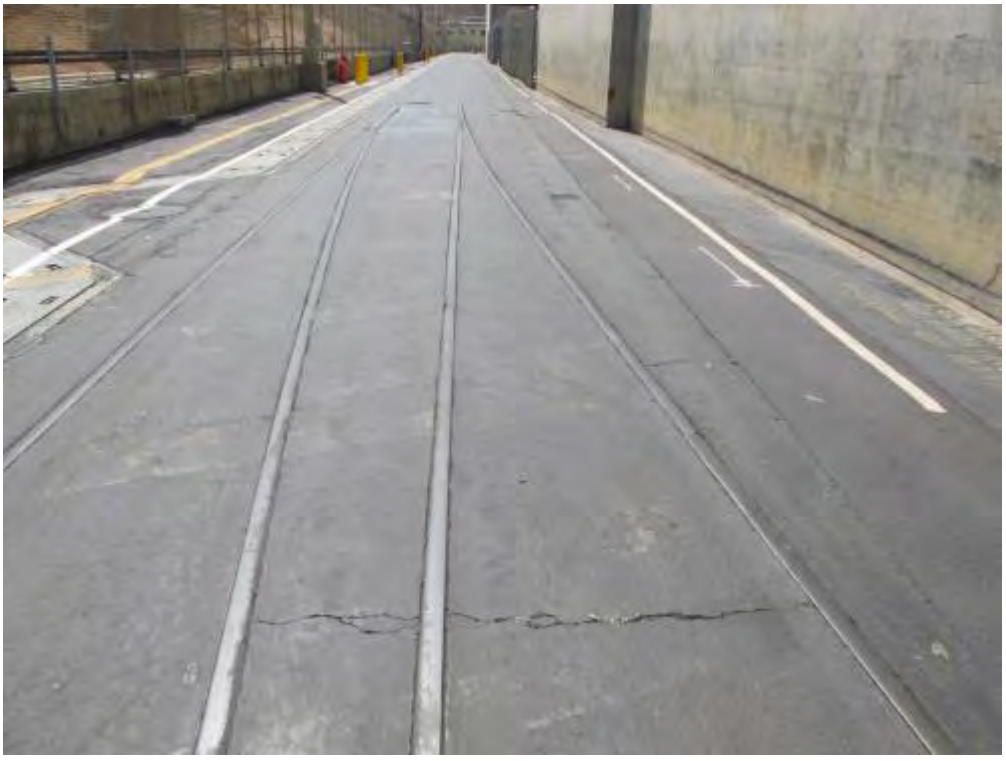


Figure 2-276. Onsite Rail System at San Onofre Site (2015)



Figure 2-277. Onsite Rail System near Independent Spent Fuel Storage Installation at San Onofre Site (Looking Southwest) (2015)



Figure 2-278. Onsite Rail System and Vehicle Barrier near Independent Spent Fuel Storage Installation at San Onofre Site (Looking Northeast) (2015)



Figure 2-279. Onsite Rail Spur at San Onofre Site (2015)



Figure 2-280. Junction of Onsite Rail Spur with Mainline at San Onofre Site (2015)

2.12.3 Near-site Transportation Infrastructure and Experience

As discussed in Section 2.12.2, the San Onofre site has direct rail access to the Pacific Sun Railroad through an on-site rail spur, and the rail spur has been used to ship several large turbine shells, turbine rotors, three steam generators, and a pressurizer during the decommissioning of San Onofre-1 (Gilson 2005, Gilson and Blythe 2005). Each steam generator weighed approximately 209 tons, was cylindrical with spherical ends, measured approximately 11 ft. 4.5 in. in diameter at the upper dome and was approximately 45 ft. long (EPRI 2008b). Lifting trunnions were attached to the exterior of the steam generators and increased the maximum width of the steam generators to approximately 14 ft. 5 in. (EPRI 2008b). The pressurizer weighed approximately 105 tons, was cylindrical with spherical ends, measured approximately 7 ft. 6.5 in. in diameter, and was about 42 ft. 7 in. long (EPRI 2008b). Low-level radioactive waste was also shipped by rail using gondola cars (Figure 2-281) and intermodal containers loaded onto rail cars (Figure 2-282) (EPRI 2008b).

In October 2015, a main generator rotor was shipped by rail from the San Onofre site to a location near Richmond, Virginia for refurbishment, after which it was shipped by rail to a storage location near the Fermi Nuclear Power Plant near Monroe, Michigan. The rotor weighed slightly over 400,000 lb., was just over 50 ft. long, and was shipped on a 12-axle QTTX railcar (see Figure 2-283).

Truck shipments of 270 used nuclear fuel assemblies were also made from San Onofre-1 to Morris, Illinois from 1972 through 1980 (SAIC 1991). Ninety-five shipments were made using the IF-100 truck transportation cask and 175 shipments were made using the NAC-1 truck transportation cask (SAIC 1991). Southern California Edison does not intend to return these assemblies to the San Onofre site (EPRI 2008b).

The mainline track in the vicinity of the San Onofre site is designated as track class 5 and is built with 115 lb. rail; the on-site spur is built with 90 lb. rail. Figure 2-284 and Figure 2-285 show the mainline. The mainline is owned by the North County Transit District. Amtrak Pacific Surfliner and Metrolink commuter rail service operate over the same track between Orange County and Oceanside, California, which limits freight service to 12:00 a.m. to 5:00 a.m. The North County Transit District also provides Coaster and Sprinter commuter rail service between Oceanside and San Diego, and Oceanside and Escondido, California. The Pacific Sun Railroad interchanges with the BNSF Railroad at the Stuart Mesa rail yard, which is located about 13 miles south of the San Onofre site (see Figure 2-286).



Photo courtesy of San Onofre

Figure 2-281. Gondola Railcar Used to Transport Large Non-Containerized Components



Photo courtesy of San Onofre

Figure 2-282. Articulating Intermodal Railcar Transporting Low-Level Radioactive Waste



Photo courtesy of San Onofre

Figure 2-283. Main Generator Rotor on QTTX Railcar (2015)



Figure 2-284. Mainline at San Onofre Site (Looking North) (2015)



Figure 2-285. Mainline at San Onofre Site (Looking South) (2015)



Figure 2-286. Stuart Mesa Rail Yard (Looking South) (2016)

In addition to rail shipments of large components, ship, barge, platform trailer, tracked vehicle, and heavy haul truck transport were used to transport four replacement steam generators from Mitsubishi Heavy Industries in Kobe, Japan to the San Onofre site. The steam generators weighed approximately 650 tons each. The two replacement steam generators for San Onofre-2 were transported from Kobe, Japan by the heavy lift cargo ship Happy Ranger to the Port of Long Beach in 2008; the two replacement steam generators for San Onofre-3 were transported from Kobe, Japan by the heavy lift cargo ship Enchanter to the Port of Los Angeles in 2010. At the ports, the steam generators were transloaded to an ocean-going barge (see Figure 2-287) and transported to the Del Mar Boat Basin (see Figure 2-288) which is located at Marine Corps Base Camp Pendleton (MCBCP). At a pre-existing bulkhead at the Del Mar Boat Basin, each steam generator was then transloaded onto a Goldhofer trailer that had been rolled from the bulkhead onto the barge under the steam generator (see Figure 2-289). The Goldhofer trailer with its steam generator was then rolled off of the barge.

After being rolled off of its barge at the Del Mar Boat Basin, each steam generator was then transloaded onto a tracked vehicle (see Figure 2-290). The tracked vehicle then traveled north on military roads. From the paved road behind the Camp Del Mar recreational vehicle park at the north end of Camp Pendleton's Camp Del Mar Beach and Recreational Area, the tracked vehicle

followed the Amphibious Tracked Vehicle access road and proceeded to the beach and past the Santa Margarita Estuary.

During travel on the beach, several natural drainages were crossed, the most important of which was the Santa Margarita River. North of the Santa Margarita Estuary, the tracked vehicle traveled along military transit routes on the beach for approximately 8 miles. Travel on the beach was below the high tide line; layovers were above the high tide line. The tracked vehicle then followed a military transport dirt road that heads east and northeast from Red Beach at the MCBCP Uniform Training Area to the MCBCP Las Pulgas gate. At the Las Pulgas Gate, each steam generator was transloaded from its tracked vehicle onto a Goldhofer trailer (see Figure 2-291). From the Las Pulgas gate, the Goldhofer trailer turned north onto a MCBCP road that parallels Interstate-5 for 0.2 miles.

The Goldhofer trailer then moved to the south bound lanes of Interstate-5 through a temporary opening made in the fencing along Interstate-5. The transfer to the south bound lanes of Interstate-5 was necessary to avoid the environmentally sensitive Skull Canyon area of the Southern California Coast. The Goldhofer trailer traveled north on the south bound lanes of Interstate-5 for approximately 0.2 miles, and then transitioned back to a MCBCP dirt road through another temporary opening made in the fencing along Interstate-5.

Travel north on south-bound Interstate-5 necessitated the closure of three of the four south-bound lanes of Interstate-5 for approximately 1 hour, and no special grading was necessary to transfer to and from Interstate-5. The transporter then traveled north on the MCBCP dirt road for approximately 1 mile and transitioned onto Old Highway 101, which is paved. The distance traveled along Old Highway 101 was approximately 5.5 miles, and transitioned from MCBCP property to State of California State Park property. Travel on Old Highway 101 required the reinforcement of drainage culverts and underground utilities which were protected with steel plates or mats. Old Highway 101 is also the main access road into the San Onofre State Beach and required the use of flaggers to direct traffic around the steam generators. From Old Highway 101, the Goldhofer trailer moved to the San Onofre site where each steam generator was offloaded. The overall length of the route from the Del Mar Boat Basin to the San Onofre site was about 15 miles (see Figure 2-292). Figure 2-293 shows the condition of the Del Mar Boat Basin bulkhead in 2016.

Heavy haul truck transport was also used to ship the four old steam generators from San Onofre to Clive, Utah for disposal; a distance of about 830 miles. Each steam generator weighed 760,335 lb., and was 15.5 ft. wide, 15.5 ft. tall, and 43 ft. long (Morgan 2015). The gross vehicle weight of each shipment was 1,561,050 lb. and each shipment required 14 days of travel time (Morgan 2015). Figure 2-294 shows a steam generator (without its steam dome) on its heavy haul truck transporter.



Photo courtesy of California Public Utilities Commission

Figure 2-287. San Onofre Steam Generators on Barge Arriving at Del Mar Boat Basin (2009)



Figure 2-288. Del Mar Boat Basin (Google 2015)



Photo courtesy of California Public Utilities Commission

Figure 2-289. Offloading of Steam Generator on Goldhofer Trailer at Del Mar Boat Basin Bulkhead (2009)



Photo courtesy of California Public Utilities Commission

Figure 2-290. Steam Generator on Tracked Vehicle on Beach (2009)



Photo courtesy of San Diego Union-Tribune

Figure 2-291. Steam Generator on Goldhofer Trailer (2009)

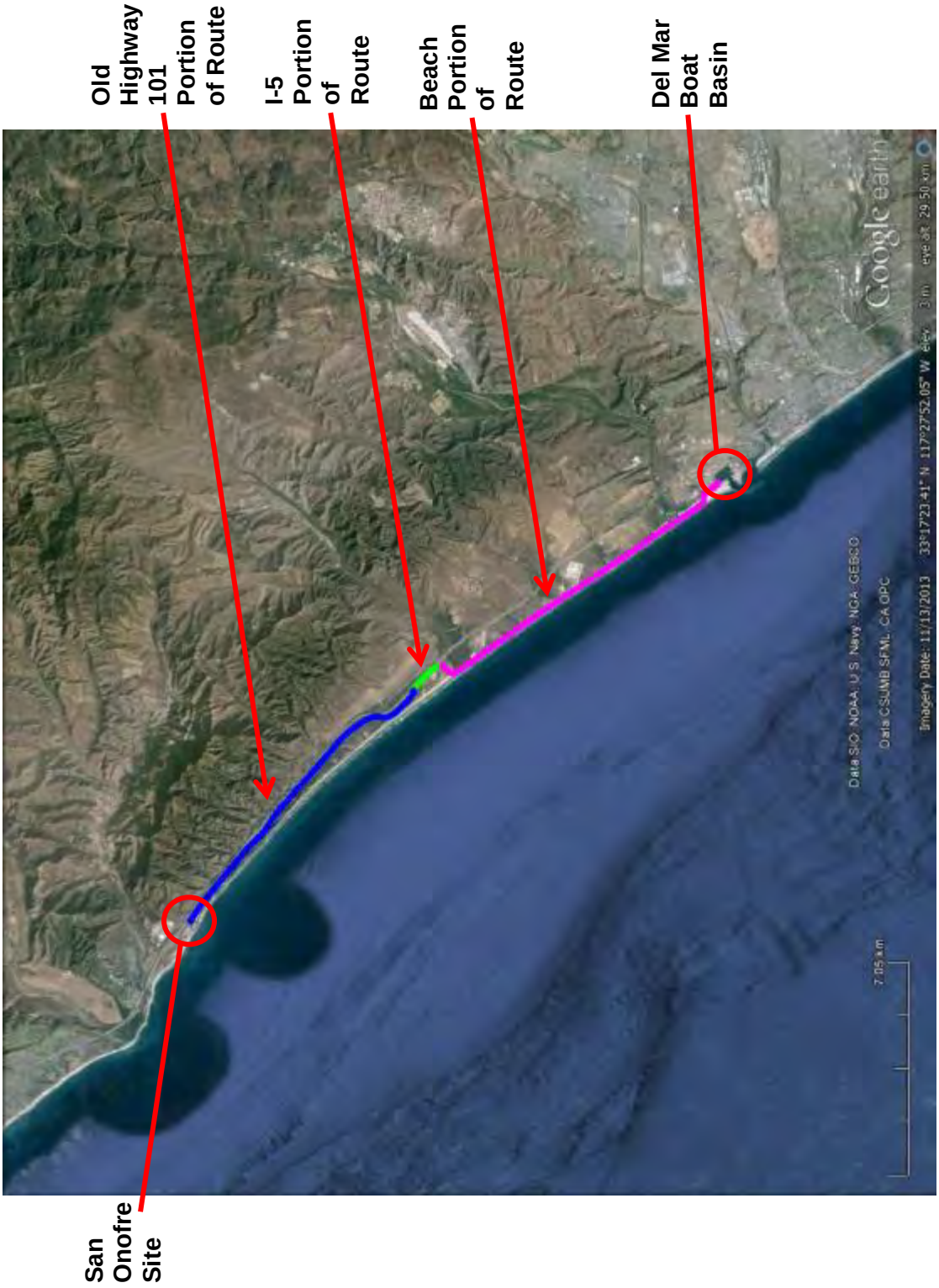


Figure 2-292. Steam Generator Route from the Del Mar Boat Basin to the San Onofre Site (Google 2015)



Figure 2-293. Del Mar Boat Basin Bulkhead (2016)



Photo courtesy of San Diego Union-Tribune

Figure 2-294. Old Steam Generator on Heavy Haul Truck Transporter (2011)

2.12.4 Gaps in Information

At the San Onofre site, an on-site rail spur provides direct access to the Pacific Sun Railroad which interchanges with the BNSF Railroad and consequently, barge or heavy haul truck transport of used nuclear fuel and GTCC low-level radioactive waste would be unlikely from the San Onofre site.

There are 1123 used nuclear fuel assemblies at San Onofre-2 and -3 that have burnups greater than 45 GWd/MTHM. Revision 7 of the certificate of compliance for the MP197HB transportation cask authorizes the transport of high burnup fuel in the 24PT4 canister; therefore, the 8 high burnup fuel assemblies stored in 24PT4 canisters would be transportable. An application for a certificate of compliance for the HI-STAR 190 transportation cask has been submitted to the NRC and the additional 1115 high burnup fuel assemblies would be transportable if they are included in the list of approved contents in the certificate of compliance for the HI-STAR 190 transportation cask. The certificate of compliance for the MP197HB transportation cask would also have to be revised before used nuclear fuel or GTCC low-level radioactive waste that may be stored in 32PTH2 canisters could be transported using the MP197HB transportation cask from the San Onofre site.

2.13 Vermont Yankee

This section describes the inventory of used nuclear fuel and GTCC low-level radioactive waste, site conditions, near-site transportation infrastructure and experience, and gaps in information for the Vermont Yankee site. The site is located at the southeast corner of Vermont in the town of Vernon, Vermont in Windham County on the western shore of the Connecticut River (TOPO 1994f).

2.13.1 Site Inventory

Vermont Yankee ceased operation on December 29, 2014 and all used nuclear fuel has been removed from the Vermont Yankee reactor vessel (Wamser 2015). A total of 3879 used nuclear fuel assemblies and one fuel debris canister are stored at Vermont Yankee, of which 2995 boiling water reactor used nuclear fuel assemblies and one fuel debris canister are stored in the spent fuel pool and 884 boiling water reactor used nuclear fuel assemblies are in dry storage at the Vermont Yankee ISFSI (Docket No. 72-59). The fuel rods in the fuel assemblies are zirconium alloy-clad. The 884 fuel assemblies are stored in 13 MPC-68 multipurpose canisters. The MPC-68 multipurpose canister holds 68 boiling water reactor used nuclear fuel assemblies and is part of the HI-STORM 100S System (Docket No. 72-1014). This system consists of a multipurpose canister, which contains the fuel; a vertical concrete storage overpack (HI-STORM), which contains the multipurpose canister during storage; and a transfer cask (HI-TRAC), which contains the multipurpose canister during loading, unloading and transfer operations. The HI-STORM 100S is a variation of the HI-STORM 100 overpack design that includes a modified lid which incorporates the air outlet ducts into the lid, allowing the overpack body to be shortened.

The HI-STAR 100 transportation cask (Docket No. 71-9261) is certified to ship MPC-68 canisters. Transport of GTCC low-level radioactive waste and high burnup (> 45 GWd/MTHM)

used nuclear fuel is not authorized in Revision 9 of the certificate of compliance for the HI-STAR 100. Although HI-STAR 100 casks have been constructed for use in the United States, these casks are being used as storage casks at the Dresden (4 casks) and Hatch (3 casks) sites (Ux Consulting 2016a). For these HI-STAR 100 casks to be used to ship used nuclear fuel from the Vermont Yankee site, they would need to be unloaded, their contents placed in other storage overpacks, and the casks transported to the Vermont Yankee site. It would also be necessary to procure impact limiters for these HI-STAR 100 casks.

At the Vermont Yankee site, it is estimated that a total of 58 canisters containing used nuclear fuel and fuel debris (Wamser 2014) and 2 canisters containing GTCC low-level radioactive waste will be stored.

Figure 2-295 illustrates the number of used nuclear fuel assemblies at Vermont Yankee, based on their discharge year. The oldest fuel was discharged in 1973 and the last fuel was discharged in 2014. The median discharge year of the fuel is 1993. To estimate the used nuclear fuel discharges and assembly burnups for the last Vermont Yankee core (368 assemblies), the TSL-CALVIN computer code (Nutt et al. 2012) was used.

Figure 2-296 illustrates the number of used nuclear fuel assemblies at Vermont Yankee, based on their burnup. The lowest burnup is estimated to be 0.96 GWd/MTHM and the highest burnup is 52.9 GWd/MTHM. The median burnup is estimated to be 30.1 GWd/MTHM. There are 248 high burnup used nuclear fuel (burnup greater than 45 GWd/MTHM) assemblies stored at Vermont Yankee. These 248 fuel assemblies are classified by the NRC as high burnup used nuclear fuel.

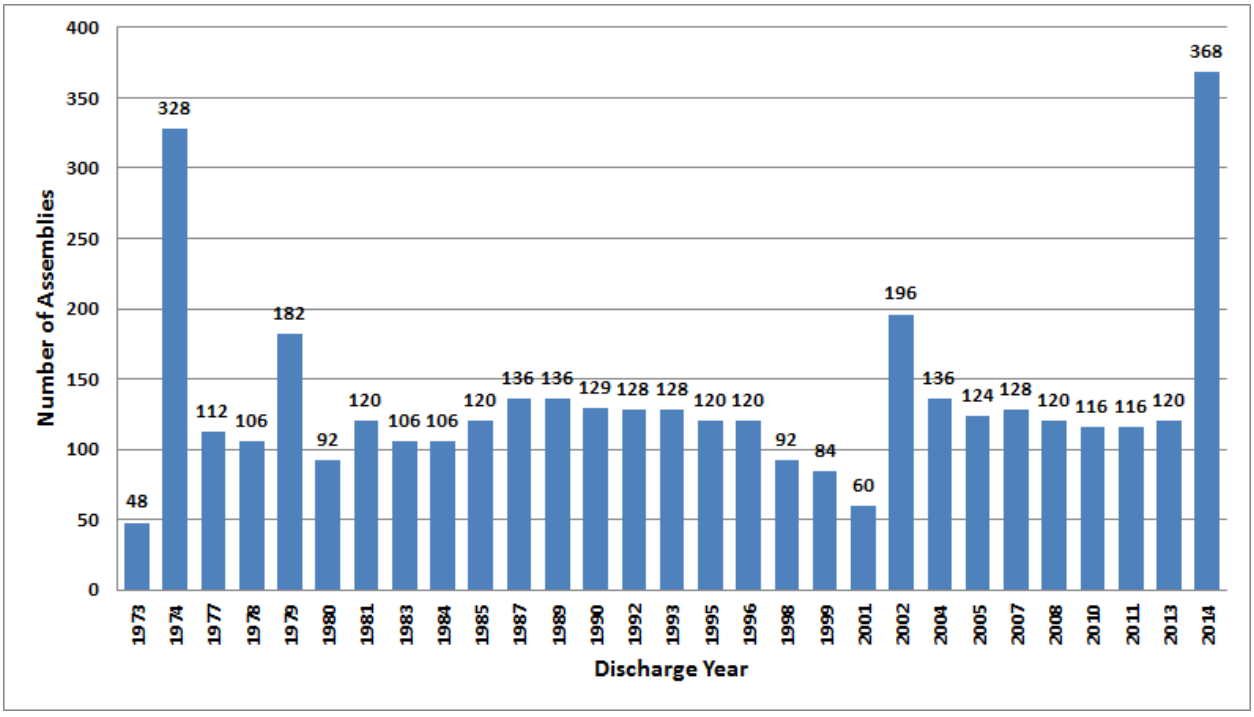


Figure 2-295. Vermont Yankee Number of Assemblies versus Discharge Year

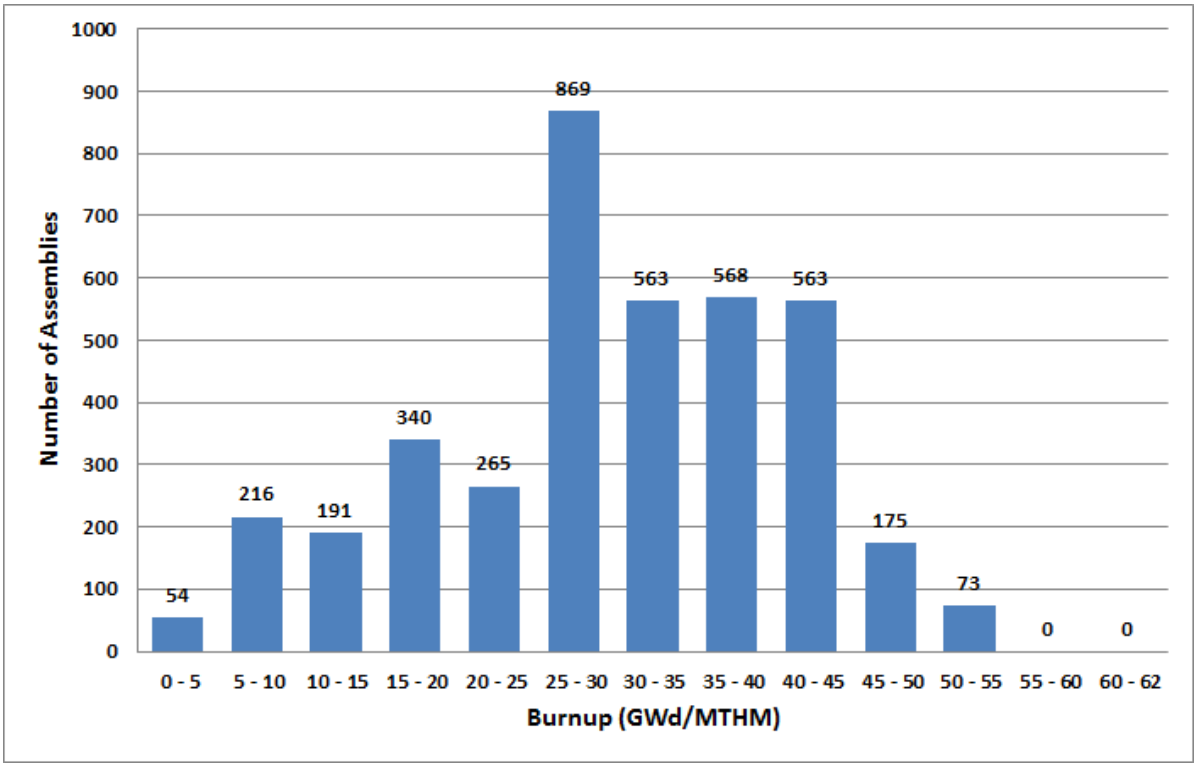


Figure 2-296. Vermont Yankee Number of Assemblies versus Burnup

As mentioned previously, Vermont Yankee has 884 used nuclear fuel assemblies stored in 13 dry storage canisters. Figure 2-297 and Figure 2-298 illustrate the number of canistered fuel assemblies based on their discharge year and burnup. The oldest canistered fuel was discharged in 1977 and the last fuel was discharged in 2004. The median discharge year of the canistered fuel is 1993. The lowest burnup is 17.0 GWd/MTHM and the highest burnup is 42.5 GWd/MTHM. The median burnup is 32.3 GWd/MTHM. There are no canistered fuel assemblies at Vermont Yankee that have burnups greater than 45 GWd/MTHM.

Figure 2-299 and Figure 2-300 illustrate the number of fuel assemblies based on their discharge year and burnup for the 2996 uncanistered fuel assemblies at Vermont Yankee. The oldest uncanistered fuel was discharged in 1973 and the last fuel was discharged in 2014. The median discharge year of the uncanistered fuel is 1992. The lowest burnup is estimated to be 0.96 GWd/MTHM and the highest burnup is 52.9 GWd/MTHM. The median burnup is estimated to be 29.4 GWd/MTHM. There are 248 uncanistered fuel assemblies at Vermont Yankee that have burnups greater than 45 GWd/MTHM.

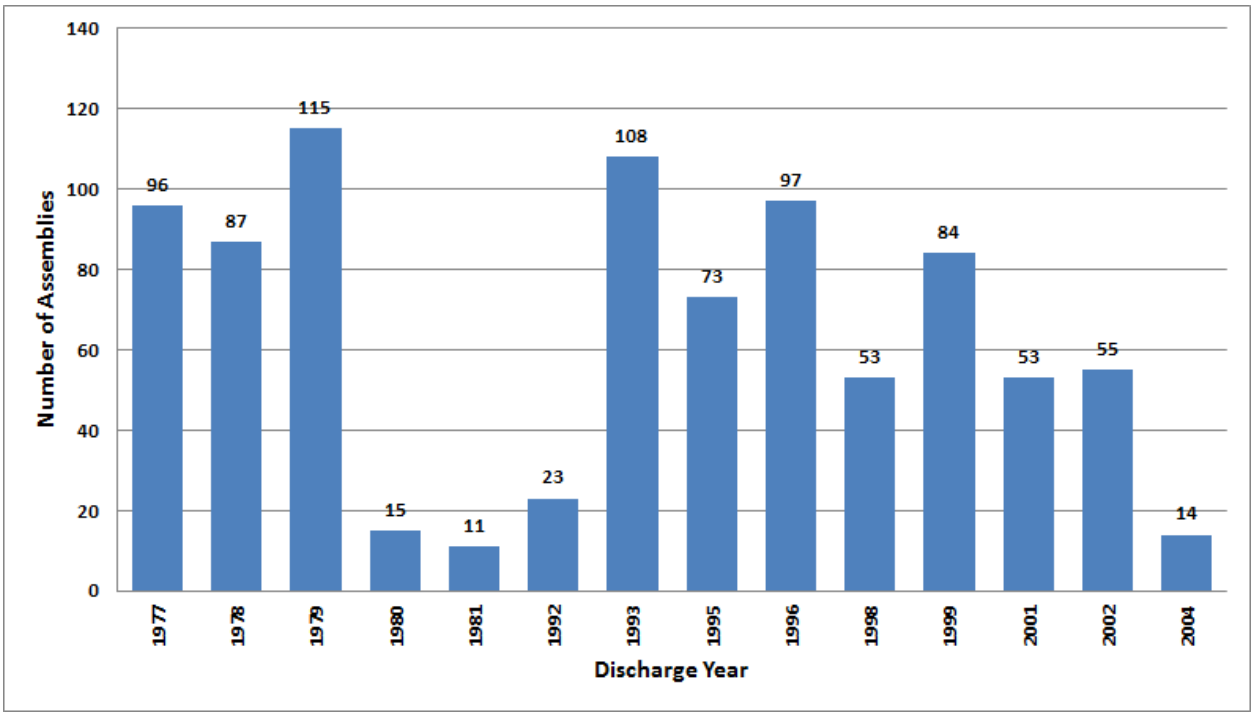


Figure 2-297. Vermont Yankee Number of Canistered Assemblies versus Discharge Year

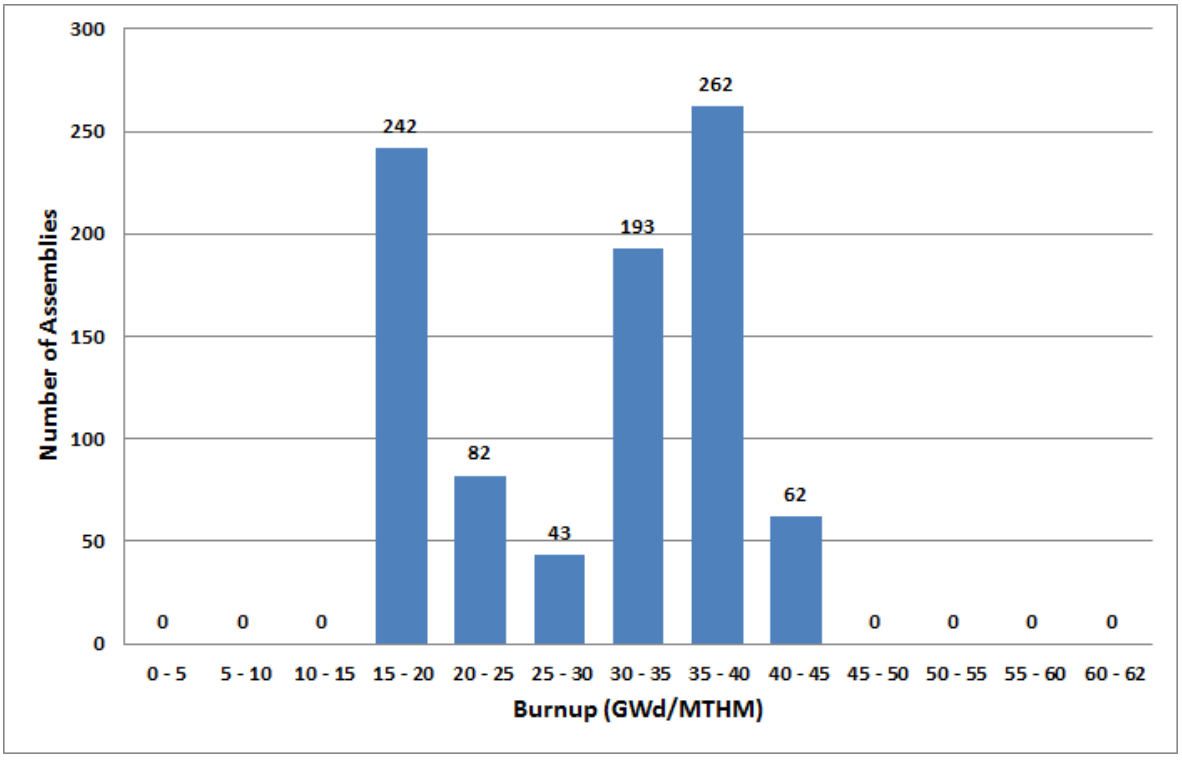


Figure 2-298. Vermont Yankee Number of Canistered Assemblies versus Burnup

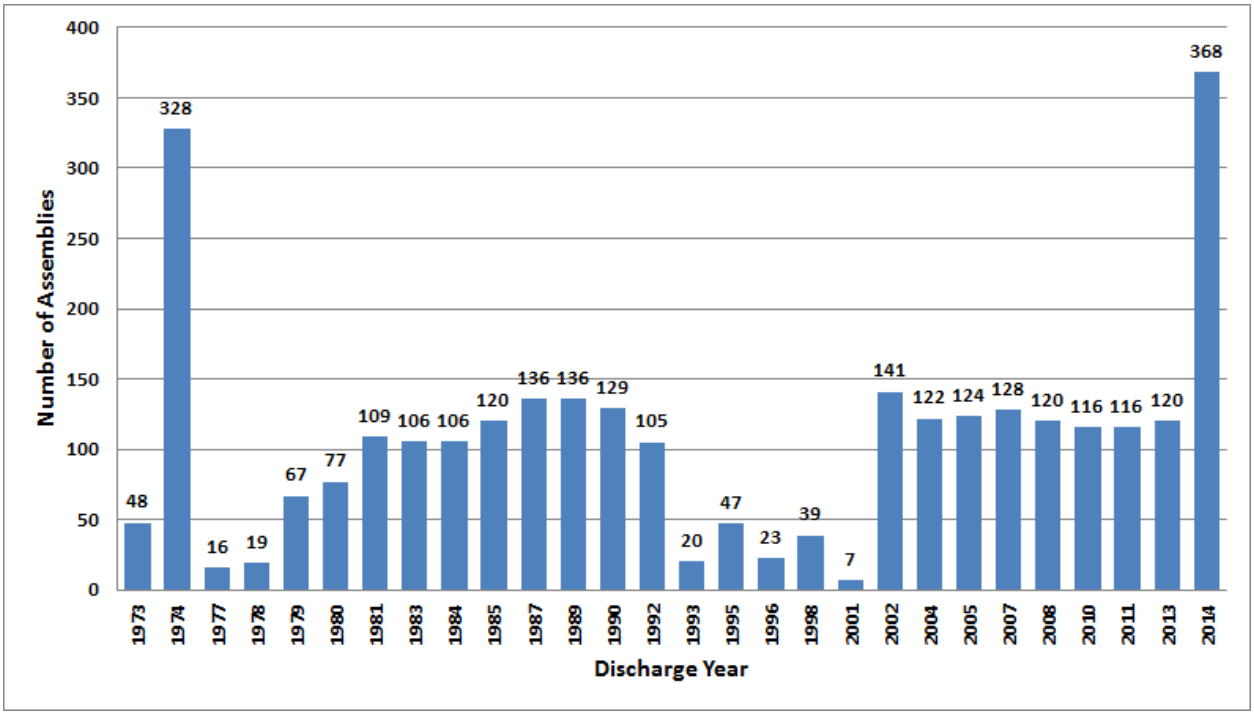


Figure 2-299. Vermont Yankee Number of Uncanistered Assemblies versus Discharge Year

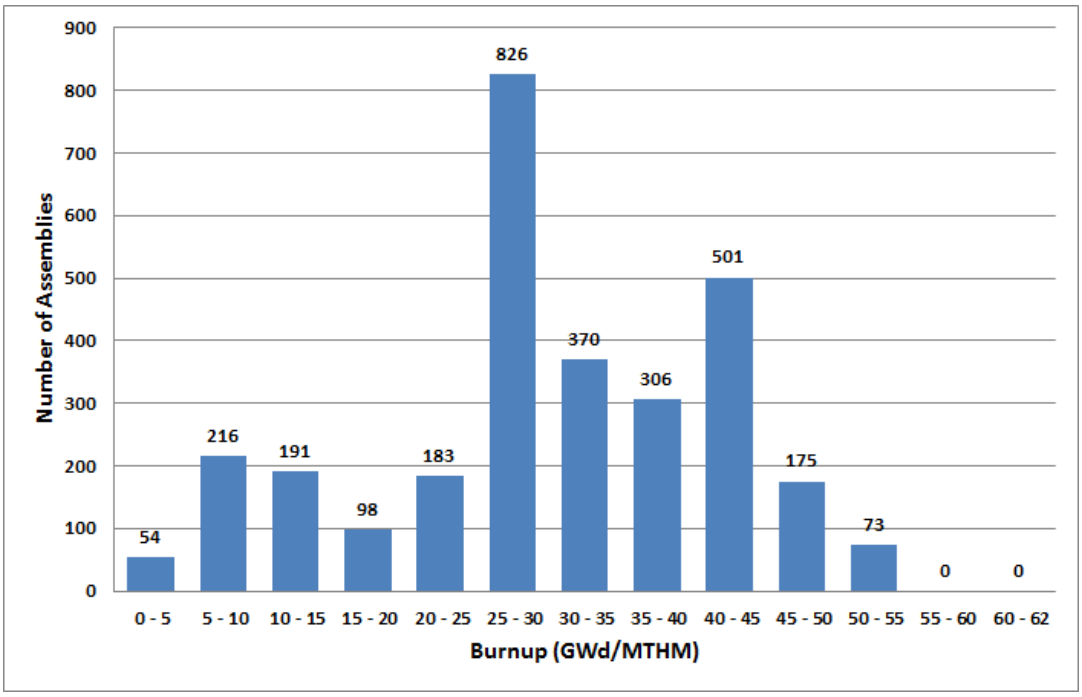


Figure 2-300. Vermont Yankee Number of Uncanistered Assemblies versus Burnup

2.13.2 Site Conditions

The Vermont Yankee site is located on the western shore of the Connecticut River, across from Hinsdale, New Hampshire, which is located on the eastern side of the Connecticut River. The site is about 5 miles southeast of Brattleboro, Vermont, and about 45 miles north of Springfield, Massachusetts. The site is located on Vernon Pond, formed by Vernon Dam and Hydroelectric Station located immediately downstream 0.75 miles from the site (NRC 2007b). Figure 2-301 provides an aerial view of the Vermont Yankee site. Figure 2-302 shows the Vernon Dam and Hydroelectric Station.

The current Vermont Yankee ISFSI (see Figure 2-303) is located at the northern end of the Vermont Yankee site (see Figure 2-304). This ISFSI pad has a capacity of 36 dry storage casks in an eight by five arrangement (the pad has four unused storage locations to allow dry storage casks to be moved if needed). A second dry storage cask pad will be built approximately 30 feet immediately to the west of the existing ISFSI pad. The second pad is being designed for storage of 25 casks in a five by five arrangement and, when combined with the existing ISFSI storage pad, a total of 58 dry fuel storage casks can be stored on the pads. In addition, the pads will allow storage of up to three casks of GTCC low-level radioactive waste (Entergy 2014). A transfer cask, the platform used to move the vertical concrete casks from the reactor building to the containment access building, and the transporter used to move the vertical concrete storage casks from the containment access building to the ISFSI are available at the Vermont Yankee site.

Rail service to the Vermont Yankee site is provided by the New England Central Railroad. However, the Vermont Yankee rail spur no longer extends into the site. In the past, the Vermont Yankee onsite rail system had two branches, one spur that ran to the containment access building and a second spur that ran to the turbine building (TOPO 1994f). The spur that ran to the containment access building has largely been removed while portions of the spur that runs to turbine building remain intact. The spur that runs to the turbine building is shown in Figure 2-305 through Figure 2-310.

To support decommissioning, the onsite rail spur that runs to the turbine building will be reactivated. The onsite portion of the rail spur (see Figure 2-311) will follow the existing rail line on the northwest side of the property and additional track will be installed to a point inside the current Protected Area (Entergy 2014).

Dams on the Connecticut River to the north and south of the Vermont Yankee site preclude barge access and consequently there is no onsite barge facility at Vermont Yankee (TOPO 1994f).

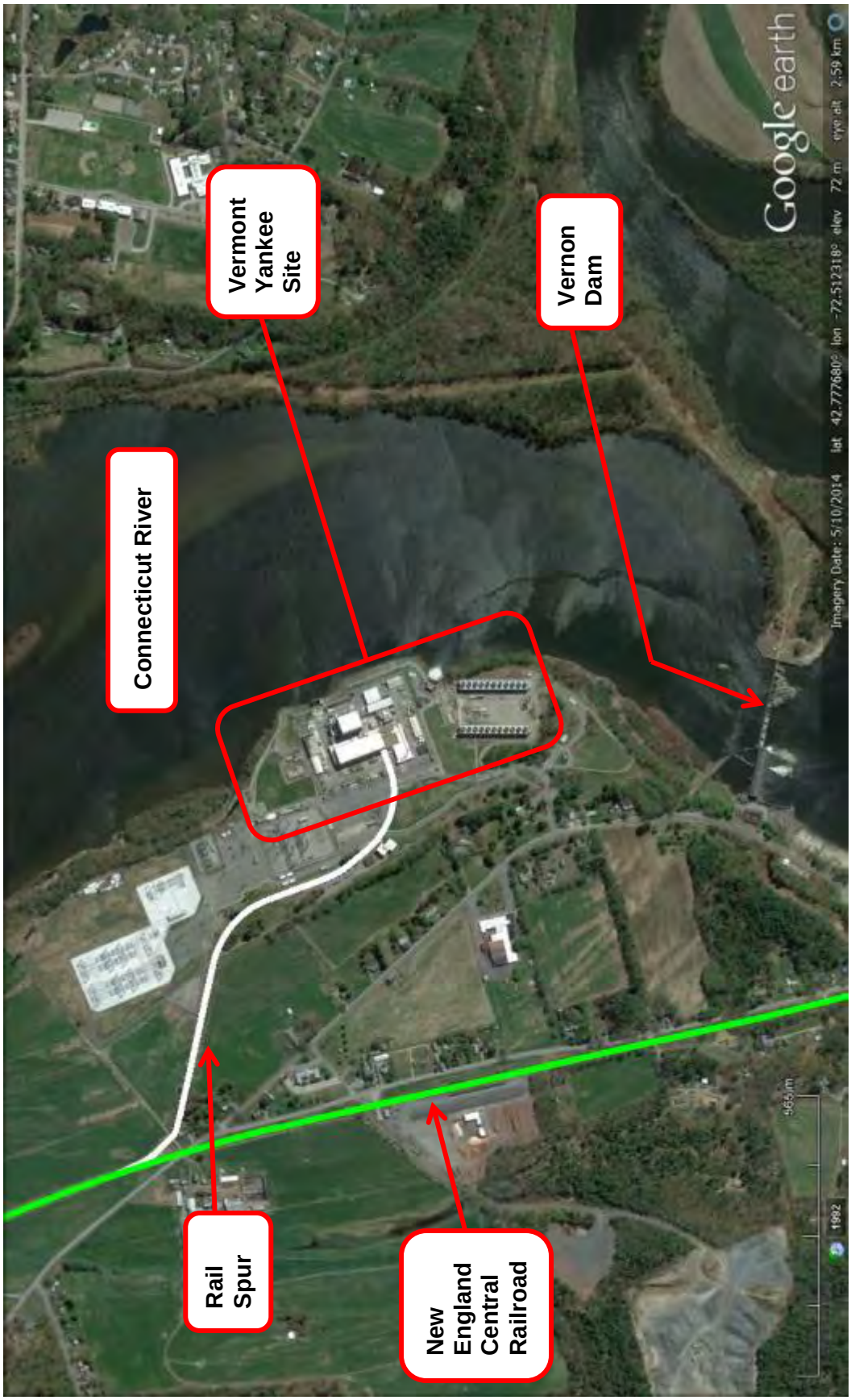


Figure 2-301. Aerial View of Vermont Yankee Site (Google 2015)



Figure 2-302. Vernon Dam and Hydroelectric Station (2016)



Photo courtesy of Vermont Yankee

Figure 2-303. Vermont Yankee Independent Spent Fuel Storage Installation (2016)

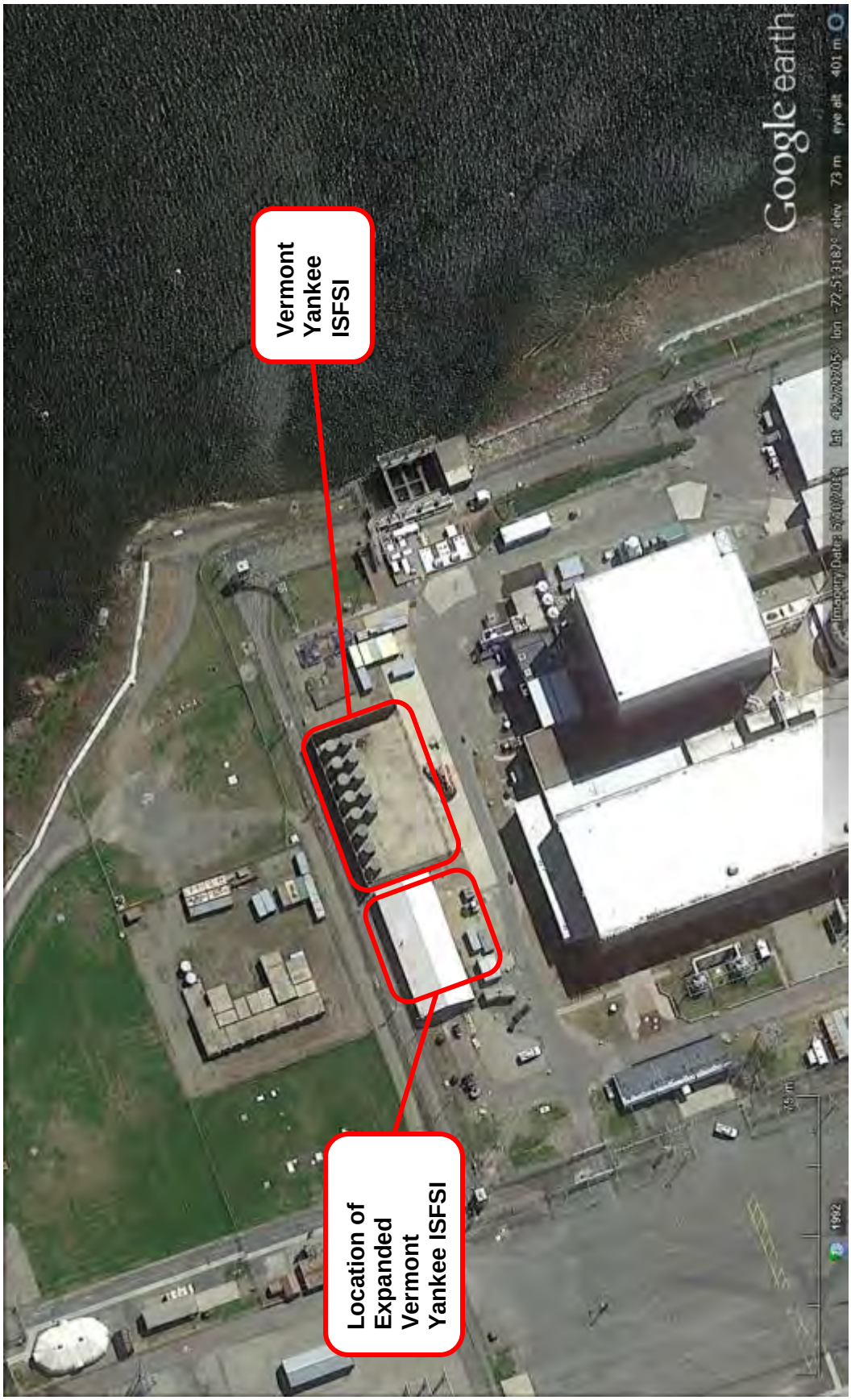


Figure 2-304. Aerial View of Vermont Yankee Independent Spent Fuel Storage Installation (Google 2015)



Photo courtesy of Vermont Yankee

Figure 2-305. Onsite Rail Spur Approaching Turbine Building (2016)



Photo courtesy of Vermont Yankee

Figure 2-306. Paved Over Portions of Onsite Rail Spur (2016)



Photo courtesy of Vermont Yankee

Figure 2-307. Onsite Rail Spur Looking North (2016)



Photo courtesy of Vermont Yankee

Figure 2-308. Onsite Rail Spur Looking South (2016)



Photo courtesy of Vermont Yankee

Figure 2-309. Onsite Rail Spur Approaching Site Exit (2016)



Photo courtesy of Federal Railroad Administration

Figure 2-310. Rail Spur at Entrance to Vermont Yankee Site (2008)

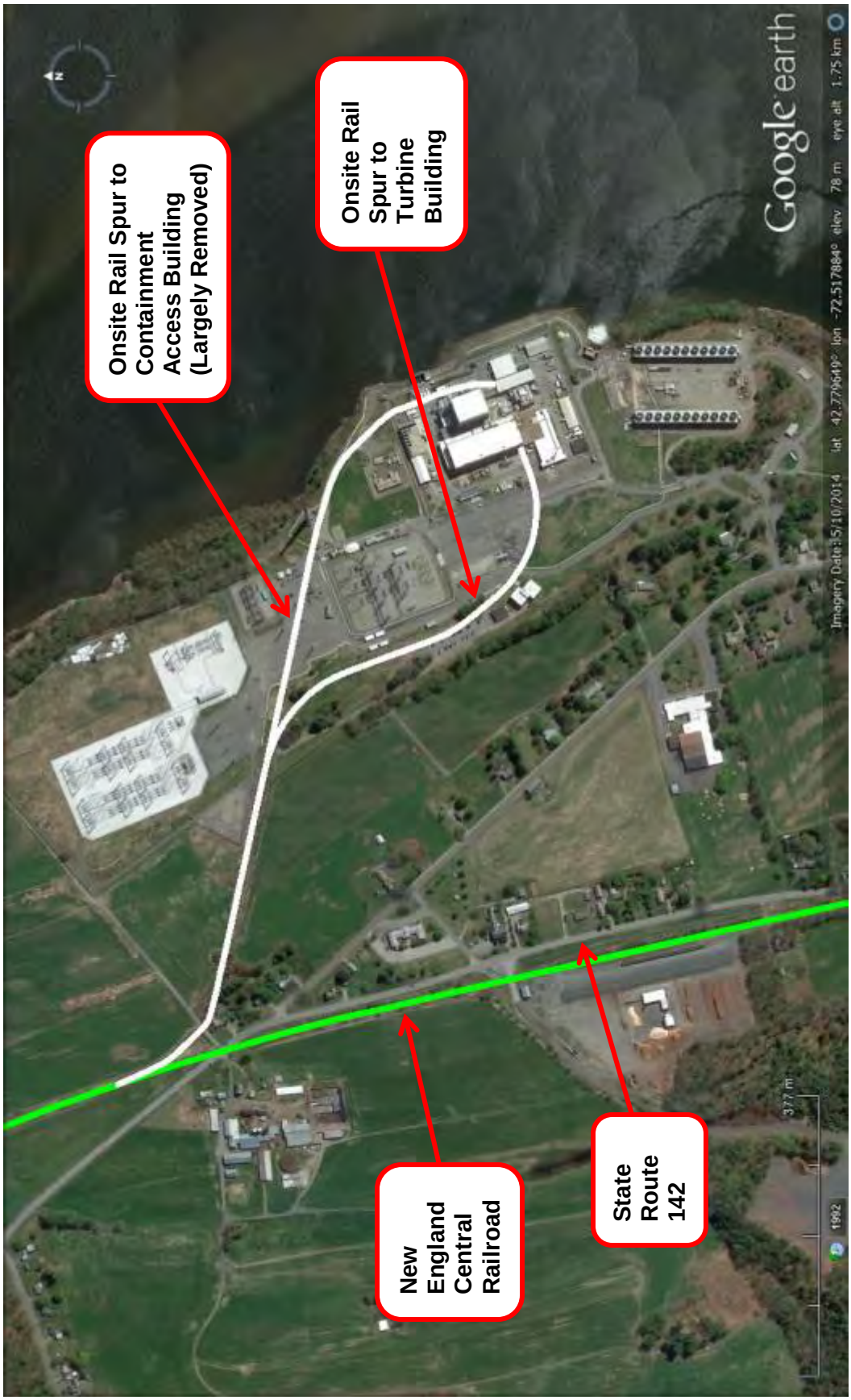


Figure 2-311. Aerial View of Onsite Rail Spur (Google 2015)

2.13.3 Near-site Transportation Infrastructure and Experience

As mentioned in Section 2.13.2, rail service to the Vermont Yankee site is provided by the New England Central Railroad. In the vicinity of the Vermont Yankee site, the New England Central Railroad is track class 3. The New England Central Railroad is a Class III railroad and operates 394 miles of track from the Canadian border at East Alburgh, Vermont to New London, Connecticut. The New England Central Railroad interchanges with the Claremont Concord Railroad, the Canadian National, the Canadian Pacific, the CSXT, the Massachusetts Central Railroad, the Norfolk Southern, the Pan Am Southern, the Providence and Worcester Railroad, and the Vermont Railway. The Pan Am Southern also operates trains via trackage rights on the New England Central Railroad between East Northfield, Massachusetts and White River Junction, Vermont. The New England Central Railroad hosts the Amtrak Vermonter passenger service from East Northfield, Massachusetts to St. Albans, Vermont, including over the tracks in the vicinity of the Vermont Yankee site.

Figure 2-312 shows the Vermont Yankee rail spur approaching the entrance to the site, Figure 2-313 shows the rail spur approaching the New England Central Railroad, Figure 2-314 shows the junction of the Vermont Yankee rail spur and the New England Central Railroad (looking south), Figure 2-315 shows the junction of the Vermont Yankee rail spur and the New England Central Railroad (looking north), Figure 2-316 shows a derailer on the Vermont Yankee rail spur, and Figure 2-317 shows a dragging equipment detector and hot bearing detector located at the junction of the Vermont Yankee rail spur and the New England Central Railroad mainline.

The two major freight railroads that the New England Central Railroad interchanges with in the vicinity of the Vermont Yankee site are the Pan Am Southern and the CSX. The New England Central Railroad interchanges with the Pan Am Southern in Brattleboro, Vermont and with the CSXT in Palmer, Massachusetts. Figure 2-318 and Figure 2-319 show the railyards in these locations. Figure 2-320 shows the junction of New England Central Railroad and Pan Am Southern Railroad in East Northfield, Massachusetts.

In 2008, DOE, the Federal Railroad Administration, and the Council of State Governments – Eastern Regional Conference conducted an assessment of the rail infrastructure at and near the Vermont Yankee site. The assessment was focused on the New England Central Railroad from the Vermont Yankee site to Palmer, Massachusetts, where the New England Central Railroad interchanges with the CSXT, a distance of about 51 miles. The assessment identified one major bridge over the Connecticut River, 13 other bridges, and 17 grade crossings.

Figure 2-321 from this assessment shows the State Route 142 railroad grade crossing at milepost 115.97, Figure 2-322 shows the grade crossing at milepost 112.68, Figure 2-323 shows the railroad bridge over the Connecticut River at milepost 109.15, and Figure 2-324 shows a smaller railroad bridge at milepost 103.33.

The Connecticut River is dammed both upstream and downstream from the Vermont Yankee site. For example, the Vernon Dam is located 0.75 mile downstream of the Vermont Yankee site at river mile 142, and the Bellows Falls Dam is located upstream of the Vermont Yankee site at

river mile 174 (NRC 2007b). TOPO (1994f) states that the nearest offsite barge terminal is located 60 miles from the Vermont Yankee site.



Figure 2-312. Rail Spur Approaching Vermont Yankee Site Entrance (2016)



Figure 2-313. Rail Spur Approaching New England Central Railroad Mainline (2016)



Figure 2-314. Junction of Vermont Yankee Rail Spur (Left) and New England Central Railroad Mainline (Right) Looking South (2016)



Figure 2-315. Junction of Vermont Yankee Rail Spur and New England Central Railroad Mainline Looking North (2016)



Figure 2-316. Derailer on Vermont Yankee Rail Spur (2016)



Figure 2-317. Dragging Equipment Detector and Hot Bearing Detector on New England Central Railroad Mainline (2016)



Figure 2-318. Brattleboro Railyard (2016)



Figure 2-319. Palmer Railyard (2016)



Figure 2-320. Junction of New England Central Railroad (Left) and Pan Am Southern Railroad (Right) in East Northfield, Massachusetts (2016)



Photo courtesy of Federal Railroad Administration

Figure 2-321. State Route 142 Grade Crossing at Milepost 115.97 (2008)



Photo courtesy of Federal Railroad Administration

Figure 2-322. Grade Crossing at Milepost 112.68 (2008)



Photo courtesy of Federal Railroad Administration

Figure 2-323. Connecticut River Railroad Bridge at Milepost 109.15 (2008)



Photo courtesy of Federal Railroad Administration

Figure 2-324. Railroad Bridge at Milepost 103.33 (2008)

2.13.4 Gaps in Information

Revision 9 of the certificate of compliance for the HI-STAR 100 transportation cask does not allow the transport of high burnup (> 45 GWd/MTHM) used nuclear fuel or GTCC low-level radioactive waste. Consequently, the certificate of compliance for the HI-STAR 100 would have to be revised before the 248 high burnup used nuclear fuel assemblies or the GTCC low-level radioactive waste from decommissioning at the Vermont Yankee site could be transported.

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3. OVERVIEW OF REQUIREMENTS FOR OFF-SITE TRANSPORTATION INFRASTRUCTURE

Off-site transportation of rail/intermodal casks containing used nuclear fuel will require that the off-site rail network, roads, or navigable waters (herein referred to as transportation infrastructure) in the vicinity of each of the shutdown sites be capable of accommodating the size and weight of the rail/intermodal casks containing used nuclear fuel and of the transport vehicles that will be used to move the casks. It will also be necessary for the operational capacities (e.g., traffic flow or re-routing capacity) of the off-site infrastructure to be capable of accommodating the movement of casks on transporters.

3.1 Railroad Requirements

Off-site railroads, either Class I (mainline railroads), II (typically regional railroads), or III (typically short line railroads) railroads, might be used to transport casks from sites that have either direct rail access (Maine Yankee, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, San Onofre, and Vermont Yankee sites) or near-site rail access with an acceptable branch line or rail siding where casks would be transferred to railcars from heavy haul trucks or barges (Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, and Kewaunee sites).

Rail infrastructure components including roadbed, track geometry and track structure to meet track class 2 Track Safety Standards, and over- and under-grade bridges, must be sufficient to ensure that these features of a railroad are capable of supporting a 6-, 8-, or 12-axle cask-railcar that conforms to AAR Standard S-2043 (AAR 2008) and has a gross loaded weight up to 500,000 lb. The railroad's infrastructure must comply with the regulatory standards of the Federal Railroad Administration and also have the capability to accommodate a train consisting of up to five cask-railcars, two or more buffer cars containing ballast, two locomotives, and an escort car.

The height and width clearances of the track alignment also must be sufficient to accommodate a loaded cask-railcar having an overall height up to 15 feet and a width up to 12 feet. Clearance along track curves must be sufficient to accommodate a railcar having a length up to 100 feet and a width of up to 12 feet. The radius of track curves (including curves in switching yards that may be used) must be sufficient to accommodate a 6-, 8-, or 12- axle railcar with a distance between the front and rear truck bolsters up to 80 feet.

For sidings or spurs where casks would be transferred from heavy haul trucks or barges to railcars, the length of rail should accommodate a minimum of one cask-railcar having a length up to 100 feet and a width up to 12 feet. The curvature of the turnout for the siding should allow for a 6-, 8-, or 12-axle cask-railcar with spacing between the front and rear truck bolsters up to 80 feet. Sidings where transloads will be conducted should include a cleared and level adjacent operations area that can support heavy vehicles and equipment and that is no less than 200 feet long and 50 feet wide. For sidings where only one- or two-cask railcars can be accommodated, there should be a nearby rail siding or rail yard where the train can be assembled.

For some sites it may be necessary to conduct intermodal operations at a nearby rail siding that has limited operating space and is close to a railroad's operating track. For such sidings it may not be possible to conduct concurrent railroad train operations on the main rail line while transloads and switching operations necessary for cask shipments are being conducted. To use such sidings, it will be necessary for the railroad to have a flexible operations schedule for, or alternative routing around, the affected track.

3.2 Highway Requirements

All 13 shutdown sites have on-site roads that connect to local roads or highways. Five of these sites (Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, and Kewaunee sites) do not have direct access to a railroad. The standards used for the design, construction, and maintenance of local roads and highways depend on several factors, including whether the road or highway is designated as an interstate highway, U.S. highway, state highway, or local road.

Interstate and U.S. Highway standards are established by the Federal Highway Administration. These standards establish the mechanical requirements for lane width, road shoulder, overhead clearance, grade, curvature, road-bed, bridges and culverts, and primary pavement materials and thickness for all roads designated as Interstates and U.S. Highways. The standards are the basis for federal weight and size limits for trucks and buses. States are authorized to issue special permits for vehicles that exceed these limits for weight and size for trucks and buses. The special permits that states issue typically consider the route to be used, normal traffic on the route, time of day and duration of use, total weight of the permitted vehicle, wheel loads, distribution of the total weight of a vehicle over multiple wheels, axle spacing, and the frequency of overweight and oversize vehicles using the permitted roadways. The permits also consider the condition of designated highways and the load capacities of the highway's bridges, overpasses, and culverts.

Standards for state highways are typically less prescriptive than standards for federal highways. Many state highways are narrower and have steeper grades and sharper curves than do federal highways and often have narrow shoulders and less overhead clearance. In addition, many state highways do not have the substantial roadbed and pavement federal highways do. State highway bridges and culverts also typically have less load capacity than do bridges and culverts for federal highways. State highway departments issue permits for overweight and oversize vehicles that use the state highways. State permitting processes for overweight and oversize vehicles that travel on state highways are generally the same as those for oversize and overweight vehicles that travel on federally designated highways.

For local roads, standards adopted by local governments consider anticipated traffic densities, truck traffic use, climate, terrain, and geology. Local roads may be wide or narrow, often have short-radius curves and sharp corners, may have substantial sub-base and pavements or may be only intended for light vehicle use, and often have low overhead clearances because of utility lines or limited overpass grade separations. Weight limits for bridges and culverts for local roads are typically less than for the same kinds of structures on state or federal highways. In addition, local roads pass through residential and local business communities often with businesses and residences being located close to the right-of-way. These local roads provide commuter,

employee, and pickup and delivery vehicles access to retail and other businesses, and provide connectors to state and federal highways.

Although the shutdown sites are generally located in rural areas, all are served by local roads that, if applicable and if practical, would be used by heavy haul vehicles. Local authorities would issue permits for overweight and/or oversize vehicles to travel on non-state, nonfederal, local roads. Such permits may be issued following consultation with local elected officials and thus may consider factors (e.g., desirability of removal of overhanging tree branches) that are in addition to technical factors concerning the proposed vehicle, load, route, and conditions of roads and road structures, and time of day for operations.

It is likely that the travel speeds of the vehicles from the shutdown site to a nearby siding or spur would be limited to an average of less than 5 miles per hour. This slow pace, based on experience, is because the local roads that would be used typically have limited capacity to accommodate oversize and overweight vehicles that would transport rail/intermodal casks from a shutdown site to a nearby rail siding or spur. Owners of sites such as Yankee Rowe and Connecticut Yankee, who have contracted for the use of heavy haul vehicles to move heavy equipment from their sites to rail sidings or spurs, report that travel times can be expected to be 8 hours or more even for distances of less than 10 miles. In addition, the heavy haul vehicle would likely block the flow of traffic on most local roads because of its size and because the roads often have two relatively narrow (10- or 12-feet) lanes and limited shoulders. Thus, one or more alternate routes must be available for use by local traffic at times when the heavy haul vehicle is on the road.

Additional requirements for roads that would be used by heavy haul trucks include the following:

- Overhead clearances must be (or be moveable or clearable to) 15 feet or greater above the roadway.
- The side-to-side width of the narrowest section of a road should be sufficient to allow passage of a 14-foot-wide vehicle.
- Curves and corners must have sufficient inside clearances to allow a 100-foot-long center section of a heavy haul vehicle to negotiate the turns without interference (the greatest requirement is for a clearance of 34 feet on the inside of a 90º corner for a 20-foot-wide road).
- Bridges, bridge supports, dam crossings, and culverts must be capable of supporting the distributed load of the heavy haul vehicle (approximately 4,000 lb. [2 tons] per lineal foot of roadway) or must have spans that are short enough to allow use of jumper bridge-deck reinforcements.
- Road sub-grade and pavement must be firm and stable and be capable of supporting the distributed load of the heavy haul vehicle (approximately 4,000 lb. [2 tons] per lineal foot of roadway over a length of 100 feet). Weak areas of roadway may be temporarily improved by use of top-ballast or jumper reinforcements.

3.3 Navigable Waterway Requirements

Off-site navigable waterways that might be used by barge operators to transport rail/intermodal casks could be accessed directly from on-site barge landings at the Maine Yankee, Trojan, and La Crosse sites; from on-site canals that connect on-site landings to a waterway at the Connecticut Yankee and Crystal River sites; or from off-site landings where rail/intermodal casks would arrive on heavy haul trucks and be off-loaded onto barges at the Humboldt Bay and Kewaunee sites. Barge landings may be docks or unimproved shorelines. Barges might be loaded at shorelines along navigable waterways. The Humboldt Bay, Big Rock Point, and San Onofre sites have unimproved shorelines that might be used to land barges.

Requirements for using navigable waterways to ship rail/intermodal casks containing used nuclear fuel include the following:

- The waterway is an inland or inter-coastal navigable waterway used by commercial maritime traffic and is maintained by the U.S. Army Corps of Engineers, port authorities, or other federal authorities (e.g., Tennessee Valley Authority).
- Docks or shoreline landings for barges must have securing stanchions or other securing points adequate for securing a barge (sea-going, lake, or river barge, depending on the route) having a minimum cargo capacity of 2,000 deadweight tons.
- Navigation from a dock or shoreline landing (where rail/intermodal casks would be on- and off-loaded to and from barges) to the navigable section of the waterway is direct and can be determined by inspection of maritime charts to be safe and clear of marine hazards.

4. ACTIONS NECESSARY TO REMOVE USED NUCLEAR FUEL FROM SHUTDOWN SITES

The Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (DOE 2013) includes siting, designing, licensing, constructing and operating a pilot interim storage facility with an initial focus on accepting used nuclear fuel from shutdown reactor sites. The strategy also includes a phased, adaptive, and consent-based approach to siting. New statutory authority would be required to construct an interim storage facility, but DOE's existing authorities would allow the DOE to begin a consent-based siting process.

The tasks that would need to be undertaken to remove used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites may be divided into two phases: 1) programmatic activities to prepare for transport operations from a shutdown site, and 2) operational activities to prepare, accept, and transport from a shutdown site. Table 4-1 provides a high-level summary of the tasks that would take place during these two phases. The tasks are described in the following sections. In the descriptions of these tasks, the terms "accept" or "acceptance" are sometimes used. In this report, these terms mean that a shipment has been properly prepared for transport. It should be noted that DOE has not made any decisions regarding the priority or preference for removing used nuclear fuel from shutdown sites.[31]

Table 4-1. Activities to Prepare for and Remove Used Nuclear Fuel from Shutdown Sites

Task	Task Activity Description
Programmatic Activities to Prepare for Transport Operations from a Shutdown Site	
1. Assemble Project Organization	Assemble management teams, identify shutdown site existing infrastructure, constraints, and transportation resource needs and develop interface procedures.
2. Acquire Casks, Railcars, Ancillary Equipment, and Transport Services	Develop specifications, solicit bids, issue contracts, and initiate preparations for shipping campaigns. Includes procurement of transportation casks and revisions to certificates of compliance as may be needed, procurement of AAR Standard S-2043 railcars, and procurement of off-site transportation services.
3. Conduct Preliminary Logistics Analysis and Planning	Determine fleet size, transport requirements, and modes of transport for shutdown site.
4. Coordinate with Stakeholders	Assess and select routes and modes of transport and support training of transportation emergency response personnel.
5. Develop Campaign Plans[a]	Develop plans, policies, and procedures for at-site operational interfaces, support operations, and in-transit security operations.
Operational Activities to Prepare, Accept, and Transport from a Shutdown Site	
6. Conduct Readiness Activities	Assemble and train at-site operations interface team and shutdown site workers. Includes readiness reviews, tabletop exercises and dry run operations.
7. Load for Off-site Transport	Load and prepare loaded casks and place on transporters for off-site transportation.
8. Accept for Off-site Transport	Accept loaded casks on transporters for off-site transportation.
9. Transport	Ship shutdown site casks.

AAR = Association of American Railroads
a. A campaign plan contains step-by-step, real-time instructions for completing a shipment from an origin site.

[31] The Secretary of Energy has discretion under the Standard Contract to decide whether to give priority acceptance to used nuclear fuel at shutdown sites [10 CFR 961.11, Article VI.B.1.(b)].

It should be noted that the tasks listed in Table 4-1 are based on the assumption that DOE or another management and disposal organization would be responsible for shipping to, and the operation of, the pilot interim storage facility. These tasks might differ if a private entity were responsible for shipping to, or the operation of, the pilot interim storage facility. In addition, it is assumed that any refurbishment or upgrade of on-site infrastructure required prior to receipt of equipment for loading and transportation will be performed by the shutdown site organization to facilitate timely shipping of used nuclear fuel and GTCC low-level radioactive waste from the site.

4.1 Programmatic Activities to Prepare for Transport Operations from a Shutdown Site

Activities that would need to be taken to prepare for transport operations at each of the shutdown sites and to ship the fuel to an off-site destination can be rolled up to the first five major groups of activities listed in Table 4-1.

4.1.1 Task 1 – Assemble Project Organization

For the initial project organization, it would be necessary to assemble the personnel and supporting resources to begin planning, collecting information, conducting analyses, developing interface procedures, and undertaking other preparations to remove used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites. These activities would establish organizations, policies, plans, and procedures necessary for the project to begin the work necessary to acquire and qualify the physical and personnel resources that would be needed to make the shipments of used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites.

Among the key activities would be to develop and implement the quality assurance plan for

- acquisitions of transportation casks and safety-related components
- selection and training of management and operations personnel
- used nuclear fuel transportation interface operations
- transportation cask maintenance and support operations.

At a minimum, the quality assurance plan would meet the requirements of 10 CFR Part 71, Subpart H.

Another key activity would be to establish interface procedures for each of the shutdown sites. Areas addressed in these interface procedures could include

- description of the transportation casks, associated equipment, and transportation vehicles/conveyances that would be delivered to the shutdown site
- delivery of transportation casks and associated ancillary equipment to the shutdown site
- description of the assistance available to train and advise site personnel regarding the operation and use of transportation casks and ancillary equipment at the shutdown site

- descriptions of the used nuclear fuel and GTCC low-level radioactive waste that would be loaded into the transportation casks at the shutdown site
- descriptions of the canisters that contain the used nuclear fuel and GTCC low-level radioactive waste that, with their contents, would be loaded into transportation casks by the shutdown site operations organization.

During this stage, it is assumed that any necessary site work and equipment acquisitions would occur in a timely manner to support transportation operations. In general, it would be necessary for DOE or another management and disposal organization to determine its transportation resource needs and assemble the organizational elements needed to be capable of transporting used nuclear fuel from each shutdown site and to conduct efficient campaigns of shipments from the sites. To ensure effective coordination of planning, preparatory, and operational activities for shipping used nuclear fuel from the shutdown sites, the resulting organization would establish communications and working interfaces with the organizations responsible for each of the shutdown sites.

4.1.2 Task 2 – Acquire Casks, Railcars, Ancillary Equipment, and Transport Services

It would be necessary to acquire a fleet of transportation casks, ancillary equipment and railcars to conduct the shipping campaigns from the shutdown sites. In the acquisition of transportation casks from cask vendors, transportation certificates of compliance would be updated, as is necessary, to accommodate all used nuclear fuel to be shipped from the shutdown sites (including damaged fuel assemblies in fuel control dry shielded canisters in storage at the Rancho Seco site) and GTCC low-level radioactive waste that is stored in canisters at the shutdown sites.

Technical specifications would need to be developed for each kind of transportation cask and for major separable components (e.g., impact limiters) as well as the cask's associated ancillary equipment and consumables. There would be a minimum of nine procurement specifications for the nine kinds of transportation casks, components, ancillary equipment, and consumables that would need to be procured.

In addition, specifications would be developed for railcars that would be needed to transport the transportation casks. Three kinds of railcars would need to be procured: railcars for transportation casks, buffer cars, and escort cars. Based on previous transportation planning conducted for used nuclear fuel shipments (DOE 2009), all three types of railcars would be specially designed cars that would need to be tested to verify their conformance to AAR Standard S-2043 (AAR 2008); however, it may be possible to use empty cask cars as buffer cars, reducing the types of railcars that would need to be procured. Testing services would need to be procured for the railcars.

Because the transportation casks that would be used to transport used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites would be similar in size and weight, it is possible that only one design for a cask railcar would be needed. It may also be possible to use, with only minor modifications, the design and specification developed and qualified by the

U.S. Navy for railcars it is procuring for the shipment of M-290 transportation casks for naval used nuclear fuel. In addition, it may be possible to adopt the design and specification being developed by the U.S. Navy for escort railcars. A buffer railcar design may be jointly developed with the Navy.

To obtain AAR's full approval that the three types of railcars perform in accordance with the provisions of the AAR Standard, it would be necessary to conduct tests which demonstrate that all car types in the consist comply with the requirements of AAR Standard S-2043; 100,000 miles of in-service use is also required.

Last, it would be necessary to procure transportation services for the off-site transportation of casks that contain used nuclear fuel and GTCC low-level radioactive waste and for unloaded casks that would be returned to shutdown sites for loading. These services will include long-haul transport services provided by Class I (Mainline), Class II (Regional), and Class III (Short Line) railroads as well as services provided by operators of heavy haul trucks, barge and port operators, and heavy lift equipment operators for transloading operations. The services of private security companies for physical security services in all stages of transit from departure from the shutdown sites to delivery to a destination site may also be procured. In-transit security personnel may also be accompanied by health physics support personnel if it is determined that this is required.

4.1.3 Task 3 – Conduct Preliminary Logistics Analysis and Planning

In this task, the information needed to estimate the amount of time that would be required to load and ship casks containing used nuclear fuel and GTCC low-level radioactive waste from each of the shutdown sites would be collected. It would also be necessary to estimate the time that would be required at the destination facility to receive, unload, inspect, and maintain, and return casks for their next shipments.

The time required for loading and preparing a cask for transportation is expected to be unique for each of the shutdown sites. The differences would arise because of differences in the resources that the sites may deploy and differences in the transportation casks that would be used. Examples of such differences include the number of transfer casks that could be used to transfer canisters from storage modules to transportation casks that are available at a site, and whether it would be necessary to move the loaded transportation casks from the loading station to the transport vehicle, e.g., on-site transfer onto a barge such as may occur at the Connecticut Yankee site versus directly onto a railcar, which would be expected to occur at the Maine Yankee, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, San Onofre, and Vermont Yankee sites. In addition, at the Humboldt Bay site the canisters that contain used nuclear fuel and GTCC low-level radioactive waste are stored in HI-STAR HB transportable overpacks, thereby making transfers from storage modules to transportation casks unnecessary. It would still be necessary to conduct inspections and tests to verify that the HI-STAR HB casks comply with the requirements of their certificates of compliance before shipments can be made. In addition, it would be necessary to install impact limiters on the HI-STAR HB casks, place the casks onto transport skids, and load the assembled transport packages onto a transport vehicle at the site.

The amount of time that would be required to transport loaded and unloaded casks from and to the shutdown sites, and to and from a destination site would also vary among the shutdown sites. Some of the differences would be because the travel distances to a destination site from the shutdown sites would be different. Other differences among the shutdown sites could have a greater influence on time in transit for shipments than the distance from the destination site. For example, if it is necessary to use heavy haul trucks to transport HI-STAR HB casks 160 to 280 miles from the Humboldt Bay site to a nearby rail siding or spur and then transfer the casks to railcars to complete the transport to a destination site, the time in transit would be significantly different than that for shipments from the Trojan or Rancho Seco sites in the western states region of the United States. The Trojan and Rancho Seco sites have direct access to a railroad and thus would be able to load casks onto railcars at the sites.

Conversely, shipments from the Humboldt Bay site would be one-way movements with no return of the transportation casks to the site for reloading whereas shipments of transportation casks from all twelve of the remaining sites would require returns of unloaded transportation casks for reloading. At the Connecticut Yankee, Yankee Rowe, Big Rock Point, and Kewaunee sites outbound loaded shipments would involve heavy haul truck or barge shipments to nearby rail sidings or spurs and transfers of casks from the heavy haul trucks, or possibly from barges, to railcars. Returning shipments of unloaded casks would require the reverse of the sequence for the outbound shipments. Barges could also be used to ship transportation casks to nearby rail sidings or spurs or ports from the Maine Yankee, La Crosse, Trojan, and Crystal River sites.

The above factors that would affect the time required to make shipments would also affect the transportation resource requirements and the resource requirements at the shutdown sites. The factors would also affect the durations of activities to remove used nuclear fuel and GTCC low-level radioactive waste from each of the sites and collectively from all of the shutdown sites. These factors along with the funding resources would be analyzed to assess the efficacy of alternative orders for shipments to be made from the shutdown sites and the numbers of each type of transportation cask (and components) and the number of cask cars, buffer cars, and escort cars to procure for each alternative set of assumptions. This information would be used to inform managers to support decisions regarding modes of transport, acquisition decisions, staffing decisions, and allocations of resources.

4.1.4 Task 4 – Coordinate with Stakeholders

Coordination with stakeholders on transport modes, routes, and training and preparedness of emergency response personnel would be an essential activity. It would build on similar coordination efforts currently supported by the DOE through the National Transportation Stakeholders Forum and through cooperative agreements with the four state regional groups (the Southern States Energy Board, the Western Interstate Energy Board, the Council of State Governments – Midwest , and the Council of State Governments – Eastern Regional Conference) and the National Conference of State Legislatures, which supports tribal engagement with DOE.

A key activity would be to develop and implement policy and procedures to provide technical and funding assistance to states and tribes that would be affected by the transport of used nuclear fuel through and near to their jurisdictions. In addition to developing and implementing procedures for technical and funding support to states and tribes for safe routine transportation

and emergency response for transportation accidents, it is expected that the transportation operations organization would work with the affected states and tribes to determine the modes of transportation that could be used to move used nuclear fuel from the shutdown sites as well as the routes that would be used. This is expected to be a collaborative effort in which the transportation operations organization, transportation carriers, and the states and tribes would identify and weigh factors that would influence the selections to be made. Identification of the modes and routes to be used for the shipments, as well as procedures to be implemented to ensure and provide confidence that the shipments would be made safely, would be the objective of this activity.

4.1.5 Task 5 – Develop Campaign Plans

As activities progress to procure resources needed to conduct shipping campaigns from the shutdown sites, it would be necessary to plan for and assemble staff who would conduct shipment operations. This planning effort would include determining the structure and organization of the work to be performed to conduct shipment operations, acquiring and training the staff who would conduct operations, developing operational procedures, and establishing the necessary supporting organizational infrastructure.

The major elements of the work structure for the transport operations activities would include transportation fleet management, shipping campaign management, and in-transit operations management. Sub-elements within these three management elements would include:

- transportation cask, ancillary equipment, and railcar maintenance and servicing
- campaign kit assembly and distribution[32]
- scheduling and expediting of shipping campaigns including shipments (loaded and unloaded casks), equipment, field personnel, and in-transit security and safety escort personnel
- coordination of shipment notifications, in-transit tracking, in-transit physical security, and emergency response operations
- field services including technical support as required.

In addition to training that would be conducted to prepare for operations, activities for the operations staff before the transport operations begin would include:

- developing operations procedures
- establishing operational interfaces with the operations organizations at each of the shutdown sites
- establishing operational interfaces with officials of state, tribal, and local governments whose jurisdictions would be affected by transportation of used nuclear fuel from the shutdown sites
- establishing operational interfaces with transportation carriers and providers of special transportation services that may be needed

[32] Campaign kits are collections of special tools and equipment that would be needed at shipping sites to load and prepare casks for transport and at transload locations where casks would be transferred to and from railcars from and to another mode of transportation.

- establishing operational interfaces with the operator of the destination facility.

Establishing organizations (or elements matrixed from other organizations) that would support shipment operations activities would also be necessary. The support organizations would include: quality assurance, licensing and regulatory compliance (to ensure that certificates of compliance are current and encompass the used nuclear fuel that would be shipped), training, procurement, public information, and field engineering. Each of these supporting organizational elements would need to acquire its own staff and resources and develop its own policies, plans, and procedures that would be tailored to meet their unique needs.

4.2 Operational Activities to Prepare, Accept, and Transport from a Shutdown Site

The activities to prepare, accept, and transport used nuclear fuel from each of the shutdown sites are rolled up into the four major groups of activities listed in the second half of Table 4-1. These are expected to include tabletop exercises that would support training for shipments and dry run activities at shipping sites and at transload locations. These readiness activities would be followed by loading of casks at the shutdown sites, acceptance of the casks loaded and prepared for transport, shipment of the casks to the destination facility, inspection and maintenance of casks following shipment, and return of unloaded casks to shipping sites.

4.2.1 Task 6 – Conduct Readiness Activities

Tabletop exercises would involve the transportation operations organization and the shutdown site operations organization along with participation by state, tribal, and local officials. It is also anticipated that in-transit tabletop exercises would involve participation by transportation planning and operations organizations and officials from affected states, tribes, and local governments. The tabletop exercises would be in-office drills designed to identify gaps in planning, procedures, and training for the full sequence of operations that would be involved in making shipments of used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites to a destination facility. These exercises would be developed jointly by the operations, training, and quality assurance organizations.

Following the tabletop exercises, the transportation and shutdown site operations organizations would conduct dry run operations to establish the operational basis for determining readiness to make shipments. The dry run operations would not involve removal of canisters containing used nuclear fuel from storage systems but would otherwise involve the full sequence of operational steps. These steps would include handling, loading, and preparation of casks for shipment; loading of the casks onto transport vehicles; and transloading of casks from heavy haul trucks or barges to railcars and the reverse operation.

Readiness reviews would be conducted jointly by the transportation operations organization, the shutdown site operations organization, and transportation service operators to review the results of tabletop and dry run activities and to verify that open issues identified in these exercises have been appropriately resolved. Readiness reviews would also be conducted with state, tribal, and local officials to ensure that there are no outstanding issues that would need to be addressed to

ensure effectiveness of emergency response and in-transit security operations that the transited jurisdictions may provide.

4.2.2 Task 7 – Load for Off-site Transport

Shutdown site operations organizations would remove the transportable dry storage canisters containing used nuclear fuel or GTCC low-level radioactive waste from on-site storage systems, load the canisters into transportation casks, prepare the loaded casks for shipment, and load the prepared casks onto transport vehicles.[33] Unloaded casks would be delivered to each of the shutdown sites either on railcars, heavy haul trucks, or barges. Following delivery of unloaded casks, it is assumed that each shutdown site operations organization

- receives casks at its site, prepares the casks to be loaded and verifies the casks are suitable for loading with canisters that contain the site's used nuclear fuel
- is registered with the NRC as a user of the transportation cask that would be loaded at the site
- uses equipment designed by the vendor of the storage system and transportation cask and follows on-site procedures to transfer canisters containing used nuclear fuel or GTCC low-level radioactive waste from its on-site storage system into the transportation cask body
- prepares the transportation cask for shipment including assembly of all components and conduct of tests to verify proper assembly for shipment specified by the cask's certificate of compliance
- places the transportation cask on a shipping skid/cradle, load the cask-on-cradle unit onto the transport vehicle, and provides the documentation required to verify that the shipment has been properly packaged for off-site transportation
- takes an average of up to one calendar week to complete the sequence of operations from receipt of an unloaded cask through to delivery of the cask for off-site transportation.

Used nuclear fuel at the Humboldt Bay site is stored in storage/transport canisters in HI-STAR HB cask bodies. The HI-STAR HB cask, when impact limiters are attached, is certified by NRC to transport the used nuclear fuel from the Humboldt Bay site. Thus, the site's operator would not have to transfer canisters from a storage system to a transportation cask. Nonetheless, the shutdown site operations organization would be required to remove the already-loaded HI-STAR HB casks from their sub-grade storage locations, complete assembly of the casks for transport including installing impact limiters, conduct pre-shipment tests that are specified in the cask's certificate of compliance, load the casks onto transport vehicles, and provide the documentation required to verify that the shipment of used nuclear fuel has been properly packaged for off-site transportation.

4.2.3 Task 8 – Accept for Off-site Transportation

At each of the shutdown sites and for each cask shipped from the sites, the transportation operations organization would accept loaded casks that have been prepared for shipment and

[33] Under the Standard Contract (10 CFR 961.11), DOE is obligated to accept only bare used nuclear fuel. Acceptance of canistered used nuclear fuel would require an amendment to the Standard Contract.

placed onto transport vehicles. The transportation operations organization would also take possession of and title to the used nuclear fuel or GTCC low-level radioactive waste that is contained in the casks at the same time it accepts the loaded cask for shipment.[34] For each such shipment, preparation would be made in advance to ensure that the contents of the shipment are verified and that the requirements of the transportation certificate of compliance have been met. The transportation operations organization field operations staff would inspect documentation for each shipment that has been prepared and provided by the owner of the shutdown site and, as appropriate, conduct physical inspections of the loaded transportation cask on its transport vehicle.

4.2.4 Task 9 – Transport

The complexity of off-site transportation of casks containing used nuclear fuel or GTCC low-level radioactive waste from the shutdown sites would vary among the sites. Shipment operations from sites that would require use of heavy haul trucks or barges to move casks to nearby rail sidings or spurs would be significantly more complex than those from sites where the casks could be directly loaded onto railcars for off-site shipment. In addition, sites where there is a practical limit of one or two casks that can be placed on railcars for shipment in a single train would require a greater application of resources than would be the case for sites that have on-site rail spurs that can accommodate many railcars and connect to a railroad that can accommodate trains hauling five or more of the heavily loaded cask cars.

Shipment operations would involve advance scheduling and notification of state and tribal governments; coordination among the transportation physical security force and state, tribal, and local security officials; coordination between transportation companies and the transportation operations organization for shipments that involve intermodal operations; and cross-country coordination among the rail carriers and the transportation operations organization to ensure that shipment schedules are known and maintained. The transportation operations organization would use satellite tracking to monitor the progress of each shipment containing used nuclear fuel or GTCC low-level radioactive waste en route. The transportation operations organization may also use satellite tracking along with expediting services to expedite return shipments of unloaded casks to shutdown sites.

In-transit operations for shipments of used nuclear fuel and GTCC low-level radioactive waste would principally involve real-time tracking of shipment locations and deployment of physical security personnel, and possibly radiological safety technicians, who would observe shipments from the escort railcars that would be included in each used nuclear fuel rail shipment.

The transportation operations organization would maintain an emergency operations center that would maintain readiness to direct resources to respond to any in-transportation event that may occur during shipment of used nuclear fuel or GTCC low-level radioactive waste from the shutdown sites. The emergency operations center would coordinate U.S. Government response efforts with those of state, tribal, and local officials in a jurisdiction that may be involved.

[34] Before such acceptance, the shutdown site operations organization would need to have an amendment to the Standard Contract permitting it to present canistered rather than bare used nuclear fuel for acceptance for transportation and an interim storage facility would have to be operational.

A typical shipment of loaded casks containing used nuclear fuel or GTCC low-level radioactive waste would require 1 to 2 weeks of transit time to complete. Shipments over distances of 500 to 1,000 miles and where railcars are loaded at shipping sites would generally be completed in about 1 week. Shipments over distances that exceed 1,000 miles and that require use of intermodal transportation would generally require about 2 weeks. Based on the experience of the U.S. Navy, shipments of unloaded casks returning to a site for reloading, if not expedited, can require up to a month.

4.3 Results

In this section, representative time sequences of activities listed in Table 4-1 and their durations were developed for scenarios involving removing used nuclear fuel from one shutdown site and for removing used nuclear fuel and GTCC low-level radioactive waste from the Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion sites.[35]

4.3.1 Removal of Used Nuclear Fuel from One Shutdown Site

In this section, representative time sequences of activities listed in Table 4-1 and their durations were first developed for four scenarios involving a single site that was assumed to be served by a railroad. For the purposes of this analysis, Maine Yankee was assumed to be representative, where 60 canisters of used nuclear fuel and 4 canisters of GTCC low-level radioactive waste are stored. The Maine Yankee site was used in constructing this scenario only for the purposes of analysis. DOE has not made any decisions regarding the priority or preference for removing used nuclear fuel from shutdown sites.

The four scenarios are described as follows:

In the first scenario used nuclear fuel was removed from one shutdown site. The time sequence presented in this scenario provides an initial estimate of the duration for key activities and the total duration for removing used nuclear fuel and GTCC low-level radioactive waste from a single site that is served by a railroad. For the purposes of the scenario, the analysis assumed that DOE would procure five transportation casks that would be dedicated to shipping used nuclear fuel and GTCC low-level radioactive waste from the site. The time durations used for the scenario were based on conservative estimates of the time durations for tasks. Figure 4-1 illustrates the time sequence of activities and their estimated durations for this scenario.

The second scenario was similar to the first scenario, but optimistic estimates of the time durations for tasks were used. Figure 4-2 illustrates the time sequence of activities and their estimated durations for this scenario.

The third scenario that assumed that DOE would procure 10 casks that would be dedicated to shipping used nuclear fuel and GTCC low-level radioactive waste from the site, and that would be operated in two, five-cask trains. The time durations used for the scenario were based on

[35] These representative time sequences are to be used for planning purposes only and shall not be construed as binding in any way on DOE.

conservative estimates of the time durations for tasks. The fourth scenario was similar to the third scenario, but optimistic estimates of the time durations for tasks were used.

Figure 4-3 presents the total time durations for the four scenarios for comparison. The estimated time from the start of the project to the completion of the last shipment of used nuclear fuel and GTCC low-level radioactive waste from this single site was shown to range from 6.2 years to 11.2 years. The estimated durations were most affected by the time required to procure casks, components, and campaign kits, and the time required to develop and procure railcars that meet AAR Standard S-2043 (AAR 2008). For procuring casks, components, and campaign kits, the estimated time durations ranged from 36 to 48 months. For procuring railcars that meet AAR Standard S-2043, the estimated time durations ranged from 36 to 66 months.

As illustrated in Figure 4-1 and Figure 4-2 the tasks to procure casks and railcars were assumed to take place in parallel. The Humboldt Bay site does not require the procurement of casks, although procurement of impact limiters and S-2043 compliant railcars would be required. Because the amount of time required to obtain AAR approved railcars would be independent of the site from which shipments were made, and because obtaining AAR-approved railcars is a critical path activity, the total time required for a project to remove used nuclear fuel and GTCC low-level radioactive waste from the Humboldt Bay site would not be significantly shorter than that for the single site example and would range from about 5 to 6 years.

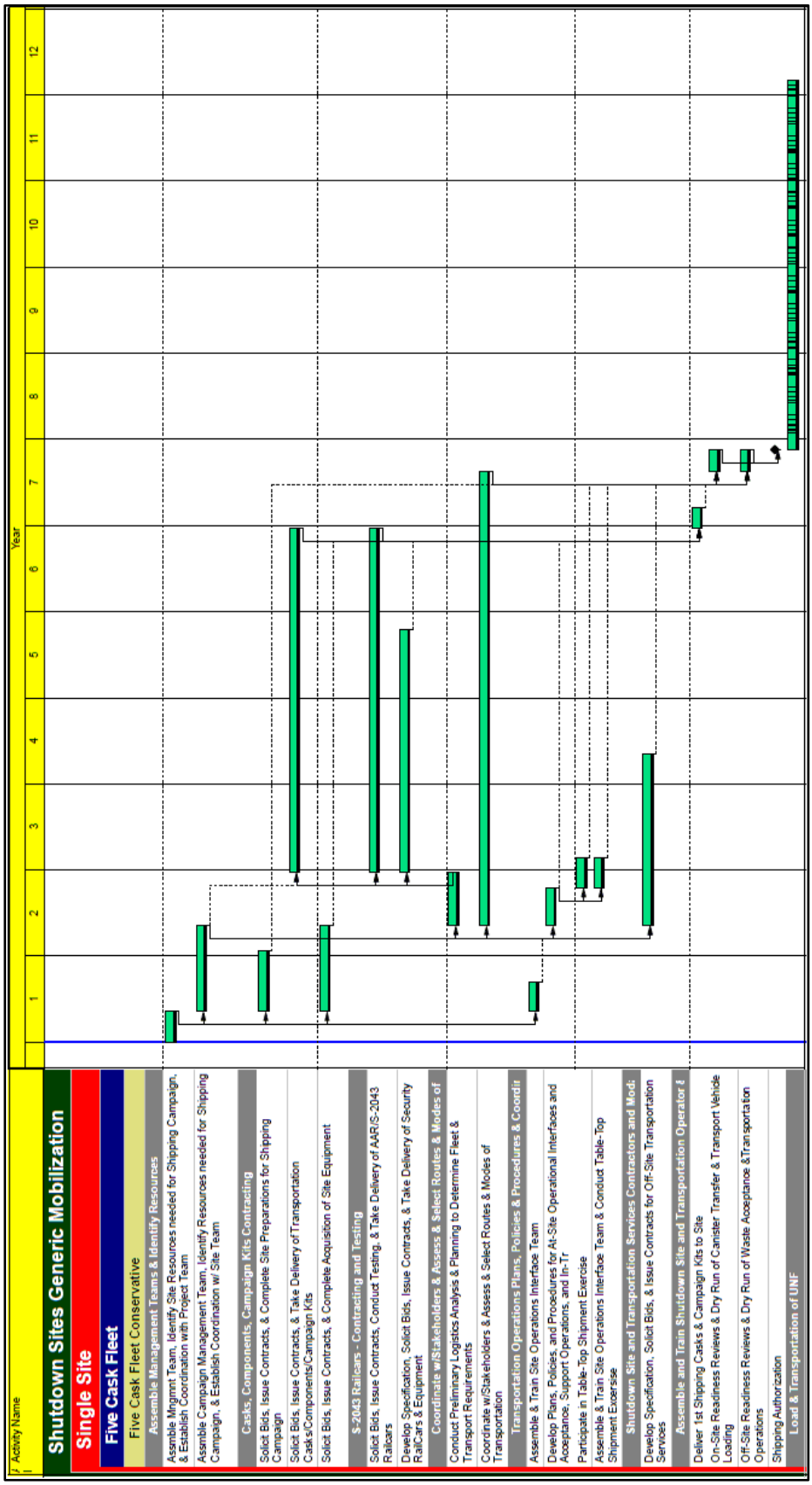


Figure 4-1. Time Sequences of Activities and Estimated Durations to Prepare for and Remove Used Nuclear Fuel from a Single Shutdown Site Based on Five Casks and Conservative Task Durations

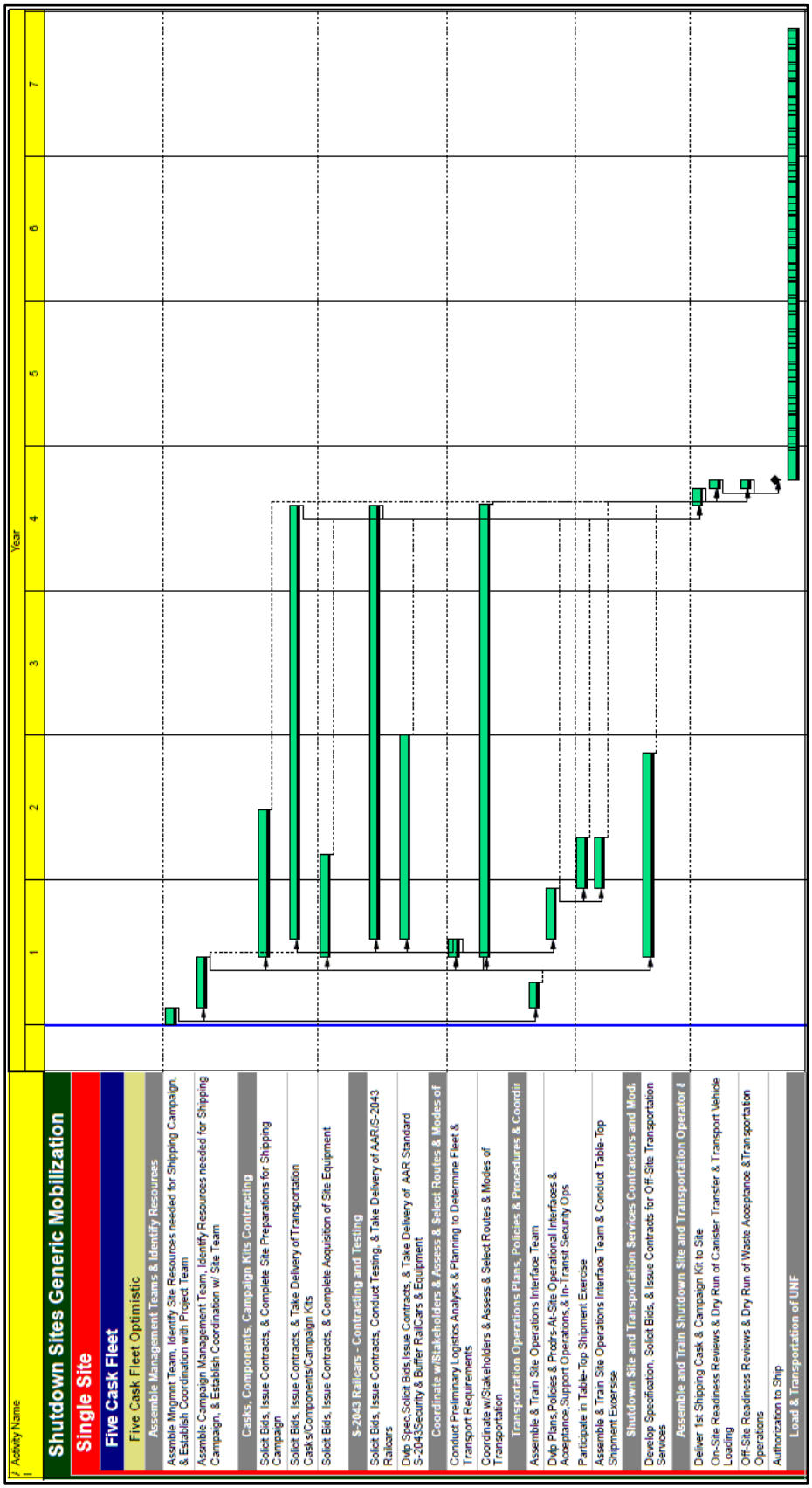


Figure 4-2. Time Sequences of Activities and Estimated Durations to Prepare for and Remove Used Nuclear Fuel from a Single Shutdown Site Based on Five Casks and Optimistic Task Durations

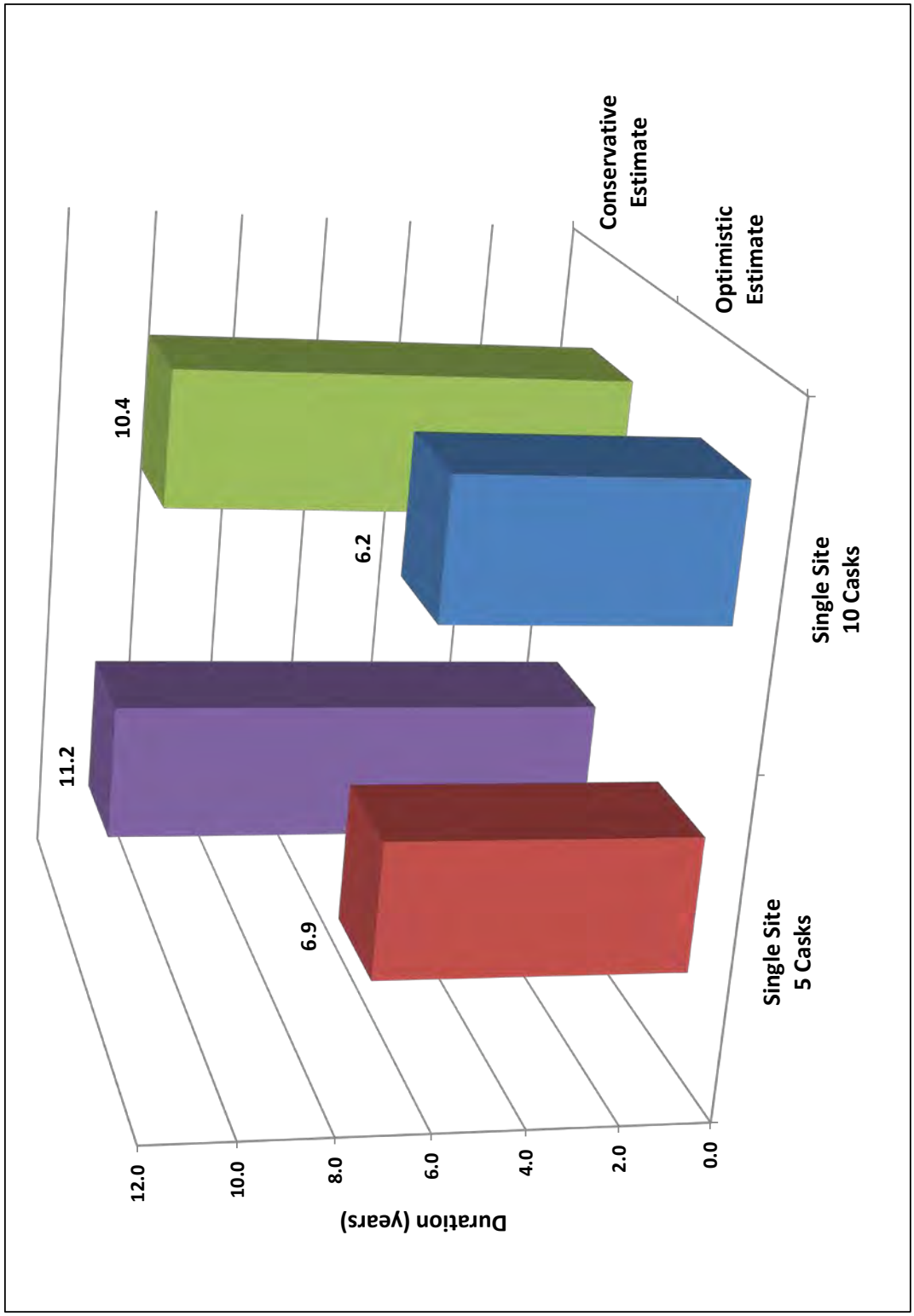


Figure 4-3. Estimated Time Durations for Four Scenarios to Prepare for and Remove Used Nuclear Fuel from a Single Shutdown Site

4.3.2 Removal of Used Nuclear Fuel and GTCC Low-Level Radioactive Waste from Nine Shutdown Sites

Figure 4-4 shows the representative durations and sequence of activities to prepare for and remove all used nuclear fuel and GTCC low-level radioactive waste from the Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion sites. The cumulative duration of 11.5 to 14.5 years shown in Figure 4-4 for the project to prepare for and remove all used nuclear fuel and GTCC low-level radioactive waste from the sites includes the schedule uncertainty associated with procurement of casks (4.5 to 5.5 years) and railcars (4 to 5 years) and coordination of shipping campaigns (7 to 10 years). The representative durations and sequence of activities shown in Figure 4-4 do not include Crystal River, Kewaunee, San Onofre, and Vermont Yankee because these sites only recently shut down and are at the beginning stages of the decommissioning process.

Project activities that would precede shipments from all shutdown sites would require only a slightly greater amount of time than that which would be required for one shutdown site. This assumes that project resources (personnel, funding, and functions such as procurement and quality assurance) would be adequate to support concurrent acquisitions of transportation casks and associated components that would include several units of each of the seven transportation casks that would be used at Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion—the NAC-STC, NAC-UMS UTC, MP187, TS125, HI-STAR 100, HI-STAR HB, and MAGNATRAN; and to acquire and certify the fleet of AAR Standard S-2043 compliant railcars that would be needed. It also assumes that there would be flexibility in making acquisitions such as limited constraints on procuring casks and associated components from non-domestic suppliers.

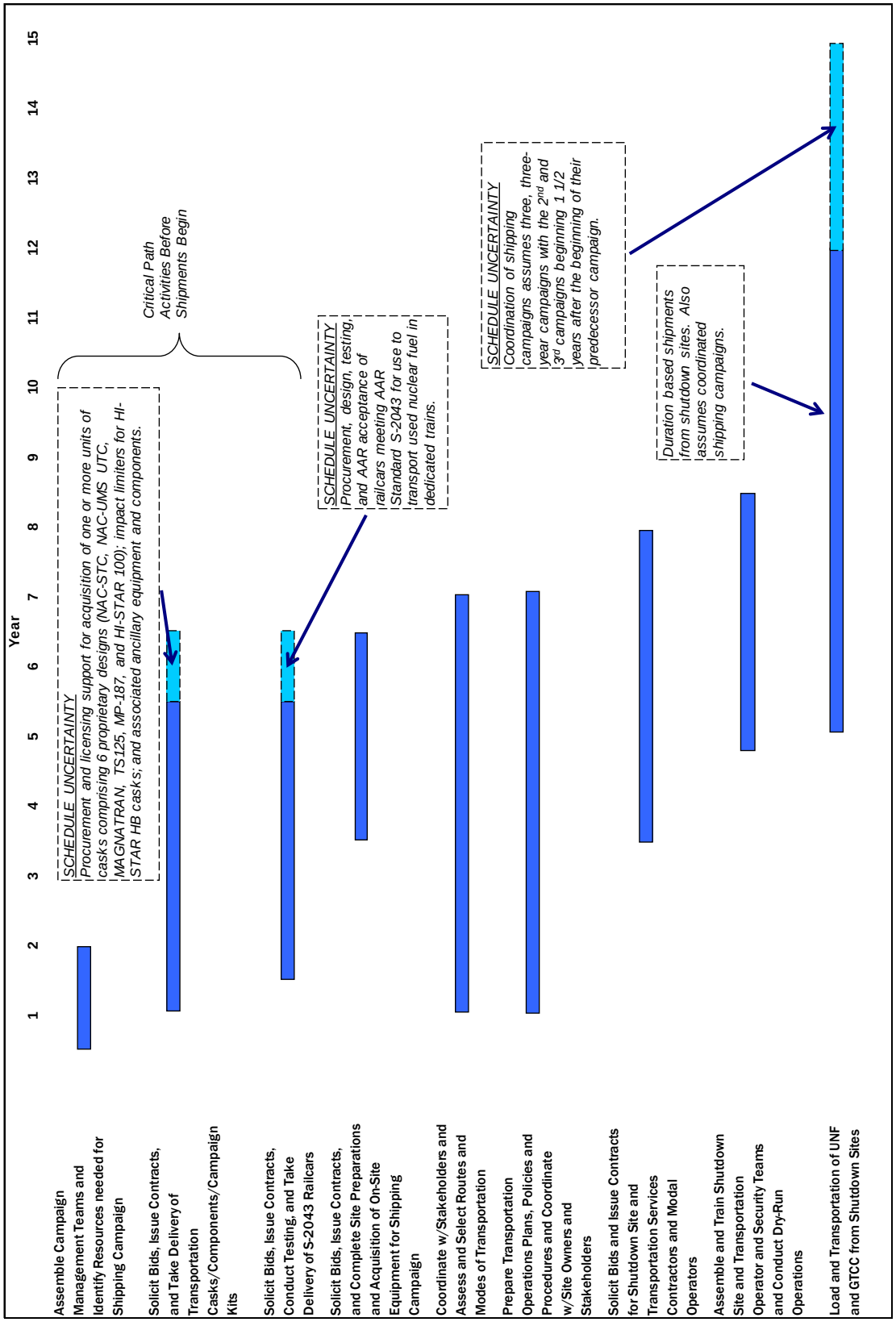


Figure 4-4. Estimated Durations of Key Activities to Prepare for and Remove Used Nuclear Fuel from Nine Shutdown Sites

5. CONCLUSIONS AND RECOMMENDATIONS

In this report, a preliminary evaluation of removing used nuclear fuel from 13 shutdown sites was conducted. The evaluation was divided into four components:

- characterization of the used nuclear fuel and GTCC low-level radioactive waste inventory
- a description of the on-site infrastructure and conditions relevant to transportation activities
- an evaluation of the near-site transportation infrastructure and experience relevant to shipping transportation casks containing used nuclear fuel from the shutdown sites, including gaps in information
- an evaluation of the actions necessary to prepare for and remove used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites.

From the evaluations, time sequences of activities and time durations were developed for preparing for and removing the used nuclear fuel and GTCC low-level radioactive waste from a single shutdown site and for the Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion sites. Crystal River, Kewaunee, San Onofre, and Vermont Yankee were not included because these sites only recently shut down and are at the beginning stages of the decommissioning process.

The 13 shutdown sites use designs from 4 different suppliers, including 11 different (horizontal and vertical) storage systems that would require 9 different transportation cask designs. Several issues were identified with the used nuclear fuel and GTCC low-level radioactive waste inventory at the shutdown sites. The most important of the issues was that there are six damaged fuel assemblies in five of the storage canisters at Rancho Seco that were not placed in failed fuel dry shielded canisters. Further evaluation would be needed to determine if the canisters containing this damaged fuel can be shipped in the MP187 transportation cask without repackaging. In addition, the transportation certificate of compliance for the HI-STAR HB cask would need to be revised to allow transport of 44 used nuclear fuel assemblies at the Humboldt Bay site with initial enrichments of 2.08 weight percent, which is less than the minimum initial enrichment of 2.09 weight percent authorized by the transportation certificate of compliance for the HI-STAR HB cask.

The lists of approved contents in the certificates of compliance for the TS125, HI-STAR HB, HI-STAR 100, and MP187 transportation casks do not include GTCC low-level radioactive waste. For GTCC low-level radioactive waste to be shipped from the Humboldt Bay, Rancho Seco, San Onofre, and Vermont Yankee sites in these transportation casks, changes to the transportation certificates of compliance would be required. Also, the certificates of compliance for the TS125 and MP187 transportation casks would also need to be updated from a -85 to a -96 designation before the casks or impact limiters could be fabricated. In addition, the used nuclear fuel or GTCC low-level radioactive waste that may be stored in 32PTH2 canisters at San Onofre would not be transportable without changes to the list of approved contents in the certificate of compliance for MP197HB transportation cask.

Six of the sites, Maine Yankee, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee, have high burnup used nuclear fuel in storage. The 90 high burnup used nuclear fuel

assemblies at Maine Yankee are packaged in Maine Yankee Fuel Cans (i.e., damaged fuel cans). This option for transporting high burnup used nuclear fuel is allowed by the certificate of compliance for the NAC-UMS UTC transportation cask (Docket No. 71-9270), and eliminates the concern over its transportability. For the Zion site, all high burnup fuel was packaged in damaged fuel cans. This also eliminates the concern over transportability of the 36 high burnup used nuclear fuel assemblies at Zion. High burnup used nuclear fuel stored in 32PTH1 canisters at Crystal River and 24PT4 canisters at San Onofre would be transportable in the MP197HB transportation cask. High burnup used nuclear fuel that will be stored in MPC-68 canisters at Vermont Yankee would not be transportable without changes to the list of approved contents in the certificate of compliance for the HI-STAR 100 transportation cask. An application for a certificate of compliance for the HI-STAR 190 transportation cask has been submitted to the NRC; high burnup used nuclear fuel that will be stored in MPC-37 canisters at San Onofre would be transportable if it is included in the list of approved contents in the certificate of compliance for the HI-STAR 190 transportation cask.

The used nuclear fuel at the shutdown sites was loaded into canisters and placed in ISFSIs as early as 2001. The initial storage licenses granted under 10 CFR Part 72 were for a period of 20 years, so renewals will need to occur starting in about 2018 to 2020. It is likely that the NRC will have questions about the condition of the stored used nuclear fuel during the storage license renewal process. In addition, transportation cask certificates of compliance are for 5-year periods, so these certificates will also need to be renewed on a regular basis. This will require a long-term commitment by the owners of the certificates of compliance to maintain these certificates.

Table 5-1 summarizes the mode options for transporting used nuclear fuel and GTCC low-level radioactive waste from the 13 shutdown sites. The modes listed in Table 5-1 were based on the evaluations of on-site transportation conditions, the near-site transportation infrastructure, and off-site transportation experience at the shutdown sites, particularly during large component removals during reactor decommissioning. An important observation regarding Table 5-1 is that all shutdown sites have at least one off-site transportation mode option for removing their used nuclear fuel and GTCC low-level radioactive waste, and most shutdown sites have multiple options. In addition, it is assumed that any refurbishment or upgrade of on-site infrastructure required prior to receipt of equipment for loading and transportation will be performed by the shutdown site organization to facilitate timely shipping of used nuclear fuel and GTCC low-level radioactive waste from the site.

Based on the activities and task durations presented in Section 4 of this report, preparing for and removing the used nuclear fuel and GTCC low-level radioactive waste from nine of the shutdown sites could be accomplished in 11.5 to 14.5 years (see Figure 4-4). This estimate did not include removing used nuclear fuel and GTCC low-level radioactive waste from Crystal River, Kewaunee, San Onofre, and Vermont Yankee. This time period was largely driven by the time required to load and transport the used nuclear fuel and GTCC low-level radioactive waste; procure casks, components, and campaign kits; and the time required to procure railcars that meet AAR Standard S-2043. While the latter two activities could take place in parallel, they still represent a significant fraction of the time it would take to prepare for and remove the used nuclear fuel and GTCC low-level radioactive waste from the shutdown sites.

Table 5-1. Summary of Transportation Mode Options for Shipments from Shutdown Sites

Site	Transportation Mode Options		Comments
Maine Yankee	Direct rail	Barge to rail	The on-site rail spur is not being maintained. The condition of the Central Maine and Quebec Railway would need to be verified
Yankee Rowe	Heavy haul truck to rail	–	The shortest heavy haul would be 7.5 miles to the east portal of the Hoosac Tunnel.
Connecticut Yankee	Barge to rail	Heavy haul truck to rail	The on-site barge slip has not been used since decommissioning but remains intact. It is uncertain whether the cooling water discharge canal is deep enough to accommodate barges without dredging. The shortest heavy haul would be about 12.5 miles to the end of the Portland rail spur. The rail infrastructure at the end of the Portland rail spur would need to be evaluated.
Humboldt Bay	Heavy haul truck to rail	Heavy haul truck to barge to rail	The heavy haul distance to a rail spur or siding would be in the range of 160 to 280 miles. The condition of the Fields Landing Terminal located two miles from the Humboldt Bay site would need to be verified for barge transport.
Big Rock Point	Heavy haul truck to rail	Barge to rail	The heavy haul would probably be about 52 miles to Gaylord, Michigan. A shorter heavy haul of 13 miles to Petoskey, Michigan may be possible. The rail infrastructure at these locations would need to be evaluated.
Rancho Seco	Direct rail	–	The rail spur is not being maintained. Weight restrictions on the Ione Industrial Lead would require route clearance by the railroad or a track upgrade.
Trojan	Direct rail	Barge to rail	The on-site rail spur was removed.
La Crosse	Direct rail	Barge to rail	The on-site rail spur was used to ship the reactor pressure vessel. The location and method for loading the transportation cask and moving the transportation cask to a rail spur is uncertain.
Zion	Direct rail	Barge to rail	The rail spur was recently refurbished to support reactor decommissioning waste shipments.
Crystal River	Direct rail	Barge to rail	Extensive on-site rail system serves co-located fossil fuel plants.
Kewaunee	Heavy haul truck to rail	Heavy haul truck to barge to rail	Condition of potential heavy haul truck routes, transload locations, and rail infrastructure would need to be evaluated.
San Onofre	Direct rail	Heavy haul truck to barge to rail	The rail spur was recently refurbished to support reactor decommissioning shipments for San Onofre-1.
Vermont Yankee	Direct Rail	–	On-site rail spur will be reactivated to support decommissioning.

As part of this preliminary evaluation, thirteen shutdown sites have been visited: Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee. As additional nuclear power reactor sites such as Fort Calhoun, Clinton, Quad Cities, Pilgrim, Oyster Creek, and Diablo Canyon shut down, these sites should be included in updates to the report.

The estimates of durations for project tasks presented here are preliminary and depend on the many identified assumptions. Consequently, in preparing a comprehensive project plan to prepare for and remove used nuclear fuel from the shutdown sites it will be necessary to refine the estimates using improved information regarding each of the sites and their near-site transportation infrastructure and using methods that will allow managers to gauge the importance of assumptions and project considerations. In this regard, it is recommended that DOE or another management and disposal organization use a quantitative risk analysis tool to provide estimates of project risks and opportunities. Such quantitative analyses would support estimating, managing, and funding of contingencies, and would increase confidence that the project would be successfully executed. Risk-informed estimates would also allow the project's managers to anticipate time and funding resources, and alternative courses of action that might be needed to effectively respond to changing circumstances.

DOE or another management and disposal organization should also take advantage of improved information regarding loading and transportation of used nuclear fuel from the shutdown sites to refine the data used in integrated waste management system analyses to evaluate optimizations that may be possible in acquiring and using transportation resources. Integrated waste management system analysis could also be used to conduct sensitivity analyses and identify important gaps in information that could be filled with additional data collected from the shutdown sites. Information developed using these analysis tools could also be used in case studies conducted using the quantitative analysis tools discussed above.

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Appendix A:

U.S. Nuclear Regulatory Commission Certificates of Compliance

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Appendix A
U.S. Nuclear Regulatory Commission Certificates of Compliance and Site-Specific Licenses

Table A-1 lists the docket number, package identification number, revision number, certificate of compliance expiration date, and ADAMS accession number for the transportation casks certified to transport used nuclear fuel from the shutdown sites. Table A-2 lists the docket number, certificate of compliance number issue date, certificate of compliance expiration date, amendment number, amendment effective date, and ADAMS accession number for the general certified storage systems used at the shutdown sites. Table A-3 lists the license number, docket number, license issue date, license expiration date, amendment number, amendment date, and ADAMS accession number for the Humboldt Bay, Rancho Seco, and Trojan site-specific licenses.

Table A-1. Transportation Casks Certified to Transport Used Nuclear Fuel from the Shutdown Sites

Transportation Cask	Docket	Package Identification Number	Revision	Certificate of Compliance Expiration Date	ADAMS Accession Number
NAC-STC	71-9235	USA/9235/B(U)F-96	13	05/31/2019	ML14148A289
MP187	71-9255	USA/9255/B(U)F-85	12	11/30/2018	ML14069A254
HI-STAR 100 and HI-STAR HB	71-9261	USA/9261/B(U)F-96	9	04/30/2019	ML14099A546
NAC-UMS UTC	71-9270	USA/9270/B(U)F-96	4	10/31/2017	ML12306A440
TS125	71-9276	USA/9276/B(U)F-85	4	10/31/2017	ML12306A387
MP197 and MP197HB	71-9302	USA/9302/B(U)F-96	7	08/31/2017	ML14114A049
MAGNATRAN	71-9356	--	--	--	--
HI-STAR 190	71-9373	--	--	--	--

ADAMS= U.S. Nuclear Regulatory Commission Agencywide Documents Access and Management System (http://www.nrc.gov/reading-rm/adams.html)

Table A-2. General Licensed Storage Systems Used at the Shutdown Sites

Storage System	Docket	Certificate of Compliance Issue Date	Certificate of Compliance Expiration Date	Amendment	Amendment Effective Date	ADAMS Accession Number
Standardized NUHOMS	72-1004	01/23/1995	01/23/2015	13	05/24/2014	ML14153A573
HI-STORM 100	72-1014	05/31/2000	05/31/2020	9	03/11/2014	ML14071A188
NAC-UMS	72-1015	11/20/2000	11/20/2020	5	01/12/2009	ML090120408
NAC-MPC	72-1025	04/10/2000	04/10/2020	6	10/04/2010	ML102920618
Fuel Solutions Storage System	72-1026	02/15/2001	02/15/2021	4	07/03/2006	ML061910527
Standardized Advanced NUHOMS	72-1029	02/05/2003	02/05/2023	3	02/23/2015	ML15054A415
MAGNASTOR	72-1031	02/04/2009	02/04/2029	5	06/29/2015	ML15180A364
HI-STORM UMAX	72-1040	04/06/2015	04/06/2035	1	09/08/2015	ML15252A426

ADAMS= U.S. Nuclear Regulatory Commission Agencywide Documents Access and Management System (http://www.nrc.gov/reading-rm/adams.html)

Table A-3. Site-Specific Licenses at the Shutdown Sites

Site	License	Docket	License Issue Date	License Expiration Date	Amendment	Amendment Date	ADAMS Accession Number
Trojan	SNM-2509	72-17	03/31/1999	03/31/2019	6	03/17/2006	ML060790069
Rancho Seco	SNM-2510	72-11	06/30/2000	06/30/2020	3	08/11/2009	ML092240338
Humboldt Bay	SNM-2514	72-27	11/17/2005	11/17/2025	3	09/17/2013	ML13196A466

ADAMS= U.S. Nuclear Regulatory Commission Agencywide Documents Access and Management System (http://www.nrc.gov/reading-rm/adams.html)

Appendix B:

Rail Infrastructure Assessments of Shutdown Sites

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Appendix B
Rail Infrastructure Assessments of Shutdown Sites

This appendix contains the rail infrastructure assessments conducted during site visits to Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, and Zion. The assessments consisted of an existing site overview and railroad operational overview.

B.1 Humboldt Bay

The Humboldt Bay site visit was conducted on July 17, 2013.

B.1.1 Existing Site Overview

The Humboldt Bay site has no rail infrastructure. Figure B-1 is a satellite view of the Humboldt Bay site.

B.1.2 Railroad Operational Overview

The Northwestern Pacific Railway (NWPY) is a regional railroad that served the north coast of California. Its main line ran from Schellville to Eureka, California, a distance of 260.1 miles. The railroad began at milepost 40.4 (Schellville) and ended at milepost 300.5 (Samoa). The rail line has 30 tunnels, 1 over-highway bridge and 52 over-water bridges from Eureka to Schellville.

In 1998 the Federal Railroad Administration issued an Emergency Order that closed the line from Arcata (milepost 295.5) to milepost 63.4 between Schellville and Napa Junction, California. In May 2011, the Federal Railroad Administration lifted the Emergency Order allowing freight trains to operate as far north as milepost 62.9 near Windsor, California. Currently, the northern section from Windsor to Arcata is not operating. There are five locomotives stored in out-of-service status on the non-operating northern section in Eureka.

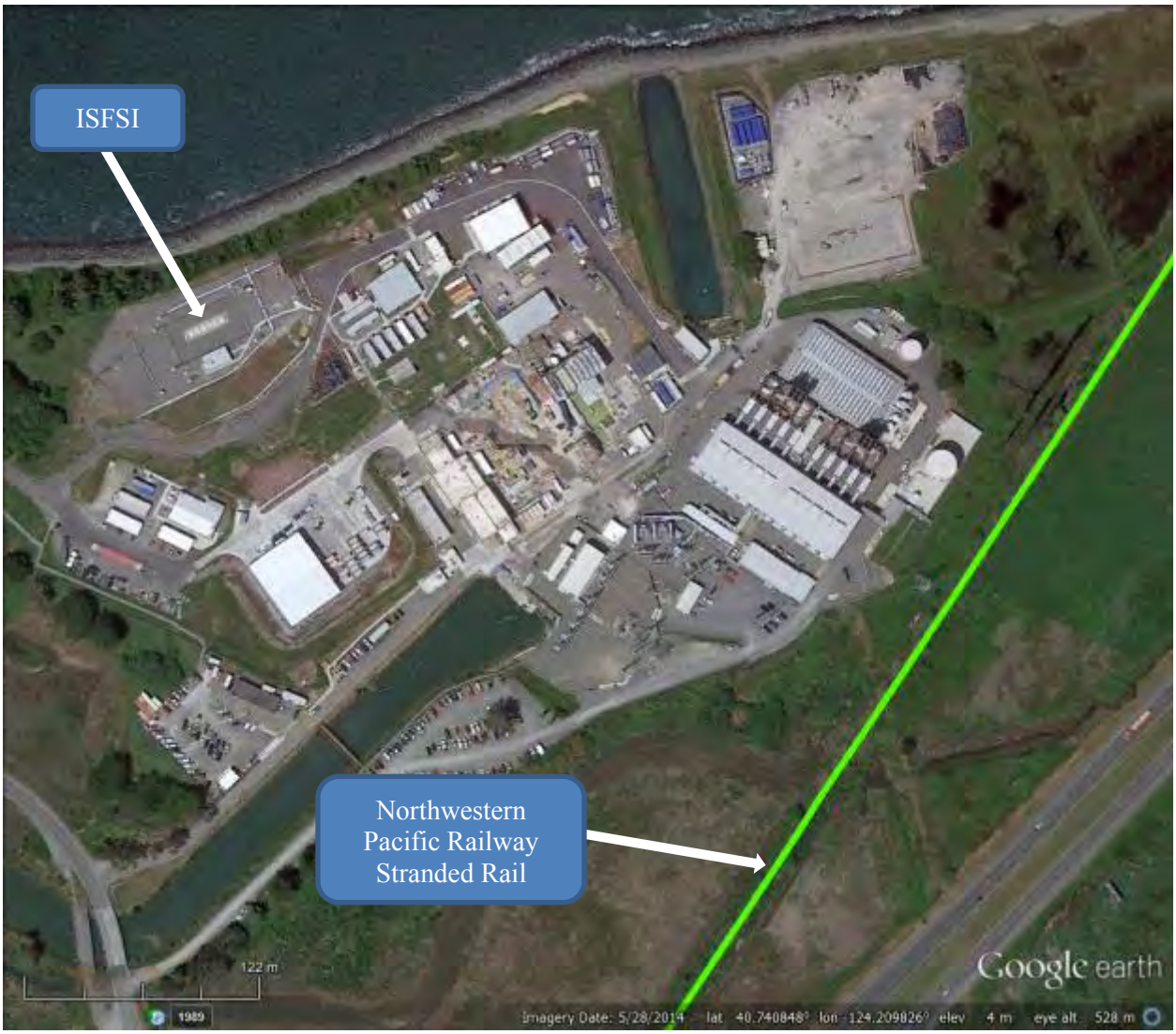


Figure B-1. Satellite View of Humboldt Bay Site (Google 2015)

B.2 Big Rock Point

The Big Rock Point site visit was conducted on July 25, 2013.

B.2.1 Existing Site Overview

The Big Rock Point site has no existing rail service. The rail line was abandoned and removed in May 1986. Figures B-2 and B-3 are satellite views of the Big Rock Point site.



Figure B-2. Satellite View of the Big Rock Point Site (Google 2015)



Figure B-3. Closer Satellite View of the Independent Spent Fuel Storage Installation Pad and the Main Office Building at Big Rock Point (Google 2015)

B.2.2 Railroad Operational Overview

Because direct rail access to the Big Rock Point site is not available, the shipment of used nuclear fuel from Big Rock Point by rail would involve heavy haul truck transport to a rail siding or spur and transloading from heavy haul truck to rail. Previously, two locations have been used for transloading of large components during decommissioning, a siding on the Great Lakes Central Railroad located in Petoskey, Michigan and a spur on the Lake State Railway located in Gaylord, Michigan. Figures B-4, B-5, and B-6 show features of the Petoskey location. Figures B-7, B-8, and B-9 show features of the Gaylord location.

The Great Lakes Central Railroad siding is located in Petoskey, Michigan and is currently used to transload plastic pellets from railcars and deliver them to a local factory. The rail line in the vicinity of the siding appears to be in track class 1 condition. The use of this location during

decommissioning of the Big Rock Point site required heavy haul truck transport for approximately 13 miles from the Big Rock Point site. The siding is approximately 1,000 feet long, has electrical power available, and there is sufficient space to perform transloads of used nuclear fuel transportation casks.

The Lake State Railway's spur is located near the intersection of North Otsego Lake Drive and Highland Avenue in Gaylord, Michigan. The use of this location during decommissioning of the Big Rock Point site required heavy haul truck transport for approximately 50 miles from the Big Rock Point site. The rail line in the vicinity of the spur appears to be in "Excepted Track" condition. Approximately 1000 feet south the track appears to have been rehabilitated to track class 2 condition.



Figure B-4. Transload Location Near Petoskey, Michigan (Google 2015)



Figure B-5. Railroad Track Located Near Petoskey, Michigan Transload Location (2013)



Figure B-6. Petoskey Transload Location Railroad Siding (2013)

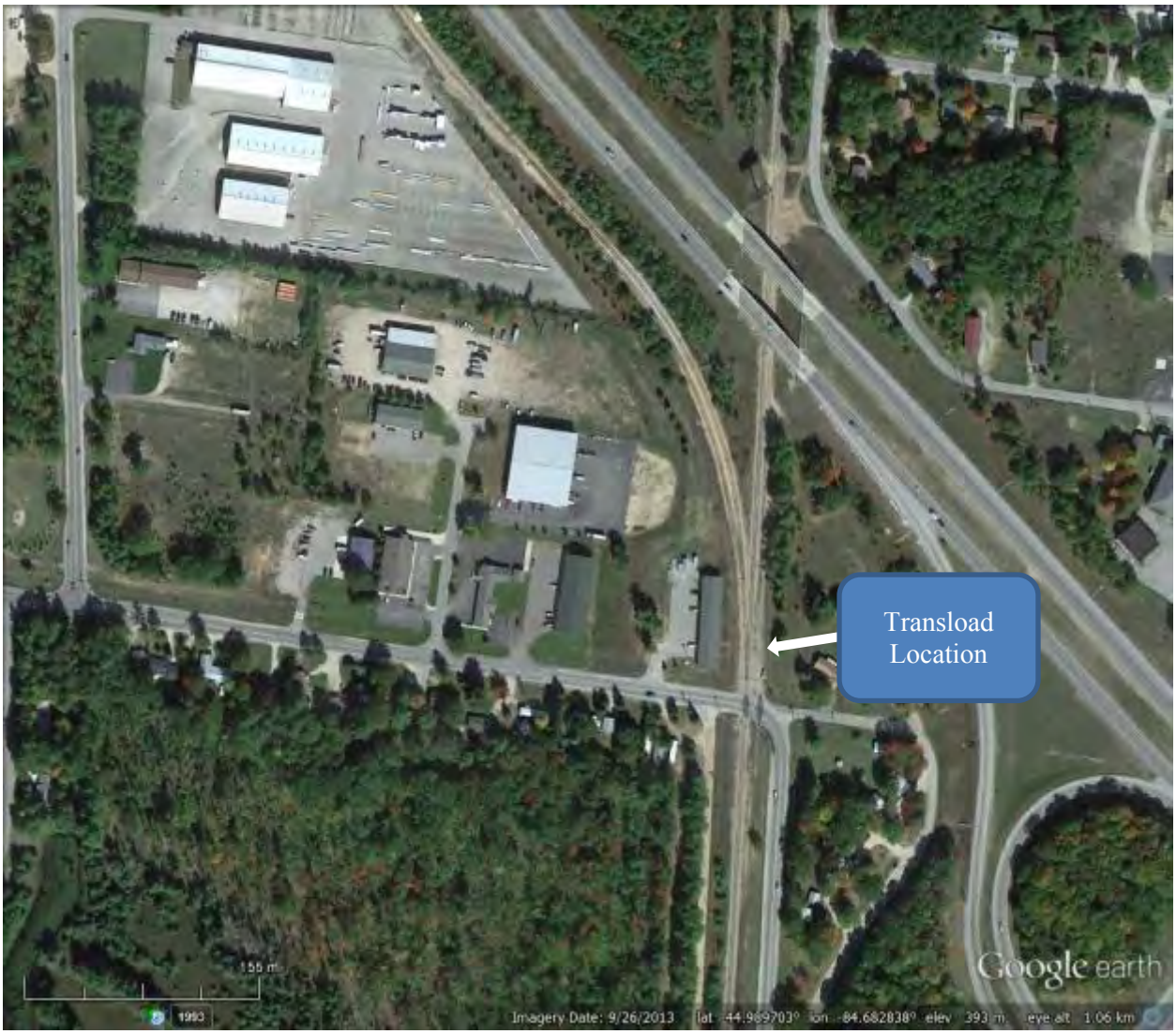


Figure B-7. Transload Location Near Gaylord, Michigan (Google 2015)

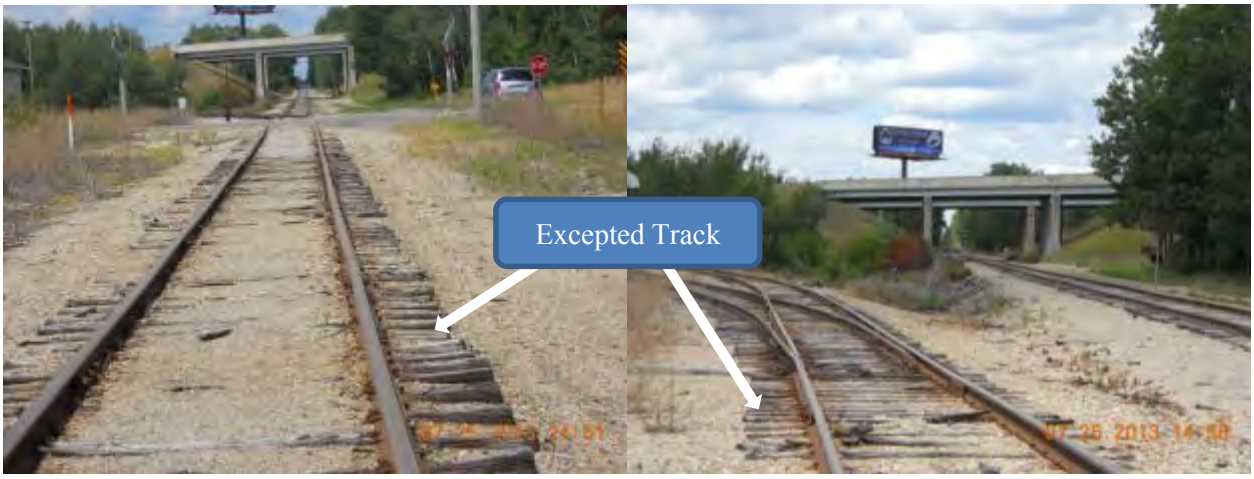


Figure B-8. Track Condition in the Vicinity of Gaylord Transload Location (Looking North) (2013)



Figure B-9. Track Condition in the Vicinity of Gaylord Transload Location (Looking South) (2013)

B.3 Rancho Seco

The Rancho Seco site visit was conducted on July 16, 2013.

B.3.1 Existing Site Overview

Figure B-10 is a satellite view of the Rancho Seco site and Figure B-11 shows Union Pacific Railroad track and switch locations. Plant site rail infrastructure is intact but not maintained to operating condition. The Rancho Seco site rail system has a section of rail removed inside the perimeter gate to prevent entry of rail rolling stock.

B.3.2 Railroad Operational Overview

The serving railroad is the Union Pacific Railroad. The plant lead is approximately 3,500 to 4,000 feet from the facility perimeter fence. The plant lead is 90-lb. rail from the Union Pacific switch to the interplant switch inside the fence. The plant lead has a split rail derailer near the Union Pacific switch preventing rolling stock entry onto the Union Pacific railroad. The plant has a flop derailer approximately 30 feet inside the facility's perimeter fence preventing rolling stock from entering the Rancho Seco site by rail. Approximately 150 feet from the fence, the facility has a switch; the rail from the switch inside the facility is 112-lb. rail. The switch leads to the ISFSI stub track. The ISFSI stub track is approximately 400 feet long and parallels the ISFSI pad ending at the south end of the pad.

The Ione Industrial Lead serves the Rancho Seco site. This lead connects to the Union Pacific mainline in Galt, California. The lead is track class 2 with a maximum speed limit of 20 mph. Six-axle locomotives are prohibited from the lead and the maximum gross weight for a railcar on the lead between Rancho Seco and Galt is 158 tons. To exceed these provisions, it would be necessary to obtain route clearance from the Union Pacific Railroad or to upgrade the track.

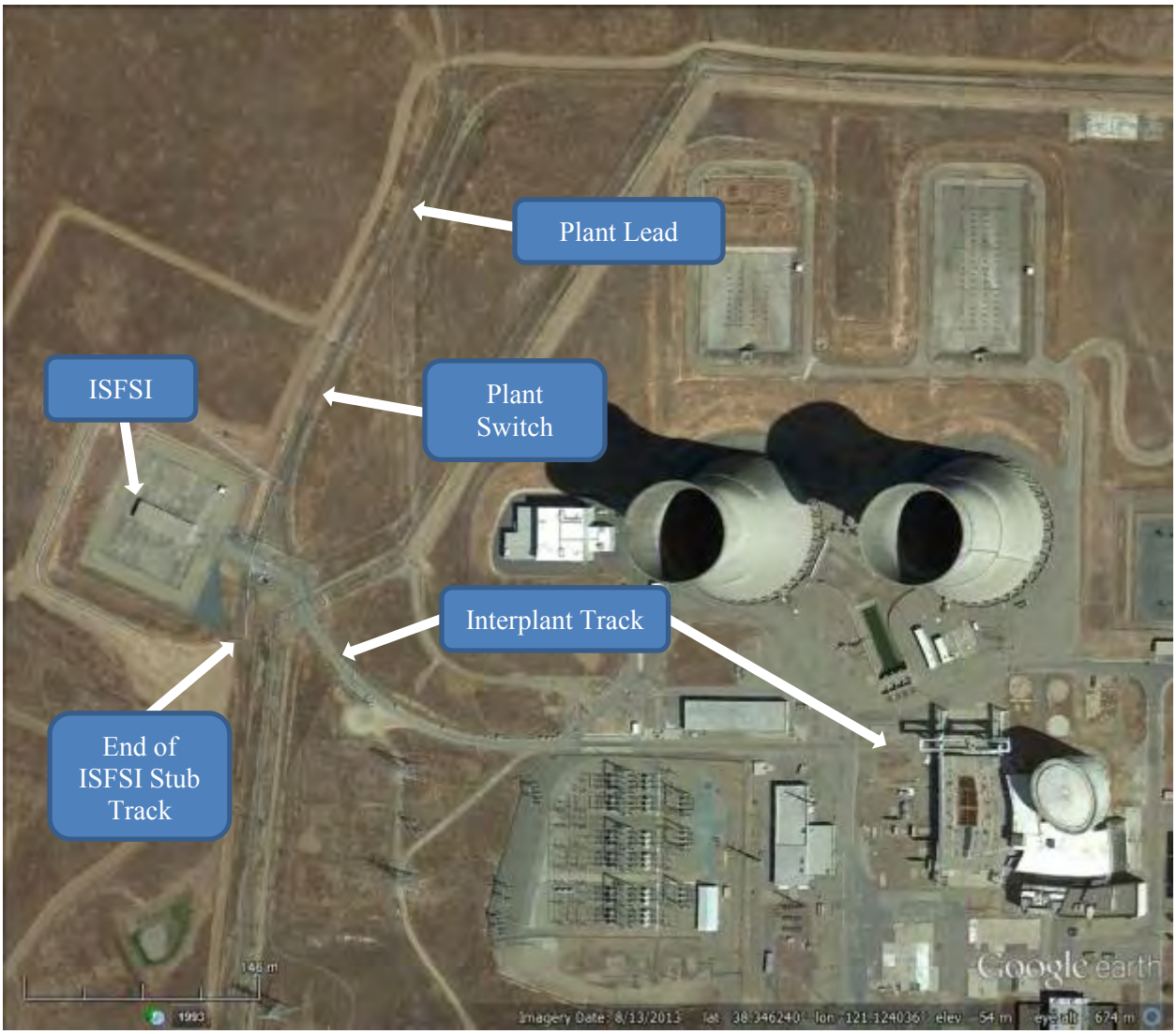


Figure B-10. Satellite View of the Rancho Seco Plant (Google 2015)



Figure B-11. Union Pacific Railroad Track and Switch Locations (Google 2015)

B.4 Trojan

The Trojan site visit was conducted on July 15, 2013.

B.4.1 Existing Site Overview

The Trojan site has sections of rail that are intact but not maintained. Figure B-12 is a satellite view of the site. The existing track runs parallel to the access road to the ISFSI pad. The rail is approximately 170 feet from the ISFSI pad gate. The existing on-site rail terminates laterally across from the gate. A stub track off of the west side of the Portland and Western Railroad's (PNWR), track was last used to load and ship low-level waste in 2002-2004. The stub track and switch were removed shortly after the last shipment. The plant lead and switch off of the PNWR was removed in approximately 1989 and the Access Control building was built on the curve from the lead into the plant facility.

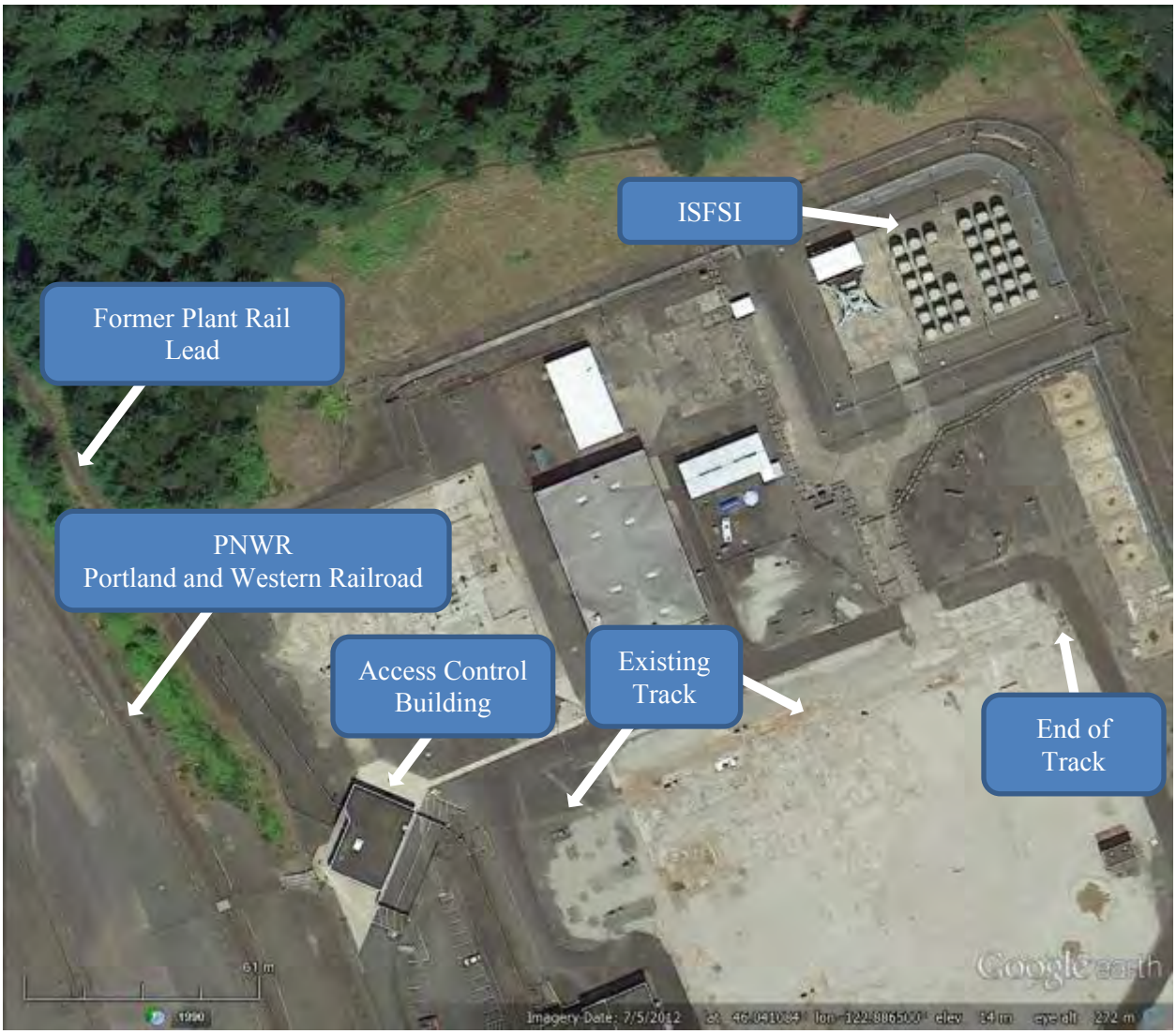


Figure B-12. Satellite View of Trojan Site (Google 2015)

B.4.2 Railroad Operational Overview

The PNWR is a 520-mile short line railroad that interchanges with the Albany and Eastern Railroad, BNSF Railroad, Central Oregon and Pacific Railroad, Coos Bay Rail Link, Hampton Railway, Port of Tillamook, and Union Pacific Railroad. Commodities transported include aggregates, brick and cement, chemicals, construction and demolition debris, food and feed products, forest products, metallic ores and minerals, steel, and scrap. The PNWR was acquired by the Genesee and Wyoming in 1995. The Genesee and Wyoming operates 63 short line and regional railroads in the United States, Canada, Bolivia, Australia, Mexico, and the Netherlands.

The PNWR was the serving railroad for the Trojan site until 2004 after completing the low-level radioactive waste shipments from the site. At that time the west stub track and switch were removed.

PNWR's Astoria District rail line would serve the Trojan site. From the Trojan site south to the BNSF interchange at Willbridge is approximately 36.5 miles. Approximately 5 miles south of Willbridge, the PNWR interchanges with the Union Pacific, which is a part of the Strategic Rail Corridor Network (STRACNET). An interchange with the Union Pacific may be possible through a waiver process. The Astoria District Rail Line is track class 2. The railroad milepost at Trojan is 40.8 and the milepost at Willbridge is 4.3. The maximum authorized timetable speed from Gasco (milepost 5.6) to Astoria (milepost 99.7) is 25 mph.

B.5 La Crosse

The La Crosse site visit was conducted on July 23, 2013.

B.5.1 Existing Site Overview

Currently there is a spur off of the BNSF double track mainline that will hold two railcars inside the La Crosse site (Figures B-13 through B-15). Sections of the facility rail system are intact but in unusable condition. The interplant rail system had two switches that had spurs that ran to the reactor building and the adjacent Genoa #3 coal-fired power plant.

B.5.2 Railroad Operational Overview

The BNSF Railroad is the serving railroad for the La Crosse site at Genoa. The track is a mainline and is part of the BNSF's Aurora Subdivision and the Chicago Division. The line is not an Amtrak Route. The line primarily is for intermodal and freight trains.



Figure B-13. Satellite View of the La Crosse Site with Switch, Spur, Mainline, and Independent Spent Fuel Storage Installation (Google 2015)



Figure B-14. Satellite View of the La Crosse Site with Switch, Spur, and Mainline (Google 2015)



Figure B-15. Satellite View of the La Crosse Site with Turbine and Reactor Buildings (Google 2015)

B.6 Zion

The Zion site visit was conducted on July 22, 2013.

B.6.1 Existing Site Overview

The Zion site is serviced by the Union Pacific Railroad. In 2012 Zion Solutions completed the interplant rail system upgrade. Figures B-16 through B-20 show the rehabilitated rail infrastructure. The installation of two switches on the Union Pacific double track mainline, a plant lead, and a crossover switch allow access from either track to the Zion facility. The rebuilt lead from the Union Pacific's mainline into the plant includes 100-lb. rail, specialty equipment, negotiable 12 degree curves, cement crossties on the two curves, and a unidirectional derailer that protects the railroad. The lead also includes two private crossings that afford access to the

beach area. The lead has three switches for three plant tracks that are approximately 1200 to 1400 feet inside the perimeter fence that has an 11-degree, 39-minute curve in it. There are unidirectional derailers outside of the perimeter fence that protect the plant from incoming rolling stock. The east track has two switches that lead to the Fuel Building and Turbine Building. The Zion site has a Trackmobile to move and stage rail cars around the site. Figures B-21 and B-22 are satellite views of the Zion site.



Figure B-16. Union Pacific Mainline at the Zion Site (2013)



Figure B-17. Rebuilt Lead from the Zion Site to the Union Pacific Mainline (2013)



Figure B-18. Private Crossing to Afford Beach Access (2013)



Figure B-19. Zion Site Plant Lead (2013)



Figure B-20. Derailers Outside of Zion Site (2013)



Figure B-21. Satellite view of Zion Site Showing Independent Spent Fuel Storage Installation Pad, the Rehabilitated Interplant Rail Line, and the Leads to the Reactor Containment Building (Google 2015)



Figure B-22. Satellite View of the Zion Lead and the Union Pacific Double Track Mainline (Google 2015)

B.6.2 Railroad Operational Overview

The Union Pacific Railroad is the serving railroad for the Zion site. The double track rail line is in the Union Pacific's Northern Region. The double track rail line is also commuter line operated by the Northeast Illinois Regional Commuter Rail Corporation. The commuter line operates from the Clybourn Station, located at 2001 N. Ashland Avenue, Chicago, Illinois, and runs north to Kenosha Station, located at 5414 13th Avenue, Kenosha, Wisconsin, a distance of approximately 60 miles. Zion Station is a commuter stop located at 2501 S. Eden Road, Zion, Illinois. This station is located less than 1,000 feet from the main line switch to the Zion site lead and approximately 4,000 feet from the plant entrance (Figure B-23).



Figure B-23. Location of Zion Station Commuter Stop (Google 2015)

B.7 Kewaunee

The Kewaunee site visit occurred on September 9-11, 2014.

B.7.1 Existing Site Overview

The Kewaunee site is located in northeast Wisconsin on the western shore of Lake Michigan, southeast of Green Bay (Figure B-24), and does not have direct rail access. Rail transport of the used nuclear fuel canisters from the Kewaunee site would begin with a highway heavy-haul to an acceptable rail location for transloading.

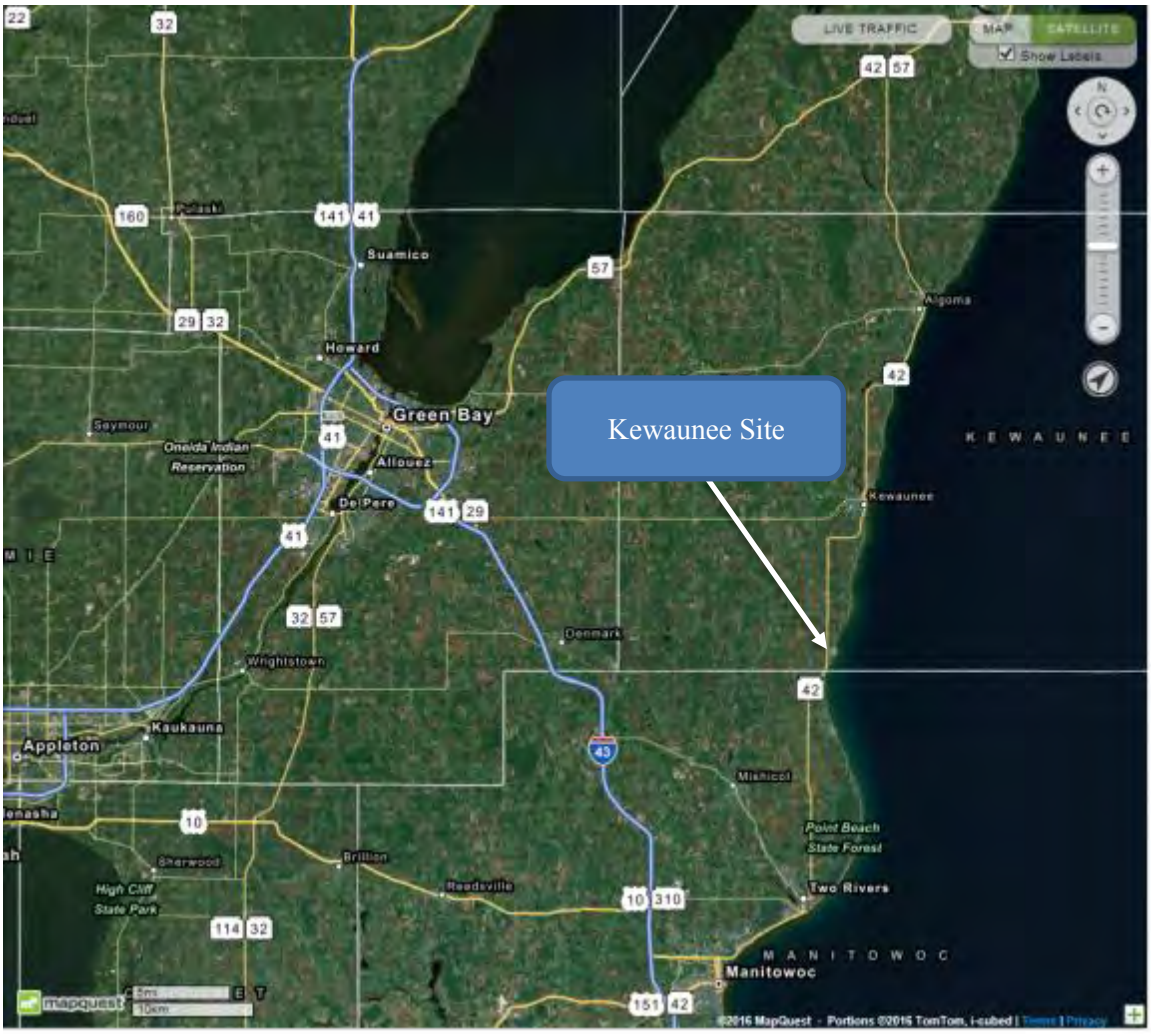


Figure B-24. Kewaunee Site on East Shore of Lake Michigan in Northeastern Wisconsin (MapQuest 2016)

B.7.2 Railroad Operational Overview

Ten potential transloading locations in the vicinity of the Kewaunee site were visited. These transload locations were on the Canadian National Railway (CN) Denmark Spur, Rockwood Spur, Luxemburg Spur, and locations on the CN in the vicinity of Manitowoc, Wisconsin.

The transload location review focused on the following elements:

- Proximity to the Kewaunee site
- Heavy-haul route to the potential transload location
- Accessibility for equipment
- Clearances for rigging equipment
- Clearances for adjacent tracks

- Track condition (FRA Track Class).

B.7.2.1 Denmark Spur

There were two potential transloading sites on the Denmark Spur, one site located in Bellevue, Wisconsin, and a second site located in Denmark, Wisconsin.

Wall Street Warehouse Siding in Bellevue, Wisconsin

This potential transloading site is located near the intersection of WI-29 and U.S. 141 (Figures B-25 and B-26). The siding is approximately 28 miles from the Kewaunee site via WI-42 north to County Road C north to WI-29 west to Wall Street. This route was used for the heavy-haul truck transport of the horizontal storage modules for the Kewaunee ISFSI. The siding at this location has direct access from the highway and the parking lot and is within 50 feet of the tracks. There are no overhead clearance restrictions at this site. The siding and main tracks are parallel to each other, requiring permission from the carrier to foul the adjacent main track. This track is approximately 7 miles from the Fox River Subdivision of the Canadian National Railway and is FRA Class 1 track with a very low volume of traffic.

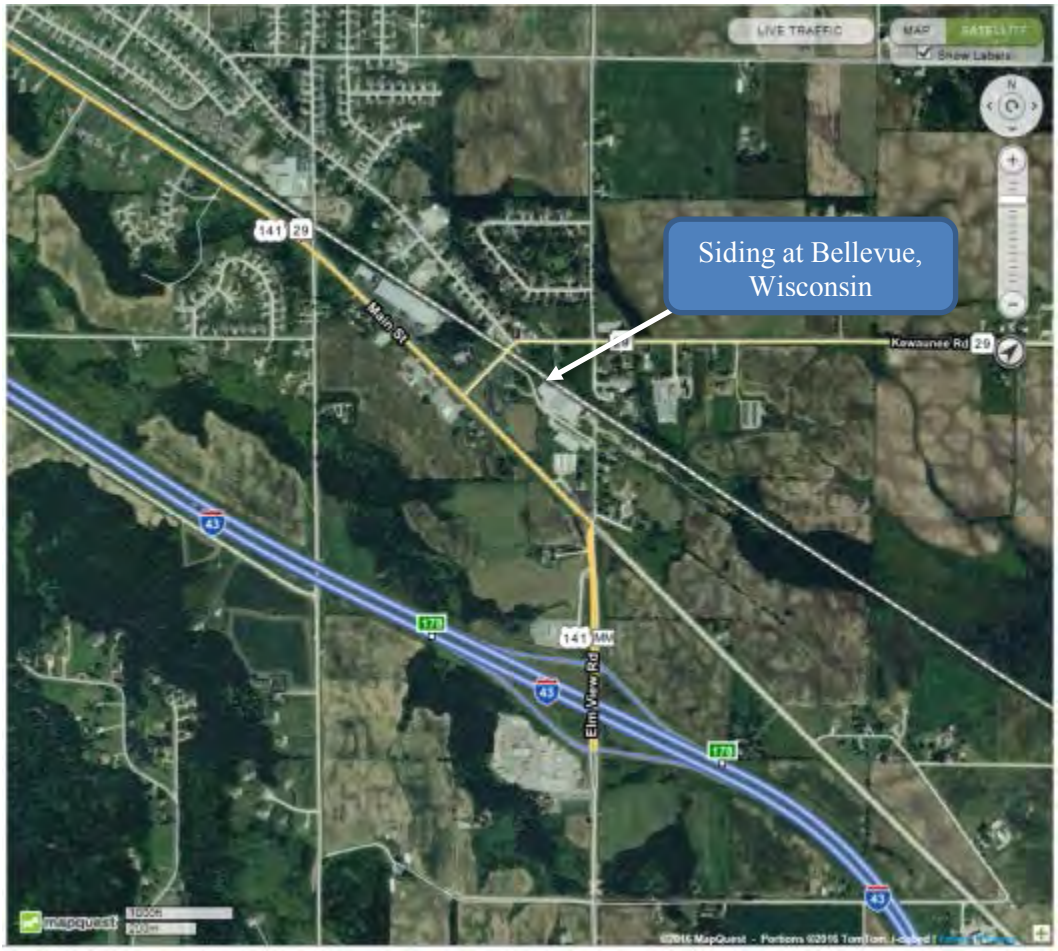


Figure B-25. Siding Location in Bellevue, Wisconsin (MapQuest 2016)



Figure B-26. Wall Street Siding in Bellevue, Wisconsin (2014)

North Avenue in Denmark, Wisconsin

This potential transloading site is located approximately 17 miles from the Kewaunee site via WI-42 south to County Road BB west to County Road R north and then east on North Avenue to the Denmark Spur, or WI-42 south to County Road BB west to County Road R north to County Road T north and then west on North Road to the Denmark Spur (Figures B-27 and B-28). There is no infrastructure at this location and a siding would likely have to be installed to avoid fouling of the main track. This track is approximately 14.5 miles from the Fox River Subdivision of the Canadian National Railway and is FRA Class 1 track with a very low volume of traffic.

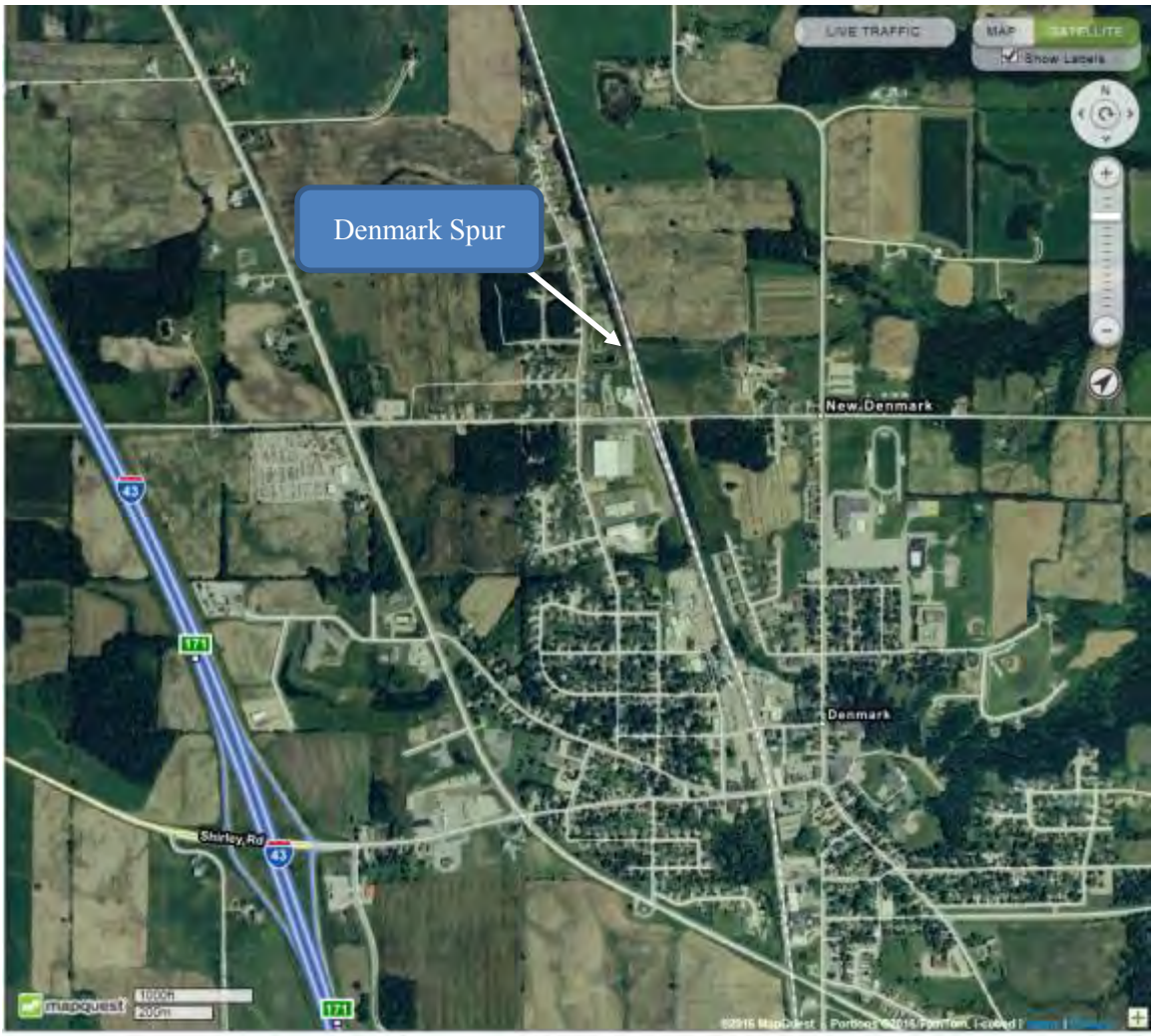


Figure B-27. Denmark Spur (MapQuest 2016)



Figure B-28. Denmark Spur at North Avenue Looking South (2014)

B.7.2.2 Rockwood Spur

There are three potential transloading sites in the vicinity of Rockwood, Wisconsin, the Carmeuse Lime Plant and the Country Visions Cooperative Fertilizer Plant Sidings (Rockwood Road between County Roads R and Q), and the Manitowoc County Highway Maintenance Facility (WI-310 between County Roads R and Q) (see Figure B-29).

Carmeuse Lime Plant or the Country Visions Cooperative Fertilizer Plant Sidings

This rail siding is located approximately 23 miles from the Kewaunee site via WI-42 south to WI-310 west to County Road Q north and west on Rockwood Road, or WI-42 south to County Road BB west to County Road Q south and west on Rockwood Road. The two sidings at this location have direct access from the highway (see Figures B-30, B-31, and B-32). There are no overhead clearance restrictions. Both the Country Visions Cooperative Fertilizer Plant and the Carmeuse Lime Plant facilities could be used to transload. This track is FRA Class 1 track and has a very low volume of traffic. It is approximately 6.5 miles from the Calumet Yard and the Manitowoc Subdivision of the Canadian National Railway.



Figure B-29. Three Potential Transload Sites Located Near Rockwood, Wisconsin (MapQuest 2016)



Figure B-30. Country Visions Cooperative Fertilizer Plant (2014)



Figure B-31. Carmeuse Lime Plant (2014)



Figure B-32. Switch to Carmeuse Lime Plant and the Country Visions Cooperative Fertilizer Plant Sidings at MP 83.2 (2014)

Manitowoc County Highway Maintenance Facility

This potential transloading site is approximately 23 miles from the Kewaunee site via WI-42 south to WI-310 west, or WI-42 south to County Road BB west to County Road Q south to WI-310 west. The location is between County Roads Q and R. The Rockwood Spur runs parallel to the maintenance facility (see Figure B-33). A wide clear grassy area is adjacent to the track with no overhead clearance restrictions, allowing a possible transloading site. This track is FRA Class 1 track and has a very low volume of traffic. It is approximately 6 miles from the Calumet Yard and the Manitowoc Subdivision of the Canadian National Railway.



Figure B-33. Manitowoc County Highway Maintenance Facility at MP 82.14 (2014)

B.7.2.3 Manitowoc, Wisconsin Locations

There were four potential transloading sites in the Manitowoc, Wisconsin area, one site near the Manitowoc County Airport, a second site near Dean Brennan Transport, a third site near Red Arrow in Manitowoc, and a fourth site at the Calumet Yard.

Manitowoc County Airport Site

This potential transloading site is approximately 22 miles from the Kewaunee site via WI-42 south to WI-42 west and northwest on Menasha Avenue. The Rockwood Spur runs parallel to the Manitowoc County Airport (see Figure B-34). An access road parallels the rail line the entire length of the airport. This track is FRA Class 1 track and has a very low volume of traffic. It is approximately 2.4 miles from the Calumet Yard and the Manitowoc Subdivision of the Canadian National Railway.



Figure B-34. Manitowoc County Airport (MapQuest 2016)

Dean Brennan Transport

This location is approximately 24 miles from the Kewaunee site via WI-42 south to WI-42 west to North 23rd Street to Fairmont Street to the Dean Brennan Transport Facility (see Figure B-35). The Rockwood Spur runs parallel to the facility. The facility has a large paved lot adjacent to the rail line. This track is FRA Class 1 track and has a very low volume of traffic and is approximately 2 miles from the Calumet Yard and the Manitowoc Subdivision of the Canadian National Railway.



Figure B-35. Dean Brennan Transport Facility (2014)

Red Arrow Siding

The Red Arrow Siding is located approximately 21 miles from the Kewaunee site via WI-42 south to Maritime Drive, west to North 10th Street, south to Franklin Street, west to Water Street, and north to the Red Arrow Siding (Figures B-36 and B-37). The siding is between Water Street and 16th Street along the Manitowoc River and has barge moorings (Figure B-38). There are two sidings at this location with an access road adjacent. This track is FRA Class 1 track and has a very low volume of traffic. It is approximately 1 mile from the Calumet Yard and the Manitowoc Subdivision of the Canadian National Railway.

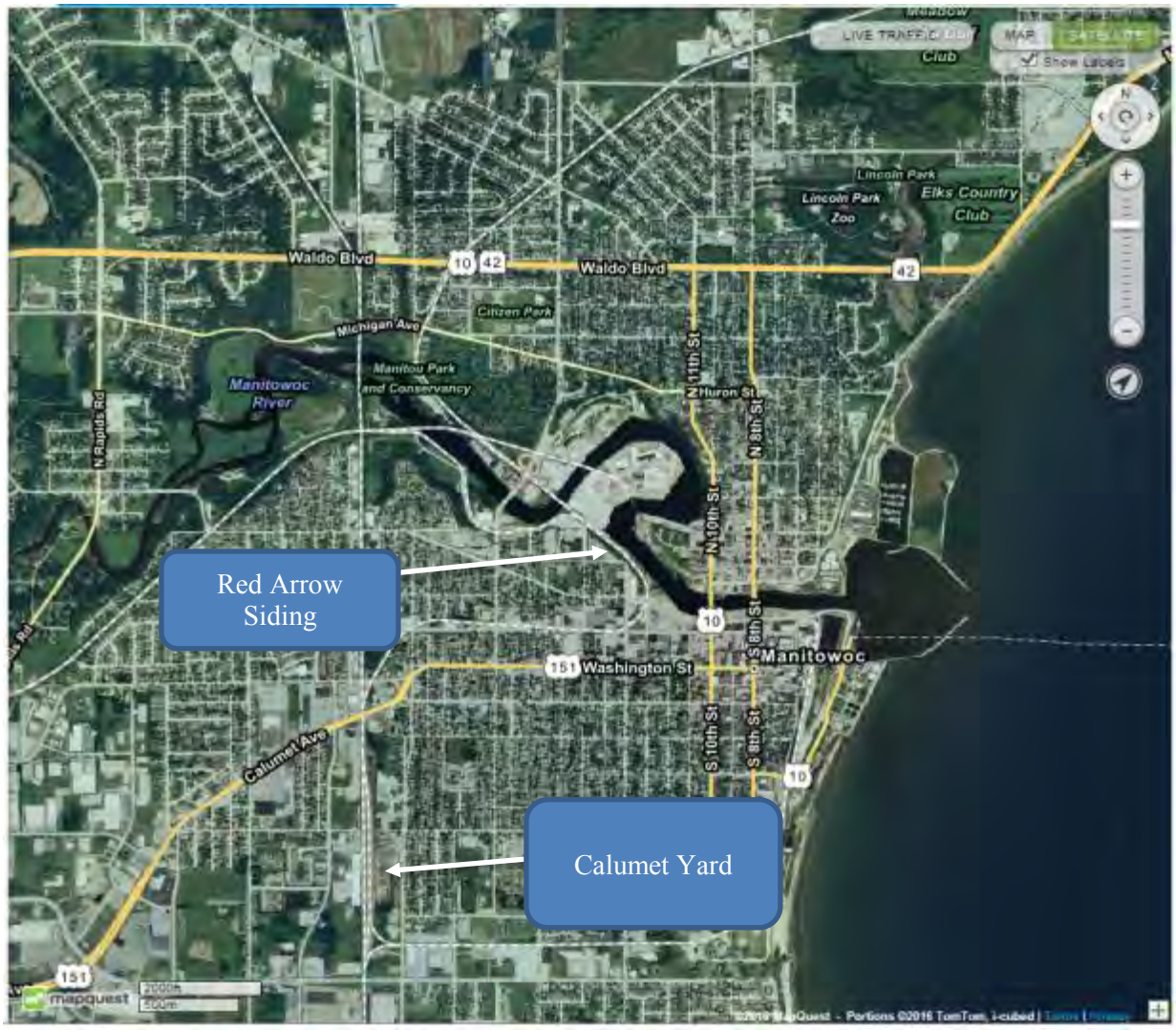


Figure B-36. Red Arrow Siding and Calumet Yard (MapQuest 2016)



Figure B-37. Red Arrow Siding (2014)



Figure B-38. Barge Slip Adjacent to Red Arrow Siding (2014)

Calumet Yard

This potential transloading site is approximately 22 miles from the Kewaunee Site via WI-42 south to Maritime Drive, west to North 10th Street, south to Washington Street (WI-151), west to South 26th Street, and south to the Calumet Yard (see Figures B-36 and B-39). This yard is on the Manitowoc Subdivision of the Canadian National Railway and is the least favorable to a heavy-haul.



Figure B-39. Calumet Yard in Manitowoc, Wisconsin (2014)

B.7.2.4 Luxemburg Spur

Luxemburg Feed Mill Siding

This potential transloading site is approximately 24 miles from the Kewaunee Site via WI-42 north to County Road C north to WI-29 west to County Road AB north, and north to Cedar Street, and west to the mill siding (see Figure B-40). The Luxemburg Spur terminates at this location and a siding parallels the spur (see Figure B-41). The spur is 80-lb. rail. The siding is used to unload grain and plastics. This track is FRA Class 1 track and has a very low volume of traffic and is approximately 19 miles from the Fox River Subdivision of the Canadian National Railway (Figures B-42 and B-43).



Figure B-40. Luxemburg Feed Mill Siding (MapQuest 2016)



Figure B-41. Siding at Luxemburg (2014)



Figure B-42. Main Track at Luxemburg (2014)



Figure B-43. Switch at Luxemburg (2014)

B.7.3 Summary

Wisconsin has roundabouts at many intersections on its highway system. County roads have many low overhead lines, and small bridges.

The Denmark, Luxemburg, and Rockwood Spurs are currently weight-restricted, with a weight limit of 263,000 lb. The Denmark and Rockwood spurs are 112- to 115-lb. rail, and Luxemburg spur is 80-lb. rail.

According to CN Engineering Department officials, the Luxemburg Spur needs to have rail and ties replaced, and the Denmark and Rockwood Spurs need ties replaced. CN staff stated that Luxemburg, Denmark, and Rockwood Spurs may be decommissioned in the near future. The track quality is FRA Class 1, but close to excepted.

To rehabilitate track from current conditions up to FRA Class 2 would require replacing every third or fourth tie. There are approximately 800 ties/mile or 3,200 ties over 4 miles. The cost per railroad tie is $70, and the cost for labor per tie is $40 to $44. The track length from the Rockwood spur (from WI-310) to Manitowoc is 7.2 miles total. The total cost estimate to rehabilitate the track is $656,640. In Wisconsin, ties last 20-30 years.

Although the Denmark, Luxemburg, and Rockwood Spurs are FRA Class 1 with a maximum speed of 10 mph, the Fox River Subdivision is FRA Class 4 with a maximum timetable speed of

49 mph. The Manitowoc Subdivision is FRA Class 3 track with a maximum timetable speed of 35 mph.

B.8 Crystal River

The Crystal River site visit occurred on February 18-19, 2015.

B.8.1 Existing Site Overview

The Crystal River site has direct rail access. Although the nuclear reactor ceased operations in September of 2009, the site also operates coal-fired power plants. Rail and barges supply the coal to the plants. The site operator is planning to build a combined cycle gas plant and close two of its coal-fired plants, but it plans to maintain its rail infrastructure to supply coal to the remaining coal fired plants on the site. The facility maintains 7 miles of track (see Figure B-44).

A recent rail project replaced all but 2.5 miles of 100-lb. rail with 132 to 136-lb. rail. In 2016, Duke Energy, the owner of the Crystal River site, decided to stop delivery of coal by rail and the remaining 2.5 miles of rail was not replaced. Duke Energy has decided to resume rail coal deliveries and is in the process of having a rail assessment performed and will make rail repairs per the recommendations of the assessment. The rail infrastructure has both concrete and wood crossties; all crossties that are replaced will be new wood crossties. The facility is currently using Southern National Track to maintain its rail infrastructure.

At its peak operation, the site received 30 to 40 unit trains of coal per month. Recently about 5 trains per month with about 100 cars per train supply the site. The unit coal trains use a loop track configuration to unload coal onto the coal stockpile and to exit the facility. Unit coal train consists are generally configured with CSXT triple-axle truck locomotives. The north side of the loop track is adjacent to the future ISFSI site (Figures B-45 and B-46). The facility has a 400-foot spur called the Nuclear Spur; this track supported four, eight-axle cars that were used to ship out four moisture separator heaters weighing 200,000 lb. each. The facility also has another spur called the Tallahassee Spur/Mine Spur that would hold approximately 20 rail cars (see Figure B-47). The site's 7 miles of railroad is operated at FRA Class 1 standards (10 mph maximum speed), although maintained at a higher standard.



Figure B-44. Railroad Access to the Crystal River Site (MapQuest 2016)



Figure B-45. Loop Track Configuration for Coal Tracks at the Crystal River Site (MapQuest 2016)



Figure B-46. Future Crystal River ISFSI Site with Adjacent Loop Track (2015)

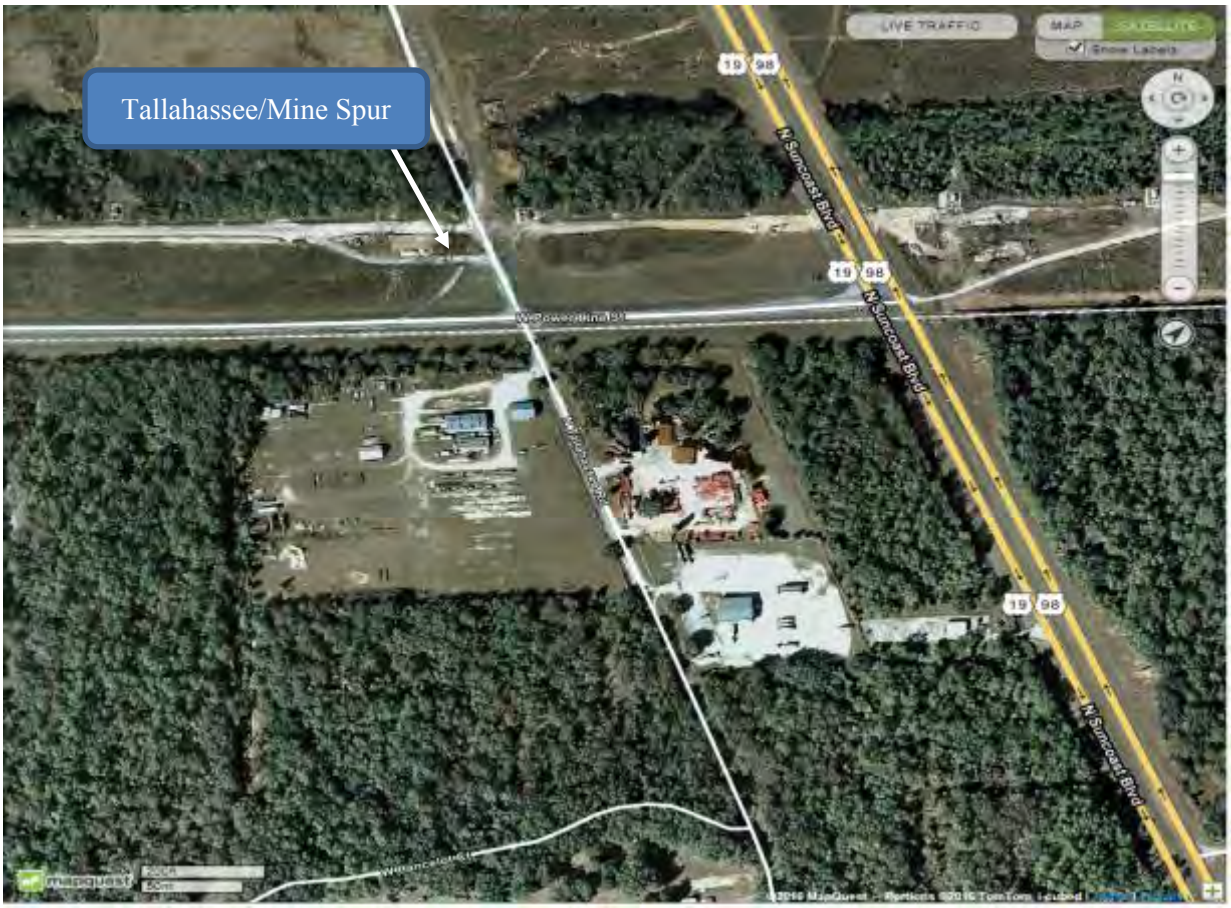


Figure B-47. Tallahassee/Mine Spur on the Crystal River Site (MapQuest 2016)

B.8.2 Railroad Operational Overview

The Florida Northern Railroad (FNOR) serves the Crystal River site. The FNOR is a part of the Pinsly Railroad Company that operates the Florida Central, Florida Midland, and Florida Northern Railroads. The FNOR was established in 1988 and operates 104 miles of track on two separate branch lines with CSXT interchange points at Ocala and Newberry. The Florida Northern's West Coast Subdivision serves the Crystal River site. The West Coast Subdivision begins at High Springs at milepost AR 716.8 at its northern end and terminates on the southern end at the milepost ARD 785.7, Crystal River's plant lead. The interchange with the CSXT is at milepost AR 730.0 in Newberry, Florida (see Figure B-48). The total distance from the Crystal River site property line and FNOR track to Newberry and the CSXT interchange is 55.7 miles. The track from milepost AR 785.7 to AR 732.0 is FRA Class 2 track and operated at a maximum speed of 25 mph for freight trains.



Figure B-48. Florida Northern Railroad and CSXT Interchange in Newberry, Florida (MapQuest 2016)

B.9 San Onofre

The San Onofre site visit occurred on June 2-5, 2015.

B.9.1 Existing Site Overview

The San Onofre site has direct rail access to the facility (see Figures B-49 through B-51). The plant is in the initial stages of preparation for decommissioning after ceasing operations in 2013.



Figure B-49. San Onofre Site (MapQuest 2016)



Figure B-50. San Onofre Site ISFSI and Facility Rail Line (MapQuest 2016)



Figure B-51. San Onofre Site Switch to Main Line (MapQuest 2016)

The San Onofre site has rail access throughout the site (Figures B-52 through B-54). As the photos depict, the rail has been paved over except for the rail head. As part of the decommissioning preparation, the facility will have a contractor evaluate the rail condition and infrastructure improvement needs throughout the site. Figure B-55 shows the ISFSI at the San Onofre site.



Figure B-52. Site Rail System Looking North (2015)



Figure B-53. Site Rail System Looking South (2015)



Figure B-54. Site Rail Lead to Main Line Switch and ISFSI Staging Area (2015)



Figure B-55. ISFSI Adjacent to Staging Area (2015)

The main line switch located at the north side of the complex is a manually operated, timed switch (see Figure B-56). The site lead is 115-lb. rail. The North County Transit District (NCTD) has a split rail derailer protecting movement from the site to the main line in place between the site property line and the main line switch (see Figure B-57). A locked gate and facility directional hinged derail are in place on the plant lead (Figures B-58 and B-59). The site lead is 90-lb. rail and descends a steep grade into the site (see Figure B-60).



Figure B-56. Manually Operated, Timed Switch (2015)



Figure B-57. North County Transit District Split Rail Derailer (2015)



Figure B-58. Locked Facility Gate (2015)



Figure B-59. Direction Hinged Derailer (2015)



Figure B-60. Site Lead 90-lb. Rail (2015)

B.9.2 Railroad Operational Overview

The Pacific Sun Railroad (PSR) is the serving railroad at the San Onofre site. The BNSF Railroad is the primary freight carrier on the North County Transit District (NCTD), and the PSR is contracted by the BNSF and NCTD as the serving freight railroad to customers on the NCTD rail system. BNSF operates freight trains from Barstow, California, to San Diego, California. These trains operate over three railroads during their trip beginning with the BNSF, then over the Southern California Regional Rail Authority (SCRRA) dispatched by Metrolink to the Orange County/San Diego County Line, followed by the NCTD dispatcher to their destination. The BNSF train off sets freight cars at the Stuart Mesa Railyard for the PSR on its way south, and picks up cars from the Stuart Mesa Railyard on its way north back to Barstow (see Figure B-61).

PSR's standard operations for the San Onofre site would consist of the BNSF setting cars off at the Stuart Mesa Railyard on its way south from Barstow to San Diego. The PSR would build its train at the Stuart Mesa Railyard prior to 12 a.m. After 12 a.m., and with dispatcher permission, the PSR would depart the Stuart Mesa Railyard heading North for San Onofre. The PSR would place and pick up cars from the San Onofre site and head south to the Stuart Mesa Railyard. The BNSF would pick the cars up from the Stuart Mesa Railyard on its way back to Barstow. When used nuclear fuel is shipped from the San Onofre site, the standard PSR operation could take place, or the BNSF may take cars directly to and from the San Onofre site if dedicated trains are used.

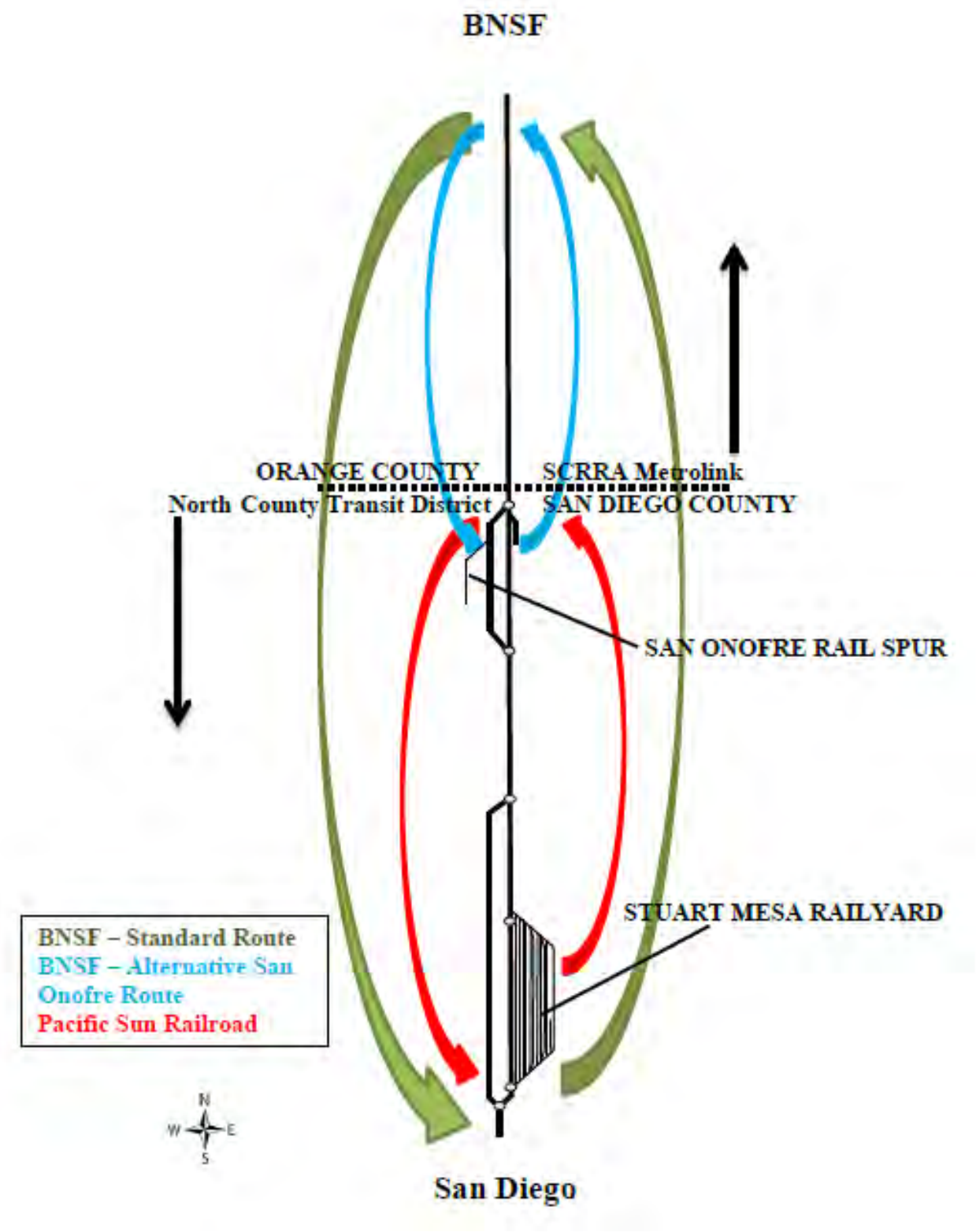


Figure B-61. Schematic of the BNSF and Pacific Sun Railroad Routes

B.10 References

Google, Inc. 2015. Google Earth (Version 7.1.5.1557). Available at https://www.google.com/earth/index.html

MapQuest. 2016. Available at https://www.mapquest.com

Appendix C:

Summary of Permitting Requirements for Oversize and Overweight Trucks

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Appendix C
Summary of Permitting Requirements for Oversize and Overweight Trucks

This appendix summarizes the permitting requirements for oversize and overweight trucks for states with shutdown sites (California, Connecticut, Florida, Illinois, Maine, Massachusetts, Michigan, Oregon, Vermont, and Wisconsin). In addition, state super load dimension and weight requirements are also summarized. A vehicle and load is considered oversized when the vehicle and the cargo it carries exceed the legal dimensions of length or width, as defined by federal requirements or length, height, or width as defined by state requirements for the state in which the vehicle will be traveling (GAO 2015). A vehicle and load is considered overweight when the vehicle and the cargo it carries exceed the legal weight limit as defined by federal and state requirements (GAO 2015). A vehicle and load is considered a super load when its dimensions and weight exceed the dimensions and weight established for typical oversized and overweight loads. The dimensions and weights that qualify as a super load are set by the states and a super load is subject to additional state permitting requirements over and above the requirements for typical oversized and overweight vehicles and loads.

The permitting summaries were compiled from information contained in the *Vehicle Sizes and Weights Manual* (J.J. Keller and Associates, Inc. 2013) and the electronic supplement to *Transportation Safety: Federal Highway Administration Should Conduct Research to Determine Best Practices in Permitting Oversize Vehicles* (GAO 2015). The electronic supplement is available at http://www.gao.gov/special.pubs/gao-15-235sp/index.htm.

C.1 California

Table C-1 summarizes the oversize vehicle permitting practices in California.

Table C-1. California Oversize Vehicle Permitting Practices

Permit Issuing Agency	California Department of Transportation – Division of Traffic Operations – Office of Commercial Vehicle Operations
Permit Enforcement Agency	California Highway Patrol – Enforcement and Planning Division – Commercial Vehicle Section
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	No
Number of Different Oversize and Overweight Permit Types Available	6 [Permit types include: single trip (fax), single trip (electronic), variance, annual, repetitive, direct crossing]
Regional Permit Agreement Membership	None
Maximum Legal Width	102 in.
Maximum Legal Height	14 ft. 0 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	15 ft. 0 in.
Super Load Height Requirement	17 ft. 0 in.
Super Load Length Requirement	135 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	None specified
Escort Vehicle Requirement for Overheight Permitted Vehicle	No
Pole Car Requirement for Overheight Permitted Vehicle	No
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	Yes (California Highway Patrol escort may be required for anything over 17 ft. 0 in.)
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes (over 12 ft.)
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes (over 15 ft.)
Route Survey Requirement for Overheight Permitted Vehicle	Yes (over 17 ft.)
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.2 Connecticut

Table C-2 summarizes the oversize vehicle permitting practices in Connecticut.

Table C-2. Connecticut Oversize Vehicle Permitting Practices

Permit Issuing Agency	Connecticut Bureau of Highway Operations – Oversize and Overweight Permits
Permit Enforcement Agency	Connecticut State Police and Department of Motor Vehicles – Commercial Vehicle Safety Division
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	No
Number of Different Oversize and Overweight Permit Types Available	5
Regional Permit Agreement Membership	None
Maximum Legal Width	102 in.
Maximum Legal Height	13 ft. 6 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	16 ft. 0 in.
Super Load Height Requirement	15 ft. 4 in.
Super Load Length Requirement	150 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	200,000 lb.
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	Yes
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes (Escorts required for loads over 12 ft. wide, 14 ft. height, and 90 ft. long)
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes (State Police escorts required for all super loads and loads over 15 ft. 4 in. height)
Route Survey Requirement for Overheight Permitted Vehicle	Yes (Required for loads over 14 ft. height)
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.3 Florida

Table C-3 summarizes the oversize vehicle permitting practices in Florida.

Table C-3. Florida Oversize Vehicle Permitting Practices

Permit Issuing Agency	Florida Department of Transportation – Permit Office
Permit Enforcement Agency	Florida Department of Transportation – Motor Carrier Size and Weight and Florida Highway Patrol – Commercial Vehicle Enforcement Unit
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	Yes
Number of Different Oversize and Overweight Permit Types Available	3
Regional Permit Agreement Membership	Southern Regional Permit
Maximum Legal Width	102 in.
Maximum Legal Height	13 ft. 6 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	16 ft. 0 in.
Super Load Height Requirement	16 ft. 0 in.
Super Load Length Requirement	150 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	199,000 lb.
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	Yes
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes
Route Survey Requirement for Overheight Permitted Vehicle	Yes
Certification Requirement for Escort Vehicle Driver	Yes
Source: GAO (2015)	

C.4 Illinois

Table C-4 summarizes the oversize vehicle permitting practices in Illinois.

Table C-4. Illinois Oversize Vehicle Permitting Practices

Permit Issuing Agency	Illinois Department of Transportation – Bureau of Operations – Permit Unit
Permit Enforcement Agency	Illinois State Police
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	Yes
Number of Different Oversize and Overweight Permit Types Available	11
Regional Permit Agreement Membership	None
Maximum Legal Width	96 in.
Maximum Legal Height	13 ft. 6 in.
Maximum Legal Length for a Semitrailer	65 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	14 ft. 6 in.
Super Load Height Requirement	14 ft. 6 in.
Super Load Length Requirement	145 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	120,000 lb.
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	Yes
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes
Route Survey Requirement for Overheight Permitted Vehicle	No
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.5 Maine

Table C-5 summarizes the oversize vehicle permitting practices in Maine.

Table C-5. Maine Oversize Vehicle Permitting Practices

Permit Issuing Agency	Maine Bureau of Motor Vehicles – Office of Motor Carrier Services
Permit Enforcement Agency	Maine State Police – Troop K, Commercial Vehicle Enforcement
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	No
Number of Different Oversize and Overweight Permit Types Available	2
Regional Permit Agreement Membership	New England Transportation Consortium
Maximum Legal Width	102 in.
Maximum Legal Height	14 ft. 0 in. (13 ft. 6 in. structural height, additional 6 in. allowed for load)
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	100,000 lb.
Super Load Width Requirement	16 ft. 0 in.
Super Load Height Requirement	16 ft. 0 in.
Super Load Length Requirement	125 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	130,000 lb.
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	No
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes
Route Survey Requirement for Overheight Permitted Vehicle	No
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.6 Massachusetts

Table C-6 summarizes the oversize vehicle permitting practices in Massachusetts.

Table C-6. Massachusetts Oversize Vehicle Permitting Practices

Permit Issuing Agency	Massachusetts Department of Transportation – Highway Division
Permit Enforcement Agency	Massachusetts Department of Public Safety
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	No
Number of Different Oversize and Overweight Permit Types Available	9
Regional Permit Agreement Membership	None
Maximum Legal Width	102 in.
Maximum Legal Height	13 ft. 6 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	14 ft. 0 in.
Super Load Height Requirement	Varies
Super Load Length Requirement	120 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	130,000 lb.
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	No
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	Yes
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes
Route Survey Requirement for Overheight Permitted Vehicle	Yes
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.7 Michigan

Table C-7 summarizes the oversize vehicle permitting practices in Michigan.

Table C-7. Michigan Oversize Vehicle Permitting Practices

Permit Issuing Agency	Michigan Department of Transportation, Michigan Transport Permits Unit – Michigan Transport Routing and Internet Permitting
Permit Enforcement Agency	Michigan State Police – Commercial Vehicle Enforcement Division
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	No
Number of Different Oversize and Overweight Permit Types Available	24
Regional Permit Agreement Membership	None
Maximum Legal Width	102 in.
Maximum Legal Height	13 ft. 6 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	164,000 lb.
Super Load Width Requirement	16 ft. 0 in.
Super Load Height Requirement	15 ft. 0 in.
Super Load Length Requirement	150 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	None specified
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	No
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes (Over 12 ft. wide)
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	No
Route Survey Requirement for Overheight Permitted Vehicle	Yes (Prior to movement)
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.8 Oregon

Table C-8 summarizes the oversize vehicle permitting practices in Oregon.

Table C-8. Oregon Oversize Vehicle Permitting Practices

Permit Issuing Agency	Oregon Department of Transportation – Over-Dimensional Permit Unit
Permit Enforcement Agency	Oregon Department of Transportation
Online Oversize and Overweight Permit System	Partial
Automated Truck Routing Software	No
Number of Different Oversize and Overweight Permit Types Available	41
Regional Permit Agreement Membership	Western Regional Permit
Maximum Legal Width	102 in.
Maximum Legal Height	14 ft. 0 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	> 16 ft. (interstates and other multilane highways) > 14 ft. (state two-lane highways)
Super Load Height Requirement	17 ft. 0 in.
Super Load Length Requirement	150 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	None specified
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	No
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	No
Route Survey Requirement for Overheight Permitted Vehicle	Route survey may be required.
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.9 Vermont

Table C-9 summarizes the oversize vehicle permitting practices in Vermont.

Table C-9. Vermont Oversize Vehicle Permitting Practices

Permit Issuing Agency	Vermont Department of Motor Vehicles – Commercial Vehicle Operations Unit
Permit Enforcement Agency	Vermont Department of Motor Vehicles – Commercial Vehicle Enforcement Unit
Online Oversize and Overweight Permit System	No
Automated Truck Routing Software	No
Number of Different Oversize and Overweight Permit Types Available	6
Regional Permit Agreement Membership	None
Maximum Legal Width	102 in.
Maximum Legal Height	13 ft. 6 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	15 ft. 0 in.
Super Load Height Requirement	14 ft. 0 in.
Super Load Length Requirement	100 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	150,000 lb.
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	No
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	Yes
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes
Route Survey Requirement for Overheight Permitted Vehicle	Yes
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.10 Wisconsin

Table C-10 summarizes the oversize vehicle permitting practices in Wisconsin.

Table C-10. Wisconsin Oversize Vehicle Permitting Practices

Permit Issuing Agency	Wisconsin Department of Transportation – Oversize Overweight Permit Section – Bureau of Highway Maintenance
Permit Enforcement Agency	Wisconsin Department of Transportation – State Patrol Division Headquarters
Online Oversize and Overweight Permit System	Yes
Automated Truck Routing Software	Yes
Number of Different Oversize and Overweight Permit Types Available	28
Regional Permit Agreement Membership	Bilateral Agreement Between Wisconsin and Minnesota
Maximum Legal Width	102 in.
Maximum Legal Height	13 ft. 6 in.
Maximum Legal Length for a Semitrailer	53 ft. 0 in.
Maximum Legal Gross Vehicle Weight	80,000 lb.
Super Load Width Requirement	16 ft. 0 in.
Super Load Height Requirement	None specified
Super Load Length Requirement	160 ft. 0 in.
Super Load Gross Vehicle Weight Requirement	270,000 lb.
Escort Vehicle Requirement for Overheight Permitted Vehicle	Yes
Pole Car Requirement for Overheight Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overheight Permitted Vehicle	No
Escort Vehicle Requirement for Overwidth Permitted Vehicle	Yes
Law Enforcement Escort Requirement for Overwidth Permitted Vehicle	Yes
Route Survey Requirement for Overheight Permitted Vehicle	No
Certification Requirement for Escort Vehicle Driver	No
Source: GAO (2015)	

C.11 Summary of State Super Load Dimension and Weight Requirements

Table C-11 summarizes the super load width, height, length, and gross vehicle weight requirements for California, Connecticut, Florida, Illinois, Maine, Massachusetts, Michigan, Oregon, Vermont, and Wisconsin.

Table C-11. Summary of State Super Load Dimension and Weight Requirements

State	Super Load Width Requirement	Super Load Height Requirement	Super Load Length Requirement	Super Load Gross Vehicle Weight Requirement
California	15 ft. 0 in.	17 ft. 0 in.	135 ft. 0 in.	None specified
Connecticut	16 ft. 0 in.	15 ft. 4 in.	150 ft. 0 in.	200,000 lb.
Florida	16 ft. 0 in.	16 ft. 0 in.	150 ft. 0 in.	199,000 lb.
Illinois	14 ft. 6 in.	14 ft. 6 in.	145 ft. 0 in.	120,000 lb.
Maine	16 ft. 0 in.	16 ft. 0 in.	125 ft. 0 in.	130,000 lb.
Massachusetts	14 ft. 0 in.	Varies	120 ft. 0 in.	130,000 lb.
Michigan	16 ft. 0 in.	15 ft. 0 in.	150 ft. 0 in.	None specified
Oregon	16 ft. 0 in.[a] 14 ft. 0 in.[b]	17 ft. 0 in.	150 ft. 0 in.	None specified
Vermont	15 ft. 0 in.	14 ft. 0 in.	100 ft. 0 in.	150,000 lb.
Wisconsin	16 ft. 0 in.	None specified	160 ft. 0 in.	270,000 lb.

Source: GAO (2015)
a. Interstates and other multilane highways.
b. State two-lane highways.

C.12 References

GAO (U.S. Government Accountability Office). 2015. *Transportation Safety: Federal Highway Administration Should Conduct Research to Determine Best Practices in Permitting Oversize Vehicles*. GAO-15-236 and electronic supplement GAO-15-235SP. Available at http://www.gao.gov/special.pubs/gao-15-235sp/index.htm.

J.J. Keller and Associates, Inc. 2013. *Vehicle Sizes and Weights Manual.* J.J. Keller and Associates, Inc., Neenah, Wisconsin.

December 12, 2016

SAN ONOFRE COMMUNITY ENGAGEMENT PANEL

Dr. Robert B. Weisenmiller
Chair
California Energy Commission
1516 Ninth Street, MS-33
Sacramento, CA 95814

Dear Chair Weisenmiller,

Thank you for your ongoing efforts to represent the interests of the State of California in favor of smart management of the state's nuclear power plants and policies. We lead the Community Engagement Panel (CEP) for the San Onofre Nuclear Generating Station (SONGS), a volunteer panel set up to help steward the process of decommissioning at SONGS. By far, the topic that has attracted the most attention at CEP meetings is how to accelerate movement of the spent nuclear fuel out of our communities into new consolidated interim storage (CIS) facilities in New Mexico, Texas, and perhaps other states. **It is in that respect that we write today and offer to work with the CEC to help sharpen a California strategy for accelerating the safe movement of spent nuclear fuel out of the state.**

We in the CEP have already benefitted enormously from the work of the CEC. We learned much when Executive Director Rob Oglesby presented at a SONGS CEP meeting in January 2015. We have also been engaged with the Department of Energy (DOE) process regarding consent for interim storage of spent fuel—a process that CEC has helped to shepherd, such as with the DOE public meeting in April 2016 in Sacramento. We think it would be useful for the CEP and the CEC to work together more closely.

Many of us in the communities around San Onofre are encouraged by the political window of opportunity that is opening for CIS. In addition to the two proposed CIS facilities that are at various stages of licensing we note that legislation was introduced in the current session of Congress to make the necessary changes in federal law, and co-sponsorship of that legislation has grown. It is quite possible that the upcoming session of Congress may see passage of that legislation as part of a larger legislative reform that would address permanent spent fuel storage (Yucca Mountain) as well as interim storage. And while the Presidential transition has created many uncertainties, DOE and the Nuclear Regulatory Commission (NRC) have been doing a lot to prepare the ground for consolidated interim storage.

It strikes us that now is the time for the State of California to accelerate planning and coordination among the appropriate state agencies in order to ensure that we are prepared to safely move the spent fuel from here—at SONGS, Diablo Canyon, Humboldt Bay, and Rancho Seco—as soon as practical. A California strategy would need to focus on how to advance our state's interests in the federal legislative and administrative processes to make CIS a reality. It would need to address questions such as how to ensure spent fuel from decommissioning nuclear sites is "first in line" when CIS becomes available, and how to ready our state, county, and local administrative bodies to work together on crucial topics such as coordination of transportation routes and safety.

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We understand that the CEC already participates in the California Nuclear Transport Working Group and, as such, coordinates with key parties such as the CHP, Cal OES, and California DPH. We appreciate that the CEC also is engaged with the Western Interstate Energy Board's High-Level Waste Committee, which offers another opportunity for the region to advance its interests. However, we are concerned that the state itself is not well enough organized to advance its interests in this debate, especially as the number of plants undergoing decommissioning in the U.S. is poised to rise—creating keen interest around the country in removing spent fuel from decommissioning sites. In the 2020s, when CIS could become available, all of the California nuclear reactors will be undergoing decommissioning—which puts our state in an almost unique position with distinct interest in making CIS a reality.

It is our hope that the CEC could help to focus and organize a statewide strategy on this important topic, and suggest ways the CEP can support such a strategy. We in the CEP have been working on many fronts—we attach a brief summary of our current strategy—but this question requires statewide and federal perspectives as well.

Those of us who serve on the San Onofre CEP would like to better understand the state-level strategy in advancing CIS while also preparing to manage the complexities of spent fuel transportation. On behalf of the CEP, we would appreciate the opportunity to discuss transportation planning with the appropriate representatives from the CEC.

We will follow-up via telephone to discuss the CEC's interest in such a discussion with the CEP or perhaps the undersigned CEP officers to start. In the meantime, thanks again for the important role you play on nuclear matters in California.

Sincerely,

David Victor
CEP Chair
Professor and Director, Laboratory on International Law & Regulation, UC San Diego

Tim Brown
CEP Vice Chair
City Council Member, San Clemente

Dan Stetson
CEP Secretary
Executive Director, Nicholas Endowment

Attachment: "San Onofre Community Engagement Panel Strategic Plan: Advocating for Federal Legislation to Enable Consolidated Interim Storage (CIS)"

cc: Members of the SONGS Community Engagement Panel
Mr. Robert P. Oglesby, California Energy Commission
Mr. Kevin Barker, Advisor, CEC
Mr. Justin Cochran, Nuclear Policy Advisor & Emergency Coordinator, CEC
Hon. Dianne Feinstein, U.S. Senator
Hon. Kamala Harris, U.S. Senator-elect
Mr. Bill Christiansen, District Director, Congressman Darrell Issa
Mr. Tom Palmisano, Vice President Decommissioning and Chief Nuclear Officer, SONGS
Mr. Manuel Camargo, Strategic Planning, SONGS
Concerned Coastal Communities Coalition

San Onofre Community Engagement Panel
Strategic Plan:
Advocating for Federal Legislation to Enable Consolidated Interim Storage (CIS)

November 2016

1. **Situation**
   - 1.1. Most stakeholders in California are aligned on need to safely store used nuclear fuel and promptly ship fuel offsite to an interim storage facility or geologic repository
   - 1.2. Senate (S 854) and House (HR 3643) bills both enjoy bipartisan support
   - 1.3. Two CIS facilities already in planning (WCS in Texas, Eddy-Lea in New Mexico)

2. ***Objectives***
   - 2.1. Make CIS a reality
   - 2.2. Be prepared to begin shipping fuel once CIS facilities are available

3. **Strategies**
   - 3.1. Advocate for federal legislation needed to enable CIS
   - 3.2. Target the California delegation of federal elected officials (particularly newly elected officials and those not yet engaged on this issue) to bolster support for CIS
   - 3.3. Leverage existing alliances:
     - 3.3.1. Decommissioning Plants Coalition, whose members include other owners of decommissioning commercial nuclear plants in the West
     - 3.3.2. Western Interstate Energy Board, High-Level Radioactive Waste Committee
   - 3.4. Keep discussions at a high level (move fuel, prioritize decommissioning plants) to maximize alliances with decommissioning sites and defer granular issues (which decommissioning sites go first) so as to avoid near-term disputes
   - 3.5. Work with the California Energy Commission (CEC) to understand its role with CIS and the roles of other state agencies (CPUC, CalTrans, CHP, Office of Emergency Services)
     - 3.5.1. Prepare a letter from the CEP to the CEC or other state agency to set forth the CEP's perspective on the importance of moving SONGS fuel offsite and to underscore the importance of an integrated strategy for state-level transportation planning
     - 3.5.2. Determine which if any state agencies require budget augmentation to support their planning efforts

4. **Tactics**
   - 4.1. <u>Messaging</u>: Develop message platform to be used in advocacy efforts which includes affirmative reasons to support CIS, rebuttals for opposition to CIS, "DOs & DON'Ts," and a call-to-action such as encouraging members to review House/Senate legislation and consider co-sponsoring

4.2. Analyze Impact of November Elections: Determine the results of the election, including president, authorizing committees, appointees to federal agencies, and new California members of the House and Senate

4.3. One-on-One Briefings: Leverage state-level support – as evidenced by Assembly Joint Resolution 29 (Chavez) and Senate Joint Resolution 23 (Bates) – to educate and engage federal officials on CIS and include encouraging members to review House and Senate legislation and consider co-sponsoring

4.4. Alliances: Build alliances to extend reach and impact

4.4.1. In the West, collaborate with existing alliances such as Western Interstate Energy Board, Western Governors Association, and/or Concerned Coastal Cities Coalition

4.4.2. In DC, collaborate with existing alliances such as the Decommissioning Plants Coalition, Bipartisan Policy Center, and the advocacy community

4.5. Workshop: As needed, conduct workshop for federal elected officials to provide background on challenge of storing used fuel on an interim and permanent basis

4.6. "Echo Chamber:" Create an "echo chamber" around all proposed legislation to build interest, momentum, and broad-based support during what may be a multi-year effort before passage

4.7. DC Advocacy Trip: Consider taking a group of regional stakeholders, including local and state elected officials, to Washington DC to advocate for CIS

5. Timing

5.1. Develop Message Platform	October / November
5.2. One-on-one Briefings	November / December
5.3. Workshop	December / January (if needed)
5.4. DC Advocacy Trip	1Q 2017

Western Governors' Association
Policy Resolution 2017-05

Storage and Disposal of Radioactive Waste and Spent Nuclear Fuel

A. BACKGROUND

1. The nation is cleaning up, treating, transporting, storing, and disposing of several classes of radioactive waste. These classes are defined in the Nuclear Waste Policy Act and other federal laws. They include:

   - Spent nuclear fuel (SNF) from nuclear power plant sites and research and naval reactors;
   - High-level radioactive waste (HLW) located at Department of Energy (DOE) facilities;
   - Transuranic waste (TRU) generated from atomic energy defense activities, the majority of which is at DOE facilities; and
   - Low-Level Radioactive Waste which is broken into four classes, including Greater-Than-Class C (GTCC) Waste.

2. Currently about 75,000 metric tons of SNF is stored at or near nuclear power plant sites, research and test reactors, and independent spent fuel storage installations (ISFSIs) in 40 states. Historically, more than 80 percent of the SNF at operating and shut down reactor sites has been generated east of the 100th meridian.

3. The amount of SNF stored on-site at commercial nuclear reactors will continue to accumulate – increasing by about 2,000 metric tons per year and likely almost doubling to about 140,000 metric tons before it can be moved off-site, because storage or disposal facilities may take decades to develop.

4. Congress mandated that the federal government begin accepting spent fuel by January 30, 1998. However, it remains uncertain when an operating repository will be sited, let alone begin accepting waste. According to DOE's January 2013 Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, the federal government does not anticipate that a geologic disposal facility will be operational until at least 2048.

5. High-level radioactive wastes that are the by-products of nuclear weapons production and used fuel from the U.S. Navy's nuclear power activities will require permanent disposal. There are also quantities of weapons-capable plutonium and highly enriched uranium that the federal government has declared surplus to national security needs, and that will require disposal in a repository. Many of these wastes are being temporarily stored at locations in western states, including California, Idaho, New Mexico and Washington.

6. DOE's Final Environmental Impact Statement (FEIS) for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOE/EIS-0375) identified seven potential disposal site candidates, six of which are in the West. Since the vast majority of this waste would be generated outside of the western region, disposal in the West would significantly add to the transportation risk. Additionally, more than 90 percent of the existing inventory of TRU waste is located in the Western states. Given existing and proposed sites for disposal of radioactive waste in the United States, the Governors are concerned that the Western states may be disproportionately impacted by radioactive waste transportation and disposal activities.

7. The preferred alternative of the FEIS is to use the Waste Isolation Pilot Plant (WIPP) and/or generic commercial disposal facilities for disposal of GTCC wastes. At present, WIPP is restricted from accepting non-defense waste and would require, at minimum, a modification of the WIPP Land Withdrawal Act in order to legally dispose of commercial GTCC waste.

B. GOVERNORS' POLICY STATEMENT

1. In the event that centralized interim storage, either private or federal, is deemed necessary, no such facility, whether publicly or privately owned, shall be located within the geographic boundaries of a Western state or U.S. flag island without the written consent of the Governor in whose state or territory the facility is to be located.

2. Any proposal to store or otherwise dispose of GTCC and high-level radioactive waste and/or SNF must be viewed as being part of an integrated program that considers all aspects of necessary operation and intergovernmental considerations. Specifically, transportation and logistical considerations should not be an afterthought to the siting process.

3. The Governors support efforts by the federal government to examine alternative waste acceptance options, including but not limited to providing funds to utilities for expanded on-site storage and taking title to SNF at individual reactor sites. The search for alternatives must not detract from the imperative to develop a permanent solution to the management and disposition of SNF.

4. The Governors strongly encourage DOE and the U.S. Nuclear Regulatory Commission (NRC) to work cooperatively with the states in implementing a policy to ensure the safe management, transportation, storage, and disposal of spent nuclear fuel and HLW and to comply with any and all agreements negotiated and entered into by a state's Governor regarding these matters.

5. Commercial SNF should remain at reactor sites until:

   - One or more storage and/or disposal sites are operational or reprocessing is deemed viable by an independent review.

   - DOE and the nuclear utility companies have consulted with states along the waste transportation corridor and implemented a mutually acceptable transportation plan for shipping the SNF waste to interim storage facilities or permanent disposal sites.

   - DOE and the nuclear utility companies have put into place adequate infrastructure capacity to handle, store and dispose of this waste.

   - DOE, the U.S. Department of Transportation and the nuclear utility companies have ensured and funded adequate state and local emergency and medical responder training and resources in case of an accident or terrorist attack while shipping this waste.

6. The creation of interim storage sites for SNF would be a direct result of the federal government's failure to begin accepting spent fuel on schedule. Therefore, the Governors maintain that it is the federal government's responsibility to ensure adequate preparation for shipments to these facilities, coordination with states, and provision of adequate federal funding, regardless of source, to reimburse the states for costs associated with shipments to any interim storage facility, whether publicly or privately owned. The Governors consider it to be entirely appropriate to use the Nuclear Waste Fund to pay for these activities.

7. Any decisions regarding the identification of an existing or planned site to dispose of GTCC and GTCC-like waste must consider any authority of the regional low-level waste compacts, and comply with all applicable low-level waste compact and NRC requirements for certification to accept commercially generated waste.

C. GOVERNORS' MANAGEMENT DIRECTIVE

1. The Governors direct WGA staff to work with Congressional committees of jurisdiction, the Executive Branch, and other entities, where appropriate, to achieve the objectives of this resolution.

2. Furthermore, the Governors direct WGA staff to consult with the Staff Advisory Council regarding its efforts to realize the objectives of this resolution and to keep the Governors apprised of its progress in this regard.

Western Governors enact new policy resolutions and amend existing resolutions on a bi-annual basis. Please consult www.westgov.org/policies for the most current copy of a resolution and a list of all current WGA policy resolutions.

COUPLING FUEL CYCLES WITH REPOSITORIES: HOW REPOSITORY INSTITUTIONAL CHOICES MAY IMPACT FUEL CYCLE DESIGN

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The United States repository for high-level waste (HLW) and spent nuclear fuel (SNF) is currently scheduled to open in 2048—more than a century after generation of the first HLW. This failure is a consequence of the cold war history and an institutional structure that provided insufficient confidence and incentives to states and communities to host a repository.

The U.S. government is now considering an alternative repository siting strategy based on voluntary agreements with state governments. If that occurs, state governments become key decision makers. They have different priorities. Those priorities may change the characteristics of the repository and the fuel cycle.

Historically the federal government has attempted to site repositories with a top-down approach driven by Administration and Congressional political considerations. This leads to siting fuel cycle facilities with associated jobs and taxes in different states.It follows that a repository will have less than optimum capabilities and benefits to the local community and state due to its geographic separation from related fuel cycle facilities.

State government priorities, when considering hosting a repository, are safety, financial incentives and jobs. It follows that states will demand that a repository be the center of the back end of the fuel cycle as a condition of hostingit. For example, states will push for collocation of transportation services, safeguards training, and navy/private SNF inspection at the repository site. Such activities would more than double local employment relative to what was planned for the Yucca Mountain (YM)-type repository. States may demand (1) the right to take future title of the SNF so if recycle became economic the reprocessing plant would be built at the repository site and (2) the right of a certain fraction of the repository capacity for foreign SNF. That would open the future option of leasing of fuel to foreign utilities with disposal of the SNF in the repository—but with the state-government condition that the front-end fuel-cycle enrichment and fuel fabrication facilities be located in that state.

Such a reorganization of the fuel cycle would reflect the end of the cold war as a major driver in fuel cycle decisions. If more than one state hosts a repository it could result in the development of a more traditional conventional industrial structure for the fuel cycle.

I. INTRODUCTION

The United States repository for high-level waste (HLW) and spent nuclear fuel (SNF) is currently scheduled [1] to open in 2048. Depending upon definitions, the failure of the proposed Yucca Mountain Repository (YMR) program is the 2^{ed} or 3^{ed} failure in a row. The U.S. Blue Ribbon Commission [2] last year recommended siting a repository using consent-based strategy. This reflects the international experience that the only successful repository programs have been those that have used a voluntary siting approach. This is a repeat of earlier recommendations ofU.S. repository siting approaches. Thirty years ago, the Office of Technology Assessment [3] made similar recommendations. Those recommendations were initially adopted and then later abandoned.

Like in previous decades, the repository program is caught in the center of partisan politics. However, there are pressures for solutions. The federal government signed contracts with utilities to take SNF for disposal starting in 1998 and now faces mounting financial penalties for failure to perform. Internationally, U.S. positions on fuel cycles relative to nonproliferation are losing their credibility because of the repository program failure. These challenges faced by the federal government create the possibility to more broadly consider what type of institutional structure is required to build a repository.

The central question is"who makes the key decisions?" The federal government has legal responsibility to dispose of the SNF. The utilities pay the bill via a levy on each kilowatt-hour of electricity generated from nuclear power plants with the oversight of state public service commissions. The state governments have a statutory role because the United States Constitution recognizes the State as an independent government entity. This is in contrast to countries such as

France with a national government with political subdivisions of the national government.

The constitutional structure of the United States and the experience of the YMP, where Nevada successfully opposed the federal government effort to site a repository,strongly suggest that state governments have effectively a veto power over the building of a repository.

We examine the consequences in terms of likelihood of siting a repository and impacts on the fuel cycle depending upon the level of government making the major repository decisions.

II. NATIONAL GOVERNMENT

As a consequence of the Manhattan Project duringWorld War II and the cold war, the United States built all the facilities needed for various fuel cycles before long-term, high level nuclear waste management was addressed. Separate facilities were built at different sites—partly to minimize the risk of a single event such as an attack, shutting down the entire system. Waste management systems were developed later. This led to the adoption of a model of the fuel cycle where wastes would be shipped from existing facilities to waste disposal facilities as they were developed. Economics was not a major consideration in the development of this system.

The federal government decision to be solely responsible for HLW and SNF disposal was a consequence of this history. Because the federal government generated large quantities of defense high level waste, the assumption was that it would be more efficient for government to be responsible for disposal of all wastes requiring geological disposal.

Another factor was nonproliferation. The first Indian nuclear detonation (1974) led to decisions by the U.S. government during the Ford and Carter administrations to adopt a once-through fuel cycle[4]. The idea was that if the U.S. set an example with a once-through fuel cycle, other countries would follow the U.S. and there would be greater barriers to nonproliferation.

This decision was made when gaseous diffusion was the primary technology for uranium enrichment—a technology that required very large plants to produce high enriched uranium suitable for construction of nuclear weapons. Consequently, it was believed that any proliferator would choose to build weapons using plutonium obtained from reprocessing SNF, as opposed to uranium enriched in gaseous diffusion plants. Since then the development of lower-cost centrifuge enrichment technology has made enriched uranium, not plutonium, the preferred route to weapons.

The non-proliferation policies contributed to a decision to establish a federal repository program that would take full responsibility and liability for defense waste as well as for utility SNF as it left the power reactor in exchange for a fee intended to cover the government's costs. This arrangement was financially attractive to the utilities and greatly reduced any utility interest in closed fuel cycles. While the change in fuel cycle directions was driven by the U.S. government, it is likely that utilities would have ultimately chosen the same fuel cycle when the greater availability of uranium and higher costs of reprocessing made the once-through fuel cycle the preferred economic choice.

The side effect was that these decisionsleft no one with a strong incentive to promptly build a repository. This is partly because the energy release from a kilogram of uranium is about a million times greater than from a kilogram of fossil fuel so the quantities of SNF are small and storable. This is in contrast to U.S. policies for disposal of other long-lived wastes. With hazardous wastes, the generator is responsible for disposal although many of these wastes include heavy metals that remain toxic forever. The chemical companies have powerful incentives to find disposal methods for their wastes.

The repository program was ultimately driven by Congressional politics where, of the candidate states, the state with the weakest Congressional delegation (Nevada) was chosen for the repository. This did not work because the balance of power between different groups in Congress (and Administrations) change faster than the time required to site, design, license, build and operate a repository. The local opposition to the repository has many roots: the major waste management problems from the weapons complex, the forced siting strategy, and a legacy of the cold war that limited benefits for the host state that accepted a repository.

The federal government (President and Congress) is now beginning a debate on the future of the repository program. Based on the recommendations of the Blue Ribbon Commission, there is a developing consensus that a voluntary repository siting strategy should be developed. If that is implemented, it makes the state (or tribal) government or governments hosting the repository, working with local communities, the key decision makers. A voluntary siting agreement would likely be implemented as a legally-binding compliance agreement in order to protect against subsequent state governments or the federal government having contrary positions.

In the following discussion, the authors assume that the candidate repositories discussed satisfy technical standards that are primarily driven by the geologic medium and geologic setting. Further, the authors make no assumptions concerning the eventual federal entity (e.g. a federal corporation) which manages the program on a national level.

III. STATE GOVERNMENTS

State governments place priorities on tax revenue and economic development (jobs). At the same time there is a

need to assure broad support across any state for industries that are recruited into that state. This leads to three challenges for a state that wants to host a geological repository: how to maximize revenue and jobs, how to assure acceptance, and how to organize the effort to achieve the above objectives.

III.A. Jobs and Revenue

The goal of most state economic development programs is to recruit an entire industry, not just a single facility. Economists have long recognized that if a specific industry reaches a critical size in a single area, this brings added industry. For example, the largest concentration of chemical plants and refineries in the United States exists between the cities of Houston and New Orleans. This started with relatively small facilities. Once one begins to build port and pipeline facilities to supportrefineries and chemical plants, other refineries and chemical plants were built in the area because of the availability of the port and pipeline facilities. This was reinforced by the knowledgeable workforce and governments that work with industry to create the common infrastructure from roads to port facilities.

This economic impact and the resultant multiplier effect are seen in many industries: chemical (Gulf coast), insurance (Hartford), food (Minneapolis), and electronics (Silicon Valley). While these developments often were accidents, the development of the auto industry in southern states such as Tennessee was not. It was recognized that if one could lure the auto assembly plants into the state with incentives, the supplier industries would follow that would ultimately provide more jobs and revenue with fewer public incentives.

If a state government is the key decision maker on whether to host a repository, a major question quickly becomes “Can the repository be used as the starting point for industrial development?” There is evidence that such a strategy is viable given that the location of many nuclear fuel cycle facilities were based on defense needs that are no longer the driver for locating facilities. Let us thus examine hosting a repository from the perspective of a state government agency responsible for industrial development.

The traditional view is that a repository is a single-purpose facility for disposal of wastes. However, from an industrial development perspective it is a package of (at least) three multi-billion-dollar coupled facilities: (1) a world-class large SNF/HLW receiving facility, (2) a world-class large waste packaging facility, and (3) a large underground disposal facility. Along with these facilities is a set of commonbut expensive support services including security and health physics.

From this perspective, if a state hosts a repository the question is: Who are the other customers for these facilities? A starting list [5] of such customers has been identified where there would be economic incentives for collocation with the repository—including the following examples.

- *SNF inspection*. U.S. navy SNF is inspected to determine its behavior and make better estimates of reactor performance for the fleet. The existing facility consists of fuel receiving, inspection, and packaging for disposal. Collocating at a repository site eliminates added transportation after packaging and the need for separate SNF receiving and packaging facilities. The same applies to commercial SNF inspection. The total budgets for these facilities we estimate near $200 million per year.
- *Safeguards*. The United States trains people around the world on safeguards. A repository would be the preferred place for training because it will have the largest selection of SNF types. It is also the preferred location to test associated equipment. A staff of several hundred people would be associated with such facilities plus a large demand for hotel and other services for people in training.
- *Nuclear industrial facilities.* There are many nuclear related services from isotope production to waste treatment. In many of these operations, waste processing and treatment are a large fraction of total costs. Co-siting with the repository facilities enables use of common services and avoids the constraints associated with shipping radioactive wastes over public roads if private roads are developed from the repository to an industrial park.

The single-purpose Yucca Mountain repository was predicted to result in ~2300 jobs to the local communities and the state. Our estimate for an open fuel cycle repository operated as a multipurpose facility is that it would increase the total workforce to between 4000 and 6000 people. This is for existing related industries where there are economic incentives for collocation. It does not include future facilities such as pilot plant reprocessing facilities where there would also be incentives for collocation.

For a state government industrial recruiting program, a second question will be who has rights to the repository capacity [5]. Most of the capacity will belong to the federal government because it has responsibility for disposal of SNF and HLW generated in the U. S. However, the state government has an interest in control of some repository capacity to aid industrial development.

For a half a century the U.S. government has wanted to create a system for leasing nuclear fuel in foreign countries as part of its non-proliferation policy. Fuel would be produced in the U.S., leased to foreign utilities,

and the SNF returned to the U.S. for disposal. This policy goal has been a failure because no state government is willing to accept foreign SNF. In addition, at this point, this would violate federal law.

Economically fuel leasing would be very attractive to everyone. There are large economic benefits for countries with small nuclear programs to lease fuel and avoid the need to build repositories. There are massive economics of scale associated with repositories. That favors a global system with a few repositories worldwide to minimize costs. Fuel leasing would potentially be a profitable business for everyone.

If the states hosting repositories have rights to some fraction of the repository capacity for foreign SNF, they could choose in the future to accept foreign SNF. The incentives for the state government to allow fuel leasing are large. The states would likely impose the condition that the fuel production (conversion, enrichment, fabrication, corporate headquarters) or other vendor facilities be located in the host state. From the state perspective, increasing the repository size by perhaps 20% could double or triple the repository benefits. Because there are no large economic incentives to build those facilities in the immediate vicinity of the repository, they could be located anywhere in the host state providing state-wide benefits.

Any foreign leasing of SNF would also require federal government approval because of import and export laws. Historically many in the federal government have viewed a state government role in foreign fuel leasing as unacceptable but the political reality is that the federal government does not have the ability to implement a fuel leasing program without state government approval. The federal government would retain its rights to site a repository over the objections of the state (current failed policy) or siting a repository offshore [6] in federal waters or on some of the island possessions that are not parts of states. In effect the federal government would not be giving up its authority but adding an alternative pathway to fuel leasing.

Last is the question of whether the U.S. will ultimately adopt a closed fuel cycle. Today the once-through fuel cycle appears to be more economic but that could change (Appendix A). Advances in technology and different regulatory structures can alter the economically preferred fuel cycle. Preliminary assessments [7] indicate that collocation and integration of reprocessing plants with the repository could lower fuel recycle costs by up to 30%; thus, states that host repositories would be the likely beneficiaries of adoption of a closed fuel cycle.

If recycle becomes economic or adopted for other reasons, there could be strong incentives to recover SNF from the repository. State governments would have strong incentives to assure any recycle facilities are built within the state and most likely at the repository site. As a consequence, there would be large incentives for any state hosting a repository as part of any agreement with the federal government to have the right to take title to the SNF in the future to assure that many of the benefits of recycle flow to the state.

III.B State Institutional Acceptance

There are many communities that expressed interest in hosting a repository. The difficulty has been obtaining state government acceptance. A question is how to get such acceptance.

A starting point is to examine social studies on public acceptance such as those by Jenkins-Smith [8] and others. These studies indicate greater acceptance of hosting a repository if (1) the repository is designed for SNF retrievability, (2) other fuel cycle facilities are collocated with the repository, and (3) research facilities are associated with the repository. These results have been interpreted respectively as providing (1) assurance of safety and maintaining future options, (2) providing jobs and revenue and (3) being part of the solution to solving national problems rather than a simply providing a "dump." Of course these issues are related since research facilities are likely to lead to jobs and revenue in both the near and the long term.

A state government would have incentives to insist that SNF retrievability be a design requirement to increase public acceptance and to keep open the option of a future closed fuel cycle that could enhance long-term economic benefits. The costs of such features appear to be small and consistent with obtaining public support for hosting a repository

TABLE 1. Change in Support for Repository Designs with Research Laboratory [8]

Initial Preference	Support (58%)	Neutral (26%)	Oppose (16%)
Support Increased	70%	55%	48%
Support Unchanged	20%	37%	21%
Support Decreased	10%	8%	31%

Public opinion polls show a strong increase in support for hosting a repository when coupled with a research laboratory. Table 1 shows the results of one poll where the question was asked "What would happen to your level of support if you learned that each of the sites also would contain a national research laboratory for studying ways to more safely and efficiently manage and dispose of nuclear materials?" This is most important to those who are neutral or are opposed to siting such a facility. Such a facility serves to both reduce the relevant

risks and provide high-prestige employment and other economic benefits.

In the context of a state hosting a repository, this has broader implications. A host state would have incentives to require, in any consent agreement, support for such a facility and support of a significant research and development program associated with its universities. The areas of interest would include fuel cycles, safeguards technologies, and geosciences. This would provide the state government with an independent source of expertise to provide assurance of repository performance, a stronger commitment to be part of the solution, a source of trained manpower, and a way to maximize local benefits of a multipurpose repository.

This is not a new role for either states or universities. From Stanford University that is the center of Silicon Valley to the large Midwestern land-grant universities that provide the technical support of American agriculture, there is a long tradition of universities supporting local industries, maximizing the local benefits from those industries, and acting as the technical experts that support state government

Lastly, any state government will want an oversight role to provide a level of confidence to its political constituents. There is a long history of states in this role at existing federal facilities and at the one operating repository in the U.S—the Waste Isolation Pilot Plant (WIPP) that disposes of transuranic wastes.

III.C. Repository Institutional Structure

If the benefits to the state hosting the repository are to be maximized, an appropriate institutional structure is required. In the context of the United States, the closest public/private institution to what may be required is the airport authority and the airport runways—a business and institutional model that combines public and private facilities [7, 9, 10]. Airport authorities own the runways, some of the terminals, and some other facilities. However connected to the runway are taxiways to a variety of public and private facilities, from terminals (passenger, air freight, etc.) to aircraft maintenance facilities to aircraft manufacturing facilities. All are collocated to take advantage of the central runway asset.

For example, the Minneapolis St. Paul International Airport, the 15th largest airport in terms of travelers each year, in 2010 generated 10.6 billion dollars in business revenue, 1.3 billion dollars in local purchases, and 626 million dollars in state and local taxes. That large revenue stream and associated taxes is a consequence of the Metropolitan Airports Commission (MAC)—a state chartered organization with the goals of providing high-quality air service to the Twin Cities while maximizing local benefits.

The structure of the commission [10] is designed to assure support for the airport by providing a mechanism for local input into the decision making process and aid economic development. Commissioners are appointed by the governor and the mayors of Minneapolis and St. Paul and represent specific nearby areas. Most of the commission members are from areas near the airport. However, four of the commissioners are appointed to represent those parts of the state that are far from the airport. It is a governing strategy that addresses local concerns while considering the economic development needs of the entire state.

A repository authority could operate in a similar manner. Some customers (SNF inspection, safeguards, etc.) would need to be connected to SNF receiving pools and hot cells by SNF transfer systems. Other customers (radioisotope production, etc.) would be connected to the repository by private heavy-haul roads or on-site rail systems. All would take advantage of the common facilities and services.

Airport authorities are larger, technologically more complex, and handle a wider range of security challenges than would be required for a repository authority. Some airports, such as Albuquerque, involve both civilian and military aviation. In such cases there are various agreements on ownership and use of the runways. The institutional models exist and have records of success.

If a repository authority was created, there would be one for each repository site. Different states have different political cultures that would result in different types of repository authorities. There would be a federal waste management authority but its activities would depend upon federal-state agreements. If more than one waste repository was built, the federal-state agreements could be significantly different with different states.

IV. UTILITIES

There is a history of waste generators being responsible for disposal of their wastes. In the United States, chemical companies are responsible for disposal of hazardous chemical wastes—including heavy metals that remain toxic forever. In Germany, the chemical companies operate geological repositories for the disposal of hazardous chemical wastes. The best known of these facilities is Herfa-Neurode, the first geological repository for hazardous wastes that has been in operation since the 1970s.

The most successful SNF repository programs are those of Sweden and Finland where the reactor owners are responsible for siting, building, and operating the repositories. Both countries have sites with local and national approval and are proceeding through licensing.

From a technical and management perspective, there is no question that an alternative to the “airport model”, a utility structure, could be assembled to operate a repository program. The issues are institutional. Unlike hazardous waste programs or the Scandinavian SNF

repository programs, U.S. policies in waste management have been partly driven by nuclear weapons programs and national nonproliferation goals. It is this connection that has made waste management a federal program.

V. OTHER CONSIDERATIONS

There is the question of how many repositories the United States should build. History supports a policy of siting and building at least two repositories. This provides a contingency option if there are unexpected technical or institutional difficulties with one site. Equally important, any voluntary siting strategy with one host state results in a monopoly. The costs of such a monopoly in the long run are likely to exceed the costs of a second repository.

There is the potential for significant cost savings if state governments are key decision makers.

- *Liabilities*. The Federal government faces significant financial liabilities for future storage of commercial SNF because of the failure to dispose of that SNF as required by contracts with the utilities. Those liabilities stop once a repository becomes operational. The time to develop a repository assuming the host state is supportive could be comparatively short.
- *Facility savings*. Making full use of the multiple facilities associated with a repository has the potential for large cost savings for several national programs.
- *Geological choices*. Work in the last decade has led to a better understanding of the costs of repositories in different geological media. There appear to be very large differences in repository costs depending upon the geology [11-12]. It implies that a new repository site may have lower total costs going forward than completion of the proposed Yucca Mountain site. There is seems to be little economic basis to select or not select Yucca Mountain as a preferred site.

VI. FUEL CYCLE IMPACTS

Which governmental entity makes which decisions on the repository will have major impacts on fuel cycledesign. Federal decision-making is likely to result ina disposal-only facility that would reflect long-termAdministration and Congressional views on the organization of the fuel cycle.

State government decision-making would likely result in a major effort to maximize use of the repository for commercial benefit. In the long-term this may include international fuel leasing with front-end fuel cycle facilities in the states hosting repositories. It also would imply a major rethinking about collocation and integration of closed fuel cycles with repository facilities.

VII. CONCLUSIONS

The historical repository siting strategy in the United States has been a top-down approach driven by federal government decision making. The Blue Ribbon Commission has recommended a voluntary siting strategy. A voluntary agreement implies state governments would become major decision makers. Such an approach is more likely to succeed. It also implies different decision makers with different priorities—jobs and revenue for the host state.

The fuel cycle structure and the concept of a stand-alone repository are legacies of World War II and the cold war. Changing the decision paradigm changes the fuel cycle. If the state governments become major decision makers, many fuel cycle facilities are likely to be located at or near the repository site for economic and political reasons. There will be an emphasis to understand the implications of collocation and integration of reprocessing with the repository versus the current model of isolated separated facilities. The decision making will more closely resemble that of other industrial sectors—particularly if more than one repository is ultimately built.

APPENDIX A: REPROCESSING AND CLOSED FUEL CYCLES

To reprocess is to treat—but for what purpose? At one time reprocessing was to produce nuclear weapons materials. At another time the U.S. began to recycle light-water reactor (LWR) SNF into mixed oxide (MOX) fuel assemblies for LWRs. In the last decade the U.S. government has processed SNF for nonproliferation reasons. High-enriched research-reactor SNF was reprocessed and the high-enriched uranium was blended with low-enriched uranium to produce low-enriched uranium that was sent to fuel fabricators to produce fuel for LWRs. In each case there are three objectives.

- Receive and store SNF from reactors
- Produce a high quality product (purified plutonium, low-enriched uranium, or MOX fuel assembly)
- Treat and dispose of wastes.

The legacy of the World War II Manhattan Project and the cold war is that separate facilities were built. However, SNF receiving and storage is a major cost. Waste management is about half the cost of reprocessing. Transportation is an important cost component and places major constraints on system design. The consequences of this [7, 13] is that there is at least a 30% cost savings by integrating these operations with the repository. This may be an underestimate but only limited studies have been done because of the historic assumptions about how to organize a fuel cycle.

Going forward we make several observations.

- If fuel is reprocessed for any reason, there are large incentives to do it at the repository site and take advantage of combined facilities and avoidance of the cost and restrictions associated with over-the-road transport of wastes.
- If fuel reprocessing is at the repository, the fuel fabrication facility should also be at the repository to avoid the shipping of plutonium between the reprocessing plant and fabrication plant, allow sharing of processing facilities, and enable use of common support operations (security, analytical laboratories, etc.). Collocation allows recycle of any off-specification MOX fuel to be easily recycled using the adjacent reprocessing plant. It also allows the use of many common waste treatment facilities. This implies major economic savings.
- With existing technologies, an integrated site with repository, reprocessing facilities, and fuel fabrication facilities could employ up to 10,000 people.
- The current economics are unfavorable [14] and the U.S. does not have the institutional structure (regulation, national policies) to implement reprocessing. However, the cost, safety, and environmental advantages of collocation are so large that a repository site should be designed to maintain the future option to build such facilities at the repository site. This would be consistent with the recommendations [2] of the Blue Ribbon Commission to maintain options.

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DRAFT CONSENT-BASED SITING PROCESS

for Consolidated Storage and Disposal Facilities for Spent Nuclear Fuel and High-Level Radioactive Waste

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U.S. DEPARTMENT OF ENERGY

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1. INTRODUCTION

The Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* (Strategy),[1] released in 2013, calls for "a phased, adaptive, and consent-based approach to siting and implementing a comprehensive management and disposal system" for spent nuclear fuel (SNF) and high-level radioactive waste (HLW). In December 2015, the Department of Energy (DOE) launched an initiative to develop a process for siting disposal or storage facilities for these materials collaboratively with the public, communities, stakeholders, and governments at the tribal, state, and local levels. As part of the first phase of this initiative, DOE issued an Invitation for Public Comment[2] and conducted a series of public meetings with stakeholders and communities around the country to seek feedback and inform future efforts.

This document outlines DOE's current thinking regarding specific steps and broader design principles for implementing a consent-based siting process. It reflects the input gathered from a wide range of participants in DOE's earlier outreach efforts,[3] as well as the findings of several expert groups that have reviewed these issues, including the Blue Ribbon Commission on America's Nuclear Future (BRC).[4] In addition, this document offers preliminary views on siting considerations for federal SNF and HLW storage and disposal facilities. As DOE continues to refine its approach to consent-based siting, it is committed to proceeding in a manner that is inclusive, participatory, and responsive to new information and the suggestions and recommendations of communities, stakeholders, and the public.

2. RATIONALE FOR MOVING FORWARD WITH A CONSENT-BASED SITING PROCESS

As the BRC explained, "finding sites where all affected units of government, including the host state or tribe, regional and local authorities, and the host community, are willing to support or at least accept a facility has proved exceptionally difficult."[5] Lacking a disposal solution, most of the nation's inventory of SNF is currently being stored at commercial nuclear reactors around the country, and additional quantities of HLW and SNF are being stored at various DOE sites. The issuance of this draft consent-based siting process reflects the DOE's judgment—grounded in conclusions reached by previous studies[6] and real-world experience with siting controversial facilities in the United States and elsewhere—that a consent-based process is more likely to deliver successful outcomes.

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[1] U.S. Department of Energy, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, January 2013.* https://energy.gov/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste.

[2] U.S. Department of Energy, *Invitation for Public Comment to Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities,* 80 FR 79872, December 23, 2015. https://www.federalregister.gov/documents/2015/12/23/2015-32346/invitation-for-public-comment-to-inform-the-design-of-a-consent-based-siting-process-for-nuclear

[3] U.S. Department of Energy, *Designing a Consent-Based Siting Process: Summary of Public Input Final Report*, December 29, 2016. https://www.energy.gov/ne/downloads/designing-consent-based-siting-process-summary-public-input-report.

[4] The BRC formed in 2010 at the direction of President Obama to develop a new strategy for managing the nation's spent nuclear fuel and high-level radioactive waste. It issued a number of recommendations in 2012 that helped inform the Administration's Strategy. A reference to the BRC's Report to the Secretary of Energy is included in footnote 5.

[5] Blue Ribbon Commission on America's Nuclear Future, *Report to the Secretary of Energy*, January 2012. https://energy.gov/ne/downloads/blue-ribbon-commission-americas-nuclear-future-report-secretary-energy.

[6] National Research Council of the National Academies, One Step at a Time: The Staged Development of Geologic Repositories for High-Level Radioactive Waste, 2003. https://www.nap.edu/read/10611/chapter/1.

DOE also recognizes that action by Congress will be needed to implement some of the steps and design principles outlined in this report, and that implementing an integrated waste management system[7] that includes disposal capabilities can be expected to take decades. In light of this reality and in the interest of getting started, DOE has sought to outline key steps for a consent-based siting process that could be applied by any federal implementing organization, including a new nuclear waste management entity as discussed in the Strategy.

3. TYPES OF FACILITIES

DOE's vision is for an integrated waste management system that will provide for the safe and secure transportation, storage, and disposal of the nation's SNF and HLW. It could include:

- A pilot interim storage facility, initially focused on accepting spent nuclear fuel from shutdown commercial reactor sites
- A larger, consolidated interim storage facility, potentially co-located with the pilot facility and/or with a geologic repository, that provides flexibility within the integrated waste management system
- One or more geologic repositories for SNF and HLW

The Department is also investigating the concept of deep borehole disposal, which could be an option for the disposal of smaller and more compact waste forms currently stored at DOE sites. Transportation infrastructure to move SNF and HLW will be needed. Planning for the safe and secure shipment of materials to a storage or disposal facility is a critical activity that demands close cooperation between the implementing entity and tribal, state, and local governments along likely transportation routes. As it has done for past radioactive materials shipments, DOE is committed to working with tribal, state, and local authorities, including state regional groups,[8] to address transportation issues and respond to the concerns of affected communities.

The remainder of this section provides a brief overview of the existing U.S. SNF and HLW inventory and a short description of the types of facilities that DOE would propose to site using a consent-based approach. Each poses different kinds and levels of opportunity, benefits, risk, and impact, and thus presents different siting challenges. Project cost and timescales for siting, licensing, constructing, operating, and closing a facility will vary from facility to facility.

3.1 SNF and HLW Types and Quantities

The types and quantities of material in the nation's inventory of SNF and HLW vary. SNF from the operation of commercial nuclear power plants accounts for the largest portion of the inventory: approximately 75,000 metric tons of heavy metal (MTHM) in total.[9] This SNF exists in the form of

[7] DOE webpage on Integrated Waste Management https://energy.gov/ne/integrated-waste-management.
[8] For example, DOE already interacts frequently with groups such as the Southern States Energy Board, the Western Interstate Energy Board, and the Midwestern Office and Eastern Regional Conference of the Council of State Governments on transportation planning issues and shipping programs associated with nuclear materials.
[9] Spent nuclear fuel quantities are often reported in terms of metric tons of heavy metal (MTHM). This is a measure of the amount of uranium used in the fuel and does not account for other metals used in the manufacture of a nuclear fuel assembly. The 75,000 MTHM figure includes commercial SNF in storage as of the end of 2015.

fuel rod assemblies, and nearly all of it is being stored at the reactor sites where it was generated, either submerged in pools of water (wet storage) or in shielded casks (dry storage).

High-level radioactive waste, most of which was generated by reprocessing for defense nuclear activities, consists of roughly 90 million gallons of high-level waste liquids, sludges, and solids. Most of the defense high-level radioactive waste in DOE's current inventory is stored at the Hanford and Savannah River sites and is planned to be (or has already been) vitrified into a glass form. DOE also manages defense high-level radioactive waste in a dry calcine form at the Idaho National Laboratory. DOE also manages spent nuclear fuel from the operation of the U.S. Navy nuclear fleet, and from research and development (R&D) activities. The DOE spent nuclear fuel inventory totals approximately 2,400 MTHM.[10]

3.2 Pilot Interim Storage

The Strategy calls for the development of a pilot interim storage facility with limited capacity that would initially be focused on taking spent nuclear fuel from shutdown reactor sites. This pilot facility would need to have the capability to transfer large dry storage canisters (DSCs)[11] from transportation casks into dry storage. DOE's current concept for this type of facility includes constructing and operating a canister handling building, a canister transfer facility, a storage cask fabrication facility, an administration building, and a visitor center. In addition, a pilot interim storage facility may provide expanded storage capability such that additional spent nuclear fuel could be handled from other shutdown and/or operating reactors that have dual-purpose casks (DPCs) and transportable storage casks (TSCs) available to ship.

3.3 Consolidated Interim Storage

Building on experience gained through the development of a pilot storage facility, the Strategy includes a larger, consolidated interim storage facility that would provide sufficient capacity to accept spent nuclear fuel from operating commercial nuclear power plants and, if necessary, from DOE sites. A larger storage facility could potentially be co-located with the pilot facility and/or a geologic repository, and could accommodate a much broader variety of storage systems. DOE's current concept for this type of facility includes constructing and operating facilities similar to those identified as part of a pilot interim storage facility, but could also be expanded to include a bare fuel receipt facility, a canister inspection and remediation facility, a research and development facility, a repackaging facility, and a fleet and cask maintenance facility. The scope of this facility would differ from that of the pilot facility in that the total spent nuclear fuel storage capacity could be as much as 70,000 MTHM. A larger facility (or facilities) would continue to receive DPCs and TSCs, and may also receive and store individual fuel assemblies, depending on the spent nuclear fuel acceptance strategy.

[10] U.S. Department of Energy, *Assessment of Disposal Options for DOE-Managed High-Level Radioactive Waste and Spent Nuclear Fuel*, October 2014, p. 8-9. https://www.energy.gov/ne/downloads/assessment-disposal-options-doe-managed-high-level-radioactive-waste-and-spent-nuclear.

[11] This draft siting process document reflects concepts that could support future decision-making by DOE. No inferences should be drawn from this document regarding future actions by DOE. To the extent that elements in this draft siting process document conflict with provisions of the Standard Contract, the Standard Contract provisions prevail.

3.4 Deep Geologic Disposal

The Strategy includes at least one permanent geologic repository for spent nuclear fuel and high-level radioactive waste from commercial and defense activities. After the President's March 2015 finding that the development of a repository for defense high-level radioactive waste only is required, DOE also has been planning for a separate repository for the disposal of SNF and HLW resulting from atomic energy defense activities and/or DOE research and development activities (hereinafter referred to as a defense waste repository).[12]

Any permanent geologic repository would be designed based on the geologic media in which it is sited. The BRC report provides a useful overview of the basic concept:

> *In a mined geologic repository, wastes would be placed in engineered arrays in conventionally mined cavities deep beneath the earth's surface. The waste itself would be contained in canisters or other packages appropriate to its particular form, chemical content, and radiation intensity. As developed and studied around the world, proposals for geologic disposal also employ the concept of multiple barriers. These include both engineered and geologic barriers that improve confidence that radioactive constituents will not return to the biosphere in biologically significant concentrations.... While engineered barriers would be tailored to a specific containment need, geologic barriers would be chosen for their in-situ properties with respect to both waste containment and isolation.*[13]

A geologic repository would also include a number of surface systems and facilities to support waste receipt, handling, and disposal operations. Many of these surface support systems would be similar to those needed at an interim storage facility. Unlike a storage facility, however, a geologic repository would also need systems and capabilities to support subsurface operations.

Borehole disposal is another form of deep geologic disposal that may be appropriate for smaller waste forms. This disposal concept consists of drilling borehole(s) to a total depth of about 5,000 meters (16,400 feet or greater than three miles) into crystalline basement rock, placing waste packages in the lower emplacement zone portion of the borehole, and sealing and plugging the upper portion of the borehole. The required bottom-hole diameter of the borehole(s) depends on the waste package configuration for the reference concept, but ranges from 22 centimeters to 43 centimeters (8.5 inches up to 17 inches). DOE is currently pursuing research and development efforts not involving nuclear waste to investigate the feasibility of the deep borehole disposal concept.[14]

[12] U.S. Department of Energy, *Draft Plan for a Defense Waste Repository*, December 2016. https://www.energy.gov/ne/defense-waste-repository.
[13] Blue Ribbon Commission on America's Nuclear Future, *Report to the Secretary of Energy*, January 2012, p. 29.
[14] U.S. Department of Energy, Request for Proposal Number/Title: DE-SOL-0010181, Deep Borehole Field Test. https://www.fedconnect.net.

4. GENERAL DESIGN PRINCIPLES FOR A CONSENT-BASED SITING PROCESS

Building on input gathered during the initial public engagement phase, DOE has identified a number of design principles for an effective consent-based siting process. The Department is committed to adhering to these design principles in its efforts to refine and move forward with the consent-based siting framework detailed in Section 5.

- *Prioritization of Safety* – The highest priority will be to site, design, construct, operate, and close nuclear waste management facilities in a safe and secure manner that is protective of human health and the environment.
- *Environmental Responsibility* – The siting process will support the development, construction, operation, and closure of facilities that successfully isolate radioactive materials from the environment and use best practices with respect to rigorous planning, implementation, and monitoring.
- *Regulatory Requirements* – The siting process will support the development of facilities that meet or exceed applicable regulatory requirements. Regulatory requirements will be applied rigorously and transparently.
- *Trust Relationship with Indian Tribes* – The siting process will respect tribal sovereignty and self-determination, lands, assets, resources, and treaty and other federally recognized and reserved rights. The process will take into account siting impacts on sacred tribal lands, and other areas and resources of religious or cultural significance. (The importance of recognizing Tribes' special trust relationship with the U.S. federal government in the siting process is discussed further in Section 5.4 of this document; siting considerations are also discussed in Chapter 6.)
- *Environmental Justice* – The process will pursue fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income. The process will also embrace environmental justice principles, and comply with federal requirements and guidance on these issues.
- *Informed Participation* – Consent is not meaningful unless it is informed. This means that the implementing organization[15] will share information and provide financial and technical resources to communities as needed to enable effective participation and provide for informed decision-making.
- *Equal Treatment and Full Consideration of Impacts* – The siting process will be conducted in a manner that is considerate of parties who are or may reasonably be affected, identifies and shares information about potential impacts, and makes explicit the role of fairness and equity considerations in its decision-making.

[15] Under current authority, DOE is legally responsible for implementing the waste program. The BRC recommended a new organization be created that would be dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed. The Administration's Strategy agrees with the recommendation of the BRC. DOE is prepared to maintain this function or support the transfer of this role to a new organization based on direction from Congress.

- *Community Well-being* – Communities will want to weigh the potential opportunities and risks of hosting a facility, including the social, economic, environmental, and cultural effects—both positive and negative—it may have on the community. To ensure that the siting process is fair and durable, consideration of all these impacts and benefits will be integral to the siting process.
- *Voluntariness/Right to Withdraw* – Participation in the consent-based siting process will be voluntary. Further, a community that volunteers to be considered for hosting a nuclear waste management facility will reserve the option to reconsider and withdraw itself from further participation up to the point that a binding agreement has been signed. Provisions specifying when and on what grounds agreements could be terminated or amended beyond that point could be negotiated as part of the agreement.
- *Transparency* – The siting process will be open to input throughout and transparent with respect to how decisions are made. Every effort will be made to share information and input with all participants in the process and explain how this information and input is being considered or applied.
- *Stepwise and Collaborative Decision-Making that is Objective and Science-Based* – The process will be implemented in discrete, transparent, and easily observed and evaluated steps, in consultation with the public, interested stakeholders, and affected parties. Decisions will be based on sound science and siting considerations and regulatory requirements will be applied rigorously and transparently. The siting process will recognize the value of supporting robust participation, encouraging multiple applications, and keeping options open, especially in the early phases of the siting process.

5. SITING PROCESS

5.1 Early Engagement and Outreach

In designing this draft consent-based siting process, DOE considered the input received during the yearlong effort to engage with the public and stakeholders in a national-level dialogue about consent-based siting for nuclear waste management and disposal facilities. DOE also reviewed and considered the findings and recommendations of other organizations and expert groups that have looked at the challenge of siting nuclear waste facilities, including the National Academy of Sciences, the Nuclear Waste Technical Review Board, and the BRC (among others). In addition, DOE considered international experience in this area, including consent-based siting efforts being undertaken by other governments (e.g., Canada and the United Kingdom). Specific activities and outputs from the initial public engagement phase of DOE's consent-based siting initiative include the following:

- Publishing an *Invitation for Public Comment to Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities* and hosting a series of 10 public meetings (including 8 regional meetings across the country and 2 in Washington, DC).
- Publishing *Designing a Consent-Based Siting Process: Summary of Public Input Report*, summarizing input gathered through the Invitation for Public Comment and public meetings.

- Publishing the *Draft Plan for a Defense Waste Repository* (December 2016) to solicit input on this proposed element of DOE's integrated waste management strategy.

- Continuing interactions with the National Transportation Stakeholders Forum (NTSF) and several ad hoc working groups associated with NTSF, the Transportation Core Group, state and regional groups, and the Tribal Caucus.16 In addition, DOE has continued to engage with the Nuclear Energy Tribal Working Group (NETWG).

- Discussing DOE's vision for an integrated waste management strategy at numerous venues (the *Summary of Public Input Report* contains a full list).

Copies of these documents can be found on the Department's Consent-Based Siting website at https://energy.gov/ne/read-more-about-nuclear-waste-management. Summaries, videos, and transcripts of the 10 consent-based siting meetings hosted in 2016 can be found at https://energy.gov/ne/activities-and-events.

Before turning to a discussion of specific phases and steps in DOE's proposed design for a consent-based siting process, it is worth reiterating that any consent-based process—by its nature—will have to be flexible and adaptive. Thus, DOE's aim in this draft consent-based siting process is to offer general direction and guidance in an effort to seek additional input, rather than to set out a rigid blueprint to be followed. Experience in the United States and elsewhere suggests that siting processes, especially for complex and controversial facilities, are inherently unique. That means the steps described here may not occur exactly in the sequence described and may need to be modified—in duration and/or scope—based on the particular needs of potentially interested communities and on the nature of the facility itself. Some steps may also proceed in parallel with others. For example, the development of generic repository standards by the U.S. Nuclear Regulatory Commission (NRC), the U.S. Environmental Protection Agency (EPA), and other agencies (if applicable) will take time and could occur in parallel with other preliminary repository siting efforts. As such, the timelines listed below are rough estimates based on preliminary planning assumptions and are meant only to provide a rough approximation of the amount of time it may take to complete any given phase.

It should also be recognized that the while the local community is generally the most affected by any siting process, local and state government, Congressional delegations, as well as any affected Tribal governing body, will play important roles in the siting process. Therefore, the use of the term "community" in the following draft consent-based siting process should be interpreted as the broad and inclusive participation from all of these groups and not limited to the local community.

[16] While these interactions focused primarily on transportation, consent-based siting was also discussed.

5.2 Draft Steps in the Siting Process

Phase I	Initiate Consent-Based Siting Process and Invite Communities to Learn More *Rough estimate of schedule: 1–3 years to initiate the consent-based siting process for each type of facility.*
Step 1	**Implementing organization obtains legislative authority and funding.** Initiate a consent-based siting program, with sufficient authority and funding, to collaborate with communities and stakeholders at the local, state, and tribal levels to site waste management facilities.
Step 2	**Implementing organization initiates the consent-based siting process.** Provide information, answer questions, and engage with the public on consent-based siting and an integrated waste management system to store and dispose of nuclear waste. Discuss consent-based siting with potentially interested communities and stakeholders, and encourage mutual learning between communities and the implementing organization. Information-sharing, open discussion, and mutual learning activities continue throughout the consent-based siting process. The NRC, EPA, and other agencies (if applicable) initiate development of generic repository standards.
Step 3	**Implementing organization issues a funding opportunity for communities to learn more.** Establish a federal grant program and issue a funding opportunity for communities interested in learning more about consent-based siting, nuclear waste management, siting considerations, and the role a waste management facility (or facilities) may play in the community. Additional funding opportunities may be issued in later steps of the process based on Tribal, state, community, and program needs.
Step 4	**Communities express interest in learning more respond to funding opportunity.** Communities respond to the funding opportunity notice indicating an initial interest in learning more about consenting to host an interim storage facility or repository. Briefings, meetings, information materials, and opportunities for open discussion are made available to communities that express interest. Communities submit grant applications.
Step 5	**Implementing organization evaluates applications and awards grants.** The implementing organization reviews grant applications and evaluates whether the community has the potential to play a role in an integrated waste management system. This early-stage evaluation focuses on high-level, readily detectable factors that could exclude a community from further consideration, such as proximity to major population centers, national parks, or other areas of special significance. This step relies on readily available information, such as reports of the U.S. Geological Survey, state geological agencies, academic papers, and National Laboratory-developed geologic information systems with data relevant to both surface facilities and underground repositories. The implementing organization awards grants based on criteria in the funding opportunity notice to enable communities to learn more. The implementing organization works closely with communities to encourage mutual learning, establish an open dialogue, identify potential environmental justice concerns, and support community planning efforts to assess whether a facility fits into the community's long-term vision

	and well-being, including economic benefits and challenges. This engagement with the implementing organization continues throughout the consent-based siting process. The NRC and EPA, and other agencies (if applicable) continue development of repository standards.
Step 6	**Community requests preliminary assessment of site.** The community decides whether to request a preliminary assessment to determine whether a site or sites within the community have the potential to possess the geological, geographical, and technical attributes expected for hosting a SNF and/or HLW management facility. Communities may choose to hire their own experts to help them evaluate if they wish to proceed to a preliminary assessment and continue their involvement with the siting process.
Phase II	**Site Assessment** *Rough estimate of schedule: 1–2 years for interim storage facility; 2–4 years for repository.*
Step 7	**Implementing organization conducts preliminary site assessment.** At the request of the community, the implementing organization conducts a preliminary site assessment. This includes site evaluation activities to assess technical concerns and feasibility, infrastructure issues, local socio-economic and environmental conditions, and potential impacts. The assessment begins with an extensive analysis based on the full range of existing information that can be obtained in a reasonable time. In addition to the information gathered in the first phase, data sources considered may include a more comprehensive review of literature and related studies in the public domain and the private sector (when available); various meteorological, environmental, socioeconomic, and transportation studies conducted in the affected area by federal or state agencies; and available data from existing exploratory boreholes or other existing field investigations in the region of the site. If this analysis identifies additional data that are necessary to support a decision to conduct a detailed site assessment in Phase III, some additional activities may be undertaken following completion of required environmental reviews, including surface investigations such as geologic mapping and geophysical surveys, compilations of satellite imagery data, aerial photography, or limited surface-disturbing work such as trenching. After analysis of the information collected, the implementing organization completes the assessment, shares the results with the community, and determines whether a site (or sites) within the community is eligible to be considered for a detailed site assessment. The decision-making process used to determine whether sites are suitable for a detailed assessment and the bases for the decision are discussed clearly and openly with the community. The NRC and EPA, and other agencies (if applicable) propose generic repository standards.

Step 8	**Community requests detailed assessment of site.** A community that has a site (or sites) that pass the preliminary site assessment decides whether to request a more detailed assessment to determine whether that site (or sites) has the potential to obtain a license for the construction and operation of a storage and/or disposal facility for SNF and/or HLW. The community decides whether it is interested in requesting a detailed site assessment for an interim storage facility, a disposal facility, or both. In addition, the community identifies any additional features of interest that would be important in terms of supporting community well-being.
Phase III	**Detailed Assessment** *Rough estimate of schedule: 2–4 years for interim storage facility; 5–10 years for repository.*
Step 9	**Implement organization conducts detailed site assessment.** The implementing organization conducts a detailed assessment of the site. Data obtained is used to develop the facility design, satisfy requirements of the National Environmental Policy Act (NEPA) and other environmental laws, and prepare licensing documentation. The implementing organization initiates activities to comply with NEPA, including issuing a Notice of Intent to prepare an Environmental Impact Statement where appropriate. The implementing organization and the community work together to engage potentially affected communities—at the local, tribal, and state levels—in the analysis of health, safety, environmental, social, economic, and cultural effects of the potential facility. This engagement with surrounding communities should include efforts to address environmental justice concerns, if any. A detailed site assessment involves data collection activities that would likely be quite extensive for a repository. Some surface-based testing, including boreholes, would likely be required to provide data related to surface facilities and operations—for both repositories and storage facilities. A repository would also require a substantial additional amount of work (referred to as site characterization in repository regulations) to establish geologic conditions and the ranges of those parameters of a particular site that are relevant for evaluating whether a repository at the site will be able to provide safe long-term isolation of the waste. This work may include subsurface investigations from boreholes, exploratory shafts, and tunnels; laboratory research; and modeling of long-term repository performance. The implementing organization then determines if any sites that have been the subject of a detailed site assessment are suitable for preparation of a license application for the type of facility in which the community has expressed interest. The decision-making process and bases for the decision are discussed clearly and openly with the community prior to, during, and after the assessment.
Step 10	**Community with suitable site(s) decides whether they may be willing to host.** If a site within the community is confirmed to be suitable in Step 9, the community decides whether to pursue the possibility of hosting a nuclear waste management facility. The decision to take this step is based on information gathered in all previous phases; considerations of community well-being and community planning; collaboration with surrounding communities at the local, state, and tribal levels; and a mutual learning process between the community and the implementing organization.

Phase IV	**Agreement** *Rough estimate of schedule (note that times overlap with the prior phase): 1–2 years for interim storage facility; 2–5 years for repository.*
Step 11	**Community offers the terms and conditions on which they would like to proceed.** Following an affirmative decision to pursue hosting a facility, the community drafts and proposes the terms and conditions of an agreement with the implementing organization to host the facility. This includes what types and amounts of SNF and/or HLW the community would consent to accepting at the proposed facility, the type of facility (storage, disposal, or both) that would be considered, and under what terms and conditions.
Step 12	**The community and the implementing organization negotiate and ratify an agreement.** The community and the implementing organization discuss, collaborate, and negotiate to achieve a workable, durable agreement. The implementing organization and the community determine whether to enter into a formal agreement.
Step 13	**The community and the implementing organization finalize the agreement.** The community determines the method to be used to ratify the agreement that the community considers suitable. The implementing organization and community accept terms of the agreement, and all required parties sign. Agreement is approved by necessary parties and finalized.
Phase V	**License, Construct, Operate, and Close** *Rough estimate of schedule:* *Licensing Process: 2–3 years for interim storage facility; 3–5 years for repository* *Construction: 18–24 months for interim storage facility; 7–10 years for repository* *Operation: 40–100 years for interim storage facility; 30–150 years for repository*
Step 14	**License facility.** The implementing organization and the community work together to finalize the facility design, safety analysis, and license application for the proposed facility (or facilities). The license application is submitted to the NRC for review and decision. The NRC considers the application under the regulations applicable to the specific type of facility proposed with opportunities for involvement by other parties as provided in those regulations.
Step 15	**Construct and operate the facility.** Assuming receipt of the required authorization from the NRC and other agencies and in accordance with the formal agreement, the implementing organization constructs and then operates the facility. Preparation for transportation and other logistical and infrastructure steps are finalized prior to start of operation. The implementing organization continues to work collaboratively with the community to ensure commitments to the community are maintained and upheld throughout the lifetime of the facility.
Step 16	**Close and decommission the facility.** The implementing organization and the community work together to close and decommission the facility under the terms agreed to in the formal agreement and consistent with applicable statutory and regulatory requirements.

Step 17	**Monitor the site post closure and maintain communication.** The implementing organization and the community continue to monitor the site to ensure safety and protection of people and the environment. The program implementer and the community maintain open, two-way communication.

5.3 Issues to Be Addressed Throughout the Siting Process

As the above sequence of phases and steps indicates, potential host communities and the implementing organization will confront multiple decision points where expressions of interest (early in the process) and more formal statements of consent and agreement to continue (later in the process) are needed to proceed to the next phase. Timely and frequent engagement with stakeholders will be critical to navigate each of these decision points in a way that is tailored to the local and regional contexts of potential host sites. In particular, key questions about the nature of consent and about mechanisms for registering consent will need to be discussed throughout the process, up to the point where a final agreement to move forward with a license application is signed.

In addition, the siting process will need to address a number of important issues and questions that cannot be specified in advance, but that will have to be resolved through active consultation, dialogue, and engagement between the implementing organization and affected parties, including Tribes, states, regional and local authorities, and congressional representatives. Examples of such issues include how to address the concerns and interests of neighboring states and Tribes; how to identify and engage other key stakeholders; how proposed agreements, including benefits and incentives, will be reviewed and evaluated; and what type of cooperation and/or oversight role host jurisdictions have in the development, operation, and closure/decommissioning of the proposed facility.

5.4 Key Role of Tribes and States

Many of the comments received in response to the Invitation for Public Comment to Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities stressed the central role of elected officials at the tribal or state level in consent-based siting.[17] Unlike local governments, Tribes and states have recognized powers that will require special attention throughout such a process. The federal government consults with tribal governments[18] and has a trust responsibility to protect tribal sovereignty and self-determination, as well as tribal lands, assets, resources, and treaty and other federally recognized and reserved rights. In general, federal Indian reservations are not subject to laws of the states in which they are located.[19] In addition, Tribes retain treaty rights and tribal interests in large areas beyond reservations.

[17] U.S. Department of Energy, *Designing a Consent-Based Siting Process: Summary of Public Input Final Report*, December 29, 2016, p. 11-21, 28-30.
[18] The federal government's responsibilities to consult government-to-government with Tribes are found in Executive Order 13175, Consultation and Coordination with Indian Tribal Governments (2000).
[19] A federal Indian reservation is an area of land reserved for a Tribe or Tribes under treaty or other agreement with the United States, executive order, or federal statute or administrative action as permanent tribal homelands, and where the federal government holds title to the land in trust on behalf of the Tribe. For more information, see: https://www.bia.gov/FAQs/.

States are the fundamental building blocks of the U.S. federal system, and retain powers that are not delegated to the federal government, or prohibited to the states, by the Constitution. States are responsible for ensuring the health and safety of their citizens, and have jurisdiction over local authorities.

All major nuclear waste legislation over the past four decades has recognized the fundamental and distinct roles of Tribes and states in the U.S. federal system, and defined explicit mechanisms for involving tribal and state governments in the process of siting, constructing, and operating repositories and storage facilities. In the case of the federal government's government-to-government relationship with Indian Tribes, the siting process will follow DOE's American Indian and Alaska Natives Tribal Government Policy and implementation guidance, as well as broader federal guidance (including Executive Order 13175 concerning "Consultation and Coordination with Indian Tribal Governments").

DOE will seek to initiate and maintain communications with host Tribes and states, as well as other affected jurisdictions from the outset in accordance with relevant Executive Orders, statutes, and regulations.

6. SITING CONSIDERATIONS

6.1 The Role of Siting Considerations in a Consent-Based Siting Process

Siting considerations play a role in the early stages of the siting process by helping communities evaluate the potential suitability of sites in the community for a nuclear waste management facility and ensuring that time and resources are not invested in exploring sites that are unlikely to support the mission these facilities need to serve. As already noted in Step 5 of Phase 1 in the draft process, the implementing organization will evaluate applicants' prospective sites against broad, exclusionary factors such as proximity to major population centers, national parks, or other areas of special significance and award grants to learn more to those applicants not excluded by these factors. Of course, later steps—including the preliminary and detailed site assessments—require increasingly detailed and rigorous analysis of the total system performance at specific potential sites.

Ultimately, the safety and appropriateness of any potential site for a particular type of facility will be assessed against a number of factors, both technical and social in nature. Regulatory standards developed and enforced by an independent regulator(s) will play an essential role in protecting the public and the environment, and holding the implementer accountable. Prior to construction and operation, the Nuclear Regulatory Commission will consider the license application to determine that the facility will meet the regulatory standards established to ensure the health and safety of the public.

The specific considerations outlined below are not exhaustive and do not preclude the consideration of other factors.

6.2 Siting Considerations

Major federal actions related to a federal proposal to site, construct, operate, and ultimately close storage or disposal facilities for SNF and HLW, including associated transportation, would be subject to NEPA (42 USC 4321 et seq.), which establishes requirements for proposed major federal actions that could significantly affect the quality of the human environment. NEPA requires federal agencies to consider potential environmental consequences of and reasonable alternatives to their proposed actions. Council on Environmental Quality (CEQ) implementing regulations for NEPA (40 CFR Parts 1500-1508) and applicable agency-specific regulations, establish the requirements for involving the public in the evaluation process, including making environmental information publicly available before making a decision or taking action.[20] The licensing of a facility by NRC would also be subject to NEPA review.

Federal agencies must integrate other planning and environmental review procedures and consultation requirements with NEPA to the fullest extent possible, including, for example, the *Fish and Wildlife Coordination Act* (16 U.S.C. 661 et seq.), the *National Historic Preservation Act* (54 U.S.C. 300101 et seq.), the *Endangered Species Act* (16 U.S.C. 1531 et seq.), and other laws and executive orders pursuant to 40 CFR 1502.25. Through NEPA, the implementing organization would consider all potential direct, indirect, and cumulative effects of the proposed facility on the human environment, including air quality, geology and soils, land use, water resources, human health, biological resources, socioeconomics, environmental justice, and cultural resources.

Proposed nuclear waste management facilities would be subject to federal, state, local, and tribal land use protected area considerations and prohibitions. This would generally exclude from consideration land designated as part of a national park, national wildlife refuge, or wilderness area. Proximity to and effects on components of the National Parks System, the National Wildlife Refuge System, the National Wild and Scenic Rivers System, the National Wilderness Preservation System, and National Forest System, as well as proximity to or impacts on sacred tribal lands, would also be given special consideration.

Social and economic considerations are also important in siting a nuclear waste management facility, since hosting such a facility could affect a community in many ways. Ideally, a community interested in learning more about potentially hosting a facility would feel empowered to investigate options and engage its citizens in such a way that most members of the community feel this exploration was a positive experience regardless of whether they choose to proceed or withdraw. One option along these lines is to conduct a community planning, economic development, or visioning activity separate from or in parallel to investigations into the risks and benefits of hosting a facility. This exercise would help a community articulate what type of future it wants before deciding whether a proposed facility or facilities might align with or enable that vision. Such as exercise could also provide a mechanism for addressing equity and environmental justice concerns and mediating different views. With a clearer vision of its long-term objectives, a community can more easily evaluate the different outcomes of a facility, including impacts on local economic development, labor supply, transportation infrastructure, public safety infrastructure, utilities,

[20] In addition to CEQ regulations, the implementing organization would likely need to promulgate and comply with its own NEPA implementing regulations. For DOE, these are the *National Environmental Policy Act Implementing Procedures* promulgated at 10 CFR Part 1021.

energy, and community services, and reach a conclusion about whether those impacts align with the community's values and priorities.

6.3 Regulatory Framework for Siting Interim Storage Facilities

The U.S. Nuclear Regulatory Commission (NRC) is responsible for regulating the storage of commercial spent nuclear fuel. The regulations that will apply to a federal interim storage facility include:

- 10 CFR Part 20 – Standards for protection against radiation
- 10 CFR Part 72 – Licensing requirements for the independent storage of spent nuclear fuel, high-level radioactive waste, and reactor-related greater than class C wastes
- 10 CFR Part 73 – Physical protection of plants and materials

6.4 Regulatory Framework for Siting Geologic Repositories

EPA's 40 CFR 197 and NRC's 10 CFR 63 were developed specifically for a geologic repository at the Yucca Mountain site in Nevada, and would not apply to a repository at any site other than Yucca Mountain. EPA's 40 CFR 191 and NRC's 10 CFR 60 regulations date from the mid-1980s, but in the absence of new rulemaking, would apply to any proposed geologic repository at a site other than Yucca Mountain, Nevada.

As noted in the Administration's Strategy, "the Administration understands the need for the Environmental Protection Agency to develop a set of generic, non-site-specific, repository safety standards to gain public confidence that any future repository will protect public health and the environment. This will be an important early step in any repository siting effort." Thus, there is an expectation that the existing disposal regulations for geologic repositories (40 CFR 191 and 10 CFR 60) will be updated at a future date to reflect the evolution of regulatory thinking during and since the development of the Yucca Mountain-specific regulations (40 CFR 197 and 10 CFR 63). In issuing 10 CFR 63, the NRC stated that the more risk-informed, performance-based approach adopted therein provides a better regulatory framework for geologic disposal than the approach in 10 CFR 60. At that time, the NRC stated that the "generic Part 60 [10 CFR 60] requirements will need updating if applied to sites other than Yucca Mountain" (66 FR 55732, p. 55736). The NRC has not yet begun rulemaking to effect this update, although the NRC continues to recognize that 10 CFR 60 needs updating if applied to geologic repositories at sites other than Yucca Mountain (Rubenstone 2016).

The early phases of a siting process can be initiated based on readily available information that does not require site-disturbing activities. These early stages can also go forward in parallel with regulatory action by the EPA and NRC to develop updated regulations for a geologic repository at a site other than Yucca Mountain.

6.5 Site Assessment Considerations

As noted above, the first step of the site assessment phase will focus on a few high-level, readily detectable factors that could exclude a site from further consideration, such as proximity to major population centers, national parks, or other areas of special significance. During the next step, more

detailed, site-specific information will need to be collected. The information collected during detailed site assessment will provide greater insights into the performance of a total system at a specific site. Such information could include:

- The current and future distribution of the population near the proposed site
- The availability of sufficient surface land area to accommodate needed capacities and functions, including facilities for the transfer and storage of waste and for associated support services, as well as sufficient area around the facility to ensure that radiation doses from all pathways resulting from facility operations are within regulatory limits and there is an adequate controlled area in accordance with applicable NRC regulations
- The potential for strong near-field ground motion from historical earthquakes on large capable faults
- The potential for seismicity induced by human activities, such as explosive blasts, subsurface fluid withdrawal or addition, mining activity, or the ground loading effects of dams or reservoirs
- Surface faulting that could cause differential ground displacement that might affect proposed facility structures or operations
- Soil or bedrock conditions that have the potential to create ground movement from liquefaction, subsidence, or landslides and the potential of such conditions to adversely affect the proposed facility structures and performance
- The potential soil-bearing capacity to support foundation loading
- The potential for long-term and short-term adverse effects from floods (from surface-water bodies or surface runoff) or the need for extensive modification of floodplains in site selection and facility design
- The potential for natural phenomena or severe weather that could adversely affect the design and safe operation of the facility
- The potential for local and regional industries to affect the proposed facility's site and design
- Proximity to transportation infrastructure

In addition to the considerations above, additional site-specific factors would have to be considered when assessing a potential host site for a geologic repository. These additional factors relate to the ability of the site to provide the required, long-term isolation of high-level radioactive wastes and spent nuclear fuel after a repository has been closed and decommissioned. They include:

- *Geohydrology*— the geohydrologic setting of the site
- *Geochemistry*—the geochemical and hydrochemical conditions of the host rock
- *Rock characteristics*—the geologic and geomechanical characteristics of the site
- *Erosion*—the structure, stratigraphy, and geomorphology of the site
- *Dissolution*—the stratigraphy, structure, hydrology, and geochemistry of the site

- *Tectonics*—the tectonic setting of the site
- *Potential for future human interference*
    - *Natural resources*—presence of mineral and energy resources at the site
    - *Site ownership and control*—arrangements for the long-term ownership and control of land at the site

7. CONCLUSION AND OPPORTUNITIES FOR PROVIDING FURTHER INPUT

The draft consent-based siting process described in this document has been informed by the Department's engagement with the public, Tribes, stakeholders, and other interested parties and by numerous other sources of information and input. Following the release of this draft document, the Department plans to continue to provide opportunities for public dialogue. Future engagements with the public, and stakeholders, as well as communities, states, and Tribes will aim to better understand, respond to, and more fully incorporate input that is reflective of expressed values and interests.

The Department welcomes public comment on the contents of this document, including comments on specific aspects of the draft process and siting steps outlined in Section 5, as well as on the siting considerations discussed in Section 6. Instructions for submitting comments are included in the Federal Register Notice accompanying this document and titled *Request for Public Comment on Draft Consent-Based Siting Process and Siting Considerations for Nuclear Waste Storage and Disposal Facilities*.

Examples of the kinds of issues and topics that the Department believes would benefit from further input and suggestions include the following:

1. What specific design elements and implementation steps should be included to ensure that the siting process, as a whole, reflects the principles discussed in Section 4 and produces outcomes consistent with those principles?
2. What provisions are needed to assure potentially interested communities of adequate opportunities for information sharing, expert assistance, and meaningful participation?
3. How can the process be improved to maximize opportunities for mutual learning and collaboration between potentially interested communities and the implementing organization?
4. How can the process ensure communities have adequate opportunity to demonstrate interest in continuing in or opting out of the siting process?
5. How can the process ensure that regional concerns and interests, including the concerns and interests of neighboring Tribes and states and any transboundary issues or impacts, are adequately addressed?
6. How can the Department best engage with local, state, regional, and tribal entities in the review of this draft siting process?
7. Are there other issues that should be considered in the siting process?

In conclusion, the Department wishes to express appreciation for the insights, suggestions, and feedback that many individuals and organizations have already provided to inform this effort. The Department looks forward to continuing an active dialogue with all stakeholders and interested communities, Tribes, and states as it seeks to refine and implement a new approach to siting that—by reflecting the best expertise and core values of a broad cross-section of participants—offers real promise for producing safe, durable, and widely accepted solutions to our nation's nuclear waste challenges.



CONSENT-BASED SITING



Designing a Consent-Based Siting Process

Summary of Public Input

Final Report

December 29, 2016

U.S. DEPARTMENT OF ENERGY

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1. INTRODUCTION

1.1 BACKGROUND

Nuclear technology has been used in the United States for decades for national defense, research and development, and electric power generation. These activities have produced spent nuclear fuel (SNF) and high-level radioactive waste (HLW). Commercial electricity generation has produced the largest amount of SNF (approximately 75,000 metric tons at the end of 2015) and continues to generate SNF at a rate of approximately 2,000 metric tons per year. HLW, almost all of which was generated by defense nuclear activities, accounts for the next largest portion of the overall inventory: roughly 90 million gallons of HLW liquids, sludges, and solids.

Most SNF and HLW is currently stored at the locations where it was generated (commercial reactors and DOE-managed sites respectively). It is widely accepted, both nationally and internationally, that deep geologic disposal is the best option for achieving safe, long-term isolation of these radioactive materials from the environment. To date, however, the United States has failed to establish such a facility. Although any number of locations around the country offer potentially suitable geological conditions for a disposal repository, the more intractable challenge thus far has been siting such a facility.

BRIEF HISTORY

The United States Congress endorsed geologic disposal in the Nuclear Waste Policy Act of 1982 (NWPA), which provides the basic policy framework for U.S. efforts to manage nuclear waste. The Act establishes procedures for evaluating and selecting sites for geologic repositories and sets key milestones for federal agencies to meet in implementing the policy. Following passage of the NWPA, DOE studied several possible repository sites. In 1987, Congress amended the NWPA to require DOE to characterize only the Yucca Mountain site in Nevada and to phase out site-specific activities at all other candidate locations. Years of delay, litigation, and controversy followed before DOE formally recommended the Yucca Mountain site to the President, the President recommended the site to Congress, and Congress approved the site in 2002—four years past the date when DOE was supposed to begin accepting commercial spent fuel for disposal. The State of Nevada strongly opposed each of these steps and the choice of the site remained highly controversial, with numerous legal and technical objections raised throughout the site evaluation and license application process. In 2009, DOE determined that a geologic repository at the Yucca Mountain site was an unworkable option due to continued lack of acceptance by the State of Nevada.

In 2010, the Blue Ribbon Commission on America's Nuclear Future (BRC) was formed at the request of the President to develop recommendations for a long-term strategy to manage the nation's nuclear waste. After conducting a comprehensive review of waste management policies and practices, both in the United States and abroad, the BRC issued its final report in 2012. The report included eight recommendations, which included using a "consent-based" approach to site waste management facilities. Drawing on the BRC's recommendations, the Administration issued its Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste (Strategy) in 2013. The Strategy endorses a phased, adaptive,

and consent-based approach to siting and implementing a comprehensive management and disposal system. The Department is undertaking activities within existing congressional authorization to do what it can, consistent with the Strategy. These activities, such as developing plans for consent-based siting processes, are designed to avoid limiting the options of either the Administration or Congress.

INTEGRATED WASTE MANAGEMENT

As outlined in its 2013 Strategy, DOE is planning for an integrated waste management system to transport, store, and dispose of spent nuclear fuel and high-level radioactive waste. The Department envisions an integrated waste management system consisting of a set of nuclear waste facilities, each serving a specific purpose, to address the challenges of safely managing both SNF and HLW. These nuclear waste facilities could include:

- A pilot interim storage facility with limited capacity capable of accepting SNF and HLW and initially focused on serving shutdown reactor sites;
- A larger, consolidated interim storage facility, potentially co-located with the pilot facility and/or with a geologic repository, that provides needed flexibility in the waste management system and allows for important near-term progress in implementing the federal commitment;
- A permanent geologic repository for the disposal of defense HLW and, potentially, some DOE-managed SNF;[1] and
- A permanent geologic repository for the disposal of commercial SNF.

We are also investigating the concept of deep borehole disposal, which potentially could be an option for the disposal of smaller and more compact waste forms currently stored at DOE sites.

CONSENT-BASED SITING

As the Department moves forward with planning for an integrated waste management system it is committed to using a consent-based approach to siting that is built on collaboration with the public, stakeholders, and governments at the local, state, and tribal levels. The Department plans to develop and implement this consent-based siting process in multiple phases. The first phase involves engaging with the public and interested parties to learn from them what elements are important to consider when designing a consent-based siting process. This report documents public feedback obtained from this input-gathering effort. The inclusion of specific comments in this report, however, should not create an expectation that the draft process will incorporate all suggestions. The comments express a wide range of viewpoints – some of which are contradictory or fall outside of existing legal authority. In the second phase of this effort, DOE will focus on designing a consent-based siting process to serve as a framework for

[1] On March 24, 2015, President Obama authorized DOE to move forward with planning for the development of a separate repository for high-level radioactive waste resulting from atomic energy defense activities. Establishing a separate repository for defense high-level radioactive waste would represent significant progress toward addressing the federal government's Cold War legacy, as well as meeting the government's obligation to manage the nation's radioactive waste.

collaborating with potentially interested host communities. In subsequent phases, the Department will use the resulting consent-based process to more deeply engage and partner with interested communities and ultimately begin siting facilities.

1.2 APPROACH

As part of the first phase of the consent-based siting effort, the Department is engaging with the public and interested parties to learn from them what elements are important to consider when designing a fair and effective consent-based siting process. This engagement effort has thus far consisted of several major components described below.

INVITATION FOR PUBLIC COMMENT AND PUBLIC MEETINGS

To launch the consent-based siting effort, DOE issued an "Invitation for Public Comment to Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities" in the *Federal Register* on December 23, 2015. The Invitation for Public Comment (IPC) included five questions for the public to consider when providing input:

1. How can the Department ensure the process for selecting a site is fair?
2. What models and experience should the Department use in designing the process?
3. Who should be involved in the process for selecting a site, and what is their role?
4. What information and resources do you think would facilitate your participation?
5. What else should be considered?

The comment period was open through July 31, 2016 (a copy of the Invitation for Public Comment is available in Appendix A).

PUBLIC MEETINGS

In parallel with receiving input through the Invitation for Public Comment, the Department hosted eight public meetings around the country. At these meetings, which were held in geographically diverse locations, the Department had an opportunity to hear first-hand from members of the public, communities, states, Tribes, and other interested stakeholders on what matters to them as DOE moves forward in developing a consent-based siting process. Meetings were held in major cities across four regions: the Northeast (one meeting), the Midwest (two meetings), the West (four meetings), and the South (one meeting). These meetings were designed to encourage participation and to provide multiple opportunities for public input and two-way dialogue. Each meeting included eight major elements: (1) welcoming remarks from a local or regional authority; (2) a presentation by DOE's Acting Assistant Secretary for Nuclear Energy John Kotek describing DOE's commitment to developing and utilizing a consent-based approach to siting; (3) remarks from panelists; (4) a question-and-answer period in which members of the public had an opportunity to ask questions of the panelists; (5) facilitated small-group discussions (using independent facilitators) that enabled individual participants to engage more closely on topics related to consent-based siting; (6) summary reports from the small-group discussions; (7) a public comment period that afforded members of the public the opportunity to make formal comments to the Department; and (8) an open house and poster session prior to and after the meeting during which attendees and DOE representatives had additional opportunities to engage in conversation. The meetings were streamed live in a webinar format and a limited number of questions from webinar participants were posed to

the panelists (more questions were posed by in-person attendees). A complete list of these public meetings, including agendas and dates, is provided in Appendix B; agendas, transcripts, video recordings, and summaries of small-group discussions can be accessed at energy.gov/consentbasedsiting.

ADDITIONAL OPPORTUNITIES FOR ENGAGEMENT

In addition to the Invitation for Public Comment and regional public meetings, the Department used other opportunities—including conferences and professional meetings—to engage in dialogue with stakeholders and members of the public on the design of a consent-based siting process. In addition, DOE welcomed and accommodated requests, where possible, for additional meetings to discuss its consent-based siting effort. A full list of these conferences and additional meetings is provided in Appendix B.

1.3 PURPOSE OF THIS REPORT

The successful siting of nuclear waste management facilities, through a consent-based process, is predicated on a robust and transparent dialogue between the Department and its stakeholders. From December 23, 2015 through July 31, 2016, DOE solicited and received public comments and heard input from a wide range of individuals, communities, states, Tribes, and stakeholders through the multiple avenues described above. Over this period, DOE received approximately 450 unique pieces of correspondence and over 10,000 form letters providing a wide range of input, thoughts, and perspectives on consent-based siting, waste management, and nuclear energy. An additional 56 unique pieces of correspondence and 45 form letters were received on the draft version of this report, during the public comment period between September 16, 2016 and October 30, 2016.

The purpose of this report is to summarize the major themes that emerged from the regional public meetings, other interactions with stakeholders at meetings and conferences, responses to the Invitation for Public Comment, and comments on an earlier draft of this report. The report also attempts to reflect the breadth and diversity of views expressed and topics identified to date by meeting participants and commenters. Given the volume of input gathered, this report could not and does not attempt to reflect every comment or opinion the Department received or heard during this initial phase of its public engagement effort. Furthermore, this report does not provide background information about nuclear waste, nor does it attempt to review the history of nuclear waste management efforts in the United States or worldwide. Information on these subjects is available from numerous other sources, including in overview materials (such as pamphlets, briefing papers, etc.) prepared for DOE's public meetings. These materials and references to other sources are available at energy.gov/consentbasedsiting.

Rather, the sole objective of this report is to offer an overview of what DOE has heard to date concerning consent-based siting. To that end it includes a selection of direct quotations, from written comments and meeting transcripts, that are intended to reflect the different perspectives and often strongly held views of a large and diverse group of participants. This report does not attempt to respond to or assess the validity of the comments DOE received nor does it propose a framework or model for conducting a consent-based siting process. Planned next steps in the consent-based siting effort are discussed in Chapter 5.

To review and organize the input received, the Department relied on a team of federal, national laboratory, and contractor staff with diverse backgrounds and experience in legislative, policy, regulatory, technical, transportation, siting, and stakeholder outreach disciplines. Report contributors attended, took notes, and answered questions during each of the eight consent-based siting public meetings and many staff members also attended the meetings listed in Appendix B.

In an iterative process, comments from correspondence as well as from public meeting transcripts were grouped into categories in order to organize information and provide an outline for writing this report. Quotes were selected that represented the major themes and diversity of viewpoints expressed by commenters, meeting participants, and stakeholders. Additionally, input from the meetings listed in Appendix B and from the consent-based siting public meeting small-group discussion sessions was used to help inform the organization of the report and validate the scope of its contents.

1.4 Other Inputs To Inform the Design of a Consent-Based Siting Process

The Department is following efforts by other organizations to address the subject of SNF and HLW management and disposal including recent studies by the Bipartisan Policy Center's Nuclear Waste Initiative and the Reset of U.S. Nuclear Waste Management Strategy and Policy by the Stanford Center for International Security and Cooperation. DOE is also tracking the progress of international waste management organizations.

In addition, DOE continues to fund research by the University of Oklahoma to analyze public perspectives on nuclear waste storage and disposal and consent-based siting. This effort has been ongoing for several years and is summarized in Appendix C. In 2016 DOE funded a report by the Social and Environmental Research Institute (SERI) on the topic of consent and how consent may play a role in the siting of nuclear waste facilities.[2] The report is available at www.energy.gov/ne/read-more-about-nuclear-waste-management.

DOE is using findings and recommendations from the above organizations and studies, lessons learned from U.S. and international experience, and the stakeholder input summarized in this report to inform its efforts to develop and revise a draft consent-based siting process.

Although this report aims to summarize DOE's early effort to gather input from the public and interested parties on the subject of consent-based siting, it is important to emphasize that DOE's commitment to engagement and dialogue is ongoing. That means that DOE will continue to welcome input and create opportunities to listen and learn from the public and stakeholders on the best ways to design and implement a durable consent-based siting process.

[2] Tuler, S. and T. Webler. 2016. "Understanding consent: Principles and challenges for a consent-based process to site facilities for interim and long-term storage of spent nuclear fuel and high level wastes in the United States." Northampton, MA: Social and Environmental Research Institute.

NOTE TO CHAPTERS 2–4

The next three chapters of this report (Chapters 2–4) summarize the input DOE received in response to its Invitation for Public Comment, as well as comments received on the draft version of this report. This summary includes written comments submitted to the Department, as well as oral comments made at regional public meetings. (Oral comments include suggestions made during small-group sessions and question-and-answer sessions at the meetings, as well as statements by session panelists and presenters.) Comments and suggestions heard by DOE in other meetings and conferences (listed in Appendix B) were also considered in developing this summary.

Given the volume of input received and the cross-cutting nature of many of the topics addressed, the challenge of organizing and summarizing this material was considerable. The Invitation for Public Comment included five questions concerning specific issues to be considered in designing a consent-based approach to siting future nuclear waste management facilities. The Department did not specify a particular facility that would be the subject of a consent-based siting process. Rather the intent was to solicit input on some generic features of a siting process or framework that could be applied to any of the facilities in an integrated nuclear waste management system.

Not surprisingly, input from this first phase of DOE's consent-based siting process—both in response to the Invitation for Public Comment and in discussions at meetings and conferences—encompassed a much broader range of topics, including (but not limited to) U.S. energy and climate policy, the role of nuclear energy, current practices for storing nuclear waste, views on Yucca Mountain, and the federal government's plans and policies for nuclear waste management more generally.

The next three chapters are organized as follows: Chapter 2 summarizes main themes from the comments that directly relate to the topic of consent-based siting, but that generally transcend the specific design questions posed in the Invitation for Public Comment. Thus, Chapter 2 touches on topics such as the nature and meaning of consent (and non-consent), equity and environmental justice concerns, and challenges related to trust and credibility. Chapter 3 then turns to the specific questions posed in the Invitation for Public Comment and gathers comments and suggestions on topics such as designing a fair process, engaging communities, and providing information and resources to participants in the siting process. Chapter 4 summarizes comments on a range of broader topics that are less directly connected to consent-based siting in and of itself.

Here it is worth reiterating that the purpose of this report is to provide a summary or overview of the input DOE received, focusing on the ideas and concerns that drew the most comment, while also providing some sense of the range and diversity of views held by different stakeholders. To better convey the spirit of the comments, direct quotations from the written correspondence and meeting transcripts are used to illustrate particular points. In general, these quotations are provided without attribution, except in a very few cases where the organization making the comment is self-identified in the quote itself. For obvious reasons, only a small subset of all comments could be directly quoted in this summary and it was not possible to fully capture all of the opinions, suggestions, and nuances contained in respondents'

individual contributions. The full set of meeting transcripts, and the full text of all comments received, are available at energy.gov/consentbasedsiting.

Note: this draft report does not correct any factual inaccuracies expressed in the input and it does not include a DOE response to the input provided or specific proposals to address the concerns DOE heard. Moreover, *the inclusion of any particular view or comment in this summary should not be taken as either an explicit or implied endorsement of that view by the Department, its staff, or the Administration*. As is clear throughout the next three chapters, commenters held a wide range of views, some of which are in direct opposition to, and in some cases fundamentally irreconcilable with, other, equally strongly held views. Again, the primary objective in these chapters is to provide a sense of the diversity of perspectives that exists on these topics and to highlight areas of common, or at least frequently expressed, concern.

2. MAJOR THEMES RELATED TO CONSENT-BASED SITING FOR NUCLEAR WASTE FACILITIES

This chapter summarizes input on broad topics that relate directly to consent-based siting for nuclear waste facilities. Responses to the five more specific consent-based process and design questions included in the Invitation for Public Comment are summarized in Chapter 3.

Note: For clarity and to distinguish text that summarizes or paraphrases comments from direct quotations that express the commenter's point in his or her own words, all direct quotations appear in italics. In addition, statements that can be attributed to a specific individual or group because they are taken verbatim from written comments or from transcripts of spoken comments are indicated by quotation marks. Other statements that were transcribed during facilitated small-group discussions at DOE's regional meetings are shown in italics but are not enclosed in quotation marks.

2.1 VIEWS ON CONSENT-BASED SITING, ON EFFORTS TO DEVELOP A CONSENT-BASED APPROACH, AND ON THE NEED FOR ACTION

Overall, commenters expressed a wide range of views about the value of attempting a consent-based approach to siting nuclear waste facilities and about the likelihood that this approach would yield successful siting outcomes. To some extent, different attitudes toward consent-based siting reflected widely divergent views about the underlying feasibility of implementing safe long-term storage and disposal solutions for spent nuclear fuel and high-level radioactive waste.

As a starting point, several respondents acknowledged the nation's several-decades-long history of efforts to develop a disposal repository and the inherent difficulty of siting nuclear waste facilities more generally:

> *"I think we're sitting here today because siting a nuclear waste repository is difficult. And nuclear waste has the capacity to outlast human civilizations and the potential to devastate public health. Because of this we've been unsuccessful in the past."*

Whether future siting efforts—consent-based or otherwise—could be more successful was a subject of considerable debate.

On the skeptical end of the spectrum, numerous commenters—citing the unique characteristics of SNF and HLW, most notably its longevity—expressed doubt that any "fair" process could produce consent for siting a disposal facility:

> *"[W]e can see no just application of consent, informed or otherwise, to the imposition of a nuclear waste legacy lasting millennia. Further, it is simply beyond the capability of a government agency to ensure safety and security to people or communities for the duration which high-level radioactive waste will remain a hazard to human health."*

More immediately, a number of commenters emphasized that neither they personally, nor members of their community, would ever consent to locating a consolidated nuclear waste storage facility or disposal repository in their state or anywhere nearby. One commenter expressed this view bluntly:

> *"'Consent' to dump nuclear waste in America's back yard is not going to be approved by the American people no matter how your PR strategists massage the lipstick on that pig."*

Numerous other commenters, however, took a different view—both of the eventual necessity of developing a disposal repository and of the value in exploring new approaches to siting.

> *"Previous attempts to site high-level nuclear waste disposal have been top-down in the political process and have failed. Starting over with a bottom-up process is a worthy effort and recognizes what failures have proven: our political, regulatory and judicial process is now set up so that a dedicated (lie down in front of the bus) group can block or stall an issue they oppose, for a long time. Nuclear power is one such issue."*

> *"I think this process is going to work for DOE. It just has to be done carefully and tactfully to be a success. Benefits of accepting a site must be communicated to communities."*

> *"As Co-Chairs of the Bipartisan Policy Center's Nuclear Waste Council, we and the other council members have deliberated on these issues for over a year. …We deliberated time and again on how to properly capture both the need for action and the necessity of careful consideration. And in the end we've come to the conclusion that consent-based siting may be a key to opening a future nuclear waste facility."*

For some respondents, it was important to separate the discussion about siting nuclear waste facilities from debates about the role of nuclear energy:

> *"We're not here to discuss or debate the relevance or the importance or the right or wrongness of nuclear energy and nuclear waste. You all in this room know that it's already here. And I'm not willing, as a citizen with 14 grandchildren, to kick the can down the road, to the next, and the next, and the next generation. I believe it's up to us to resolve this and to do it in a way that's respectful, that's trusting and that's enduring and sustainable. We don't need a short-term political decision that will be reversed or negated with the next election. We've got to have a commonsense, enduring solution - that's built, I believe, on consensus…"*

A number of commenters observed that designing and implementing a consent-based siting process would be difficult and would take time. As one commenter noted, consent-based siting "*involves issues of ethics, politics, socioeconomic issues, time, technology, culture, many factors."* Another commenter cited experience with the Waste Isolation Pilot Plant (WIPP) in New Mexico to illustrate these challenges:

> *"[E]ven at WIPP, which was decided by the Blue Ribbon Commission as an example of a consensus-based approach, it took 11 years longer than was projected. Consent-based – I was there. It wasn't always consensus, there was a lot of pulling and tugging, it wasn't like everybody held hands and sang "Kumbaya" around WIPP – it was quite a challenging process."*

Several commenters also cautioned that success was far from guaranteed:

> *"The approach being followed here seems to be headed in the same direction as the German and Japanese examples. The almost universal experience has been local support that fades with distance (distance from the economic benefits) and turns to opposition farther away in areas not needing the economic stimulus of a nuclear project. These are harsh realities that call into question a very broad definition of what is involved in 'consent.'"*

For this commenter, the "agonizingly slow approach in order to create a 'fair' site-selection process is tantamount to wasting the taxpayers' hard earned dollars at an incredible rate for many years to come." Another commenter questioned whether DOE had statutory authority to begin pursuing consent-based siting in the first place, absent prior action by Congress to define (1) how such a process should be structured and (2) what entity should be responsible for implementing high-level nuclear waste disposal:

> *"The current DOE 'consent-based siting process' is premature and should be terminated. Consent is not the law of the land. Thus, no federal law requires, or even allows, that the administration, Congress or the Courts give any status to any "consent" agreement for nuclear waste facilities. DOE sites have never been chosen by consent, and when communities do not consent to continued nuclear weapons missions, they are ignored. Congress must enact legislation that defines how free, prior, and informed consent can occur, including what legal or constitutional constraints prevent future congresses from overriding consent agreements or withholding funding. New legislation must define whether DOE or some other agency is responsible for commercial spent fuel and high-level nuclear waste disposal."*

Other commenters expressed the opposite concern, namely that DOE wasn't moving fast enough and indeed was *"in no hurry to come up with a consent-based siting plan for commercial nuclear waste."* These commenters voiced impatience to begin making progress:

> *"My concern is what I feel is the lack of urgency in dealing with this. Particularly when I hear…it's going to take decades to solve this problem. We've already been dealing with this problem for 70 years. It's time to get the solution done, resolved and unless we can't get it done very quickly, I contend that we need to stop making this stuff."*

> *"I'm tired of hearing DOE talk about being in the early stages of something we've been at for decades now. I've seen people grow old in this business of trying to solve the nuclear waste problem. Words don't engender consent. Actions do. It's time for the DOE to start taking some actions, get out there and start earning consent where it has the opportunity to do so."*

A sense of urgency was especially pronounced among commenters from communities that are already hosting spent nuclear fuel at operating and shutdown reactor sites. As several of these commenters pointed out, consent had neither been sought nor granted in earlier decisions to site nuclear facilities in their communities in the first place. Thus many of them expressed a desire to see spent fuel removed from their communities as soon as possible (as well as a desire to be compensated for their involuntary role as de facto long-term storage sites in the interim – these comments are discussed at greater length in a later section). For some of these commenters and others, the time required to design and implement a consent-based siting process provided all the more reason to move forward without delay:

"Slipping deadlines, inadequate funding, on-site storage and the continued storage rule have all contributed to a lack of urgency in removing spent fuels from sites that were never meant to be long-term storage sites. The communities impacted by on-site long term spent nuclear fuel storage problem have been patient while deadlines for removing the fuel have come and gone, but our patience is wearing thin."

"So the best we can hope for is 15 to 20 years for the removal of the nuclear storage waste out of San Onofre. Obviously, we need to get started today. If not us, who? If not now, when?"

2.2 VIEWS ON THE NATURE OF CONSENT

Commenters offered different definitions of consent, but certain terms or attributes—for example, "informed," "voluntary," "democratic"—were mentioned repeatedly in connection with consent. In terms of what would constitute consent, several commenters spoke of a contract or agreement:

"It's a binding contract between parties but it's more than that. It's a power relationship that takes place and it's an agreement that's made unencumbered by coercion; it's a mutually-arrived-at position."

"Consent must be informed; it must be voluntary; and consent requires control."

"To be fair, consent must be democratic. Consent means the willing approval by governments and a majority of the people…"

Several commenters pointed out that voluntariness necessarily implies the existence of an option to *reject* or withhold consent:

"It is a ruse to discuss terms of consent if there is no choice to refuse consent! This is basic."

"What I think the most important thing that we can learn from Idaho is the importance of non-consent. If you're asking someone to say 'yes,' and someone says 'no,' you have to hear that; you have to recognize it and you have to respect it. Non-consent is a very important part of a consent process."

Who gives consent is a key question for designing a consent-based process. Many commenters articulated an expansive view of consent that includes all communities and entities likely to be affected by a proposed facility as well as county, state, tribal, and other authorities.

"Once potential host sites are identified, a consent-based siting process should include all affected entities...agreement by state and county governing bodies as well as tribal governments in addition to acceptance by the host communities and acceptance by all adjacent communities to that host community. Agreement by all communities that will be impacted by transport routes, including truck, barge and rail to that host community."

A common theme in a number of comments was the idea that priority should be given to the consent of the most "directly affected parties." Though the latter term is subject to interpretation, directly affected parties were generally understood to include, at a minimum, the citizens of communities that are in the geographic vicinity of the proposed facility and of transportation routes to the facility. Thus, a number of commenters expressed the view that the communities closest to a proposed facility should retain ultimate authority to consent (or not).

"We believe that local consent, beyond that of elected officials, is perhaps the most important level of consent, given the allocation of risks in siting a nuclear waste facility."

"DOE must give deference to the community closest to the proposed site, since they bear the greatest risk."

Some commenters noted that the circle of affected parties will, in many cases, transcend political boundaries. A facility located in one county or state may be closer to a community in a neighboring county or state than it is to any community in its home jurisdiction. One commenter pointed out that using city or county lines to define consent could be particularly problematic in very sparsely populated rural areas, where local decision-makers could end up supporting projects that affect individuals who have had little input to the siting process.

In terms of potential environmental impacts, the geographic area affected by a proposed facility could also be quite large. One commenter noted that entire watersheds could be considered affected communities for purposes of siting nuclear waste facilities.

Exactly who is asked to give consent at different points in time and how consent (or non-consent) will be registered are also critical questions:

"What we need to do better it is figure out what a real voice means and how you have access to meetings and how your voice gets heard and how we can ensure that the response is given and we also have to decide when does the community get to say "no" and when does "no" mean "no," right? How many times do folks have to keep getting asked? Those are all important questions that we need to think through."

Some commenters focused on the role of local elected representatives in officially defining consent:

"To the extent possible, DOE should rely on elected representatives of local communities (city council members, mayors, county supervisors, and tribal council leaders) to make official determinations of community consent."

A related concern that emerged in some small-group discussions, however, was that county-level judges and commissioners were elected to decide smaller-scale, local issues and could not represent their constituencies on a decision as controversial and far-reaching as siting a nuclear waste facility. There was also concern that county authorities could prioritize budget considerations over other issues or even that local officials could be bribed or "bought."

Many also stressed the central role of elected officials at the state or tribal level:

"It is the partnership between federal and state partners that is key to arriving at state consent to host any amount of permanent nuclear waste disposal."

"Again, being realistic, a local jurisdiction is the point to begin, but ultimately it will be the governor or state that will make the final decision. The state will be the final arbiter and should not be minimized or forgotten in the process."

"WGA [Western Governors' Association] represents the Governors of 19 western states and three U.S.-flag islands… WGA Policy Resolution 2014-06, Storage and Disposal of Radioactive Waste and Spent Nuclear Fuel, outlines the Governors' position on the importance of state involvement in the siting of any radioactive waste storage or disposal facility. Specifically, the policy states that no centralized interim storage facility shall be located within the geographic boundaries of a Western state or U.S. flag island without the written consent of the Governor in whose state or territory the facility is to be located."

"A role must be clearly defined for members of a state or region's Congressional delegation, as all terms agreed to by the parties will require ratification through either or both of the authorization and appropriation process(es). Support from both Senators is particularly important as they are elected in state-wide balloting and therefore able to exercise significant influence in Congress and within their state."

However, there was also support for the view that citizens—at the community or state/tribal level, or both—should have a direct role in giving consent via a vote or referendum:

"Community consent must be measured by referendum, not merely by agreement of elected officials."

"A simple vote by a County Commission should not constitute 'consent.' A vote should be required in each of the potentially impacted communities."

"Local jurisdictions should negotiate terms with DOE but the state should be the legal entity with the final signature authority. To strengthen the likelihood that a State's position would not change with future administrations, DOE should require a binding referendum from the state which locks the state in, assuming that DOE meets its agreed to obligations. In other words, the State (not a governor) has committed to host the facility with the proviso that if DOE fails to meet its obligations, the state can negate the agreement."

"The residents of the state should be contacted for a vote on approval or not."

Further, one commenter suggested that the necessary threshold required to establish consent could be different at different levels of government:

"You'd need to define then what we mean by 'consent.' So a vote by elected officials in a particular town or county, even if it's unanimous - is not really probably going to cut it - I think you're going to have to go directly to having citizens involved in defining what consent would mean. You'd probably need a referendum…

And although as mediators we often define consent as unanimity, when everyone is at least willing to live with the proposal - unanimity is probably too high of a hurdle - but any threshold set, which should part, again, of the terms and conditions, should likely be something that's much closer to 100% than a simple majority of 51%.

I think that what we probably learned in the past is that not only the town, but we're going to need to engage the state…and do a similar interactive workshop format with state residents...and if the community is a certain amount of miles away from the border, then you'd need to have a vote in a neighboring state as well. I think for the state referendum - the state vote - I don't think you'd need 100%, I think it could be a different threshold than for the local community; at least a simple majority - maybe two-thirds…"

Finally, several commenters made the point that consent would mean different things in different contexts and that therefore no "one size fits all" approach would be appropriate in all circumstances. Thus, the mechanisms used to register consent would be likely to vary in different situations and will be difficult to determine in advance:

"It is not clear what facilities, transport routes or programs the 'consent' process will enable or facilitate. Greater clarity is essential. Providing input on what 'consent' is may vary depending on the type of facility (long-term or short-term as only one example)."

"Two key questions for reaching a siting agreement are who negotiates and who decides? Any agreement must be secured within the framework of our democratic institutions, which by definition means that the public delegates these responsibilities to elected officials or the public exercises its franchise directly through referendum. The political and institutional construct will need to be situation specific based on geography and jurisdictional boundaries. The degree of involvement and level of benefits should be commensurate with the potential risk burden. An additional consideration is the relative ability of a jurisdiction to promote or impede success. A successful consent-based siting process can be expected to be multi-jurisdictional and involve tribal (if tribal nations are potential hosts of a spent nuclear storage or disposal facility), state and local governments in a nested hierarchy of political jurisdictions. Alternatively, new, special purpose, institutional and political constructs (e.g., a regional authority) can be created with accountability to a board of directors made up of representatives from impacted jurisdictions."

> *"While consent must begin with a local community, state agreement and mutual commitments between the parties is key to the long-term durability of the decision to site any facility of this nature. At the same time, we think it would be an error for the federal government, at this point in the conversation, to develop a 'one size fits all' approach to consent based siting of either an interim or permanent disposal facility. Not only are the considerations for the two types of facilities likely to be different, but as we can attest through our geographically diverse locations, communities and states will likely have differing perspectives on the nature of, and the circumstances under which they grant, their consent."*

Given the critical importance (and substantial complexity) of defining exactly what consent means and how it would be expressed in the context of siting a nuclear waste facility, one commenter suggested that Congress should provide a statutory basis for addressing this issue:

> *"In developing an initial draft of a consent-based siting process, DOE should be thinking now about the written consent agreement that will be required at the end of that process. We believe DOE should recommend that Congress enact a new statutory basis for binding written agreements between DOE (or any other program-managing entity) and state, local and tribal governments that consent to host nuclear waste storage and disposal facilities. We urge DOE to support the approach taken in S.1825, The Nuclear Waste Informed Consent Act, legislation introduced in the 114th Congress by Senator Harry Reid and Senator Dean Heller. We believe the Secretary of Energy should be required to obtain written consent from any potential host state and county, adjacent county impacted by transportation, and affected Indian tribe, before expending any funds from the Nuclear Waste Fund for repository construction."*

As already noted, several commenters also pointed out that the option to withhold consent, or to withdraw or cancel consent, is inseparable from the concept of consent. Thus, some commenters asked DOE to explicitly consider mechanisms that would allow communities to permanently opt out of being considered for a consolidated storage or disposal repository site. A number of commenters also addressed the critical question of when and under what circumstances parties could withdraw or revoke earlier expressions of consent.

> *"The contract for hosting a nuclear waste dump needs to be cancelable for cause, including unacceptable engineering changes, violation of safety standards or provisions, or other nonperformance by the Department of Energy or its contractors. Further, it needs to be cancelable if material new information becomes available such that the hosting entity would not have entered into the contract if that information had been known."*

Other commenters pointed out that all parties to a siting decision, including not only host communities and states or Tribes but also the entity sponsoring the facility, would need some clarity and certainty on these questions:

> *"What can you do to provide greater certainty and greater control for the entity that is undertaking this process?... How do you get to a point where you can be assured that the decisions you make aren't going to be changed?"*

> *"We need to set a clear path for what consent means; when host communities can withdraw and when they are bound by their commitments, so everybody knows where they're going moving forward."*

Additional discussion of these issues—including questions of local control, consultation, and participation in decision-making—may be found in later sections of this chapter and in Chapter 3 which explore the many specific aspects and demands of conducting a "fair" consent-based siting process.

2.3 THE MEANING OF "INFORMED CONSENT"

Numerous commenters focused on the notion of "informed consent" as basic to the success and validity of a consent-based siting process. As one commenter put it:

> *"In order for communities to be able to consent, they need to fully understand what all this means."*

In a nuclear facility siting context, several commenters emphasized that informed consent needed to start with a basic understanding of the type of facility being proposed, the type and amount of nuclear waste to be stored or disposed of, the timeframe of operations, and other key parameters. Without this basic information, they argued, any discussion of informed consent would be premature:

> *"Any community or private/public partnership considering participation needs to understand the DOE's concept of the facility scope of operations, duration of licensure, and the construct and frequency of shipments to the site."*

"In the current process, it is unclear if the federal government will be seeking consent for a pilot facility, a consolidated facility, or a permanent repository. The amount of spent fuel is unspecified, though growing. The length of storage time will always be uncertain. There's no legal framework, no environmental standards. It's not clear how a consent agreement would be enforced. There is no state regulatory authority. In other words, we don't know who is being asked to do what or with what protections. Under these circumstances, informed consent is not possible."

"It is impossible to consent to a project, or not consent to accept a project, for which the basic parameters are not known. All that has been provided to the communities is diagrams of storage containers and systems, and ideas and plans for the tens of thousands of tons of nuclear waste in this country, DOE is not defining exactly what or how much nuclear waste a community would be consenting or not consenting to accept. It is, of course, impossible to consent to a project for which the basic parameters of the project are unknown."

In addition to understanding a proposed project's parameters and scope, some commenters cited definitions of "informed consent" from the medical and legal fields that specifically emphasize the importance of a full understanding of impacts, risks and trade-offs:

"Informed consent is where you discuss fully with somebody the risks and benefits of all the options available to them. And any even unforeseen complications that could occur."

"'Informed consent' is 'assent to permit occurrence of an event that is based on complete disclosure of the facts needed to make a decision intelligently, such as knowledge of the risks entailed or alternatives.'"

Several commenters pointed out that comprehension has to accompany information. In other words, information has to be presented in a way that the parties being asked to consent can understand. One commenter cited a 1979 report by the U.S. Department of Health, Education and Welfare on the requirement of comprehension:

"The manner and context in which information is conveyed is as important as the information itself. For example, presenting information in a disorganized and rapid fashion, allowing too little time for consideration or curtailing opportunities for questioning, all may adversely affect a subject's ability to make an informed choice."

Several commenters also pointed out that informed consent poses particular challenges in the context of siting nuclear waste facilities. Such facilities involve highly scientific and technical considerations, difficult-to-quantify risks and long timescales, and have the potential to affect large numbers of people over large geographical areas. Commenters pointed out that in this context, it is important to be able to separate misinformation from information and also help people understand what they need to know.

> *"Some of this information is really, really technically very difficult…and I've worked and talked about this issue for a long period of time - some of these issues get incredibly complicated and so we have to keep that in mind as well."*

> *"I'm addressing my question to the Secretary. You mentioned in your wrap-up to your slides that we have the technology to manage this waste. And I know that's a big subject. It would probably fill reams of paper. But could you give us a little bit of a run-through on what that technology might be? And also where we as concerned citizens might go to look at some of that data? All these terms around radiation and isotopes and running trains through our communities is a bit scary and I think one way to help us would be to give us more information and that addresses the trust issue - the more informed we are, the more likely we would be to give you consent or to give you our very clear message that we don't give you consent to do this. But we want to be informed, either way. We're asking for more information and data, so thank you."*

Consistent with this emphasis on the importance—and challenge—of achieving informed consent in the particular context of siting nuclear waste facilities, many commenters stressed the need to provide technical support and resources, including funding, to help communities and the public participate meaningfully in the siting process. This critical topic and other specific ideas for designing a process that would allow for informed consent are discussed in the next chapter (Section 3.4), which discusses responses to Question 4 in the Invitation for Public Comment (i.e., "What information and resources do you think would facilitate your participation?").

Finally, several commenters made the general point that it would be important to break information down in ways that could be understood by people without a scientific or technical background. At the same time, other commenters pointed out that it would also be important not to alienate participants in a consent-based process by assuming that the public is not sophisticated enough to understand the scientific and technical issues. DOE was urged to avoid "talking down to people" and to use terms like "inform" instead of "educate."

2.4 Equity, Environmental Justice, and the Meaning of Voluntary Consent

Integral to the concept of consent, according to many commenters, is the attribute of voluntariness. In other words, an agreement that is coerced does not qualify as consent-based. For numerous commenters this aspect of consent is intimately linked to basic questions of equity and concerns about environmental justice.

"From past practice we know that only the poorest communities will be asked to participate. This is so not fair."

"Asking communities to go through this process of deciding whether or not they want to store radioactive nuclear waste will most likely -as it has in the past - result in environmental racism. Low-income and communities of color will be unfairly, unjustly targeted by this process."

Several commenters expressed concern that low-income communities could be exploited, particularly if consent is based on an expectation of incentives or inducements and/or economic benefits such as jobs, infrastructure investments, etc.

"There is a fine line between incentives and coerced consent. We need to acknowledge that line, and walk it carefully."

"The element of voluntariness is sharply questionable with regard to the communities which will likely become the subject of this process. Even inducements that would ordinarily be acceptable may become undue and improper if the subject is especially vulnerable, such as an economically depressed or politically powerless community."

It is worth noting here that several commenters also approached the subject of incentives and inducements from a more positive perspective—as potentially contributing to siting outcomes that have a net positive impact on community wellbeing. These comments, and the important topic of community wellbeing more generally, are discussed in Section 3.5.

Social equity concerns were also raised in a number of comments that specifically addressed the participation of Indian Tribes in a consent-based siting process. Several commenters expressed the view that Indian communities had been targeted in previous nuclear waste facility siting efforts and that they found this very troubling from an environmental justice perspective. (Additional comments that relate specifically to tribal concerns are discussed in Section 2.9).

For many commenters, the challenge of addressing environmental justice and equity concerns was inherently linked with the challenge of designing a "fair" consent-based siting process (discussed further in Chapter 3 of this report). Fairness, in this context, implies a process that—according to several commenters—is voluntary, inclusive, participatory, competitive, transparent, and guided by "clear" technical standards and criteria. According to one commenter, a fair process, by definition, produces outcomes that are viewed as a "win" by all parties.

To address environmental justice and equity concerns, several commenters emphasized the particular importance of providing information, technical resources, and support for

participation to rural, lower-income, and minority communities. (Additional comments on the need for technical and other assistance to support participation more generally are discussed further in Section 3.3.)

> *"Economically disadvantaged communities are especially at risk. Special effort must be made to inform and engage disadvantaged groups that could possibly be affected."*

In addition, commenters urged DOE to consult broader federal guidance on addressing environmental justice concerns including Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) and DOE's own Environmental Justice Strategy (PI-00139-5), as well as the National Environmental Justice Advisory Council's Guidelines on Public Participation.

2.5 Intergenerational Equity and the Durability of Consent

Several commenters, noting that equity has temporal as well as social dimensions, raised the subject of intergenerational equity. A frequent point was that the nature and longevity of the risks posed by radioactive waste make it inherently difficult to address equity concerns with respect to future generations:

> *"There is no mechanism for consideration of the rights of future generations that inevitably would be affected."*
>
> *"We are talking about something that stays toxic and dangerous for generations to come. How can one generation give 'consent' for future generations?"*
>
> *"We need to expand our timeframe to include future beings, future generations, way down the road, when we're considering nuclear waste."*

Other commenters suggested ways to think about this issue that would allow for action in the present and suggested that constructing a fair process was the best way to address intergenerational equity concerns. Some commenters also pointed out that continued failure to find disposal solutions for nuclear waste would itself impose burdens on future generations.

"My other comment is addressing the issue that was raised during the panel discussion about the question of how do you secure the consent of future generations when they're not here to speak for themselves. And I agree that this is a very tricky issue and here's my proposal for how we deal with this. There is a concept in a variety of social sciences, original economics, called Tiebout competitions, named after the guy who thought of it. A simpler way to talk about it is "voting with your feet." If there's some sort of physical amenity or disamenity in a location, people will choose to move there or move away. And on the timescales we're talking about of 2 million years, people have plenty of time to make an informed decision about, 'Do I want to live near this location as a permanent geologic repository or not?'"

"I think we need to do the best job that we can of having the best process, recognizing again that this is going to be there for thousands of years and we can't fairly represent all those generations to come."

"Over the past 25 years, our command of science and technology has grown exponentially. Our wrists are now adorned with computers that were once the size of office cubicles. Yet we remain hamstrung by decades-old facility siting strategies that fail to produce positive results. In the nuclear waste arena in particular, our reluctance to adapt and seek new approaches to facility siting has exposed us to increasing costs while we fail in our moral obligation to solve this national problem and not transfer these risks to future generations."

"A final concern I'd like to mention is that of intergenerational justice. We will leave behind amazing technologies and political accomplishments that will leave better off the policies of our children and children's children and their children. But nuclear waste enmeshes potentially dozens to hundreds of generations of humans and future human societies in our nuclear system. Anything that we accomplish based on a consent-based siting in the next 5, 10, 20, 100, 1,000 years will impact these generations. Creating management plans that are both enforceable and recognize our needs today but are also flexible enough for future generations to alter or amend based on their social values should be a gold standard of CBS as well."

Though discussions of intergenerational equity tend to focus on very long timescales (multiple generations), commenters also raised questions about the meaning and durability of consent over much nearer-term timescales (within one or two generations). Commenters pointed out that there would inevitably be "*turnover of politicians, generations, citizens, town councils*" over the long time periods covered by agreements to host a nuclear waste facility.

Even if we assume everything is right and local and regional governments agree, how is stability of the process guaranteed over long timeframes?

What is the plan to/strategy to make it stick after next election?

No single answer emerged from comments that addressed this topic, although many commenters pointed to factors that would play a role, among them the perceived fairness and integrity of the siting process itself, the existence of a strong technical basis for consent, and the perceived legitimacy of the mechanisms used to register consent.

A strong technical basis for consent is absolutely critical to ensure the viability of any facility over the intergenerational timeframes involved. A strong technical basis could ensure that the best site possible was selected that would outlive the election cycles of the political process.

Many commenters emphasized that durable consent would require maintaining credibility among the entities involved—to that end, they called for measures such as long-term monitoring of facility performance and robust state and local control. Others noted that it would be important to agree on key questions, such as 'w*ho will have responsibility for:*

- *Honoring commitments?*
- *Accidents?*
- *Issues not part of the original agreement?*
- *Who pays fines, levies fines, who receives fines?*'

Another commenter recommended including "*severe penalties for violating the agreement*" as another feature that would make an agreement more durable.

Yet another commenter focused on trust as the ultimate source of durable consent:

"Collectively, these attributes should engender trust in the siting process and in those responsible for implementing it. Without that trust, in our view, no siting process will lead to durable consent."

2.6 State, Tribal, and Local Control as an Element of Consent

Several commenters argued that another requirement for consent is "control"—in the form of some degree of regulatory oversight and enforcement authority over the nuclear waste facility being sited. As one commenter put it "*consent requires the ability to ensure that what you consented to is what actually happens.*"

> *"States have long supported early, meaningful, and substantial state involvement in the development and implementation of environmental statutes and related processes… DOE should continue to engage states as co-regulators during the development and implementation of a consent-based siting process."*

More specifically, several commenters argued that the federal government's current preemption of state authority to regulate radioactive nuclides under the Atomic Energy Act creates a fundamental barrier to consent since it deprives state, tribal, and local authorities of the authority to exercise the control they need to assure that the safety and interests of their constituents are protected.

> *"The first point that states must have regulatory authority – what I'm really saying is that we have to have an amendment to the Atomic Energy Act. Currently, states are preempted to have authority over health and safety issues, so what that means is that they are powerless. If they perceive, or perceive in the future, that there could be health issues, safety issues, issues that impact property values – they really don't have a say. So this would require Congress to get on the ball, amend the Act; I think the authority probably comes under or could come under the Resource Conservation Recovery Act, the Clean Water Act, the Clean Air Act. This is not a radical suggestion. In fact, the state of New Mexico cut a deal so they would have authority over the WIPP site and so when there was a problem in 2014, they had authority. I think to ask and expect a state to accept either a deep repository or to accept an interim site without giving that type of authority is dreaming."*

Another commenter points to a "*deep misunderstanding of federalism and the necessary role of states at the heart of the NWPA*" as "*the root of the problem*" in all efforts to site a geologic repository to date. According to this commenter:

> *"Our political system has never easily digested or durably solved profound national problems…by either federal fiat or, conversely, by turning matters over to the states entirely…in every instance of national decision making on these and other complex issues, heavily compromised laws or regulations have taken into account the needs and perspectives of states. Bedrock environmental laws reflect this fact. With the notable exceptions of the Atomic Energy Act… there is federalist intention at the heart of environmental statutes and a role expressly reserved for the states. As examples, the Clean Water Act, Clean Air Act, and Resource Conservation & Recovery Act (RCRA) allow states authority to implement those air, water, and waste programs, respectively, in lieu of a federal program. States that obtain "delegated" authority from the federal government must meet minimum federal standards (and the federal government retains independent oversight and enforcement authority). And generally, depending on state law, those delegated states can impose stricter requirements or different regulatory mandates. Nuclear waste should be no different, but under the AEA and the NWPA, it is."*

Another commenter, however, expressed concern about the potential for "dual regulation" that could result in "*multiple people telling you what to do, so you can't figure out how to do anything.*" This commenter asked whether proponents of greater state and local regulatory control had developed specific proposals for changing current law regarding federal preemption.

Some commenters spoke to the need for states and Tribes to be able to monitor facility performance and identify problems as a necessary corollary to exercising independent regulatory authority.

> *"Communities considering becoming consenting communities for DOE nuclear waste storage facilities need to go beyond typical DOE and typical state monitoring programs if they hope to have adequate monitoring of airborne emissions from above ground storage containers, airborne or soil contamination effects of transportation accidents, or buried waste migration in watersheds."*

Another commenter pointed to the example of the Carlsbad Environmental Monitoring and Research Center (CEMRC), which conducts independent monitoring to detect accidental releases of radiation at the WIPP facility in New Mexico. According to this commenter, CEMRC "*provided reassurance to the local community by providing an independent voice and an independent confirmation of DOE-supplied environmental monitoring results as opposed to only receiving information from the DOE or its operations contractor*." Noting that this reassurance was particularly helpful in the aftermath of the accident that took place at WIPP in February 2014, this commenter concludes "*an independent environmental monitoring program should become part of the requirement for any future consent-based siting decisions*."

Several commenters emphasized that regulatory control and legal enforcement authority were also critically important concerns for Tribes. These issues and the potential for state–tribal tensions in the context of Tribes' sovereign nation status are discussed in Section 2.9.

> *"In reality, siting of spent nuclear fuel and high-level waste is challenging with the expectation that some level of opposition will always exist. With this in mind, the Department must determine how it will balance varying perspectives while accounting for tribal sovereignty and individual state rights. Differing views between Indian country and a state should be given great consideration and, at minimum, the same treatment as state-to-state opposition. Before the Department adopts and implements a consent-based approach, it must appropriately recognize state approval is not necessary for decisions made on tribal land."*

2.7 TRUST AND CREDIBILITY

A major recurring theme across numerous comments is a lack of trust in the federal government and in DOE in particular. Many commenters identified this lack of trust and an associated credibility gap as a major impediment to the success of a consent-based siting process. For one commenter, lack of trust in DOE and in DOE's intentions cast a shadow over DOE's efforts to gather input on consent-based siting:

> *"This call for comment seems designed to manufacture 'consent' to whatever DOE intends to do."*

Several commenters spoke at some length about the origins and consequences of lack of trust in DOE and in the federal government's waste management program more broadly. An example of this point-of-view follows:

> *"We were put up here, I think, to provide a context for how to move forward and I don't think you can move forward unless you take a look at the past. You know, those who don't understand history are doomed to repeat it. And quite frankly, from our 34-year experience dealing with government agencies like the Nuclear Regulatory Commission, the Department of Energy, and others it's a pretty sorry history that this process is going to have to overcome before you can expect communities to take you seriously. […]*
> *[B]ut the bottom line here is that the agencies dealing with nuclear waste in this country have an enormous credibility gap. The public lacks confidence in everything that's gone on before; your history is very clear on how selective you are on what treaties, on what agreements you will keep and which ones you will break with or without consequence. That it's very hard to get a community to*

trust you and move into an informed consent dialogue under those circumstances."

Several commenters expressed the view that lack of trust was likely to be one of the biggest challenges DOE would face in designing and implementing a consent-based approach to siting.

"So if there is to be any process that is to be successful in achieving consent, it has to be a process that earns consent. It can't be consent on paper, even on brightly covered paper with lots of markers on it. And how do you get to that? Well, it's going to take time, and one might argue with DOE's history that it's going to be hard."

"On the subject of trust. If you moved into an apartment house and then found out that the builder had not put toilets in, would you ever trust that builder again? And here we have this nuclear waste that we were assured that it was clean, safe and too cheap to meter, but I don't know if anybody besides me remembers that, but - and nothing was done with the backend of the nuclear cycle and now we are stuck with this and our children, grandchildren and great-grandchildren are stuck with it. And this is the tragedy of it."

For several commenters, the federal government's past and ongoing involvement in nuclear-related activities was fundamentally intertwined with the challenge of building sufficient trust to site nuclear waste management facilities:

"We strongly object to all the proposed sites for storage of spent reactor fuel, including those in NEW MEXICO, our residence. Currently, New Mexico is dealing with the consequences of dangerous and volatile storage at the WIPP site in Carlsbad, NM.
This deadly, expensive problem originated at our lethal, prohibitively expensive nuclear lab in Los Alamos, NM. Los Alamos National Lab itself is the locus of historic and ongoing contamination, toxicity, and disastrous, intractable storage problems."

Others saw DOE's consent-based siting effort as potentially offering an opportunity to begin repairing trust:

"With the CBS process, the DOE has an incredible opportunity to do much more than site a waste repository. In a nation where conversations about science and technology are often made at an elite level, which further alienates the public from the decision-making process, the efforts to create a CBS could be applicable to a whole host of other techno-scientific issues, where trust is broken between experts, federal agencies, and the public. Dissenting, as well as supporting, voices need to be heard throughout the process and as other options and considerations crop up, they should also be taken seriously rather than dismissed as outside the purview of the CBS process."

"The last point I just want to note has to do with the long timelines involved in undertaking these technical assessments of sites and people often talk about the challenges of keeping communities or regions actively interested and involved for many years. It's a really complicated project, and certainly it's important to have a journey that's respectful and well-supported for all those in it. But at the same time, longer timelines actually bring opportunities. Unlike some other projects, there's really a chance here to develop trusting relationships and continue to strengthen those. There's time to co-create what the siting process looks like and start to envision together what a partnership could look like at the hosting stage. There's also time for meaningful discussion in the broader regions involved in the siting area. A really important discussion, and that takes time."

Some commenters thought it important for DOE to acknowledge the troubled history of the waste management program as a first step to regaining credibility.

"The history has to be recognized; it has to be acknowledged, and then you have to try to move forward."

"We want to trust the agency that goes forward with this process, but we need you to make some overtures that say, 'We can trust you.'"

For many others, however, keeping commitments was the key to reestablishing trust.

"The DOE must demonstrate that the federal government can fund, transport, and manage nuclear waste without significant radiation leaks and demonstrate that the federal government can comply with existing nuclear waste laws, contracts and agreements. They have not done this."

"We have contracts with the Department of Energy to pick up these materials. Those contracts were supposed to start getting honored in 1998. So certainly we encourage progress in this area."

"There are things that DOE can do to begin to restore trust. It can begin living up to its numerous commitments and following the law (to include all provisions of the NWPA)."

"The DOE must honor the Nuclear Waste Agreement that was signed by Idaho Governor Batt."

The idea that keeping commitments is central to gaining the trust and credibility needed to sustain consent is behind one commenter's idea of "earned" consent:

"Two words: earned consent. … You have to do it continuously, you have to do it every day - it's hard. You have to live it."

Other commenters likewise echoed the importance of sustaining consent:

"I'd like to comment that consent not only has to be granted, but then it also has to be maintained. You can't just create it - you have to maintain it."

For some commenters, lack of trust in DOE derives at least in part, from the perception that DOE is motivated by an agenda to support nuclear power and the nuclear energy industry. As one commenter put it:

"The Department of Energy is tasked with promoting nuclear energy. So, when we go through this process, we know that the motivation to move the nuclear waste is to promote nuclear energy, to encourage further nuclear energy; to clear the spent fuel pools and remove the liability from the nuclear industry and onto the backs of the citizens."

Several commenters expressed the view that any consent-based process would be unlikely to succeed, and indeed should not succeed, as long as the goal of siting nuclear waste management facilities is to enable more nuclear waste to be generated.

In addition to keeping commitments, several commenters underscored the need for openness and transparency as a way to rebuild trust and credibility.

> *"Transparency is essential, and transparency is created when time is invested in education and listening to the public. And transparency also leads to trust."*

> *"Transparency, openness between the community and the operator of the site so everybody has a feeling of trust, which is so important and lacking to date."*

A number of commenters also noted specific examples where transparency had been lacking in the past and one commenter pointed out that more recent terrorism concerns had complicated the task of providing transparency going forward. Other commenters emphasized additional aspects of trust, such as developing an understanding of communities' needs, values, and concerns and the importance of fostering trust between individuals as a first step toward building trust between institutions:

> *"You begin to develop trust by developing trust in individuals. And then you develop the trust in the institutions, which I know is an uphill battle but you have to start somewhere. And there are situations where you can put pressure on individuals to put pressure on their institutions and if they can be seen to be doing that, then that will give you trust in what they are putting forward. But developing a process like this from the bottom up hopefully will engender trust at least in the process and if you then have trust in the individuals involved in a trustworthy process, hopefully the institutions then become more trustworthy."*

Further specific suggestions for designing a consent-based process that fosters transparency and trust are discussed in Chapter 3.

2.8 VIEWS ON THE NEED FOR A NEW WASTE MANAGEMENT ORGANIZATION

Citing the trust issues discussed in the previous section, a number of commenters voiced support for the idea that a new organization, separate from DOE, should take over the nation's nuclear waste management program.

"I don't know how any host community could sign on to a binding agreement without having some special purpose independent organization—they're not going to sign on to DOE, we've been burned too many times in host communities."

"I think that trust is a thing. Trust is a very fragile thing. It's easy to break. It's easy to lose. And it's very difficult to get back. The Blue Ribbon Commission, not to mention before, recommended a new agency. One unburdened by over a half a century of failure. We need that new agency. We want to participate. We need a permitted waste facility. But we need an agency that we can trust to begin that process."

Given that both the Blue Ribbon Commission on America's Nuclear Future and the Department's own, more recent waste management Strategy support the transfer of waste management responsibilities to a new organization, some commenters asked why DOE was moving ahead with a consent-based siting process before a new organization had been established.

"I am concerned that the DOE is starting this process too soon, before there is clarity on important institutional elements. Although the DOE has embraced the Blue Ribbon Commission's (BRC's) support for consent-based siting, this IPC appears to contradict the BRC's finding that 'A new waste management and disposal organization (MDO) is needed to provide the stability, focus, and credibility to build public trust and confidence'... Until there is clarity regarding the form, funding, constitution, and responsibilities of this 'new organizational entity,' it seems premature for DOE to begin the process, for at least two reasons. First, public trust and confidence in the process depend on who is conducting it, and there is considerable public skepticism directed at the DOE in this regard. Second, what might be learned in a public consultation process begun today may not be well-suited to conditions that could prevail if and when a new MDO begins its work."

One commenter argued that responsibility for managing nuclear waste should be transferred to the nuclear industry itself, with appropriate federal regulatory oversight:

"Getting nuclear waste management right is important if America is to continue benefitting from nuclear energy, which currently supplies 19 percent of the nation's electricity. The Department of Energy is seeking to define a consent-based process for siting interim and long-term storage facilities for commercial nuclear waste. Yet the faulty system of misaligned incentives to manage commercial waste remains in place, muddling not only the goal of attaining true consent, but also long-term storage. The nuclear industry is capable of and should be responsible for, nuclear waste management. This naturally allows "consent" to take whatever shape communities or states deem best, without government coercion, and opens the possibility for innovation. The government should maintain the role of regulator. Finland, as the first country to license construction of a long-term repository, provides a good example."

Not all commenters agreed with the need for a new organization:

"Creating a new agency does not resolve the issue of trust that plagues the federal government and DOE in particular, when it comes to waste management. Rather DOE should strive to restore trust in the agency and correct the behaviors and culture that has led to this widely acknowledged crisis of confidence."

"I don't see that we need a new agency, we need to make sure though that the laws are changed to allow interim storage; the laws changed that an administration can't change it the next time that the administration changes, and we should be working hard on all of that…instead of staying in this world of 'don't trust' and 'don't do.' We have got to face that this fuel exists and it must be protected."

As the foregoing comment suggests, there was support for the idea that the waste management program should be more insulated from political influences and considerations regardless of whether a new waste management organization is created. As one commenter put it:

"It is important to insulate the process from the normal election cycles and attempt to immunize the process from 'politics' or 'ideology.'"

For commenters who supported the formation of a new organization, on the other hand, greater insulation from political influences was one of the chief arguments for transferring the waste management program out of DOE.

2.9 PERSPECTIVES OF TRIBES

Numerous commenters raised concerns and topics specific to Tribes, whose communities have long been affected by nuclear facility siting decisions. A first point of emphasis in many of these comments concerned the sovereign status of Tribes and their unique government-to-government relationship with the federal government:

> *"One of the foundational principles of Indian law is the federal government's trust responsibility to Indian tribes. Federal trust responsibility includes legal duties, moral obligations, and the fulfillment of understandings and expectations arising over the entire course of the relationship between the United States and federally recognized tribes. Therefore, it is the right of federally recognized Indian tribes to make development decisions in Indian country, without state objection or oversight."*

Several commenters pointed to a "disconnect" and a "lack of integrity and consistency" in DOE's implementation of policies that impact tribes:

> *"As sovereign nations, Tribes are not equivalent to states. Sovereignty and trust responsibility aside, from an ethical standpoint, tribes should be treated at a minimum, in tandem with states. As the current policies and processes exist relating to the siting of nuclear waste, tribes are inappropriately afforded less deference than states. Regardless of where waste is sited, it is incumbent upon DOE to provide American Indians with the legal distinction and respect they deserve."*

> *"An overarching theme of concern for NETWG [Nuclear Energy Tribal Working Group] is the lack of consistency and integrity in DOE's approach to incorporating tribal views and concerns throughout its efforts…Generally, because of the Department's inconsistent consideration to the laws, policies, and inherent sovereign rights of tribal governments, there tends to be disconnect and a lack of trust and confidence in the Department's decisions."*

> *"There is a level of distrust when it comes to tribes and the federal government. …And that's kind of how we view the government - to a degree is that they're saying, "Hey, yeah, we're going to do this," and then they wave as they drive by. They want to include us and it's sometimes - I think we just get left out. We're in the back. We're not really in the forefront. So we are left out."*

As specific examples of instances when tribes were not accorded the appropriate level of deference, commenters pointed to the experience of the Skull Valley Band of Goshute Indians and a more recent instance involving the Yucca Mountain project. In the first example, a

proposal to build a storage facility on tribal land in Utah was stopped despite the Tribe's support for the project. In the second example, from another commenter, a map put out as recently as 2016 for a supplemental environmental impact statement on the Yucca Mountain project failed to include tribal lands, even though the Tribe had been granted 'affected status' for the project.

With this history in mind, a number of commenters emphasized the importance of being consulted and treated as equal partners by the federal government in nuclear waste management and siting decisions going forward. In particular, some commenters highlighted the desire for DOE to follow existing treaties and engage in regular and meaningful consultation with Tribes. Commenters also stressed that Tribes' right of self-determination means that states cannot interfere with a Tribe's decisions for or against the siting of nuclear waste facilities on tribal land:

"The Tribes must be invited to be involved in any of the DOE's site selection processes. It is up to the Tribes to then make a decision as to our involvement."

"Federal government's trust-responsibility should uphold Tribal self-determination, and not cater to the states activities that impede on the Tribes right to self-determination during the consent-based siting process."

"Consent from all affected government units is ideal, but the right of federally recognized Indian tribes to develop or site a facility on tribal land, without state objection or oversight, is a sovereign right."

Further, according to several commenters, DOE's trust responsibility creates an obligation to provide resources and funding to Indian Tribes to allow them to participate as equal partners and manage the impacts of nuclear waste facilities and transportation on their lands. In making this point, one commenter reminded DOE that, "*notification is not communication*."

"Tribes want to be on equal ground. We want to build a trust with the nuclear industry, the NRC, the Department of Energy. And we want to know that when they're telling us that they're going to do something that they do it, and when they're giving us information, that that information is accurate and complete, so when it comes time to make that decision on consent-based siting, we want to make an educated decision on that. Not an emotional decision."

"You need to go to the community and do these types of outreach meetings over time. Not just one, but to develop a relationship - go there, explain this stuff, and come back multiple times. At all of the Tribal Nations in the entire country."

> *"The INL transportation corridor transverses the Fort Hall Indian Reservation and increased shipments can and will directly affect SBT, tribal members, natural and cultural resources. SBT has historical experience, knowledge, and measures in place to mitigate potential hazards through the Tribes Department of Public Safety and Emergency Operations Center. DOE has a trust-responsibility to provide resources and funding for affected Federally Recognized Tribes with lack of experience and resources. This will enhance the affected Tribes ability to provide protection and safety in a newly developed and/or increased use of an existing transportation corridor."*

Commenters also emphasized the unique connection between Tribes and their land:

> *"So tribes are working harder to be part of a consent-based process because it has a profound impact on tribes, because we can't pick up our tribal lands, we can't pick up our history, we can't pick up and move to another neighborhood, we can't move to another city. That's where we are from. That's our ties. That's our place. And to have it possibly contaminated is deeply troubling to our people and you take the elders and they just get tied up in knots over what are we going to do? How are we going to handle this?"*

Other commenters noted that their sovereign status gives recognized Tribes the ability to set and enforce their own laws and regulations within tribal lands, including laws and regulations governing land use, hazardous and non-hazardous waste, environmental cleanup, water quality and the protection of other human, environmental, and natural and cultural resources. As one commenter put it: having the "*legal enforcement we need to exercise our sovereignty*" enables tribes to provide "*protection over our ancestral lands and people, as well as our culture… so the key word here is 'protection.'*"

A related point in some of the comments is that sites of cultural and historical importance to Native Americans also exist outside the boundaries of federally recognized tribal lands. Thus, potential impacts—including impacts from transportation—must be considered, not just within reservation boundaries but anywhere there are sacred sites, and cultural and historical lands.

> *"If you come and visit the Nez Perce Tribe we have through our Treaty what we call 'usual and customaries,' so our area of influence in the Northwest is much greater than our land base that we have in Idaho. It extends from the Pacific Ocean and the resources of the Columbia River in salmon and lamprey to the buffalo in the Midwest… So the area of impact for us is much greater and…the Nez Perce Tribe is going to have an issue to say about those areas; those are our sacred areas, those are areas that we've taught as our history and just using our example, the Nez Perce, times that by 500-some nations across this country is going to be a daunting challenge to communicate well with each of these folks."*

In addition to these broad points, commenters raised a number of additional concerns, including some points of specific interest to a particular Tribe:

- Tribal nations with lands near or adjacent to nuclear reactors share the concern that they have become hosts of facto long-term spent fuel storage sites. (An example is the Prairie Island plant in Minnesota, which is near the Prairie Island Indian Community. The tribe recently bought additional land outside the reservation so that families can choose to re-locate if there are safety concerns associated with these facilities.)

- Some Tribes are still suffering adverse health and environmental quality impacts from retired and still-operating nuclear facilities. The example given involved legacy health effects from uranium mining operations on Navajo lands.

- DOE, EPA, and NRC must assess health risks in a way that includes a culturally appropriate context for tribal populations. Previous modeling to set radiation protection standards for Yucca Mountain, for example, failed to consider lifestyle differences that lead to a disproportionate burden of health risks for Native Americans.

- Some Tribes strongly oppose the "*transportation, storage or production of spent nuclear fuel, high-level nuclear waste, and low-level radioactive was*te" in specific locations, including within the traditional homelands of Turtle Island and at Yucca Mountain. As one group stated in its comments: "*The United States government has a long history of abrogating treaties entered into by the Indigenous tribes of this country and the United States. If Congress approves Yucca Mountain for a nuclear waste dump, it will be another attack on the treaty rights of the Western Shoshone.*"

- In Canada, an effort to engage young people as well as elders has led to the creation of the Elders and Youth Circle to advise the government on "*respectful engagement - respect for treaties, rights - and also how to appropriately embrace indigenous knowledge and interweave it with contemporary science*." This is seen as a way to prepare the decision-makers of tomorrow as well as a way to bring intergenerational perspectives to the table.

- Tribes offered examples of steps that could be taken to implement a fair siting process, including creating Tribal Working Groups, examining current arrangements, such as the Agreement-in-Principle between the Shoshone-Bannock Tribes and DOE, and creating additional opportunities for engagement and information exchange.

- Commenters emphasized that any siting efforts for nuclear waste storage and disposal should honor existing treaties.

- Some commenters also encouraged DOE to design the consent-based siting process in a manner that would not infringe upon American Indian religious freedoms.

2.10 TRANSPORTATION

DOE received many comments on the topic of transportation. As one commenter pointed out, the transportation demands associated with DOE's current integrated waste management strategy could be substantial:

> *"We are now considering the prospect of transport of spent nuclear fuel to one or more consent-based interim storage facilities; the possibility of the subsequent transport of spent nuclear fuel to interim storage, or from interim storage, to a permanent disposal site or sites, and the possible transport of high-level waste to a defense-only geologic repository. That could be an awful lot of transportation. Transport of 70,000 metric tons to Yucca Mountain was estimated to involve 1.3 million shipment miles over 25 years and to directly affect 891 corridor communities: one hundred of those in the Northeast; 289 in the South; 353 in the Midwest and 140 counties in the West. Of the 891 corridor communities, some would be affected by shipments from just one or two origins sites - perhaps over a very brief period of time. Whereas others would be affected by shipments from many origins sites, up to 40 or more, perhaps over decades."*

More generally, several commenters noted that transportation considerations are integral to siting decisions for nuclear waste facilities and that related issues of public acceptance and consent are likely to be significant given the safety concerns that can be expected to arise in connection with nuclear waste shipments.

> *"Just using the word 'siting' without adding the word 'transportation' seems like we're going to pick a place and then worry about it later... it's critical that we think about transportation from the get-go."*

"Facility siting identifies destinations for SNF/HLW transport, and largely determines routes, which, in turn, largely determine transportation impacts. So, facility siting should not be addressed in isolation from other program components."

"[T]o the extent practicable, accessibility should be a criterion for evaluating the suitability of a potential site. This is one of the useful lessons that came from the licensing of the Private Fuel Storage facility in Utah, which was ultimately blocked due to the inability to construct the necessary transportation infrastructure to move spent fuel to the site."

Commenters voiced a range of opinions on whether the concept of consent-based siting needed to include a consent-based approach to transportation planning and decision-making or not. Several argued for applying the concept of consent to communities along transportation routes:

"The key message here is that as we consider consent-based siting in host states and communities, we should simultaneously consider the acceptance of transportation in corridor states and communities. Assuming that a good transportation outcome will necessarily follow and be compatible with a good interim storage outcome is not a sound approach."

"Shouldn't we be looking at consent for those communities that are on these transportation routes? If they're going to be cast on the sidelines as thousands and thousands of truckloads of some of the most dangerous material in the world goes by their homes and communities, shouldn't they be engaged and give consent for this waste being transported through their communities?"

"No consideration of the rights or consent of those along radioactive waste transport routes is being made or requested, although one of the greatest dangers to the most people, environments and ecosystems is the movement of tens of thousands of tons of nuclear waste on roads, rails and waterways. Even the DOE stated at its Washington D.C. 'kickoff' meeting that there is complete federal preemption over transport of nuclear waste so that would not be part of the process."

"To be fair, the DOE must engage the communities on the proposed transportation routes. The communities on these routes must be part of the consent-based siting process. At this time, it does not appear that the DOE intends to acknowledge the stake that these communities have in this process and include them in any meaningful way. This is a big mistake."

Other commenters questioned whether it was practical to seek consent from communities along transportation corridors in the same way consent might be sought for a facility:

"We do not believe, as others have asserted, that each corridor community must provide its consent for transporting these shipments through their jurisdiction. Section 180 (c) of the NWPA authorizes funding to states and tribes through whose jurisdiction the Secretary of Energy plans to ship spent nuclear fuel and high-level waste. In turn, the states will provide funding and training to its sub-jurisdictions to prepare for shipments."

"We feel it is important for DOE to develop a thoughtful answer to the question of whether consent will be sought for transportation. It is easy to document that the Blue Ribbon Commission on America's Nuclear Future advocated for consent-based siting but not consent-based transportation. We recognize that consent-based transportation is neither practicable nor is it enforceable under the Commerce Clause. A more positive answer to the question, however, would be to emphasize that states, Tribes, and local governments are the representatives of the people. As such, they have an obligation to protect the health and safety of the public and the environment. Involving these governments in decision making may not constitute granting consent, but it does help the peoples' representatives ensure that the public is well protected and their concerns are being addressed."

"I would add that the problem with transportation is that it's very distributed. Right? Depending on where these get sited, thousands of communities could be affected in one way or another. I think the issue of consent about the criteria for how things should be moved is a national issue and there ought to be careful consideration of how the transportation system is designed, and the storage while it is in transport, the supports for communities that might be affected as you go along; those things can be dealt with as a national issue, but ultimately if you have every single community having a say about whether something can go through their community or not, ultimately, I can't see how that could possibly work."

Many commenters stated that affected communities must be properly informed and included in transportation planning and that particular attention would have to be paid to equity and environmental justice concerns.

"None of these communities have a clue what you're talking about doing to them as far as transport."

"The DOE must make transportation maps available as soon as possible when an area is under consideration as a site for either a commercial or federal consolidated interim storage site, permanent INF repository, disposal of HLNW, or related facility. The public must be made aware of transportation routes as soon as possible."

"I think that communities that are already at a disadvantage economically and culturally will have less resources and less ability to cope with the challenges of this kind of endeavor. And so I'm particularly concerned about those communities like on the Southside (of Chicago) and that's also a community that has a lot of rail, a lot of highways…"

Numerous commenters expressed the view that transporting nuclear waste was inherently risky and dangerous and that it would therefore be difficult to gain public acceptance for nuclear waste shipments.

Some commenters spoke of "mobile Chernobyls" and "floating Fukushimas" in underlining their opposition to nuclear waste transport—whether by barge, rail, or truck. Specific concerns included the potential for accidents and derailments, terrorist attacks, infrastructure failures, incidental exposure to radiation, loss of property values, and liabilities in the case of an accident:

"We do not consent to high-level radioactive waste truck and train shipments through the heart of major population centers; through the agricultural heartland; on, over, or alongside the drinking water supplies of our nation. Whether due to high-speed crashes, heavy crushing loads, high-temperature/long-duration fires, falls from a great height, underwater submersions, collapsing transport infrastructure, or intentional attack with powerful or sophisticated explosives, such as anti-tank missiles or shaped charges, high-level radioactive waste shipments, if breached, could unleash catastrophic amounts of hazardous radioactivity into the environment."

"I am strongly opposed to the shipping of railroad trains to travel around the country with radioactive deliveries. We have seen already repeated disastrous derailments and explosions of trains carrying petroleum. You must be aware that terrorists, as in Belgium, could be tracking a nuclear facility for material for a dirty bomb - centralized locations and railroad trains would be an added attraction."

"What if this stuff is stuck and I'm next to it on the highway, and I'm in a traffic jam or there's an accident? Just being near it is not safe."

"It's a fact that experience has shown that property values decline significantly along nuclear waste routes. Using the Department of Energy's own data, it was estimated that between 70 and 310 accidents and over 1,000 incidents would occur during the nuclear waste shipping campaign to Yucca Mountain if trucks were used as the preferred mode, and between 50 and 260 accidents and over 250 incidences if trains were used as the preferred mode."

"Not all communities are equipped with hazmat; according to the American Society of Civil Engineers, our nation's crumbling infrastructure and system of highways, roads and bridges is rated D, making it prone to accidents."

"You're talking about moving more waste than has ever been transported before. So it seems like you're suggesting doing something that we haven't actually done. Things that we have even done before - accidents happen. So what I'm asking is how do you account for human fallibility in the face of such a huge task? And I guess even more so, how can you - I guess who shoulders that risk, really? Where does that responsibility land? Knowing that humans are imperfect?"

Many commenters who expressed concerns about the transport of nuclear waste also voiced objections to implementing consolidated storage. In their view, any added movement of waste would incur additional large and unjustified risks. Views on consolidated storage are discussed at some length in Section 4.2. A few examples are given here:

"Transporting nuclear waste is an unacceptable risk for temporary storage."

"We believe you should only transport the waste once. And that is from where it is to where it's going to end up permanently."

"I oppose the consolidation and transportation of waste to new sites unless and until a viable long-term management facility is in operation, per the Nuclear Waste Policy Act."

Other commenters saw the scope and nature of the challenges associated with nuclear waste transport as manageable and pointed to the record of radioactive and hazardous materials shipments in the United States as providing a basis for confidence in that assessment:

"Over 50 years of nuclear energy generation, really nearly 60, you arguably could fit all the spent fuel on 100 acres, so this is not a high-volume in terms of the magnitude of the issue. In terms of transportation, it would take about one shipment a week to transport this stuff to a central repository, and so that's out of three million hazardous waste shipments a year…. Already around the world, more fuel has been transported than is currently actually sitting in pools or outside plants in the U.S., so the transportation experience without harm to the public has been carried out safely, so the track record is great there."

"With the WIPP site as an example, we have had shipments, loaded shipments, that would be equivalent to going to the moon and back 26 times. The Defense Department has been shipping Navy fuel for over 30 years without incident. And the WIPP shipment system is the envy of every trucking company probably in the world, but it certainly is in the United States. And it doesn't occur lightly. It occurs because of the integrity that's put into the system. It's the training, it's having people that have never had a moving violation, it's the way the trucks are monitored, it's the only truck going down the highway whose tires are filled to the right level; there are no leaks in the hydraulic hoses and it's the only truck going the speed limit, by the way. So it has some unique characteristics aside from being monitored continuously in its routing."

"Scientifically, we know how to package this stuff. We built these transport containers, we ran them 80 miles an hour into cement-brick walls; we burned them in 2000° jet fuel fires; we dropped them from a height over a cliff. I mean you can't make the container any better than it is, okay? And there's never been a problem with it."

Several commenters stressed that it would be important to take a proactive approach to addressing transportation concerns, including working with existing groups that have expertise in this area and implementing additional safety measures for transportation. One commenter suggested that new federal legislation could be warranted to specifically address transportation issues and concerns, and several commenters urged DOE to implement specific transportation recommendations developed by the National Academy of Sciences (NAS) and the Blue Ribbon Commission on America's Nuclear Future (BRC).

"We cannot emphasize enough that if transportation and emergency response impacts are set aside or deemed to be secondary considerations, it is a mistake."

"Federal agencies should make an effort to review and take advantage of the work and knowledge found in many of the state collaborative efforts such as the Western Governors' Association and Western Interstate Energy Board. It has been estimated that advanced planning time frames on the order of a decade would be required to develop a coordinated transport strategy and the associated logistics and physical infrastructure. Defining priority shipping factors and developing a shipping schedule are likely to become contentious issues. Furthermore, older decommissioning facilities and stranded ISFSIs have less direct management oversight, security, and regulatory monitoring than operating facilities; consequently, they represent a unique risk profile that must be addressed. Identification of shipment priority should begin early in this process. Moreover, early identification provides the essential lead time required to develop the transportation procedures, routes, policies, and supporting state and local infrastructure."

"We believe that new federal legislation will be needed to address the radiological impacts and social impacts of transporting spent nuclear fuel and high-level radioactive waste… With or without new statutory requirements, DOE should make a clear commitment to implement the transportation safety and security measures recommended by the NAS and the BRC before the commencement of any shipments of spent nuclear fuel or high-level radioactive waste to consolidated interim storage or disposal facilities."

Finally, commenters offered a number of specific ideas for reducing transportation-related risks and addressing attendant public concerns. Suggestions included upgrading rail and other infrastructure, such as roads and bridges; giving communities on-line access to accident records and transportation infrastructure status reports; and developing "*a transportation protocol that would maximize public safety for all citizens who could potentially be affected by any calamity that might befall a shipment of nuclear waste*."

Other commenters raised additional concerns, including the need for more detail on transportation-related costs and technical and safety issues (including details on cooling requirements, canister integrity, and condition of fuel assemblies), the need to standardize transportation canister designs, the lack of working transportation infrastructure at some shutdown reactor sites, and the need to clarify responsibility for liabilities and costs during transport. On this latter point, some commenters offered the view that the utilities alone, or utilities and the federal government, should bear the costs of transporting spent nuclear fuel, not states or Tribes.

3. VIEWS ON DESIGNING A CONSENT-BASED SITING PROCESS

In the Invitation for Public Comment and at public meetings held around the country in 2016, DOE posed five questions aimed at eliciting input on the design of a consent-based process for siting nuclear waste storage and disposal facilities. This section summarizes responses to these questions by commenters. In many cases, the comments DOE received also addressed other topics and/or made larger points that are captured in Chapters 2 and 4 of this report. There is also obvious overlap between many of the general themes discussed in the previous chapter and the specific design questions included in the Invitation for Public Comment. For example, the topic of "informed consent" (discussed in Section 2.3) is closely aligned with the question "What information and resources do you think would facilitate your participation?" (discussed in Section 3.4).

3.1 HOW CAN THE DEPARTMENT ENSURE THE PROCESS FOR SELECTING A SITE IS FAIR?

Responses to this first question about how to ensure a fair process touched on many of the larger themes discussed in the previous chapter (e.g., information, voluntary participation, full disclosure of risks and benefits, trust and transparency, etc.). For many commenters, a fair process would have to accomplish multiple objectives:

> *"Achieving and ensuring "fairness" in the siting of a nuclear waste repository requires a commitment to a transparent process of informed consent. Informed consent is achieved only when the affected entities acquire the requisite depth of knowledge and understanding of the constraints and consequences of the proposed plan and processes. To engage in an equitable and virtuous agreement, the negotiation requires engagement of the right entities while ensuring the appropriate support and education during a transparent process. Before any binding agreement is formed, the affected community must clearly understand the nature and consequences of the generational agreement to which they are committing."*

Another commenter thought it might be more fruitful to focus on establishing performance measures for a fair siting process, rather than attempting to define such a process in advance:

"Rather than dictate a specific public engagement process for all potential nuclear waste host communities, the federal government should instead consider defining performance measures that would establish community outreach, inclusion, and transparent decision-making outcomes with an emphasis on the identification of environmental and socioeconomic justice concerns from the outset. That would allow local jurisdictions and states to design their processes around established rules and procedures while also establishing a clear, high bar by which everyone involved understands that consent is to be broad and deep and arrived at through inclusive and transparent community engagement and decision-making."

In addition to the general points discussed in Chapter 2, commenters offered a number of specific suggestions for ensuring that the siting process is fair. A sampling of these suggestions follows:

- Undertake an "*unprecedented*" effort to engage the public, including giving notice of any meetings and providing a summary of the subject at least a month in advance to major local and social media, government entities, state and local first responders, civil groups, local associations, interested stakeholders, and colleges.

- Ensure that the public knows "*immediately*" when any entity "*volunteers or inquires about volunteering.*"

- Ensure that all meetings are public and scheduled at times and places that are conducive to broad community participation. In addition, ensure that all proceedings are recorded and published

- Provide "*high-level summaries and fact sheets to keep participants informed throughout the process*;" "*allow for remote participation as travel to specific events is not always possible*;" and "*provide those who could not attend either access to an online video or detailed notes from the event*."

- Consider how the process will address minority opinions.

- "*Retain some flexibility to detail parts of the siting process*" as it goes forward; be willing to "*pause*" to allow for collaboration with the community; and retain the flexibility to "*continually review and update*" funding programs so they can keep pace with communities' needs.

- Ensure that communities understand siting requirements and suitability criteria for different types of facilities. In the case of a repository, this could include developing a list of suitable geologic conditions or media for disposing of nuclear waste (e.g., salt, granite, etc.) and indicating where these media exist to help inform potentially interested communities.

- Use a mediator who is truly neutral. The person who mediates the agreement [between the host community and the federal government] cannot work for the agency.

- Create a site advisory board for each prospective site that is "*made up of either local elected officials or qualified persons appointed by a vote of local elected officials…. The establishment of a site advisory board should be a negotiated, consensus process among local governments with very minimal facilitation by DOE…*"

- Include *full disclosure of all known capital and long-term costs of the site, including any hidden costs, assurances for permanent financial support, and impact on the local, state, federal, and investor community*, as well as full disclosure about who will pay for hidden and unexpected costs.

- "*Provide an emergency response plan that details what will be done if there are problems. Provide details on the oversight, monitoring, and auditing of the site that will be performed and how this information will be made available to the public*."

- Don't assume that "*communities that are already dealing with active nuclear sites or decommissioned sites…would be then more willing to host new sites."*

- Recognize the expertise that exists in areas that have been hosting spent fuel and among the nuclear industry workforce and try to move beyond the polarized debate between anti-nuclear activists and nuclear industry insiders.

- Don't preclude those companies and localities that have already come forward to volunteer to site facilities, whether those proposals involve consolidated storage facilities or repositories or are located in Texas, New Mexico, or Nevada or elsewhere. "*Those kind of efforts should be encouraged.*" At the same time, don't constrain consideration to communities or proposals that have already come forward.

Several commenters emphasized the importance of establishing clear technical and social requirements and siting criteria *before* sites are selected for consideration to assure the transparency and technical integrity of the siting process. Since most commenters who addressed the subject of criteria and standards did so in response to Question 4 (What information would facilitate your participation), this topic is discussed in Section 3.4.

Some commenters urged DOE to identify discrete steps in the siting process, and the order in which these steps would be implemented. Some commenters also offered specific proposals for what these steps might entail. For example, one commenter outlined a generic six-step process for siting a deep geological repository that begins with "*a preliminary list of potential sites that meet scientific criteria for appropriateness*" (step 1) and then proceeds to engaging in discussions with potential volunteer communities near these sites (step 2); full safety characterizations for at least three or more sites with favorable geology and community support (step 3); an administrative safety determination for one or more candidate sites based on the results of the characterization studies (step 4); "*a final, irrevocable decision on community consent*" (step 5); and construction and "*ongoing community oversight*" of the proposed facility (step 6). It is important to stress that the foregoing represents just one suggestion from a single commenter concerning how to approach the siting process; it is

included here only as an example of some of the more specific feedback DOE received in response to Question 1 in the Invitation for Public Comment. (At this time, DOE has made no determination as to how it would propose to structure a consent-based siting process.)

Other commenters proposed different models for the siting process or offered detailed suggestions on other aspects of the process. One commenter, for example, offered a detailed list of specific "filters" that could be applied in different phases of the process to screen candidate sites, ranging from technical, geographic, and logistical criteria (e.g., access to utilities and transportation infrastructure) to social and political considerations (e.g., a letter of support from the governor of the host state).

3.2 What Models and Experience should the Department Use in Designing the Process?

A number of commenters urged DOE to look at consent-based siting efforts in other countries, such as Canada, Finland, France, and Sweden.

> *"It certainly must be true that we have something to learn from our citizen-colleagues abroad how they were able to successfully deal with the siting process."*

Several commenters offered examples of the kinds of lessons that could be learned by looking to other countries' siting experience:

> *"The experience and model of effective site selection is, more often than not, the selection of a site in an area where nuclear facilities already exist, are accepted, and trusted to be safe. This was the case in Sweden and in Finland, and will be the case in Canada. France has a site in a rather poor area looking for an economic boost, but generally the French nuclear industry is seen favorably and trusted, which is not the case for DOE."*

> *"The role for potential host communities in Canada's process can also help inform DOE's consent-based siting process…the Canadian government has done a good job of outlining the different phases of their program and what each phase will entail. That level of information is very helpful for potential host communities to have at the outset so stakeholders know what to expect and understand that the government has a comprehensive approach over time."*

Some commenters noted that there are differences between the United States and other countries that could have implications for the design and likely success of consent-based siting processes. Examples include differences in governance structure and differences in the level of public trust in government:

"While many would suggest that the Department look to Sweden or other European countries for models of successful siting processes, it is important to note that the legal frameworks regarding federal, state and local governance and related land uses decisions are quite different from those in the United States. In Europe, local communities enjoy significantly greater control over land uses proposed by national governments. The process for siting defined within the Nuclear Waste Policy Act recognized the significant role of the federal and state governments in the United States regarding land use decisions and the role of local governments regarding said decisions."

"We saw …Sweden, Finland and Canada being ahead - those cultures are very different than America in their trust in government and anyone who's paid any attention - trust in government in this country is probably at an all-time low. So how do we get there? I just don't see it happening."

Other commenters pointed out that experience with consent-based siting in other countries has not all been positive—indeed, some countries' efforts have run into the same tensions between local or state and national interests, among other challenges, that have frustrated past U.S. efforts to site a geological repository:

"The Yucca Mountain project, Private Fuel Storage, MRS and other U.S. efforts seemed to have failed because of lack of state support even though local support was significant. Consent processes in England, Japan and Canada seem to have significant problems. Sweden and Denmark are moving forward and are now close to the finish line. The political structure of those two countries has made it possible for communities to step up without the interference of states or other political sub-divisions, as exists in the U.S. France is also moving forward, but has an approval process in 100 years that may foil the process."

"What models do NOT work? The fair and comprehensive national site selection processes widely advertised in Germany (iteration number two) and Japan (also iteration number two) have produced no results. Allowing cantons to reject repository siting studies in Switzerland had to be taken away by the national government to allow progress to be made."

Besides looking to international examples, several commenters suggested that DOE should learn from its own experience and from the history of the U.S. waste management program to date, including lessons from Yucca Mountain, from the Waste Isolation Pilot Plant in New Mexico, and from other "*successful and unsuccessful sites that are currently in use or shut down.*"

Commenters also noted two earlier efforts with specific relevance to the siting of nuclear waste facilities—a 1981 task force report on siting and the experience of the Office of the Nuclear Waste Negotiator in the early 1990s:

"In 1979, President Carter appointed a task force led by Gov. Dick Riley of South Carolina with 17 other members including governors, state legislators, mayors, and four federal officials. Its name was something like the Presidential Planning Council on Radioactive Waste Management. It submitted its report in 1981. A large part of the council's work focused on developing a fair process for siting decisions. The presence of 7 or 8 governors on the council and their regular participation in meetings was significant. If you have not already reviewed the report, it would be worth the effort of taking a look."

One commenter described lessons learned from the federal government's first effort, through the Office of the Nuclear Waste Negotiator, to recruit volunteer communities to host a monitored retrievable storage facility:

"A principal barrier to the siting of these facilities is distrust in centralized governments and government agencies, regrettably including the Department of Energy."

"Political leaders at all levels will be pressured to exercise early preemptive vetoes over the process and must always be given devices to be insulated from the process to avoid that type of pressure."

"National grants or other study monies to let people make their own independent research and evaluation are necessities."

"Site tours of existing facilities are one of the best ways that average citizens as well as political leaders can understand what these facilities are, and how safe they are."

"Special attention and working press protocols must be emphasized from the outset to create media understanding and the accurate delivery of communication."

In this commenter's view, "Whether the political conditions are correct anywhere in the United States for the voluntary siting of nuclear waste facilities remains an open question." Further, this commenter cautions that, "These processes and decisions will take time if we are to reverse 50 years of nuclear fear which grips our citizens – in other words, sometimes we must slow down to speed up on issues relating to nuclear waste."

Another commenter drew an analogy to a popular movie from 1993, *Groundhog Day*:

"Too often, when government officials are faced with complex, controversial, multistage approval processes, they overemphasize the uniqueness of their particular situation and neglect to learn from similar efforts in other parts of the country or world. This is a mistake… [Former BRC member Allison] MacFarlane recently commented, "There is nothing new with nuclear waste. History keeps repeating itself, like 'Groundhog Day'…" In the 1993 film, Bill Murray is doomed to continue reliving the same day until he breaks the cycle by learning to love. While no nation will learn to love nuclear waste, all nations have a responsibility to learn from past experiences to improve the repository process and its chances for success. Applicants and regulators need to learn to love the public approval process if they ever hope to break the nuclear waste impasse. It is only by accepting this process in its entirety—getting the public and nongovernmental organizations to the table early and often, submitting to strong local regulatory authorities, and accepting politics as inevitable and possibly useful—that society can move toward solving the nuclear waste issue. [From Goldstein, J. 2010. "How to build a better sepulcher: Lessons from New Mexico's Waste Isolation Pilot Plant." Jon Goldstein, Bulletin of the Atomic Scientists 67(5): 77–88.]"

Some commenters also suggested that communities interested in being considered as potential hosts for a facility could learn from the experience of communities that are already hosting storage facilities for nuclear waste at operating and shutdown reactors and at DOE sites. (See also discussion in Section 4.3) Though these facilities were not sited using a consent-based process, current host communities nonetheless have years of experience engaging with DOE and utilities and managing local impacts, including addressing public concerns about safety and risk.

"Creating more opportunities for conversation between the unintentional current host communities, and those interested in hosting is an essential part of this process. The waste was created by generating power, by protecting our country, and by medical and other research. Our job today is to take full advantage of the opportunity to be part of moving this process forward."

Several commenters suggested that useful models and experience could also be found outside the realm of nuclear waste management. Specific suggestions included the work of the Consensus Building Institute; the Facility Siting Credo; EPA's "*collaborative problem-solving model;*" the Department of Defense's Base Realignment and Closure Commission (BRAC), "*which has a history of interagency cooperation relevant to the consent-based process at hand;*" and legislation on facility siting introduced in Illinois (SB 172).

3.3 WHO SHOULD BE INVOLVED IN THE PROCESS FOR SELECTING A SITE, AND WHAT IS THEIR ROLE?

An inclusive, participatory approach was widely viewed as central to the success of a consent-based siting process.

> *"Let's do an inclusive thing - bring everybody to the table. Everyone should know what's going on."*

Responding to the question, "who should be involved and what is their role?" many commenters mentioned citizens, community leaders, local politicians, and state elected officials (see also discussion in Section 2.2):

> *"The ordinary people who will be living near the site should have the defining say as to where a site is or is not located."*

> *"Local government is on the front line when it comes to ensuring the health, safety and welfare of persons residing in the United States. Local governments strive to provide for the health, safety and welfare of their residents in part through making informed decisions regarding land uses. Local governments then should be foundational and integral participants in any siting process."*

> *"Cities, counties and Native American tribes' governing bodies represent their constituencies, and they should take the lead in identifying a site, developing public support through the multiple avenues of outreach to fulfill Phase 1 criteria. Once public consensus is reached, resolutions of support should then be acted upon by the entities."*

> *"Everyone who lives in the state of siting should be allowed to vote on the question of siting within that state. Those who are still in high school, ninth grade or above, should be allowed to vote on the question as well, since they are capable of understanding what they are voting on and since they will be living with the nuclear waste for their entire lives (unless they happen to move away). In addition, in a separate election, everyone who lives in the county of siting should be allowed to vote on the question of siting within that county as well."*

"a) Local residents and their political representatives must be informed and provided with a veto right.
b) Persons local to the transport route should be apprised of the likely risks associated with accidents and the efforts made to reduce those risks, and also the efforts deliberately not made to reduce those risks.
c) Independent geologists, scientists, and engineers should have full access to the technical data while avoiding compromises to security of the site and transport route."

"A successful consent-based siting process can be expected to be multi-jurisdictional and involve tribal (if tribal nations are potential hosts of a spent nuclear storage or disposal facility), state and local governments in a nested hierarchy of political jurisdictions." Alternatively, new, special purpose, institutional and political constructs (e.g., a regional authority) can be created with accountability to a board of directors made up of representatives from impacted jurisdictions."

"It is of the utmost importance … that efforts to streamline the consent-based siting process not overlook the important role of state legislators across the country. We feel that DOE can accomplish this consultation by clearly specifying in any rulemaking or guidance that the presiding officer of each legislative chamber be included in regards to site selection, study and siting for both the repository and storage facility processes. This language would also allow DOE to remain consistent with the Nuclear Waste Policy Act of 1982, Section 117, which clearly states that, 'the Department shall consult and cooperate with the [G]overnor and legislature of such...State...'"

In addition to citizens, elected officials, and affected members of the public, several commenters pointed to a role for other types of stakeholders in the siting process. Examples included state public utility commissions, independent technical experts, public safety agencies, public health agencies, health professionals and organizations, social justice organizations, environmental justice organizations, and faith organizations.

Another commenter drew a distinction between community-based and stakeholder-based processes, ultimately concluding that aspects of both are probably needed to conduct a consent-based siting process for a nuclear waste facility:

"There are fundamentally two kinds of processes that are consent-based that you can imagine. One of them is stakeholder-based; the idea that in fact what you look for is all of the individuals; the types of individuals who are affected by the disposal issue, and you try in fact to put together a process in which you bring together very good representatives of those perspectives and try to work it out amongst a selected group of people who represent those perspectives.

And the second is to try to do it in a way that is actually quite representative of the communities in which you are engaging. And those representative processes by their very nature require many more people to be involved; many people who have less expertise and less involvement than you would find if in fact you do a stakeholder-based [approach]; and the issue will be how do you balance those? At some level you have to, for an issue like this, you have to have both of those…"

Several commenters expressed concern that ordinary citizens might not be adequately represented in the siting process, and indeed might lack the basic information and resources—such as the notice and means to attend meetings—that would allow them to participate:

"I cannot help but reflect on the demographics of our meeting. And wonder where all the other people are who might represent different demographics? I think that's an important thing for us to notice among ourselves here tonight. Why is it that we came out and others did not? I think a big part of that is that people don't have enough information and the information they do have seems overwhelming and their lives are very busy, they're kind of in survival [mode], perhaps, and so they don't come. Those people cannot possibly give informed consent for what it is you're asking. They cannot. We need to consider that."

"The best thing that we can do going forward is holding more public forums like this and making them more accessible to all citizens, all communities, particularly the younger generation, because my crowd is the one that is going to have to deal with this issue. So, I mean there's a big problem in America today with political advocacy, particularly amongst my generation - I mean I'm a 16-year-old in a room full of older people. [Laughter]. Let's just call it what it is. But yeah, I think just making the information more - I don't want to say user-friendly, but more citizen-friendly - and just making it known that there is an issue and what's going on in our country is definitely the biggest first step that needs to be taken in solving this issue."

Recognizing that "*a public meeting is only successful if it is attended by the public*," several commenters offered specific suggestions for improving public outreach and engagement:

"DOE should devise a multifaceted outreach strategy" that includes "reaching out to local associations, schools and decision-makers as well as utilizing multiple communication avenues -both on and offline -to advertise the meeting. Advertising must take into consideration literacy and language barriers. Notice -proper and frequent notice of a public meeting should be given to communities and stakeholders. We recommend an initial notice of at least four weeks with subsequent follow-up notices up until and including the morning of the meeting."

"Your approach needs to be more grassroots. Your marketing needs to communicate at the level of these individuals. Get into the churches, schools, senior centers, grocery stores, etc., where these people congregate and talk. Hit the local breakfast hang-out, the water aerobics class, etc. where the older generations who actually own the land pursue their activities. Your marketing is out of touch with the messaging you're trying to deliver."

Several commenters also suggested that DOE establish a dedicated webpage and make more effective use of social media, while also deploying more traditional modes of outreach (e.g., newspaper and radio, flyers in libraries, etc.) to better engage the public:

"DOE should create an active presence on social media dedicated to communicating specifically about this issue and process. For example, DOE could create a twitter account with a handle such as @DOESpentFuel that regularly posted information about events, public comment periods, and updates to the DOE website. Tweets are a really easy way for interested parties to quickly share information with their networks through the re-tweet function. Such a twitter account could also publicize hashtags or facilitate public conversation between interested parties."

"You need a website devoted only to the "Consent Based Siting" meetings. Going through the DOE website is too confusing. Do you want to reach the public or not? If yes, do away with the bureaucratic hurdles. Advertise in newspapers. Put flyers in public libraries. DO NOT ASSUME EVERYONE GOES ONLINE. They do not."

Commenters also offered several general observations about the importance of a process that allows people to feel that their participation is meaningful, that creates room for respectful and constructive dissent, and that values the contribution of non-technical people even in the context of a very technical decision-making process.

"As environmental justice communities, we can't help but want to make sure that all the history that we have gone through is used as part of us moving forward, right? So if we're talking about processes and looking at what DOE has done in the past, there's definitely a lot of processes that people have been part of and parts that people have been part of, surveys that people have been part of, but if there is no real traction or teeth to their participation after a while, people are going to be like, "What am I participating in? Why am I participating?" And forgive my language, but "I'm going to get the crap participated out of me." So at what point does that actually become tangible work on the front-end? Where do actual community members get to see their work, with pen and paper signed off on, where they know again what their rights are?"

"But clearly consent-based is not the same thing as consensus. So the point… about the need for dissenting views and talking to people with whom we disagree is crucially important, even if people don't agree with the final decision, we need to have some way to know whether it's a consent-based system and we're really watching."

"There is a role for non-technical people in technical decision-making, and it should not be underestimated. It's not easy. It's not straight-line decision-making, and requires a significant amount of education, commitment and listening. Not everyone is going to agree on a particular policy, and some will be vociferous in their opposition, but the community and individual input can often lead to epiphany moments that otherwise might never be found. When people know that their voices are heard, even if they disagree with the outcome, conflict is diminished, trust is established and sometimes even consensus can be found."

3.4 What Information and Resources Do You Think Would Facilitate Your Participation?

Many commenters emphasized the importance of funding and technical assistance to enable communities to participate fully and make informed decisions in the siting process. Such assistance was widely viewed as essential, both in terms of addressing equity concerns and as a way to provide the basis for informed consent (discussed in Section 2.3). Numerous commenters stressed this link between support for participation and process legitimacy and emphasized that without support many communities would come to the table at a significant disadvantage in terms of resources and expertise:

"All of the folks who need to understand the issue come at this with very different resources. They don't all have the resources that the Department of Energy has; they certainly don't have the resources that the utility companies where the waste is stored right now; they don't have the resources that those companies have; they don't even have the resources available to them that, say, a commission would have, or that a state agency would have available to them, and so it's really, really important to try to bridge that gap and to try to give the resources to the people who are going to be affected by this."

"To ensure that affected local governments and their communities make informed decisions, they must be educated on all aspects of a potential project. A local government needs to have a full understanding of the benefits and risks …To that end, financial resources must be provided as early as possible to local governments in potential host communities…"

According to a number of commenters, an important function of financial assistance would be to enable local governments to hire and retain their own third-party experts and undertake independent analyses. Many commenters viewed this as crucial for building confidence within communities that they have the full and accurate information needed—in a range of areas—to make decisions in their own best interests. As one commenter noted, communities don't come into the siting process because they've decided to host a facility—rather, "*they're in a learning process*." Therefore it is "*important to equip them to take their own decisions at the end of the day*."

One commenter's experience with the Canadian siting effort prompted the suggestion that support be provided for social as well as technical assessments:

"One program that has proven to be very important is the funding of strategic planning; envisioning futures, and allowing community members to sit and together really assess whether this kind of project is a good fit for their area. There's a big economic impact of this kind of project, but there are also impacts socially; culturally; spiritually – what does it mean for an area – and it's important to think through with community members what this really means. Our organization can undertake safety work and technical analysis. The communities are the only ones that can assess the social assessment."

Another commenter points out that funding is needed well beyond the early phases of identifying and characterizing potential volunteer sites:

> *"As identification and development advance, it is equally important that funds be made available for communities to participate in the process of regulatory documentation, including environmental assessments, intermediate technical progress reports and design documents, environmental impact statements, and license applications."*

Yet another commenter notes that the timing and sequencing of funding can create some dilemmas:

> *"The principal resource needed to initiate negotiations for a volunteer site for an interim storage facility or repository is funding to study the site sufficiently to know that it has a chance of performing safely. Herein lies the first dilemma of a consent-based program—without funds, a state or community has little means for performing the scientific investigations needed, and those funds are not likely to materialize unless a site is picked and consent contracts are signed. Alternatively, a number of sites could be selected from a number of volunteer sites, and all could be studied… Assuming regulatory siting guidelines exist and an equitable way can be found to identify one or more sites, then it just comes down to sufficient funding for affected entities to participate meaningfully at each stage of the development process…."*

In terms of financial support for state and community participation, several commenters urged DOE to work with Congress and the administration to secure the necessary resources.

Commenters also noted that financial and technical assistance to communities had been made available in other consent-based siting efforts, including in the effort in Sweden and in the case of the Nuclear Waste Negotiator and the Waste Isolation Pilot Plant in the United States. Another suggestion was that DOE should engage with existing organizations that serve communities and local interests and that have established local, regional, state, and federal partnerships. Examples include the National Association of Development Organizations (NADO), the National Association of Counties (NACo), and the International Economic Development Council (IEDC).

A separate category of responses to the question "what information would facilitate your participation?" focused on the need for non-site-specific regulatory standards and generic siting criteria.

"To avoid repeating the failures of past decades and consistent with BRC recommendations, both the standards for site screening and development criteria must be in final form before any sites are considered. Generic radiation and environmental protection standards must also be established prior to consideration of sites."

Commenters suggested that criteria for initial site selection should be clear, to help ensure that decisions are neither arbitrary nor politically driven, and should include social as well as technical considerations:

"Establish site screening criteria, such as hydrology, geology, seismic, population density, transportation access, environmental justice issues…"

Although a strong technical basis for siting is absolutely critical, criteria relating to social equity and social acceptance must be developed to ensure that benefits and costs are considered, to ensure that the storage/disposal facility is viable over the intergenerational time span. The criteria would also allow a potential host community to evaluate what factors it needs to consider in deciding whether to 'volunteer,' what restrictions they might place on a site, and what oversight role they would want.

Another commenter spoke more generally of the importance of ensuring that site screening and selection decisions are based on science, so as to avoid the politicization of the siting process:

"Science and only science should come first, extensive research that tells us what is the safest site for permanent storage of waste. A large reason for the failure of Yucca Mountain was that the decision was based on politics, not science. Now DOE is trying to do the same thing again."

While some commenters suggested that consent-based siting should start with expressions of interest, others suggested that screening should be the first step and only communities with suitable geology should be approached.

"Do you start with finding the best places and then seeing how it goes with the communities, or are we going to look for the communities of interest, and then find the best places in terms of engineering criteria?"

Site solicitation should be on the front end of the process. Understanding that the ultimate goal of the consent-based siting process is to select sites for the interim storage and the permanent disposal of nuclear waste, the DOE should begin this process by conducting an initial site solicitation request to communities.

The DOE should provide a document that outlines the federal requirements for a potential interim storage and permanent disposal site(s) to include, but not limited to, the following items: science criteria (including geological data), peer reviews, expert opinions, irrevocable standards, and international experience.

This could "jump start" the process by focusing consent-based siting efforts on communities that at least meet the 'to be determined' minimum site hosting requirements. Then a more detailed site selection process could take place.

Finally, several commenters also spoke to the need for generic safety and environmental standards for a geologic repository:

"Both the final report of the Blue Ribbon Commission on America's Nuclear Future (2012) and the Administration's Strategy for Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste (2013) state that an important early step in the siting process is establishment of generic repository safety standards. In preparing its report on this IPC, as part of its "implementing a consent-based siting process" DOE should consult formally with the Nuclear Regulatory Commission and Environmental Protection Agency on the urgent need for safety standards and regulations to support a new repository siting process that relies on early public confidence to make informed consent possible from potential host jurisdictions and communities."

"We need clear and understandable safety and environmental standards. Those are actually well in place for consolidated storage facilities. The NRC regulations are clear and they make sense. However, for a generic repository, if the government decides it wants to develop another repository in addition to Yucca Mountain, there are no good usable, understandable generic standards and the government should take the initiative to establish them."

Several commenters urged DOE, EPA, and the NRC to begin working together to develop generic repository standards as soon as possible, either "*very early in the process"* or even before the process begins (including the process for siting a defense high-level waste repository), *"because creation of such standards takes many years."*

3.5 WHAT ELSE SHOULD BE CONSIDERED?

Impacts on a host community are obviously central to any discussion of informed and voluntary consent. Chapter 2 introduces the idea that communities must have a full understanding of the costs, benefits, and risks associated with consenting to host a nuclear waste facility. This section summarizes additional comments that elaborate on the subject of community wellbeing. One commenter, for example, argues for a nuanced view of community interest that focuses on the importance of a positive "value proposition" for the host community:

> *"There really has to be a strong value proposition for the receiving community. There should be quantifiable benefits, both economic, and otherwise, to the entire community, both now and in the foreseeable future. The benefits must be significant enough where the communities really stand in line and hopefully compete to have this storage site in their particular area. These benefits could include financial payments, local hiring preferences, community infrastructure improvements and so forth. Somehow, the value proposition must stand the test of time and a new political administration can't come in and sweep them away as perhaps they have done in the past. Regretfully, trust is a huge issue because the rules of the game have often been changed in the past."*

Given the importance of incentives and benefits, one commenter suggested that DOE use this time, while awaiting further direction from Congress and a new administration, to begin developing an initial list of the types of incentives or compensation a host community might be eligible to receive. This commenter pointed out that having some understanding of what the federal government might be willing to negotiate would be helpful—not only to potential host communities and states but also to local and state officials who might be looking to engage with the public and build interest or support in being considered to host a facility.

A related point, voiced by commenters from communities that currently host shutdown reactors, is that communities have to take a long view of the trade-offs involved in hosting a facility, including looking beyond immediate jobs, tax, and infrastructure impacts to consider what happens when a facility closes or no longer supports active operations.

> *"The closure of a nuclear power plant highlights a poignant gap in these makeshift accommodations [nuclear power plant communities becoming unwitting hosts], one that critically affects host communities' ability to plan and move forward, particularly from an economic standpoint. Attempts to tax the spent fuel and their storage facility, as the means to derive value from an open-ended, non-consensual commitment to host the spent fuel, have generally failed. The outcome is that communities that have lost the economic benefit of an operating nuclear facility - jobs, spending, and tax revenue - are left with a long-term liability but are entirely left [out] of a framework of compensation."*

Another commenter suggested that the long-term economic calculus for hosting a nuclear waste facility could shift dramatically if spent nuclear fuel has value in the future because a new generation of reactors can use this material.

One commenter suggested that all residents of a host community who opposed a facility should be offered the option of being re-located, at the federal government's expense, to equivalent housing in any other location of their choosing within the continental United States.

Other specific suggestions for protecting the interests of host communities that are not discussed elsewhere in this report include the following:

- The federal government should be responsible for fully compensating residents and businesses for any damages and costs in the case of accidents or leaks.

- The operations of the proposed facility should be fully explained. *"What type of warning systems will be put into place? What type of evacuation processes will be put into place? What types of insurance changes are needed?"*

- Elected officials should be required to disclose any financial interest in the outcome of a decision to host a facility.

- National Environmental Policy Act (NEPA) requirements should be applied to a consent-based siting process.

4. OTHER TOPICS

This chapter summarizes comments received on a number of topics related to nuclear energy and nuclear waste management policy more broadly. These topics are distinct from those discussed in Chapters 2 and 3 in that they transcend or are separable from the subject of consent-based siting and the specific questions posed in the Invitation for Public Comment. Nonetheless, a summary of these comments is included here to provide a fuller understanding of the range of views, assumptions, and perspectives that different commenters and stakeholders brought to the consent-based siting discussion.

4.1 VIEWS ON THE ROLE OF NUCLEAR ENERGY

As noted in Chapter 2, a number of commenters offered views on nuclear energy and its role in U.S. energy policy. Among commenters who opposed a continued role for nuclear energy, a common view was that still-operating nuclear power plants should be shut down immediately to avoid adding to the inventory of spent nuclear fuel that already exists. Many of these commenters also expressed support for renewable energy and energy efficiency as preferable non-carbon sources that could substitute for nuclear power:

> *"Since after over 50 years of nuclear fission in the United States there is still no feasible safe storage solution for nuclear waste - the answer must be to stop making the waste. This is not rocket science but simple common sense."*

> *"Nuclear power is too dangerous and expensive. Furthermore, nuclear waste is a long-lasting problem. Concerning nuclear waste—stop making it. The only truly safe, sound, just solution for the radioactive waste problem, is to not make it in the first place. Electricity can be supplied by clean, safe, affordable renewable sources, such as wind and solar, and demand decreased significantly by efficiency, rather than generating radioactive waste via dirty, dangerous, and expensive nuclear power."*

Some commenters saw current efforts to advance management and disposal solutions for nuclear waste as extensions of a nuclear policy that was flawed and misguided from the outset (see also discussion in Section 2.7):

> *"The problem of storing/disposing of nuclear waste should have been considered before the US began to produce nuclear power. Instead, millions of people and all who will follow them carry the dangers indefinitely. As we all know, there is no safe way to store/dispose of nuclear waste. And, as we know, there are alternatives to nuclear power that are less costly and renewable. And yet, the DOE has spent considerable time developing a plan that would be extremely dangerous to implement and extremely unjust to any communities that would consent to it."*

"Until such time as there is a safe way to transport and store nuclear waste and production of nuclear energy is 100% safe, do not ask me where to put the waste. You have no right to even ask this question."

Other commenters expressed the view that nuclear energy had a continued role to play because of climate change concerns and saw the risks and trade-offs associated with nuclear technology, and nuclear waste disposal, in a fundamentally different light:

"Nuclear power is obviously a power source we need to emphasize and expand if we are to curb the menace of global warming. It is important to realize America is the special nation, since the world looks to us for guidance on such global issues as climate change. This makes our choices and speedy movement toward ways of addressing the problem all the more important. Our non-profit, volunteer expert citizen group, I want to emphasize again, is an environmental one. We are not committed to any single power source. We just want a source that is ready and capable of meeting the challenge of powering America without carbon emissions. In terms of scale, we see nuclear as the obvious choice today."

"I keep trying to put everything in context. You know, we're worried about maybe a few people being harmed by radiation or leaking waste that might happen someday, when in fact the waste has not killed anybody; the stored waste at all the sites in 60 years hasn't killed anybody. We've got a monster approaching us from behind. It's called global warming…Yeah, we've got this monster looming over us and here we are worried about maybe someday there'll be this leak and this rule is not exactly right. Let's put all of this in the context of what's coming down on us and our children, and our grandchildren. Please, please think about that. We've got to get this right. We're coming up to the last time when we can make a decision. And after that, our decisions won't matter. So that's my pleading with everybody tonight."

4.2 VIEWS ON CONSOLIDATED INTERIM STORAGE AND CURRENT ON-SITE STORAGE ARRANGEMENTS

Numerous commenters expressed views on the wisdom of moving forward with consolidated interim storage, regardless of the process used to site such a facility.

Among commenters who opposed consolidated storage, many expressed concern about incurring added risks from transportation and handling and about the possibility that a consolidated storage site would become a *de facto* permanent disposal site.

"Nuclear waste should be stored where it is being generated, not handed off to a rural state with little political clout."

"So-called 'temporary storage' means forever."

"Yucca Mountain efforts have failed and no permanent repository is available yet, so why ship this dangerous waste just to store it in a new location?"

"Why spread more misery and contamination to new locations? All resources should now be dedicated to secure the spent fuel rods in dry casks and enhanced security from terrorism, until a permanent and final solution is actionable."

"Depending on how long the waste remains in a proposed interim consolidated storage system, the waste may need to be transported multiple times, as community consent periods expire. The extended periods of storage may require siting of new consolidated storage operations. However, if a site becomes a de facto long-term or even permanent waste site, there would have been no technical qualification or scientific basis for choosing the site. Therefore, the willingness of a community to support the siting of a temporary storage facility would be violated, and the consent-based process would be meaningless, if not fraudulent."

"Why is DOE trying to proceed with consolidated storage, when 30 years of experience with public and private consolidated storage sites show that there is broad, enduring opposition to such facilities? Why not recognize the 'non-consent'?"

Some suggested that if consolidated storage facilities are needed, utilities should provide them:

"The third fact from my view is that federal-government consolidated commercial storage sites are not necessary. The Nuclear Regulatory Commission has said that irradiated fuel can safely stay where it is for decades or longer. If that's not true, can we really trust the Nuclear Regulatory Commission? If it is true, there is no reason to have these kinds of consolidated facilities, and the risks of extra handling, as has just been discussed, the transportation - extra transportation problems - the extra costs of doing those things. The storage of irradiated fuel is the responsibility of the utility companies and if there's a need for consolidated storage, the utility companies can and should create sites to do that."

A number of commenters who were skeptical of the need for federal consolidated storage facilities urged changes in current practices for storing spent fuel at commercial reactor sites. A few commenters also offered detailed technical suggestions concerning safety specifications for dry cask storage.

"Please consider Hardened on Site Storage for Nuclear waste (HOSS). We need to minimize risk. I am a biochemist and medical researcher. I have used radioactive tracers in research. They are very useful. But I also respect the risk of these long-lived radio-isotopes. Please, do not move radioactive materials. Reduce risks by keeping them at current locations."

"Store irradiated nuclear fuel in HOSS dry casks, as safely and securely as possible, as close to the point of generation as possible, in a monitored, inspectable, retrievable manner."

DOE also received comments in support of consolidated interim storage:

"Yes, please move as fast as possible to move the nuclear fuel to a temporary storage in a remote place."

"[A] hardened, geologically-stable site for storage of spent fuel is a matter of immediate necessity…"

"NARUC [the National Association of Regulatory Utility Commissioners], by resolution, which is how we set our policies, has suggested that some consolidated interim storage is needed, although the amount, basis of need, and duration should be determined."

"Residents, elected officials and city councils, businesses, and community organizations throughout California are informed and active on the need to safely remove and secure SNF. Over a dozen local Southern Californian cities and government officials have expressed their support of a bill currently before the U.S. House of Representatives: H.R. 3643, the Interim Consolidated Storage Act, which authorizes interim consolidated storage facilities and prioritizes the transfer of nuclear waste from decommissioned sites…Judicious examination of where to construct an interim nuclear waste repository site and of proposals on how to collect, transport, and securely store the radioactive waste is necessary and needed now. The country has been waiting for nearly three decades since Yucca Mountain, Nevada, was designated as the sole location for permanent repository. Removing the waste spread across the country will improve our national security, save Americans billions of dollars, and fulfill the federal government's obligation to safely store nuclear waste."

"We would like to provide a further recommendation to the Department of Energy to establish a National Above-Ground Temporary Storage Facility for America's Spent Nuclear Fuel (SNF). The removal of these materials from some 70 different sites nationwide is long overdue because of the above stated political obstruction. It is only correct in serving the citizens of this country that the DOE would initiate a process to establish a National Above-Ground Temporary Storage Facility. In respect to, either reconsideration of Yucca Mountain and or some other community approved siting, the DOE through congressional approval, should develop a mechanism to relieve the nuclear waste materials from the private nuclear companies, who have been forced to retain them for long after the original contractual basis."

Several commenters questioned DOE's authority to pursue efforts aimed at siting a consolidated interim storage facility citing the linkage that currently exists in the NWPA between consolidated storage and disposal (see also discussion in Section 4.5):

"The DOE must clearly state the federal authority under which the DOE is authorized to pursue a siting process for interim consolidated storage of commercial nuclear waste."

"The Department of Energy has gone rogue in pursuing consent-based siting for consolidated storage first and suggesting that the public's input has any value when the agency has no statutory authority to pursue such a program. Unless and until Yucca Mountain is removed from consideration under the Nuclear Waste Policy Act, there will be no progress on a legal site. The current DOE administration must stop scapegoating the NWPA for prohibiting consolidated storage independent of an operating repository, instead of offering candor in admitting that the Department of Energy failed in its effort to implement NWPA."

4.3 PERSPECTIVES FROM CURRENT HOST COMMUNITIES

Residents and stakeholders from communities in the vicinity of operating and shutdown nuclear power plants voiced several common concerns at the public meetings and in comments submitted to DOE. A first concern was the safety of existing spent fuel storage arrangements at reactor sites—one commenter pointed out that spent nuclear fuel poses a significant radiation risk even after the fuel has spent years cooling in wet storage. A second common theme was a sense of urgency about removing spent fuel from these sites, particularly in light of the fact that local communities had not been asked, and thus had never consented, to serve as hosts for long-term nuclear waste storage facilities. A third message from these communities was that they should be compensated for storing spent fuel, in recognition of the economic damages and risks they were incurring and to help offset these costs and burdens, including the loss of use of land around the reactor sites.

For example, several commenters spoke of safety concerns and urged that spent fuel be removed from their communities as soon as possible:

"Forty-three years of nuclear waste is currently being stored at Pilgrim either in an overcrowded wet pool or in storage casks located precariously close to the shoreline (i.e., in reach of rising tides, coastal storms, and saltwater degradation). This default situation risks contamination of the regional environment and is a primary concern."

"These sites [in California] – and again there are many of them along our coast… coastal sites are a valuable resource. We've tried to preserve that for a lot of uses, but certainly waste storage is not one the people had in mind. So again, trying to move them off of there is important."

"This region of over eight million people (Southern California) is greatly concerned about the future of nuclear waste. Unfortunate incidents, such as in the 2011 Fukushima Daiichi, Japan, when radioactive waste spilled into the Pacific Ocean, serve as reminders of potential destruction if the Department does not act."

"I am writing this letter as a very concerned resident and homeowner in San Clemente. I have public safety concerns over the burial of nuclear waste at San Onofre... We are living under threats of terrorism. Storing nuclear waste near a densely populated area and adjacent to one of our largest U.S. military bases is asking for trouble. On another note, San Onofre and San Clemente are close to earthquake faults that run along the coast and inland. The burial of nuclear waste in any approved canister is unsafe. This nuclear waste needs to be removed, not stored for 25 years. By then, any containers will be hazardous to transport."

"There was never an understanding that once the plant closed, the Zion community would play host to radioactive, and I'll be blunt here, a radioactive dump that contains 2.2 million pounds of spent fuel rods. 2.2 million pounds of spent fuel rods are sitting in our community. And the benefits that we had when the plant was operating are gone. There are no more jobs and there are no more tax dollars. Or very little tax dollars; I think they pay $1.5 million to the entire community now. And that was not a part of the deal that we would be hosting these things. I speak for all of Zion in saying that we do not want to be a storage facility for radioactive waste."

One commenter argued that a consent-based policy must also include consent from communities that currently host reactors where spent fuel is being stored, given that these communities could be affected by handling and transport operations to remove radioactive materials from these sites:

"Your policy on consent based must include reactor communities as well as receiving communities. As a grassroots organization the Indian Point Safe Energy Coalition does not consent to the transport of high-level radioactive waste from the Indian Point nuclear reactors. I see nothing in your procedure that takes into consideration this part of the equation. Furthermore, hearings must be held in all of the reactor communities involved. Lacking these basic parts of the equation, what you are doing cannot qualify as 'consent based.'"

A number of citizens and representatives from current host communities also argued that their communities are incurring direct costs and should be economically compensated as long as they continue to serve as nuclear waste storage sites:

"Under these circumstances, we see the Town of Plymouth currently serving as a de facto nuclear repository and, with the quickly approaching 2019 end of operations at Pilgrim, are deeply concerned about the remaining spent fuel and its impacts upon the residents, the environment and the public safety of the town. We therefore are seeking appropriate assistance, including financial

compensation, from the NRC, our federal government, and the Department of Energy's Nuclear Waste Fund. While we support your efforts to find a consent-based solution to the spent fuel storage problem, the burden of the spent fuel at Pilgrim continues to fall directly and solely on the Town of Plymouth with no mitigating benefits. This spent fuel was never intended to be stored in Plymouth permanently. We ask your support, advice and cooperation in providing adequate compensation to the Town and its residents until a future permanent fuel storage location is established and the spent fuel is removed from Plymouth."

"The consent-based conversation is a great opportunity for the DOE to recognize communities with these [already existing] facilities and maybe help broker some agreements about the continuation of spent fuel storage in a manner that conforms more broadly to local and state policy and land-use-rights regulation. Why it matters is that current practices create unnecessary economic hardships for communities. The DOE has a framework in place to compensate licensees and operators for the burden of construction and maintenance of the facilities, but host communities have been left out of that equation. The result is a nonconsensual liability that gets in the way of redevelopment; it removes control and certainty and any attempts that have been made to stabilize local revenues by levying tax on the spent fuel have been unpredictable or unsuccessful."

"[Current] Hosting communities should be compensated at a rate equal to the average of the last ten years of on-line power producing operations of both the direct and the indirect revenue streams realized by that community."

"It bears reminding that there is a cost for inaction, both at the local level and the federal level. We understand that one of the goals in removing the spent fuel is to reduce federal government's liability for partial breach of contract, estimated to be $20 Billion by 2020. This liability is now the responsibility of the US taxpayers, you and me. At the very local level, we have spent millions of dollars participating in licensing dockets, hearings at the federal and state levels, meetings with the NRC and DOE, all in an effort to get the nuclear waste out of our backyard. This is the cost of inaction on our community; these are funds that could have used for other purposes. Because of the federal government's inaction, we have taken the unprecedented and drastic step towards making an emergency evacuation and relocation plan for our community. We have purchased 112 acres east of St. Paul, MN, because of the continued storage of spent nuclear fuel or in the event of accident at the plant. Relocating our community is not something we take lightly, but it is something we must consider for the future of our community."

In addition to calling for compensation, representatives from current host communities urged DOE to support engagement and information sharing between these communities to more fully inform federal policies:

> *"Multiple federal agencies would benefit from having an organized group of nuclear host local communities to provide local government stakeholder input on policy matters related to spent nuclear fuel, nuclear waste, and nuclear plant closures and decommissioning. Specific issues include integrated waste management and consent-based siting of spent fuel and high-level radioactive waste, spent fuel transport, and decommissioning rulemaking discussions. Relevant agencies include the Department of Energy, the Environmental Protection Agency, and the Nuclear Regulatory Commission, but also the Economic Development Administration and Department of Agriculture as communities, especially rural communities, plan for socioeconomic impact mitigation in the wake of the closure of a major contributor to employment, household income, and local taxes. This need will become all the more relevant as the current wave of nuclear plant closures continues. Engaging host local governments in the consideration of multiple interrelated nuclear plant closure, decommissioning and waste policy matters would establish a cadre of well-informed local stakeholders who are most directly affected by plant closures to advise multiple federal agencies."*

DOE also heard from host communities in states with DOE sites that are currently storing high-level radioactive waste and government-owned spent fuel. For example, a number of commenters objected to the idea of moving radioactive waste to their state and emphasized the importance of the federal government's living up to existing commitments.

> *"There should be zero tolerance for shipping more commercial radioactive waste to Idaho. We have one of the greatest pure aquifers in the nation and enough toxic radioactive waste at this time."*

> *"Hanford is effectively an interim storage repository. With never a single vote of the local population. Hanford has some of all of it. Like Idaho, we have spent commercial nuclear fuel; we have weapons- complex waste and even Navy submarine and cruiser-ship reactors. And Hanford has the dubious honor of being an interim repository for at least the next 50 years. The waste treatment plant is now scheduled to start in 2034 - 2034 - eighteen years from now. And operate for some 30 years."*

Another commenter voiced opposition to any consideration of current DOE sites as potential locations for storing or disposing of commercial spent nuclear fuel or for a defense waste repository.

"Despite the burden of past contamination and insufficient cleanup efforts, DOE sites are being targeted for expanded missions, including storage or disposal of commercial spent nuclear fuel. The new DOE strategy apparently also targets DOE sites for the defense high-level waste repository. The ANA [Alliance for Nuclear Accountability] does not consent to such proposals."

4.4 VIEWS ON GEOLOGIC DISPOSAL

Some commenters recommended that permanent disposal in deep geologic repository should be the nation's solution for the ultimate disposition of high-level radioactive waste and spent nuclear fuel, and that prompt efforts to develop geologic disposal should be undertaken.

"Since the 1980s…we have been in favor of a permanent deep geologic repository as the nation's solution for the high-level radioactive waste spent fuel issue."

"NRDC concurs with the recognition that our generation has ethical obligation to future generations regarding nuclear waste disposal. Adherence to the principle of deep geologic disposal as the solution to nuclear waste is consistent with more than 60 years of scientific consensus and the views of the BRC."

Other commenters raised questions about geologic disposal as a solution:

"The three large-scale repositories that have operated in the world, Asse and Morseleben in Germany and the Waste Isolation Pilot Plant in New Mexico have all faced challenges during their operating phase, raising questions about the adequacy of technical and safety requirements for geologic repositories."

"The DOE must consider the possibility that there never will be a deep geologic repository in the United States for Irradiated Nuclear Fuel ((INF) termed Spent Nuclear Fuel (SNF) by the DOE and other entities) that meets all siting, operational, environmental, and safety criteria AND receives the approval of the state and relevant communities and entities (including those on the transportation routes) as a result of any consent-based process. The DOE must consider the possibility of a permanent above ground dry cask storage/disposal site."

Some commenters raised a separate concern related to geologic disposal—they questioned whether it was fair or sensible from a logistical standpoint to site a repository in the western United States, when most of the spent nuclear fuel inventory is in the East:

"92% of the commercial spent fuel we're talking about is east of the 100th meridian. It's in the eastern part of the country. So ask yourself why it makes sense to transport it all to the West."

4.5 VIEWS ON THE LINKAGE BETWEEN STORAGE AND DISPOSAL

A number of commenters said that the linkage between interim storage and disposal needs to be considered, and raised a concern that there would be no incentive to pursue disposal if there is no such linkage.

"Must SNF be removed from current sites in order to limit breach-of-contract costs? Note that the framers of the NWPA were reluctant to authorize transport to an interim storage site, which it anticipated could become permanent, thereby subverting the overall program objective. It therefore established a close 'linkage' between interim storage and permanent disposal, for two key purposes: to prevent an interim storage facility from becoming permanent, and to keep the program focus on final disposal."

"Just to be clear though, right now the policy is for the federal government to take it and dispose of it permanently. And I think that we need to be very careful on severing the storage and disposal process and one thing we should probably take into account is that if all the stuff gets consolidated, and stored and DOE takes care of all of it, where is the incentive to then dispose of it and where are the private companies that sort of generated this waste coming into play? So I think it's an important conversation to have, and a meaningful conversation to have, and I would urge us to have the conversation together with the conversation about a permanent repository."

"The Nuclear Waste Policy Act does not allow Monitored Retrievable Storage sites, now termed Consolidated Interim Storage, until a final repository is operational and we support that linkage as essential to the success of the federal government's nuclear waste management mission."

4.6 VIEWS ON YUCCA MOUNTAIN

A number of commenters expressed views on siting a geological repository for nuclear waste at Yucca Mountain in Nevada, and on the Obama administration's decision to stop work on that project. Opinions on this subject were starkly divided. Some commenters, pointing to the requirements of the Nuclear Waste Policy Act and to the considerable time and resources that had already been devoted to Yucca Mountain, argued that DOE was bound by settled law to continue efforts to license a repository at this location. Others voiced equally strong agreement with the Obama administration's assessment that Yucca Mountain is "unworkable"—on

multiple grounds. For example, opponents cited continued lack of support at the state level; the non-consent-based nature of the site's selection, by Congress, in 1987; and questions about Yucca Mountain's technical suitability. It is worth noting that a number of the comments DOE received on Yucca Mountain—both in favor and opposed—came from individuals and organizations in Nevada.

Following are examples of comments *in support of* proceeding with efforts to license a repository at Yucca Mountain:

"I am a Nevada resident and strongly favor the location of the nuclear waste repository at Yucca Mountain. This plan was approved by our Congress and others long ago. It's time to go forward with it."

"The 1982 Nuclear Waste Policy Act, NWPA, is still the law. Yucca Mountain remains the only legal, high-level waste site authorized by Congress. NRC completed and released the Yucca Mountain Safety Evaluation Report only after being directed to do so by the U.S. Court of Appeals for the D.C. Circuit. …That NRC report, when finally released, after much delay, clearly confirmed that Yucca Mountain is a safe nuclear repository."

"Recognize that to start over with a new repository program is not productive since it will take twenty to thirty years for any other site to get where Yucca Mountain is today and could still end up with another state declining to take the wastes. Yucca Mountain is a good site with a balance of favorable geologic and hydrologic attributes. The site is isolated and on land the Federal government already controls."

Following are examples of comments *in opposition to* proceeding with efforts to license a repository at Yucca Mountain:

"The central problem afflicting nuclear waste policy in the United States is the selection of Yucca Mountain as the sole site to be considered for a nuclear waste repository. Yucca Mountain was chosen by Congress through an unscientific and politicized process of elimination, excluding all other sites before Yucca Mountain was studied to determine whether the site could isolate the radioactivity in this waste. The first step to getting nuclear waste policy on track is to remove Yucca Mountain from the U.S. nuclear waste program."

"DOE's new interest in consent-based siting does not change Nevada's opposition to Yucca Mountain. Governor Brian Sandoval has clearly stated that Nevada will not consent to storage or disposal of spent nuclear fuel or high-level nuclear waste at Yucca Mountain. This site is unsafe for commercial and defense high-level nuclear wastes, whether combined in one repository, or disposed separately."

"Yucca is not scientifically suitable. It is an active earthquake zone, a volcanic zone, and water-saturated underground. If waste is ever buried there, it will leak massively into the environment. And the State of Nevada has never consented to becoming the country's high-level radioactive waste dump."

Some commenters, noting that the Nuclear Waste Policy Act links development of consolidated storage to the opening of a disposal repository (see also Section 4.5), argued that DOE should pursue consent-based siting as a *complement* to moving forward with the licensing process for Yucca Mountain, rather than as a substitute or alternative to that process:

"ECA supports moving ahead with the Yucca Mountain licensing review - not only because it is the law - but the site has been analyzed and studied, billions of taxpayer and ratepayer dollars have been spent, and science should be the basis of decision-making. A parallel consent-based siting approach authorized by Congress may help resolve the current political impasse, avoid incurring billions of taxpayer dollars in projected future liabilities, and allow nuclear waste to be moved out of our communities as safely and expeditiously as possible."

"Along with finishing the Yucca Mountain licensing review, Congress needs to pass legislation to modify the Nuclear Waste Policy Act to allow other sites to be considered for interim storage or permanent disposal, but allow Yucca Mountain to be included in those alternatives."

4.7 VIEWS ON THE NEED FOR A SEPARATE REPOSITORY FOR DEFENSE WASTE

A few comments were received on the need for a separate repository for high-level defense waste. These comments expressed divergent opinions, both for and against moving forward with a defense waste repository:

"A defense-only kind of waste repository is not needed. For more than 30 years, Congresses, administrations, and others have said, defense high-level waste can be disposed of in commercial spent fuel repositories. And there is no technical reason that that can't be done."

"Since vitrified high level waste at Savannah River Site is essentially ready for disposal, the glass waste canisters would make an ideal pilot project for permanent disposal at a federal repository. Given that South Carolina has shouldered the burden of this legacy waste and other risks for so long, priority should be given to disposal of the vitrified waste. Lessons learned from early disposal of this small volume (and similar waste forms at other DOE sites) could be applied to larger system solutions across the nation."

"We have often noted that defense - or legacy - waste is older and in cases, less radioactive than commercial spent fuel, and it has no value, as it can never be reused. Some of it remains in storage tanks that are already well beyond their expected safe lifetimes. Moving forward now to evaluate a separate repository for defense HLW can lead to lessons learned for subsequent repositories, including how to do consent-based siting, transportation planning and to rebuild public trust that nuclear waste disposition can be done in a way supported by sound science and protective of public and environmental health."

Others pointed to the need to honor previous commitments made to remove spent nuclear fuel and other wastes from existing DOE sites:

"Beyond spent fuel being housed at commercial nuclear utilities, large volumes of both spent nuclear fuel and high-level nuclear wastes are currently stored at DOE facilities across the country, including here in Idaho where they are managed primarily by the Idaho Cleanup Project. These fuels and wastes are subject to a court-enforceable agreement between the Department of Energy and the State of Idaho. It is clear that portions of the agreement will not be met as a result of the failure to construct and operate a repository and that it is in the interests of the State of Idaho, the federal government, and U.S. taxpayers that the federal government move forward with construction of a repository as soon as possible."

4.8 Views on Current Private Efforts to Develop Consolidated Interim Storage Facilities

A number of commenters addressed two current efforts by private companies to develop consolidated storage facilities for commercial spent nuclear fuel. Commenters noted that Waste Control Specialists (WCS), LLC has proposed to build a consolidated storage facility for spent nuclear fuel near Andrews, Texas where WCS already has a facility for low-level radioactive

waste.[3] Eddy-Lea Energy Alliance (ELEA), LLC is proposing a consolidated storage facility in Lea County, New Mexico (the project also has support in neighboring Eddy County, New Mexico).[4]

Several commenters suggested that the WCS and ELEA efforts should be viewed as successful examples of consent-based siting based on the support that both projects have received from state and local stakeholders.[5] Further, several commenters suggested that DOE could make use of these private facilities and reserve its own consent-based siting effort for identifying a repository site. Some advocates of this approach urged DOE to support the WCS and ELEA efforts, if possible, and, at a minimum, to avoid interfering by "layering on" the federal government's own consent-based process.

> *"We submit that our community of Andrews, Texas could serve as one model of successful consent-based siting. And, we think our experience could be an important contribution to the conversation... We believe it is essential to understand that a supportive host community is entirely possible and already in existence."*

[3] WCS has partnered with Areva, Inc and NAC International to jointly support the licensing, design, construction and operation of its proposed facility. More information on this project is available at: http://us.areva.com/EN/home-3328/areva-inc-areva-and-nac-partner-to-support-wcs-used-fuel-consolidated-interim-storage-facility-in-texas.html.

[4] The Eddy Lea Energy Alliance (ELEA), LLC, is owned by Eddy County and Lea County, along with the cities of Carlsbad and Hobbs, New Mexico. In April 2015, ELEA signed an agreement with Holtec International to build a consolidated interim storage facility in southeastern New Mexico, about 12 miles away from the WIPP facility. Under the Agreement, Holtec will design, license, build and operate the storage facility. More information on the ELEA-Holtec proposal is available at http://www.holtecinternational.com/2015/04/holtec-partners-with-elea-llc-in-new-mexico-to-build-consolidated-interim-storage-facility/.

[5] DOE has issued a Request for Information on Private Initiatives to Develop Consolidated Interim Storage Facilities; see: www.energy.gov/ne/downloads/private-isf.

"Both WCS and Holtec have expended considerable effort to gain the consent of their respective host states and communities. The Department should not interfere with the WCS and Holtec efforts (and perhaps others that may be in the offing in the near term) by imposing on them any consent-based siting process DOE ultimately develops. Nor should DOE require the WCS and Holtec projects to be stayed or delayed while DOE determines whether there are other communities that also might be interested in hosting storage or disposal facilities. Grafting a new siting process onto ongoing projects would be particularly unfair and provide no measureable benefit."

Other commenters objected to the view, expressed by some commenters, that the WCS or the ELEA projects had been sited using a consent-based approach and are moving forward with community and state support.

"Andrews County Commissioners did in fact say that they supported Waste Control Specialists move to bring in high-level radioactive waste, but they are not widely supported in this decision in the community. I have personally gone to Andrews County. I have talked to people. I have worked with local citizens who have talked to people. And nine out of ten people on the street either don't even know what's happening because nobody told them, or they do not want this in their backyard, or both. Now, those County Commissioners are not speaking for the people. These are people who are looking at the dollars that may flow into their county. And that's all they're looking at. They're not looking after the health and safety of their community."

"A 'No Consent to High-Level Radioactive Waste' resolution became the number one Democratic Party resolution this year, passing in 29 County and District Democratic Conventions. As a result, the 2016 Democratic Party Platform includes the following: "We support… halting the plan to import high-level radioactive waste for consolidated storage in Texas due to risks of water contamination, security concerns and transportation accidents, and we oppose transport of high-level radioactive waste on our highways or railways."

"It is our view that local communities are only now becoming aware of plans to potentially locate radioactive waste in their state. From communities across Texas, there have been numerous petitions opposing this proposal. These communities deserve to have their voices included in this process — at minimum via a series of local hearings in potential host counties, as well as counties through which nuclear waste may be transported and counties that could be impacted by soil and groundwater contamination. As members of the Texas Legislature, we must make clear that Texas has not consented to accepting radioactive waste for storage, and will not do so until a fair, broad-based, and intensive discussion of the risks involved is held in impacted

communities, and those communities affirmatively consent to the associated risks."

"We as residents of New Mexico do not invite DOE to bring waste to New Mexico. We DO NOT CONSENT to the storage of high level nuclear waste in our state now or ever!"

Some commenters expressed the view that Texas and New Mexico had been "targeted" for nuclear waste facilities and questioned why DOE had not held one of its consent-based siting meetings in that region:

"The DOE's efforts to minimize opposition, to appear to be understanding and listening, and to use the guise of 'consent' to gather support from other states for shipping off their radioactive waste is deplorable and deceptive. It is a thinly veiled effort to build alignment to dump it on us. Texas and New Mexico are Radioactive Waste Targets.…Transparency has been lacking about this very basic fact. Our region is definitely being targeted and this must be acknowledged by the DOE, minus claims that we want the waste."

"Considering that Waste Control Specialists' application has been filed with the NRC, why were no hearings or public meetings like we're having tonight held in Texas or New Mexico?"

Independent of views on the WCS and ELEA efforts, some commenters raised more general points concerning the potential role of private facilities and entities:

"The IPC posed five questions centered on a public approach to site development. That is a very constrained approach to used fuel management, and may not provide the best options for moving forward. The stated goals in DOE' s consent based siting process can also be met through private/public partnerships that are developed outside of DOE's outreach efforts. These private/public partnerships can deliver the same level of the consent of the fully public process, with the added benefit of strong private sector project management for implementation. This combination of private and public interests offers meaningful cost and schedule benefits for the federal government and should not be excluded from the Department's contracting considerations."

"So the normal negotiations on siting are with private entities. It's actually much more rare to negotiate over a government facility. This is an issue of course, because of the length of time in which the nuclear waste remains an issue, the whole question about how private corporations maintain things over

time and their durability and what happens if they in fact fail is obviously something that would have to be integrated into that. I would think that the consent processes ought to be fairly parallel - that how one thinks about achieving or siting a facility with government ought to be similar to how one thinks about it in a private setting and the issues will be somewhat different, because on the one hand the government can change its mind and it's hard to bind it; on the other hand, companies don't necessarily have the financial resources to follow through on their commitments and so issues about the continuity and other things will become more problematic."

For some commenters, an additional concern about privately owned or operated nuclear waste facilities was the possibility that profit interests and a "*company town*" mentality could compromise the commitment to safety first. There was also a concern that a commercial entity might not always provide accurate or complete information about facility performance.

4.9 VIEWS ON FEDERAL FUNDING FOR NUCLEAR WASTE MANAGEMENT

Several commenters expressed concern about the adequacy of federal funding for nuclear waste management and disposal and about the federal government's rapidly growing exposure to financial liabilities for failing to meet existing waste management commitments on time. Some commenters also raised issues specific to the Nuclear Waste Fund.

"Time is of the essence. The federal government's financial responsibility for continued storage of UNF (used nuclear fuel) at nuclear power plants is expanding rapidly. That rapid liability expansion is being driven by the unexpected early closure of large numbers of nuclear power plants. This new market trend brings new urgency for addressing the spent nuclear fuel management problem with consolidated storage. In order to benefit from the schedule and cost advantages offered by the industry/community partnerships the DOE must be prepared to advance its contracting schedules to minimize the government's life cycle costs for used fuel management. The monies in the Nuclear Waste Fund come with an obligation to manage them efficiently. Meeting that obligation requires a more aggressive used fuel management contracting approach than DOE has considered previously."

"Some communities have expressed a need for funding from the federal government to educate its citizens and further explore pros and cons to seriously assess interest in hosting a site. The amount necessary for numerous communities to undertake such an effort could be substantial. In addition, potential incentives and economic benefits for communities and states that host consolidated interim storage or permanent disposal sites have been proposed. Again, this could be substantial. While not opposing funding for such purposes from other sources, our members have considerable concern regarding any potential expanded uses of the NWF beyond those outlined in the NWPA."

"We are very concerned about stewardship of the nuclear waste fund. […]. There have been lawsuits against the Department; and there will be more - the Department currently estimates its liability for not performing on its Contract to be $29 billion. […] [T]he taxpayers are on the hook for the lawsuits and the ratepayers paid for the repository that didn't get built. So if you've paid your electric bill, and you're paying your taxes, you're suing yourself. And that's a sad state of affairs. That is not conducive to earning the consent of the American people."

"Address the shortfall in funding for forevermore storage of high-level radioactive waste. Dr. Mark Cooper of Vermont Law School has estimated the first 200 years of commercial irradiated nuclear fuel storage (assuming just a single repository, although at least two will be required!) will cost $210 to $350 billion, even though there is only some tens of billions of dollars remaining in the now-terminated Nuclear Waste Fund, collected from nuclear power ratepayers."

4.10 ADDITIONAL TOPICS

Commenters also offered views on a wide range of additional topics, including sub-seabed disposal for nuclear waste; policies concerning the importation of nuclear waste from other countries; alternative technologies and advanced reactor technologies, including fusion; arguments for (and against) reprocessing as a waste management strategy; and recent problems with DOE's effort to site a Deep Borehole Test Facility.

Excerpts of comments on some of these topics follow:

"Sub-seabed disposal of the SNF at the HBPP [Humboldt Bay Power Plant] ISFSI is a potential alternative to the current plan that could be implemented more quickly than the schedule noted above. This would be the last major activity needed to complete the decommissioning of HBPP and allow the site to be restored. This would be consistent with the Blue Ribbon Commission recommendation that spent fuel currently being stored at shutdown reactor sites be "first in line" for transfer to a consolidated storage facility (Blue Ribbon Commission 2012)."

"The biggest point is that waste is not a problem. It can be burned up in advanced reactors. We need to develop them and move in that direction."

"Substantial time, money, and intellectual resources should be focused on developing and bolstering nuclear waste transmutation and other innovative technologies that seek to recycle and reuse waste, reduce radioactivity, and minimize waste volume. Only when solutions arise for dealing with the existence of nuclear waste should investment in continuing nuclear power production resume with any justification."

"I believe that all waste products (SNF, HLW, excess weapons inventory, etc.) should be treated together and a national policy should be established of recycling/reprocessing (for example, into Mixed Oxide [MOX] fuel as an interim step) including final processing within Fast Neutron Reactors (FNR) in which the bulk of the waste product (long-lived actinides) could be permanently eliminated from the waste stream, and that which is left over would be a small fraction of the waste the DOE is currently faced with, and much less radiologically active. The siting process for final disposal of the waste after recycling would be far less painful than what you are now facing, and the use of domestic FNRs would ensure national security."

"Do not reprocess irradiated nuclear fuel. Not discounting the astronomical expense, this would risk nuclear weapons proliferation, terrorism threats, and environmental ruin downwind and downstream."

"Objections have also been heard in both of the Dakotas regarding DOE's recent efforts to develop the science on a borehole disposal approach to some forms of nuclear waste."

5. LOOK AHEAD

As DOE takes next steps toward designing a consent-based siting process, careful consideration will be given to the input summarized in the foregoing chapters. Engaging and developing relationships with, collecting feedback from, and responding to the concerns of the general public, partners, and stakeholders will allow DOE to design and implement a stronger and more robust waste management program than would otherwise be possible. In essence, stakeholder engagement leads to better outcomes.

5.1 SUPPORTING ENGAGEMENT THROUGH OUTREACH, INFORMATION, AND FUNDING

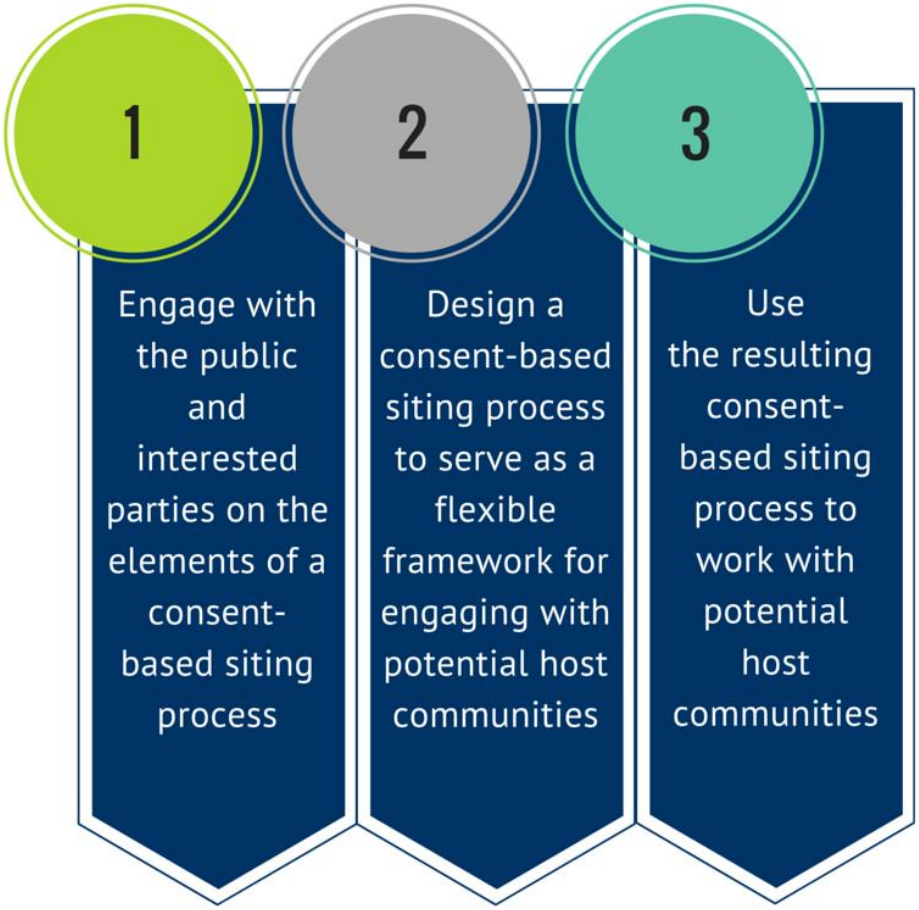
Through this initial period of public engagement on the subject of consent-based siting, the Department consistently heard that communities and stakeholders need support—in the form of outreach, information, and funding—to sustain their meaningful engagement in a consent-based siting process and to build a durable foundation for informed consent.

At the outset, potentially interested parties are likely to have varying levels of understanding as to the siting process itself, the technical and operational requirements for a facility, and the desired characteristics of a host site. DOE plans to continue outreach efforts and efforts to provide information to communities interested in learning more.

The Department's FY 2017 Budget Request, pending congressional approval, includes funding to help transition mutual learning and engagement activities for consent-based siting to the community level through a Funding Opportunity Announcement. Funds will enable communities to learn more about nuclear waste management and explore their potential roles in consent-based siting and other waste management efforts. Pending congressional approval, DOE plans to convene focused meetings with interested parties and conduct public outreach on a range of topics such as:

- Consolidated interim storage
- Disposal of defense HLW
- Transportation of commercial SNF and DOE wastes from current storage locations
- Results from focus groups, general education articles and public surveys
- Analysis of public preferences related to siting, characterization, and operation of facilities for the storage and disposal of radioactive waste

Figure 5.1 Phases of a Designing a Consent-Based Siting Process



6. APPENDICES

APPENDIX A – COPY OF INVITATION FOR PUBLIC COMMENT AND EXTENSION

SEAs, with instructions, and will request that SEAs commence submitting FY 2015 data to the Census Bureau on Tuesday, February 2, 2016. SEAs are urged to submit accurate and complete data by Friday, March 18, 2016, to facilitate timely processing.

Submissions by SEAs to the Census Bureau will be analyzed for accuracy and returned to each SEA for verification. SEAs must submit all data, including any revisions to FY 2014 and FY 2015 data, to the Census Bureau no later than Monday, August 15, 2016. Any resubmissions of FY 2014 or FY 2015 data by SEAs in response to requests for clarification or reconciliation or other inquiries by NCES or the Census Bureau must be completed by Tuesday, September 6, 2016. Between August 15, 2016, and September 6, 2016, SEAs may also, on their own initiative, resubmit data to resolve issues not addressed in their final submission of NPEFS data by August 15, 2016. All outstanding data issues must be reconciled or resolved by the SEAs, NCES, and the Census Bureau as soon as possible, but no later than September 6, 2016.

In order to facilitate timely submission of data, the Census Bureau will send reminder notices to SEAs in May, June, and July of 2016.

Having accurate, consistent, and timely information is critical to an efficient and fair Department of Education (Department) allocation process and to the NCES statistical process. To ensure timely distribution of Federal education funds based on the best, most accurate data available, the Department establishes, for program funding allocation purposes, Monday, August 15, 2016, as the final date by which the SEAs must submit data using either the interactive survey form on the NPEFS data collection Web site at: *http://surveys.nces.ed.gov/ccdnpefs* or ED Form 2447.

Any resubmissions of FY 2014 or FY 2015 data by SEAs in response to requests for clarification or reconciliation or other inquiries by NCES or the Census Bureau must be completed through the interactive survey form on the NPEFS data collection Web site or ED Form 2447 by Tuesday, September 6, 2016. If an SEA submits revised data after the final deadline that result in a lower SPPE figure, the SEA's allocations may be adjusted downward, or the Department may direct the SEA to return funds. SEAs should be aware that all of these data are subject to audit and that, if any inaccuracies are discovered in the audit process, the Department may seek recovery of overpayments for the applicable programs.

Note: The following are important dates in the data collection process for FY 2015:

February 2, 2016—SEAs can begin to submit accurate and complete data for FY 2015 and revisions to previously submitted data for FY 2014.

March 18, 2016—Date by which SEAs are urged to submit accurate and complete data for FY 2014 and FY 2015.

August 15, 2016—Mandatory final submission date for FY 2014 and FY 2015 data to be used for program funding allocation purposes.

September 6, 2016—Mandatory final deadline for responses by SEAs to requests for clarification or reconciliation or other inquiries by NCES or the Census Bureau. All data issues must be resolved.

If an SEA's submission is received by the Census Bureau after August 15, 2016, the SEA must show one of the following as proof that the submission was mailed on or before that date:

1. A legibly dated U.S. Postal Service postmark.
2. A legible mail receipt with the date of mailing stamped by the U.S. Postal Service.
3. A dated shipping label, invoice, or receipt from a commercial carrier.
4. Any other proof of mailing acceptable to the Secretary.

If the SEA mails ED Form 2447 through the U.S. Postal Service, the Secretary does not accept either of the following as proof of mailing:

1. A private metered postmark.
2. A mail receipt that is not dated by the U.S. Postal Service.

Note: The U.S. Postal Service does not uniformly provide a dated postmark. Before relying on this method, an SEA should check with its local post office.

Accessible Format: Individuals with disabilities may obtain this document in an accessible format (*e.g.*, braille, large print, audiotape, or compact disc) on request to: Mr. Stephen Q. Cornman, NPEFS Project Director, National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Telephone: (202) 245–7753 or by email: *stephen.cornman@ed.gov.*

Electronic Access to This Document: The official version of this document is the document published in the **Federal Register**. Free Internet access to the official edition of the **Federal Register** and the Code of Federal Regulations is available via the Federal Digital System at: *www.gpo.gov/fdsys.* At this site you can view this document, as well as all other documents of this Department published in the **Federal Register**, in text or Adobe Portable Document Format (PDF). To use PDF you must have Adobe Acrobat Reader, which is available free at this site.

You may also access documents of the Department published in the **Federal Register** by using the article search feature at: *www.federalregister.gov.* Specifically, through the advanced search feature at this site, you can limit your search to documents published by the Department.

Authority: 20 U.S.C. 9543.

Dated: December 18, 2015.

Ruth Neild,

Deputy Director for Policy and Research Delegated the Duties of the Director for the Institute of Education Sciences.

[FR Doc. 2015–32266 Filed 12–22–15; 8:45 am]

BILLING CODE 4000–01–P

DEPARTMENT OF ENERGY

Invitation for Public Comment To Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities

AGENCY: Fuel Cycle Technologies, Office of Nuclear Energy, Department of Energy.

ACTION: Notice of Invitation for Public Comment (IPC).

SUMMARY: The U.S Department of Energy (DOE) is implementing a consent-based siting process to establish an integrated waste management system to transport, store, and dispose of commercial spent nuclear fuel and high level defense radioactive waste. In a consent-based siting approach, DOE will work with communities, tribal governments and states across the country that express interest in hosting any of the facilities identified as part of an integrated waste management system. As part of this process, the Department wants public input on implementing this system. In order to solicit public feedback, DOE is submitting this Invitation for Public Comment (IPC). Through this IPC, we are requesting feedback from communities, states, Tribes, and other interested stakeholders on how to design a consent-based siting process. In addition, the Department intends to host a series of public meetings to engage communities and discuss the development of a consent-based approach to managing our nation's nuclear waste.

DATES: Written comments will be accepted beginning December 23, 2015 through June 15, 2016. Separate announcements will be made for each public meeting.

ADDRESSES: You may submit questions or comments by any of the following methods:

Email: Responses may be provided by email to *consentbasedsiting@hq.doe.gov.* Please include ''Response to IPC'' in the subject line.

Mail: Responses may be provided by mail to the following address: U.S. Department of Energy, Office of Nuclear Energy, Response to IPC, 1000 Independence Ave SW., Washington, DC 20585.

Fax: Responses may be faxed to 202–586–0544. Please include ''Response to IPC'' on the fax cover page.

Online: Responses will be accepted online at *www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Requests for further information should be sent to *consentbasedsiting@hq.doe.gov.* Please include ''Question on IPC'' in the subject line.

SUPPLEMENTARY INFORMATION:

Background

Electricity generated by nuclear energy has powered homes, schools, and industry in the United States since the 1950s. Nuclear material is used to power naval vessels and was used to build the U.S. nuclear weapon stockpile during the Cold War. These activities have generated spent nuclear fuel (SNF) and high-level radioactive waste (HLW).

Isolating and containing this radioactive waste is necessary to ensure the long-term safety and security of the public and environment. Though the Cold War ended a quarter century ago and commercial nuclear power has been generated for over half a century, the country still lacks a permanent disposal solution for SNF and HLW. Instead, commercial SNF is stored at operating and shutdown reactor sites around the country while HLW from defense activities resides at Department of Energy sites. Previous attempts to develop long-term solutions for storage and disposal of this waste have resulted in controversy, litigation, protracted delays, and ultimately a failure to address the problem.[1]

Failure to dispose of nuclear waste has proven costly for energy ratepayers and taxpayers who are paying for the inability of the government to meet federal waste management commitments. States, Tribes, and others in the public carry the undue burden of hosting radioactive waste they were promised was only temporary.[2] Collectively, we have the responsibility to dispose of waste using a process that is fair to present and future generations. We must live up to our obligations and develop a lasting solution.

Purpose

The purpose of this IPC is to seek input on the elements that the Department of Energy should consider in the development of a consent-based siting process. As reflected in the Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste* (Strategy),[3] the Department concurs with the recommendation from the Blue Ribbon Commission on America's Nuclear Future that a phased, adaptive, consent-based siting process is the best approach to gain the public trust and confidence needed to site nuclear waste facilities. As the Department begins to consider a process for consent-based siting, we want to hear from all interested parties.

The Administration's Strategy envisioned the implementation of an integrated waste management system consisting of a range of nuclear waste facilities, each serving a specific role, to address the challenges facing the U.S. These nuclear waste facilities could include:

- A pilot interim storage facility with limited capacity capable of accepting used nuclear fuel and high-level radioactive waste and initially focused on serving shut-down reactor sites;
- A larger, consolidated interim storage facility, potentially co-located with the pilot facility and/or with a geologic repository, that provides the needed flexibility in the waste management system and allows for important near-term progress in implementing the federal commitment;
- Deep borehole disposal, which could be an option for disposal of smaller and more compact waste forms currently stored at Department of Energy sites;
- A permanent geologic repository for the disposal of defense high-level waste and, potentially, some DOE-managed spent nuclear fuel, which would be generally less radioactive, cooler, and easier to handle, enabling a simpler design and earlier availability; and
- A permanent geologic repository for the disposal of commercial spent nuclear fuel.

In early to mid-2016, the Department of Energy will host a series of public meetings to receive input for the design of a consent-based siting process. This IPC announces the Department's intention to hold meetings and to request input about what considerations are important when designing a fair and effective process for consent-based siting. Written input as well as feedback from public meetings will enable the Department to draft the initial steps on a proposal for a phased, adaptive, consent-based process for selecting sites.

Moving forward, the Department of Energy will draw upon extensive experience in storage, transportation, siting, policy, legislative, and regulatory issues both in the U.S. and elsewhere. A top priority is to build upon and improve existing relationships with states, Tribes, communities, and stakeholders to help identify important considerations, challenges, and opportunities for discussion.

Questions for Input

(1) How can the Department of Energy ensure that the process for selecting a site is fair?

Consent based siting seeks to ensure fairness in the distribution of costs, benefits, risks and responsibilities now and in future generations. How, in your view, can fairness be best assured by the process for selecting a site?

(2) What models and experience should the Department of Energy use in designing the process?

The challenges and opportunities of site selection drive us to continue to learn from previous or ongoing examples. From your perspective, what experience and models do you think are the most relevant to consider and draw from in designing the process for selecting a site?

(3) Who should be involved in the process for selecting a site, and what is their role?

The Department believes that there may be a wide range of communities who will want to learn more and be involved in selecting a site. Participation in the process for selecting a site carries important responsibilities. What are your views on who should be involved and the roles participants should have?

(4) What information and resources do you think would facilitate your participation?

The Department of Energy is committed to ensuring that people and communities have sufficient information and access to resources for engaging fully and effectively in siting. What information and resources would be essential to enable you to learn the most about and participate in the siting process?

(5) What else should be considered?

[1] Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy, January 2012. *http://energy.gov/ne/downloads/blue-ribbon-commission-americas-nuclear-future-report-secretary-energy.*

[2] Ibid.

[3] Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, January 2013. *http://www.energy.gov/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste.*

The questions posed in this document are a starting point for discussion on the design of the process for consent-based siting of nuclear waste facilities, the Department of Energy would like to hear about and discuss any related questions, issues, and ideas that you think are important.

Next Steps

Written comments from this IPC, along with input from public meetings, will be documented in a draft report scheduled to be released in summer 2016. The Department is planning to solicit comments on the draft report in order to ensure the content accurately reflects input received.

If you are unable to attend a public meeting or would like to further discuss ideas for consent-based siting, please propose an opportunity for us to speak with you. The Department will do its best to accommodate requests and help arrange additional opportunities to engage. To learn more about nuclear energy, nuclear waste, and ongoing technical work please see *energy.gov/consentbasedsiting.*

Submitting Comments

Instructions: Submit comments via any of the mechanisms set forth in the **ADDRESSES** section above. Respondents are requested to provide the following information at the beginning of their response to this IPC:

State, tribal, community, organization, public or individual name;
State, tribal, community, organization, public or individual point of contact; and
Point of contact's address, phone number, and email address.

If an email or phone number is included, it will allow the DOE to contact the commenter if questions or clarifications arise. No responses will be provided to commenters in regards to the disposition of their comments. All comments will be officially recorded without change or edit, including any personal information provided. Personal information (other than name) will be protected from public disclosure upon request.

Please identify your answers by responding to a specific question or topic, if possible. Respondents may answer as many or as few questions as they wish. Any additional comments that do not address a particular question should be included at the end of your response to this IPC as ''Additional Comments.''

DOE would appreciate early input in order to identify initial interest and concerns, as well as any early opportunities. Amended or revised inputs from commenters are also welcome throughout the comment period to help DOE develop this process. Comments received after the closing date will be considered as the planning process progresses; however, the DOE is only able to ensure consideration of comments received on or before the closing date as the initial phase of the consent based siting process is developed. Subsequent comments and input will also be welcome as DOE views this as a core component of a phased and adaptive consent-based siting process.

Privacy Act: Data collected via the mechanisms listed above will not be protected from the public view in any way.

Issued in Washington, DC, on December 15, 2015.

Andrew Griffith,

Associate Deputy Assistant Secretary for Fuel Cycle Technologies, Office of Nuclear Energy, Department of Energy.

[FR Doc. 2015–32346 Filed 12–22–15; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. NJ16–4–000]

City of Banning, California; Notice of Filing

Take notice that on December 15, 2015, City of Banning, California submitted its tariff filing: Filing 2016 Transmission Revenue Balancing Account Adjustment and Existing Transmission Contracts update, to be effective 1/1/2016.

Any person desiring to intervene or to protest this filing must file in accordance with Rules 211 and 214 of the Commission's Rules of Practice and Procedure (18 CFR 385.211, 385.214). Protests will be considered by the Commission in determining the appropriate action to be taken, but will not serve to make protestants parties to the proceeding. Any person wishing to become a party must file a notice of intervention or motion to intervene, as appropriate. Such notices, motions, or protests must be filed on or before the comment date. On or before the comment date, it is not necessary to serve motions to intervene or protests on persons other than the Applicant.

The Commission encourages electronic submission of protests and interventions in lieu of paper using the ''eFiling'' link at *http://www.ferc.gov.* Persons unable to file electronically should submit an original and 5 copies of the protest or intervention to the Federal Energy Regulatory Commission, 888 First Street NE., Washington, DC 20426.

This filing is accessible on-line at *http://www.ferc.gov,* using the ''eLibrary'' link and is available for review in the Commission's Public Reference Room in Washington, DC. There is an ''eSubscription'' link on the Web site that enables subscribers to receive email notification when a document is added to a subscribed docket(s). For assistance with any FERC Online service, please email *FERCOnlineSupport@ferc.gov,* or call (866) 208–3676 (toll free). For TTY, call (202) 502–8659.

Comment Date: 5:00 p.m. Eastern Time on January 5, 2016.

Dated: December 17, 2015.

Nathaniel J. Davis, Sr.,

Deputy Secretary.

[FR Doc. 2015–32270 Filed 12–22–15; 8:45 am]

BILLING CODE 6717–01–P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket No. IN16–2–000]

ETRACOM LLC; Michael Rosenberg; Notice of Designation of Commission Staff as Non-Decisional

December 16, 2015.

With respect to an order issued by the Commission on December 16, 2015 in the above-captioned docket, with the exceptions noted below, the staff of the Office of Enforcement are designated as non-decisional in deliberations by the Commission in this docket.[1] Accordingly, pursuant to 18 CFR 385.2202 (2015), they will not serve as advisors to the Commission or take part in the Commission's review of any offer of settlement. Likewise, as non-decisional staff, pursuant to 18 CFR 385.2201 (2015), they are prohibited from communicating with advisory staff concerning any deliberations in this docket.

Exceptions to this designation as non-decisional are:

Larry Parkinson
Lee Ann Watson
Janel Burdick
Maria Brun
Sam Bonar
Gabriel Sterling
Carol Clayton
Wesley Heath
Seema Jain

[1] *ETRACOM LLC and Michael Rosenberg,* 153 FERC ¶ 61,314 (2015).

Ave. SW., Room 3E207, Washington, DC 20202. Telephone: (202) 453–6891 or by email: *ddra@ed.gov.*

If you use a TDD or a TTY, call the FRS, toll free, at 1–800–877–8339.

If you request an application from ED Pubs, be sure to identify this program as follows: CFDA number 84.022A.

VIII. Other Information

Accessible Format: Individuals with disabilities can obtain this document and a copy of the application package in an accessible format (*e.g.,* braille, large print, audiotape, or compact disc) on request to the program contact person listed under **FOR FURTHER INFORMATION CONTACT** in section VII of this notice.

Electronic Access to This Document: The official version of this document is the document published in the **Federal Register**. Free Internet access to the official edition of the **Federal Register** and the Code of Federal Regulations is available via the Federal Digital System at: *www.gpo.gov/fdsys.* At this site you can view this document, as well as all other documents of this Department published in the **Federal Register**, in text or PDF. To use PDF you must have Adobe Acrobat Reader, which is available free at the site.

You may also access documents of the Department published in the **Federal Register** by using the article search feature at: *www.federalregister.gov.* Specifically, through the advanced search feature at this site, you can limit your search to documents published by the Department.

Dated: March 17, 2016.

Lynn B. Mahaffie,

Deputy Assistant Secretary for Policy, Planning, and Innovation, Delegated the Duties of Assistant Secretary for Postsecondary Education.

[FR Doc. 2016–06485 Filed 3–21–16; 8:45 am]

BILLING CODE 4000–01–P

DEPARTMENT OF ENERGY

[OE Docket No. EA–417]

Application to Export Electric Energy; Tenaska Energía de Mexico, S. de R.L. de C.V.

AGENCY: Office of Electricity Delivery and Energy Reliability, DOE.

ACTION: Notice of application.

SUMMARY: Tenaska Energía de Mexico, S. de R.L. de C.V. (Applicant or TEM) has applied for authority to transmit electric energy from the United States to Mexico pursuant to section 202(e) of the Federal Power Act.

DATES: Comments, protests, or motions to intervene must be submitted on or before April 21, 2016.

ADDRESSES: Comments, protests, motions to intervene, or requests for more information should be addressed to: Office of Electricity Delivery and Energy Reliability, Mail Code: OE–20, U.S. Department of Energy, 1000 Independence Avenue SW., Washington, DC 20585–0350. Because of delays in handling conventional mail, it is recommended that documents be transmitted by overnight mail, by electronic mail to *Electricity.Exports@hq.doe.gov,* or by facsimile to 202–586–8008.

SUPPLEMENTARY INFORMATION: Exports of electricity from the United States to a foreign country are regulated by the Department of Energy (DOE) pursuant to sections 301(b) and 402(f) of the Department of Energy Organization Act (42 U.S.C. 7151(b), 7172(f)) and require authorization under section 202(e) of the Federal Power Act (16 U.S.C. 824a(e)).

On March 10, 2016, DOE received an application from TEM for authority to transmit electric energy from the United States to Mexico as a power marketer for a five-year term using existing international transmission facilities. TEM will be submitting an application requesting the Federal Energy Regulatory Commission (FERC) authorization to make wholesale power sales at market-based rates. TEM will also register with the Public Utility Commission of Texas (the PUCT).

In its application, TEM states that it does not own or control any electric generation or transmission facilities, and it does not have a franchised service area. The electric energy that TEM proposes to export to Mexico would be surplus energy purchased from third parties such as electric utilities and Federal power marketing agencies pursuant to voluntary agreements. The existing international transmission facilities to be utilized by the Applicant have previously been authorized by Presidential permits issued pursuant to Executive Order 10485, as amended, and are appropriate for open access transmission by third parties.

Procedural Matters: Any person desiring to be heard in this proceeding should file a comment or protest to the application at the address provided above. Protests should be filed in accordance with Rule 211 of the Federal Energy Regulatory Commission's (FERC) Rules of Practice and Procedures (18 CFR 385.211). Any person desiring to become a party to these proceedings should file a motion to intervene at the above address in accordance with FERC Rule 214 (18 CFR 385.214). Five copies of such comments, protests, or motions to intervene should be sent to the address provided above on or before the date listed above.

Comments and other filings concerning TEM's application to export electric energy to Mexico should be clearly marked with OE Docket No. EA–417. An additional copy is to be provided to Norma Iacovo, Tenaska Power Services Co., 1701 E. Lamar Blvd., Suite 100, Arlington, TX 76006 and Neil Levy, 1700 Pennsylvania Ave. NW., Washington, DC 20006.

A final decision will be made on this application after the environmental impacts have been evaluated pursuant to DOE's National Environmental Policy Act Implementing Procedures (10 CFR part 1021) and after a determination is made by DOE that the proposed action will not have an adverse impact on the sufficiency of supply or reliability of the U.S. electric power supply system.

Copies of this application will be made available, upon request, for public inspection and copying at the address provided above, by accessing the program Web site at *http://energy.gov/node/11845,* or by emailing Angela Troy at *Angela.Troy@hq.doe.gov.*

Issued in Washington, DC, on March 14, 2016.

Christopher Lawrence,

Electricity Policy Analyst, Office of Electricity Delivery and Energy Reliability.

[FR Doc. 2016–06400 Filed 3–21–16; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Extension of Comment Period; Invitation for Public Comment To Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities

AGENCY: Fuel Cycle Technologies, Office of Nuclear Energy, Department of Energy.

ACTION: Notice of extension of comment period.

SUMMARY: The U.S Department of Energy (DOE) is extending the comment period provided in the notice entitled ''Invitation for Public Comment to Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities'' that appeared in the **Federal Register** of December 23, 2015. That notice announced that DOE is planning to design a consent-based siting process to establish an integrated waste management system to transport, store, and dispose of spent nuclear fuel

and high-level radioactive waste and requested comments by June 15, 2016. DOE is extending the comment period to July 31, 2016.

DATES: DOE is extending the comment period for the ''Invitation for Public Comment to Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities'' to July 31, 2016.

ADDRESSES: You may submit questions or comments by any of the following methods:

Email: Responses may be provided by email to *consentbasedsiting@hq.doe.gov*. Please include ''Response to IPC'' in the subject line.

Mail: Responses may be provided by mail to the following address: U.S. Department of Energy, Office of Nuclear Energy, Response to IPC, 1000 Independence Ave. SW., Washington, DC 20585.

Fax: Responses may be faxed to 202–586–0544. Please include ''Response to IPC'' on the fax cover page.

Online: Responses will be accepted online at *www.regulations.gov*.

FOR FURTHER INFORMATION CONTACT: Requests for further information should be sent to *consentbasedsiting@hq.doe.gov*. Please include ''Question on IPC'' in the subject line.

SUPPLEMENTARY INFORMATION:

Submitting Comments

Instructions: Submit comments via any of the mechanisms set forth in the **ADDRESSES** section above. Respondents are requested to provide the following information at the beginning of their response to this IPC:

State, tribal, community, organization, public or individual name;

State, tribal, community, organization, public or individual point of contact; and

Point of contact's address, phone number, and email address.

If an email or phone number is included, it will allow the DOE to contact the commenter if questions or clarifications arise. No responses will be provided to commenters in regards to the disposition of their comments. All comments will be officially recorded without change or edit, including any personal information provided. Personal information (other than name) will be protected from public disclosure upon request.

Please identify your comments as responding to a specific question posed in the Invitation for Public Comment, if possible. Respondents may answer as many or as few questions as they wish. Any additional comments that do not address a particular question should be included at the end of your response to this IPC as ''Additional Comments.''

DOE would appreciate early input in order to identify initial interest and concerns, as well as any early opportunities. Amended or revised inputs from commenters are also welcome throughout the comment period to help DOE develop this process. Comments received after the closing date will be considered as the planning process progresses; however, the DOE is only able to ensure consideration of comments received on or before the closing date as the initial phase of the consent based siting process is developed. Subsequent comments and input will also be welcome as DOE views this as a core component of a phased and adaptive consent-based siting process.

Privacy Act: Data collected via the mechanisms listed above will not be protected from the public view in any way.

Issued in Washington, DC, on March 9, 2016.

Andrew Richards,

Chief of Staff, Office of Nuclear Energy, Department of Energy.

[FR Doc. 2016–05797 Filed 3–21–16; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Project No. 1494–433]

Grand River Dam Authority; Notice of Request To Reduce Comment Period From 60 to 30 Days on Draft Amendment Application and Soliciting Comments, Motions To Intervene, and Protests

Take notice that the following hydroelectric application has been filed with the Commission and is available for public inspection:

a. *Application Type:* Request to reduce the comment period from 60 to 30 days for a draft amendment application to permanently modify the reservoir elevation rule curve under Article 401 of the project license.

b. *Project No:* 1494–433.

c. *Date Filed:* March 15, 2016.

d. *Applicant:* Grand River Dam Authority (GRDA).

e. *Name of Project:* Pensacola Hydroelectric Project.

f. *Location:* The project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma.

g. *Filed Pursuant to:* Federal Power Act, 16 U.S.C. 791(a)–825(r).

h. *Applicant Contact:* Tamara Jahnke, Grand River Dam Authority, 226 West Dwain Willis Ave, P.O. Box 409, Vinita, OK 74301; telephone (918) 256–5545.

i. *FERC Contact:* B. Peter Yarrington, telephone (202) 502–6129 and email *peter.yarrington@ferc.gov;* or Linda Stewart, telephone (202) 502–6680 and email *linda.stewart@ferc.*

j. Deadline for filing comments, motions to intervene, and protests is 15 days from the issuance date of this notice by the Commission. The Commission strongly encourages electronic filing. Please file comments using the Commission's eFiling system at *http://www.ferc.gov/docs-filing/efiling.asp*. Commenters can submit brief comments up to 6,000 characters, without prior registration, using the eComment system at *http://www.ferc.gov/docs-filing/ecomment.asp*. You must include your name and contact information at the end of your comments. For assistance, please contact FERC Online Support at *FERCOnlineSupport@ferc.gov*, (866) 208–3676 (toll free), or (202) 502–8659 (TTY). In lieu of electronic filing, please send a paper copy to: Secretary, Federal Energy Regulatory Commission, 888 First Street NE., Washington, DC 20426. The first page of any filing should include the project number (P–1494–433).

k. *Description of Request:* On March 15, 2016, GRDA filed with the Commission: (1) A draft amendment application to permanently modify the reservoir elevation rule curve under Article 401 of the Pensacola Project for Grand Lake O' the Cherokees, (2) a request for a temporary variance contained in the draft amendment application, and (3) a waiver request to reduce from 60 to 30 days the comment period for resource agencies, Indian tribes, and other stakeholders to provide comments on the draft amendment application mentioned above. The Commission's regulations at 4.38(a)(7) require GRDA to provide resource agencies, Indian tribes, and other stakeholders 60 days to provide comments on the above draft amendment application. GRDA requests Commission approval of a 30-day comment period instead to expedite the Commission's review of any final application filed with the Commission.

This notice solicits comments, motions to intervene, and protests on GRDA's request to reduce the comment period from 60 to 30 days as discussed above. Comments on the draft application and temporary variance request contained in the draft application should be filed directly with

APPENDIX B - LIST OF CONSENT-BASED SITING MEETINGS

This appendix lists meetings that DOE hosted, attended, and/or made presentations related to consent-based siting. Each of these meetings provided opportunities to discuss consent-based siting and nuclear waste management topics with individuals and groups and to listen, share information, and answer questions.

B.1 Consent-based siting public meetings

- January 20, 2016, "Kick-off" Public Meeting; Washington, DC
- March 29, 2016, Public Meeting; Chicago, IL
- April 11, 2016, Public Meeting; Atlanta, GA
- April 26, 2016, Public Meeting; Sacramento, CA
- May 24, 2016, Public Meeting; Denver, CO
- June 2, 2016, Public Meeting; Boston, MA
- June 23, 2016, Public Meeting; Tempe, AZ
- July 14, 2016, Public Meeting; Boise, ID
- July 21, 2016, Public Meeting; Minneapolis, MN
- September 15, 2016, Public Summary Meeting; Washington, DC

B.2 Additional meetings by request

- April 10, 2016, Meeting with Nye County Commission representatives; Atlanta, GA
- June 3, 2016, Public meeting with citizens at Wiscasset Community Center; Wiscasset, ME
- June 22, 2016, San Onofre Community Engagement Panel Meeting on Consolidated Interim Storage (public meeting); San Juan Capistrano, CA
- June 22-23, 2016, Small Group Forums with San Diego County Community Members, Non-governmental Organizations, Orange County Community Members, Southern California Edison; San Juan Capistrano, Oceanside, and Santa Ana, CA
- July 7, 2016, Meeting with Nye County Commission representatives; Washington, DC
- July 12, 2016, Meeting with Shoshone-Bannock Tribes Department of Public Safety; Fort Hall, ID
- July 22, 2016, Meeting with Prairie Island Indian Community Tribal Council; Welch, MN

B.3 Meetings and conferences

- January 12-14, 2016, Institute of Nuclear Materials Management 30th Spent Fuel Seminar; Arlington, VA
- January 27, Meeting with Natural Resources Canada; Ottawa, Canada
- January 28, Meeting with Nuclear Waste Management Organization; Toronto, Canada
- February 2, 2016, US Nuclear Infrastructure Council Members Meeting; Washington, DC
- February 16, 2016, Nuclear Waste Strategy Coalition, Washington, DC
- February 17-18, 2016, Energy Community Alliances Peer Exchange Meeting; Austin, TX
- March 1, 2016, Stakeholders for Nuclear Waste Reform/Nuclear Energy Institute; Washington, DC

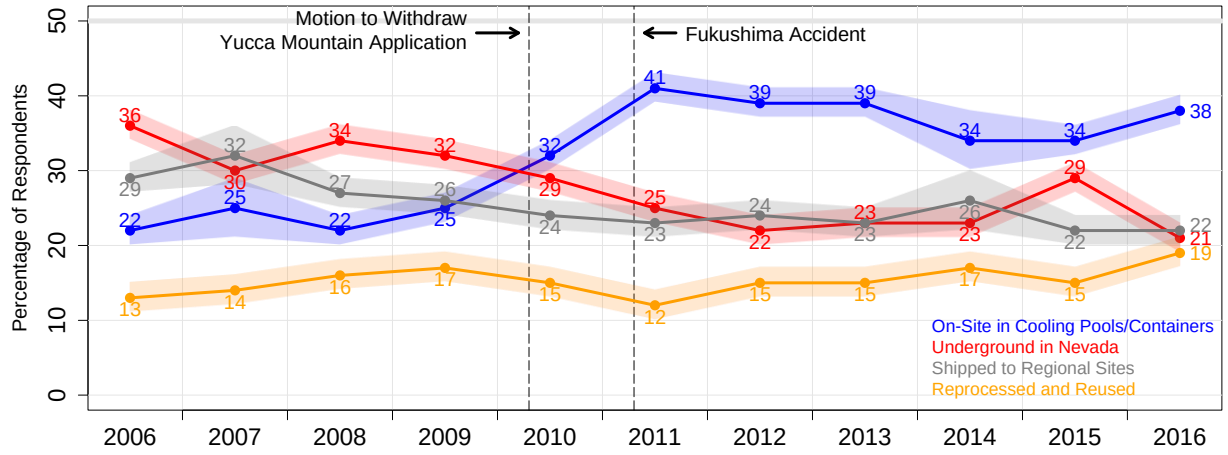
- March 2-3, 2016, DOE Office of Nuclear Energy Transportation Core Group; Washington, DC
- March 6-10, 2016, Waste Management Symposia 2016; Phoenix, AZ
- March 8, 2016, Meeting with Chicago Bridge and Iron (CB&I); Phoenix, AZ
- March 8-10, 2016, U.S. Nuclear Regulatory Commission's Regulatory Information Conference; North Bethesda, MD
- March 9, 2016, Consent-based Siting Dialogue with DOE in conjunction with Waste Management Symposium 2016; Phoenix, AZ
- March 9-10, 2016, Stanford, CISAC Reset of Nuclear Waste Management and Policy
- March 16, 2016, National Association of Regulatory Utility Commissioners (NARUC); Teleconference
- March 17, 2016, Environmental Council of the States (ECOS); Teleconference
- April 5, 2016, Nuclear Waste Technical Review Board Staff Discussion; Washington, DC
- April 6, 2016, Nuclear Energy Advisory Committee – Fuel Cycle Subcommittee Meeting; Washington, DC
- April 25-28, 2016, Nuclear Energy Tribal Working Group; Fort Hall, ID
- May 3-5, 2016, Nuclear Energy Institute, Used Fuel Management Conference; Orlando, FL
- May 11, 2016, National Governors Association, 2016 Federal Facilities Task Force Spring Meeting; Henderson, NV
- June 6, 2016, Tribal Caucus; Orlando, FL
- June 7-9, 2016, National Transportation Stakeholders Forum; Orlando, FL
- June 12-16, 2016, American Nuclear Society Annual Meeting; New Orleans, LA
- June 15-17, 2016, Nuclear Energy Legislative Working Group; Idaho Falls, ID
- June 17, 2016, Nuclear Energy Advisory Committee Meeting; Washington, DC
- June 30, 2016, U.S. Senate Committee on Energy and Natural Resources Briefing; Washington, DC
- July 26, 2016, Council of State Governments Webinar on Nuclear Waste Solutions; Webinar
- July 27-28, 2016, Nuclear Energy Tribal Working Group; Augusta, GA
- August 17-18, 2016, DOE Office of Nuclear Energy Transportation Core Group; Chicago, IL
- August 24, 2016, Nuclear Waste Technical Review Board Meeting; Washington, DC
- September 6-9, 2016, 2016 RadWaste Summit; Las Vegas, NV

APPENDIX C - PUBLIC PERSPECTIVES ON WASTE STORAGE AND DISPOSAL: AN OVERVIEW OF THE ENERGY AND ENVIRONMENT SURVEY SERIES (2006–2016)

As described in this report, the U.S. Department of Energy (DOE) launched a nationwide consent-based siting initiative in December 2015. The initiative commenced with an Invitation for Public Comment in the Federal Register that solicited input on important considerations about the design of a fair and effective siting process. Following that invitation, DOE organized a series of public and stakeholder meetings that were designed to gather additional comments about the design of a consent-based siting process. These efforts are complemented by an ongoing, decade-long collaborative project supported by DOE, Sandia National Laboratories (SNL), and the University of Oklahoma (OU). Known as the *Energy and Environment* (EE) project, this collaboration aimed to explore public perspectives on nuclear waste storage and disposal and consent-based siting using OU-owned data from nationally representative surveys that are administered every year. Results from the EE project complement the input collected in Phase 1 of DOE's consent-based siting process and are briefly described in this appendix.

The EE project was initiated in 2006 with support from DOE, SNL, Texas A&M University, and the University of New Mexico. The project was designed to analyze baseline data on public views about energy security, perceptions of nuclear energy, and preferences regarding nuclear waste management options, including transportation, storage, and disposal (Jenkins-Smith and Herron 2007). In subsequent years, the EE project has continued to analyze these concepts in the context of changing national priorities, concerns, and evolving international and domestic events (such as the nuclear accident at Fukushima in March 2011 and the incident at the Waste Isolation Pilot Plant in New Mexico in February 2014). These analyses provide critical information about the evolution of public perspectives on nuclear energy and nuclear waste management. For example, Figure 1 shows the evolution of public knowledge about nuclear waste management in the U.S. in relation to the motion to withdraw the Yucca Mountain license application (in March 2010) and the Fukushima accident.

Figure C.1: To the best of your knowledge, what is being done currently with most of the spent nuclear fuel produced in the U.S.? (2006–2016)



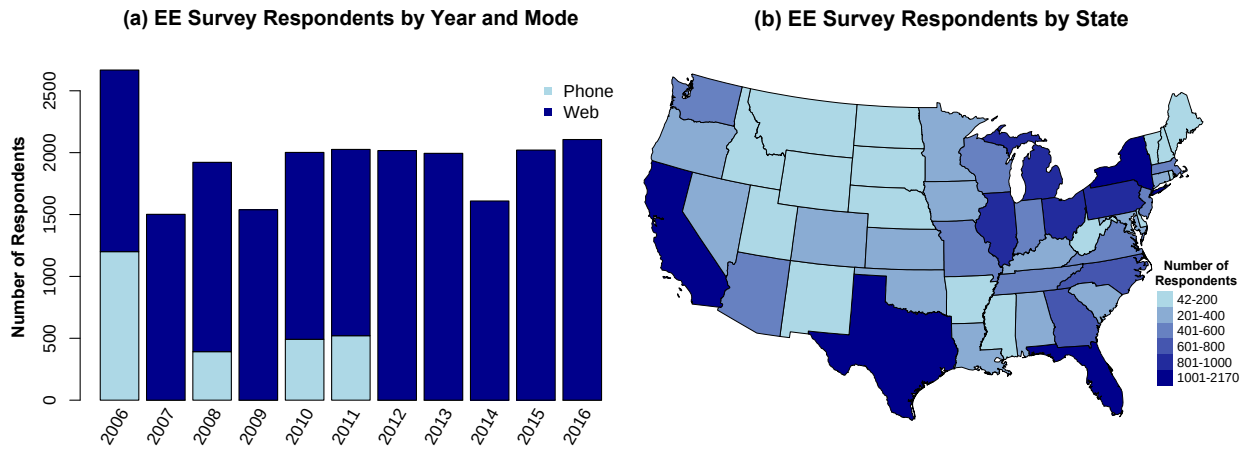
In 2010, OU and SNL established a jointly run Center for Energy, Security, and Society (CES&S)[6], which now manages the EE survey series. Motivated by the 2012 report of the Blue Ribbon Commission on America's Nuclear Future (BRC), a section on consent-based siting was added to solicit public perspectives on a number of questions, such as:

1. How should consent be defined and registered?
2. Who should be allowed to block/veto a siting decision?
3. When should host communicates be allowed to withdraw consent?
4. What should come first, a technical or social evaluation of a potential host community?
5. Who should manage a consent-based siting process?
6. Does public/community consent increase the legitimacy of siting decisions and, consequently, support for the decisions that are made?

The EE project has relied on a series of 11 annual surveys, one for each year from 2006 to 2016. Each year, the project begins with a "concept development" phase, where OU and SNL researchers in the CES&S collaborate with specialists at DOE and other organizations to define ongoing challenges and emergent issues (concepts) associated with nuclear energy, nuclear waste management, and consent-based siting in the U.S.

Following the design phase, the survey process proceeds to the "administration" phase, where researchers at OU design and implement the survey.[7] Approximately 2,000 U.S. residents (18 or older) complete a survey each year. Each survey takes an average of 30 minutes to complete. The mode of data collection has included both phone and Internet surveys. In 2006, 2008, 2010, and 2011, data collection included both phone and Internet surveys to test the comparability of results using different modes of communication. Analysis indicated that the results were comparable, so the 2007, 2009, 2012, 2013, 2014, 2015, and 2016 surveys were administered exclusively on the Internet.

[6] Information about the program is available at the CES&S website at http://cess.ou.edu/index.html
[7] From 2006 through 2011, survey design and data collection were funded by SNL. Beginning in 2011, survey design and survey data collection have been independently funded by the University of Oklahoma.



To ensure that survey results are comparable over time, across modes, and generalizable to the U.S. population, U.S. Census estimates are used to define pre-survey quotas and calculate post-survey adjustments (weights). The quotas and weights account for gender, age, race, Hispanic ethnicity, and region.

When the administration phase is complete, the survey moves on to the "analysis" phase, where researchers at CES&S collaborate with staff at DOE, SNL, and other organizations to assess and disseminate results by way of multiple outlets and venues, including DOE briefings, in-depth presentations at SNL, SAND reports, and peer-reviewed journal articles.

Overall, the EE project has provided valuable insights into the perspectives of U.S. residents on nuclear materials management, with a specific focus on transport, storage and disposal of spent nuclear fuel. Annual surveys conducted over the past decade have allowed researchers to track evolving public views and preferences as major events have unfolded (e.g., the Fukushima nuclear accident in 2011) and as design and program changes have taken place. These perspectives serve as an important complement to the input obtained through DOE's regional public meetings between 2015 and 2016.

The Better Water Project: How SunRiver will Ensure Water Security for the American Southwest

By Randy Carlson, SolRio Co-Founder

There are currently two large-scale water projects proposed with the goal of securing water supply in times of drought and changing climate in the American Southwest. The first aims to redistribute existing water resources by building two massive tunnels underneath the Delta. The second project actually creates a brand new water resource by combining renewable energy with existing infrastructure and cutting-edge technology. Chances are, you haven't heard about this second project – the project that will deliver more water to more people with less environmental impact at a lower cost.

California Water Fix and Eco Restore (the project you know about)

In the 1960's, politicians wanted to build a canal to carry water from the Sacramento River, around the delta to the intake pumps feeding the State Water project, and from there south to irrigate the San Joaquin Valley, and on to Southern California cities. The objective was to allow more pumping from the delta without sucking salt water into California's fresh water plumbing - and incidentally killing a bunch of endangered fish. California voters buried this canal project in a June 1982 referendum that lost by 63% to 37%.

The California Water Fix and Eco Restore (formerly known as the Bay Delta Conservation Plan) is the last of these "old water projects". It's a rather controversial plan proposed by Governor Jerry Brown to build two large, four-story tall tunnels to move fresh water from the Sacramento River, underneath the Sacramento-San Joaquin Delta, to intake stations for the State Water Project. Essentially, this project moves water from where nature put it to where monied interests want it.

Huge tunnels will create a "peripheral canal" running beneath the Delta - out of sight and out of mind for voters who want such a thing. If the California Water Fix project survives environmental challenges, it will likely be the last big project for moving water from where nature put it to other parts of the Southwest.

Drought has worsened in California, population has grown, and dependence on water from the Delta has increased. Saltwater intrusion and destruction of endangered fish now restrict pumping from the delta, and if drought conditions persist Central Valley farms and Southern California cities will suffer.

Additionally, the Delta Tunnels, costing tens of billions of dollars, produce no additional water. Even if the project gets built, the existing aqueducts heading south will deliver no more water than they could before. This project acts as a Band-Aid to keep the old system working in the

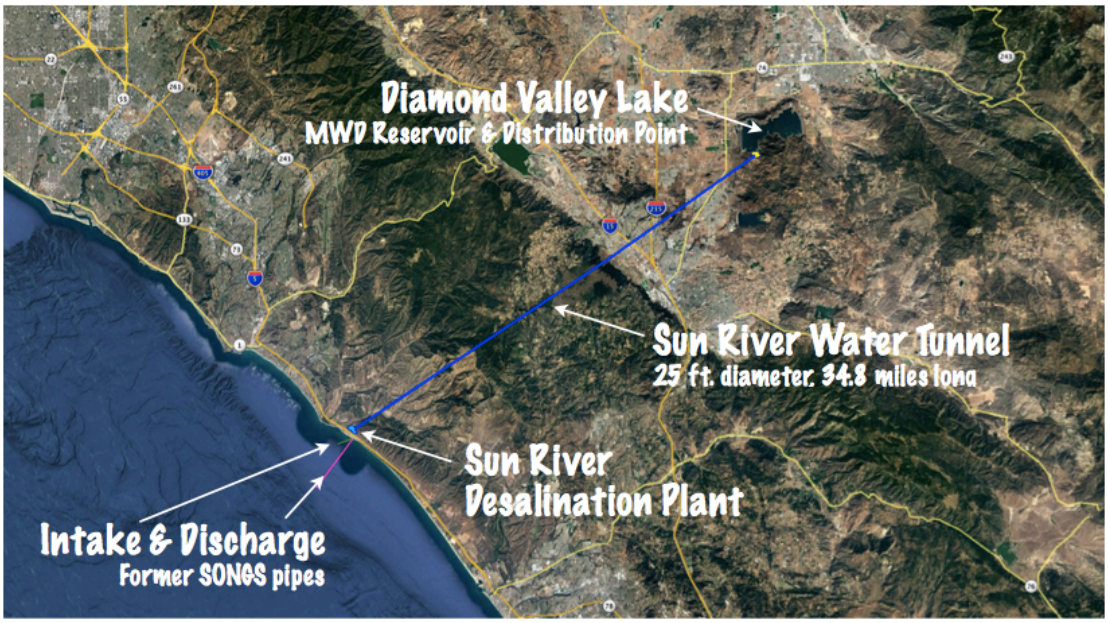
face of drought and changing climate.

SunRiver (the project you've probably never heard of)

If the Delta Tunnels are the last of the old water mega-projects, Sun River is the first of the new. Instead of gathering up water nature provides, SunRiver uses solar generated electricity to desalinate seawater at regional scale. SunRiver technology isn't new, but making such huge volumes of new water is revolutionary.

Sun River uses the existing seawater inlet and discharge pipes and high power grid connection at the decommissioned San Onofre Nuclear Generating Station (SONGS) on the Southern California coast. This existing infrastructure saves huge expense and avoids the environmental impact of new construction. But there is a still greater savings.

SunRiver includes construction of a 35-mile long water transport tunnel (roughly the size of one of the proposed Delta Tunnels). This tunnel would deliver water from the SunRiver desalination plant directly to Diamond Valley Lake, which acts as the storage and distribution point for the Metropolitan Water District (MWD). This new desalinated water can then be swapped for water MWD would otherwise drawn from the Colorado River or the Central Valley.



SunRiver is the first of the new Southwest US water mega-projects. It delivers 1.1 billion gallons a day of new, drought-proof water for use in the region. Sun River incorporates seawater intake / discharge and high power grid infrastructure built to serve SONGS, saving enormous cost and reducing environmental impact. None of the old SONGS plant is used.

Water Swaps

At first look, the SunRiver project might only look like a local water solution with its short 35-

mile connection to MWD. However, this project provides 'water swaps' which work to supply distant needs.

Currently, water is being taken from both California's Central Valley system and from the Colorado River to feed MWD and their customers in Southern California. When Sun River delivers a gallon of water to MWD, a gallon less water needs to flow from the Central Valley or the Colorado River. That means there is another gallon of water for some Central Valley farmer, or Northern California city, for a Las Vegas casino, or a Denver homeowner. SunRiver can even offset Colorado River water that the US, by treaty, is obligated to supply to Mexico.

Notice that no aqueducts to the Colorado River or Central Valley need to run backwards, we just turn down the flow going to MWD, and that water becomes available for other users of those systems. By replacing water currently taken by MWD through the short SunRiver water tunnel, water needs hundreds of miles away are satisfied without additional infrastructure.

Costs

Swapping MWD's replaced water to other Colorado River and Central Valley users allows Sun River to supply water to the California Bay Area, Las Vegas, Mexico, or even Denver. Using existing infrastructure is the key to making Sun River affordable to build. Incorporating solar power plants and grid storage connected through existing transmission lines controls energy costs making SunRiver economical to operate.

Cost of solar power is falling while the efficiency of desalination is getting better. We have reached the point where renewably powered, environmentally friendly desalination works. Carefully using key existing infrastructure, allows large-scale desalination to compete with old-school water mega-projects. And, desalination is proof against drought and climate change. Sun River is insurance for our future water needs.

SunRiver Cost Estimate

	$ Billions
Solar Plants (3.3GW, Tracking)	7.2
Water Tunnel (25'Dia, 35mi.)	5.0
Grid Storage (12GWh, 6GW)	3.1
RO Plant (1.5 billion gpd)	7.0
Total	22.3

SunRiver Desalination and the Ocean

There are two big environmental problems with seawater desalination: sea life can get sucked in and lots of extra salty water comes out. Impingement and entrainment of fish and other organisms can endanger marine ecosystems. Un-diluted brine from desalination can kill sensitive creatures. It is irresponsible to do large-scale desalination projects without addressing these

environmental issues.

The seawater inlet and discharge system serving SONGS addressed both of these issues. A fish separation and return system minimized impingement and entrainment of larger fish and wetland restoration was done to offset loss of smaller organisms sucked through the plant's condensers. Arrays of mixing nozzles - a mile long on each discharge pipe - mixed the hot cooling water into the ocean to greatly lowering discharge temperature.

Using these facilities for a large desalination plant raises additional and different concerns. The discharge pipes with their existing mixing nozzle arrays will dilute brine from the plant by 10 to 20 times, raising local salinity only a few percent and is environmentally responsible. But the open-inlet intakes present a challenge.

We all know open intakes that suck up fish eggs, larva and immature fish do serious ecological damage. At the same time, a desalination plant must remove all small particles, including eggs, larva and little fish or these will clog the desalination membranes. Because SunRiver is a very large desalination plant, it necessarily requires a very large intake filter. There is limited land area available at the Sun River desalination plant. What's to be done?

The most straightforward, and we believe the best solution by far is to put the plant's inlet filter on the seabed ahead of the existing intakes - that is "seabed filtration".

SunRiver Energy and Related Environmental Impact

Seawater desalination takes about 15 kilowatt-hours of electricity for every thousand gallons of fresh water. This is about the same as pumping the water up a mile high mountain. SunRiver produces an average of 1.1 billion gallons of water a day and uses as much electricity as a large coal power plant produces.

Instead of a fossil fueled power plant, which would dump millions of tons of CO2 into the atmosphere, SunRiver gets its power from a combination of solar panels and grid storage batteries. Altogether 25,000 acres of solar power plants and 12 Gigawatt-hours of storage are used. The storage is distributed strategically at the solar plants, transmission substations and the desalination plant so energy for Sun River moves through the grid at times of low demand when the wires are under-utilized.

SunRiver's renewable solar power and grid storage does more than make it a low carbon footprint water project. These generating and grid storage resources also provide backup energy for the Southwest grid. This backup energy will become increasingly important as more industries shift towards alternative energy.

During unusual events that stress the grid, SunRiver desalination can be throttled back, and power diverted to stabilize the grid. SunRiver solar power generation and storage are available to the grid during times of unusual stress at far lower cost than having stand-by generation that is rarely used. Not only does this diminish SunRiver's carbon footprint, it lowers the carbon

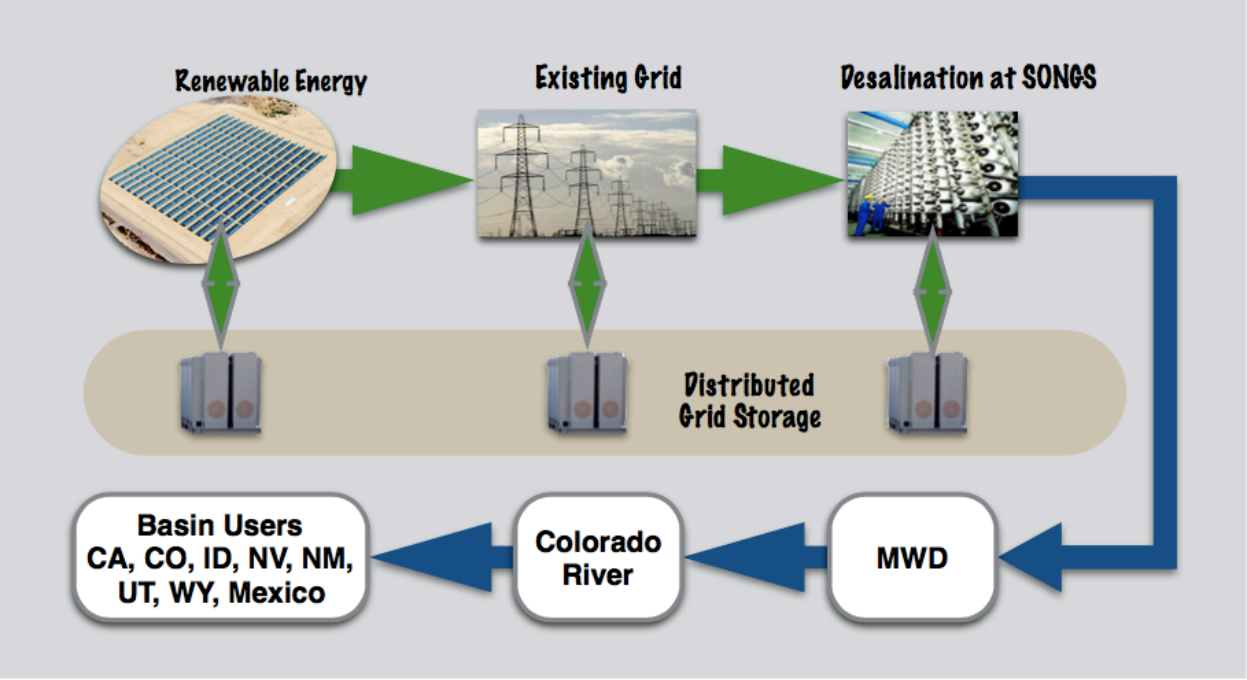
footprint of the entire Southwest grid.

Critical Steps to Secure Reliable Southwest Water

Implementing SunRiver and obtaining the large amounts of new, clean, affordable water we need requires action now. SONGS is being decommissioned right now. State regulators, the California Lands Commission, other agencies and the utilities who own SONGS need to preserve infrastructure that SunRiver will need. This includes the grid connection assets and the cooling system seawater inlet and discharge system. Abandoning and/or demolishing these assets would be irresponsible because it will increase the cost and delay implementation of Sun River.

For community safety reasons, and to support early and SunRiver implementation, spent fuel at SONGS must be removed from overloaded pool storage to dry casks, and those safely isolated. Delay is not only dangerous for the community, it makes implementing Sun River more costly and time consuming.

Prompt, thoughtful, resolute action to preserve useful assets and speed the safe decommissioning of SONGS will speed Sun River and help deliver the new clean reliable water that our region needs. It is the right path forward for all concerned.



Why SunRiver Is Worth It

SunRiver is a regional-scale solution to drought and climate change. There have been desalination projects before along the California coast. These projects meet a localized need here and there, but don't pretend to address drought in the whole Southwest. SunRiver is much, much bigger. Sun River replaces 100% of the water DWP takes from the Colorado River - 1.3 million

acre feet a year, 1.1 billion gallons per day, 50 metric tons of fresh water per second.

Bigger is better. SunRiver produces enough water to realize economies of scale, and enough water to meet needs of multiple, large, high value uses. Sun River's scale makes it worthwhile for distant cities, states and even the federal government to have a stake in the project. This in turn brings enough diverse and powerful stakeholders to the table to make the necessary water swaps achievable.

SunRiver isn't just bigger - it is different. Unlike every previous Southwest water mega- project, SunRiver isn't about stealing someone else's water. Sun River delivers new water, created from the ocean using our abundant sunshine. It's drought-proof water. For the first time, large Southwest regional water needs can be met without steeling other people's water. And come to think if it, that's pretty big, too.

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REPORT OFFERS 'LESSONS LEARNED' FROM VERMONT YANKEE

OCT. 16, 2016, 7:52 AM BY MIKE FAHER 4 COMMENTS



Vermont Congressman Peter Welch talks during a press conference in Brattleboro, Vt., about lessons learned from the closure of Vermont Yankee Nuclear Power Plant in Vernon on Friday, Oct. 14, 2016. Kristopher Radder/Reformer Staff

BRATTLEBORO – Early in a new report on Vermont Yankee's shutdown, Windham Region officials acknowledge that the closure's full impacts "have yet to be realized and may not necessarily be easy to quantify."

Nevertheless, they believe they've got a story to tell.

That's the purpose of the report, framed as "lessons learned" both before and after the Vernon nuclear plant's December 2014 closure. The document – the result of a tri-state effort – serves as an advisory, a tutorial and a warning for other communities that may face a loss

of jobs, tax revenue and residents due to a nuclear shutdown.

The report was released on Friday at a downtown Brattleboro gathering attended by U.S. Sen. Patrick Leahy, D-Vt.; U.S. Rep. Peter Welch, D-Vt.; and Matt Erskine, a top official at the U.S. Economic Development Administration.

“Other towns, regions and communities across the nation will learn from your experience to help set their course forward,” Erskine said.

In the wake of Vermont Yankee’s closure, officials in Windham County have wrestled with challenges including complex federal nuclear regulations; abrupt economic impacts; continued conflict between the state and the plant’s owner; and limited financial and technical resources to deal with it all.

The plant’s demise also has had an impact on neighboring Franklin County, Massachusetts, and Cheshire County, New Hampshire. The three counties hosted the majority of Vermont Yankee employees, who numbered about 550 just prior to shutdown.

Now, the tri-state counties have teamed up to produce a report titled “When People and Money Leave (and the Plant Stays) – Lessons Learned from the Closure of the Vermont Yankee Power Station: A Tri-Region Experience.”

In Windham County, Brattleboro Development Credit Corp. and Windham Regional Commission contributed to the report. Also involved were the Franklin Regional Council of Governments in Greenfield, Massachusetts, and the Southwest Region Planning Commission, based in Keene, New Hampshire.

That cooperative effort across state lines, which has spurred other conversations among the counties, was lauded repeatedly at Friday’s event. “What I’ve seen that’s inspiring to me is the all-in approach that folks in the region are taking,” Welch said.



U.S. Deputy Assistant Secretary of Commerce for Economic Development and Chief Operating Officer for the Economic Development Administration Matt Erskine talks with Vermont Senator Patrick Leahy before a press conference in Brattleboro, about lessons learned from the closure of Vermont Yankee Nuclear Power Plant in Vernon, on Friday, Oct. 14, 2016. Kristopher Radder/Reformer Staff

Some of the new report’s key points “are applicable to any locale that will or could lose a major employer,” said Adam Grinold, executive director of Brattleboro Development Credit Corp.

Leahy said he believes the document may have broad applicability for any region struggling with economic recovery. It could apply, he said, to Appalachian communities dealing with a transition away from coal mining and coal-fired plants.

“This is not a Republican or Democratic issue,” Leahy said. “This is a people issue.”

But the report – which was produced with funding from the Economic Development Administration and BDCC – mostly focuses on nuclear decommissioning issues. Those issues have caused uncertainty in this region and beyond.

Experts have said the Vermont Yankee situation is representative of a new wave of nuclear closures. They typically involve “merchant” plants, which are not utility owned and sell power into the wholesale market. And they’ve been marked by a shift toward the lengthy SAFSTOR decommissioning schedule, under which plant cleanup can take 60 years.

Chris Campany, Windham Regional’s executive director, said he recently has fielded decommissioning inquiries from New Jersey, California and Massachusetts, where Entergy has announced plans to close the Pilgrim Nuclear Power Station in 2019.

“I’m getting more questions from other places,” Campany said. With the issuance of the new report, he added, “now I can point them to

something and say, 'take a look at this.'"

Key points from the report include:

• Many of the "lessons learned" preach comprehensive planning – as much of it as possible, and as early as possible.

For example, though Vermont Yankee was always controversial, Windham Regional Commission stayed involved in plant proceedings over the years from a "neutral position so it could promote conversation among all sides," officials wrote.

Also, the report notes that the Windham Region's Comprehensive Economic Development Strategy was developed "with the assumption that VY would, at some point, close."

Though such conversations may be difficult to have when a nuclear plant has not yet been scheduled for closure, they are vitally important, officials say.

• Thorough planning and study should lead, the report says, to an in-depth understanding of a nuclear plant's role in a community.

The report notes the high salaries associated with a nuclear plant: The average Vermont Yankee staffer earned about $105,000 annually, "which is two and a half times greater than the average pay in the region," officials wrote.

They also offer sobering advice about efforts to retain former nuclear workers. Many will be recruited to work and live elsewhere, the report says, and replacing a region's lost wages "will likely require more jobs at a lower wage level."

The report also notes that "there is a need to look beyond employment and income … to also understand the role of employees, spouses and children in the community and civic life." One Vermont Yankee example is the big drop in charitable contributions in the Windham Region since the plant shut down.

• Such studies, however, come at a cost. The report warns that "there is no dedicated funding stream to assist communities with the economic impact mitigation of nuclear plant closures. You'll need to piece together other federal, state and local resources."

In some cases, a local organization simply has to bear the burden. Windham Regional officials write that they've spent "more than $125,000 in staff time on critical decommissioning-related work and regional plan policy advocacy between 2009 and 2016 with no dedicated funding source."

"That's other work we're not able to spend time on," Campany said.

In addition to those main themes, the report offers other bits of information and advice including the importance of citizens' advisory panels; the probability that a nuclear site will remain off-limits for redevelopment for many years; and the sharp drop in workforce associated with the slower SAFSTOR method of decommissioning.

Additionally, officials exhort nuclear host communities to "please get involved" in federal decommissioning rule-making. The Nuclear Regulatory Commission is in the midst of that process, and Vermont's congressional delegation has been among those weighing in, pushing for more state and local involvement.

At Friday's gathering, Welch reiterated that "we have got to make certain that the (decommissioning) procedures that are enacted … absolutely, fundamentally include the local community."

Filed Under: Energy
Tagged With: Entergy, Patrick Leahy, Peter Welch, Vermont Yankee, Windham County

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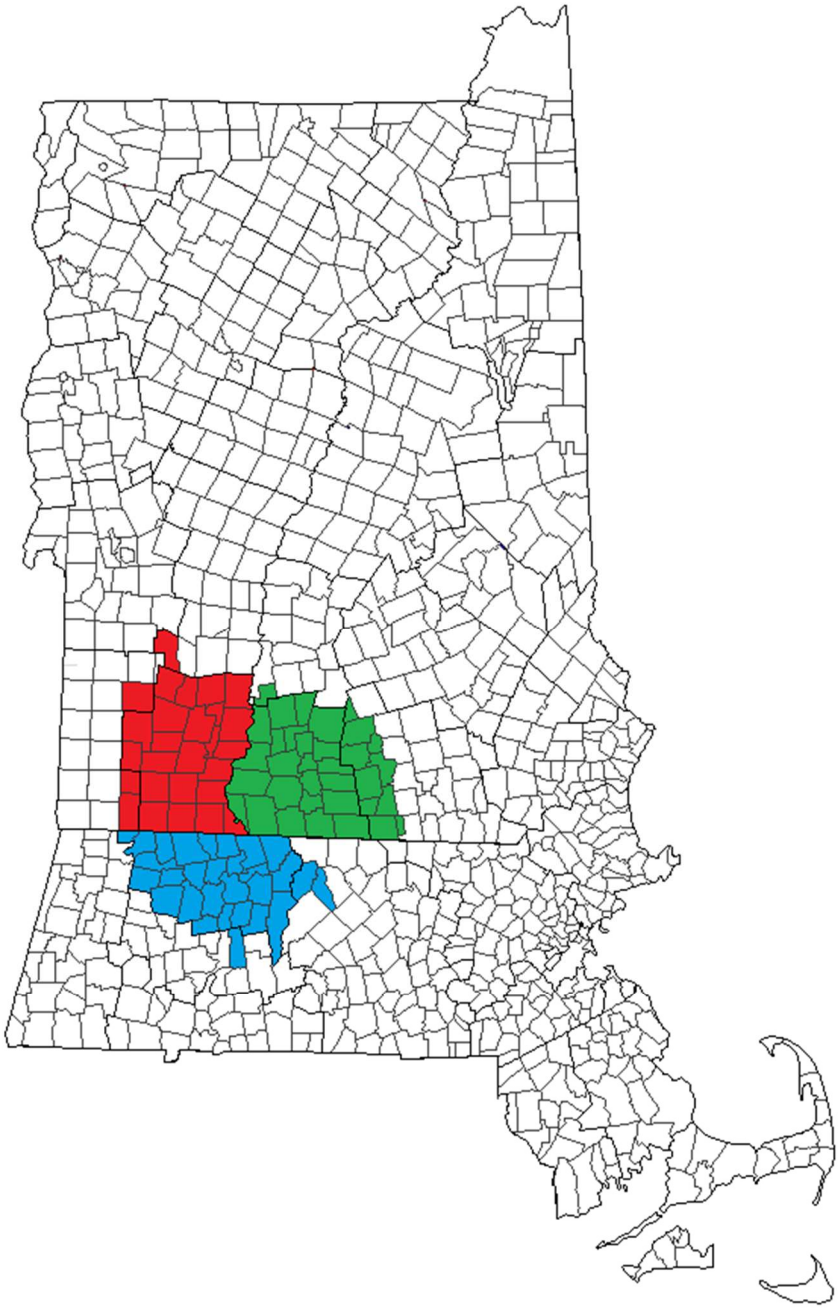
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When People and Money Leave (and the Plant Stays) – Lessons Learned from the Closure of the Vermont Yankee Power Station: A Tri-Region Experience

Presented Oct 14, 2016 in Brattleboro, Vermont



Attributions:

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When People and Money Leave (and the Plant Stays) – Lessons Learned from the Closure of the Vermont Yankee Power Station: A Tri-Region Experience

Introduction

This is a summary of the "lessons learned" by the Tri-State Region team comprised of the Franklin Regional Council of Governments in Massachusetts, the Southwest Region Planning Commission in New Hampshire, and the Windham Regional Commission and Brattleboro Development Credit Corporation in Vermont in the wake of the closure of the Vermont Yankee (VY) Nuclear Power Station located in Vernon, Vermont. The Windham Region is host to the nuclear power station itself, while together the Tri-State Region area is home to the vast majority of those employed by the plant and where the loss of VY employees, employee income, as well as indirect and induced job loss, will be most acutely experienced.

We hope our experience will empower the reader to better know:

1. The types of questions you'll have and want to ask.
2. The kinds of information you'll want to gather or develop.
3. Things to keep in mind when organizing to act.

While the discussion here relates specifically to the closure of a nuclear power station in a rural area, the lessons learned are applicable to any locale that will or could lose 1) a major employer; 2) a major source of local earned income; 3) a major contributor to the local tax base; and 4) a major contributor to charitable organizations in terms of both funding and volunteer time. There are also lessons to be learned about a major employer whose site and physical plant present land use and orderly redevelopment questions including plant decommissioning, site restoration, the presence of hazardous materials, and complex regulatory frameworks.

We note that the perspectives shared and story told here are those of the Tri-State Region team of regional organizations. This is not the story of the individual towns or states and their experiences. We respect that their perspectives on our work, and the situation as a whole, may differ from ours and we encourage them to share their stories so other towns and states might learn from them.

Background and Context



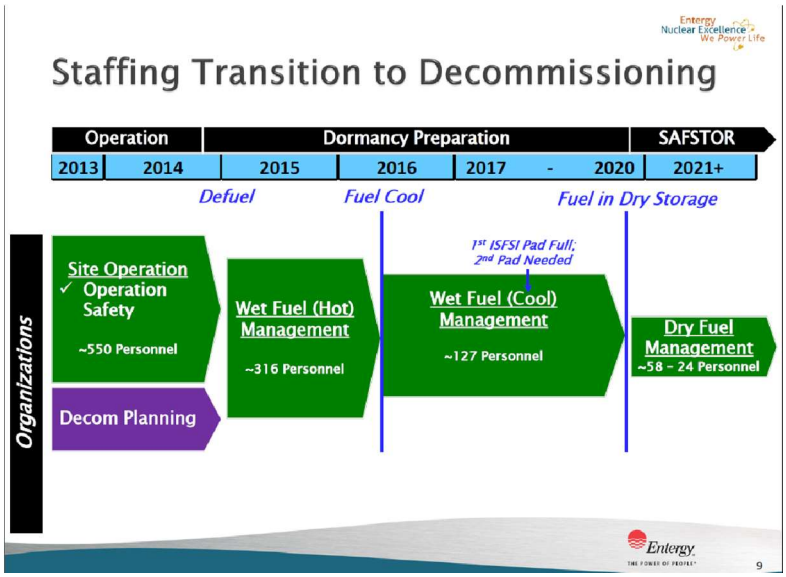
The Vermont Yankee (VY) Nuclear Power Station is located on the Connecticut River in the Town of Vernon in the extreme southeast corner of the State of Vermont. The power station site is approximately 125 acres in size. Vernon is bordered by Franklin County, Massachusetts to the south and by Cheshire County, New Hampshire along and across the Connecticut River to the east.

The boiling water reactor became operational in 1972 and was owned and operated by the Vermont Yankee Nuclear Power Corporation, which was a public utility. It was originally constructed to produce 500 megawatts of electricity, but was later uprated to produce 620 megawatts. In 2002 the plant was purchased by Entergy Nuclear Vermont Yankee, thereby becoming a merchant plant rather than a public utility. Merchant plants are funded by private investors and sell power into a wholesale electricity market rather than directly to retail customers. In August, 2013 Entergy Nuclear Operations announced it would cease operations and close VY during the fourth quarter of 2014 due to economic factors and filed a letter with the Nuclear Regulatory Commission (NRC) on September 23, 2013 stating its intention to permanently cease power operations. It filed its Post Shutdown Decommissioning Activities Report, its decommissioning activities plan, with the NRC on December 14, 2014 and ceased operation fifteen days later on December 29th.

VY reported in December 2011 that it had 623 employees, with 167 of those residing in Massachusetts, 210 in New Hampshire, and 238 in Vermont. Eight employees lived elsewhere. The majority of employees resided in the three adjoining counties of Windham County, Vermont, Cheshire County, New Hampshire, and Franklin County, Massachusetts. These three counties are served by the Windham Regional Commission (WRC), the Southwest Region Planning Commission (SWRPC), and the Franklin Regional Council of Governments (FRCOG) respectively. These regional commissions serve as an essential link between local, state and federal government in the absence of county government. In Vermont, regional development corporations, which may take the lead on regional economic development planning, are separate entities from regional planning commissions. The Brattleboro Development Credit Corporation (BDCC) is the regional development corporation that serves the Windham Region.

We should mention that none of the entities that comprise the Tri-State Region team have any direct fiscal ties to VY as we have no taxation authority. This fact may or may not be relevant to the context of others that do have direct fiscal ties to the plant. Current or future negotiating positions related to property valuation and taxation were never a concern for us, though understanding the plant's post-closure taxation assumptions were important to estimate the potential fiscal impacts to the Town of Vernon. It is our hope that having direct fiscal ties to a facility will not weaken community resolve to understand and plan for resilience in the face of an eventual closure, but we understand anecdotally that these ties may cause some reluctance. If anything, that reluctance should underscore the importance of understanding what the impacts will be and how they can be mitigated.

Impacts Still Unfolding



Since it ceased operation in December, 2014, VY has ramped down its number of personnel from approximately 550 to approximately 125 as of July, 2016. Once spent fuel has been transferred from the spent fuel pool to dry casks, a task which should be complete by 2021, the plant will employ approximately 24 people, most of whom will be security staff. Although closure has occurred and staff reductions have been well underway, the full impacts of the closure on our communities and the local economy have yet to be realized and may not necessarily be easy to quantify or otherwise measure.

Lessons Learned

Early, ongoing, and neutral engagement in state regulatory processes enabled the host region to understand what the impacts would be when the plant would eventually close, for whatever reason that might be, and to develop evidence-based policy positions.

The WRC actively engaged in Vermont Public Service Board[1] (PSB) dockets related to VY, but it did so from a neutral position as to whether or not the plant should continue operation. The context here is important. VY was controversial from the outset, both locally and within the states it bordered. The WRC adopted a neutral position so it could promote conversation among all sides. Importantly, it also meant that while the focus of most parties in PSB dockets was on the continued operation of the plant, the WRC was in the position to ask what happens when the plant ceases to operate. To that end it was able to look at the evidence presented by all parties about the socioeconomic impacts of the plant on the region (employment, income, taxes, charitable contributions, etc.) as well as how the plant owner intended to decommission the plant and restore the site when it did shut down. Based upon this evidence the WRC was able to develop policy positions as to what would be in the region's best interest when the plant eventually ceased operations for whatever reason in order to mitigate the socioeconomic impacts and to restore the plant site to industrial reuse as soon as possible. It also meant the WRC had knowledge of and understood information introduced into the record that described in considerable detail:

- how many people the plant employed,
- in what communities they lived,
- employee average salaries,
- beneficiaries of charitable contributions,
- plant owner assumptions about taxes to be paid post-closure and the basis for value assessment,
- plant owner assumptions about decommissioning, site restoration, and site restoration standards,
- plant owner assumptions about the decommissioning trust and the management thereof, and
- the corporate structure of the plant owner and how that structure related to decommissioning responsibilities, including financial responsibilities.

[1] This is the entity in Vermont that supervises energy utilities. In other states this might be referred to as a public service commission or utility board.

With this foundation of evidence from the formal record the WRC could present to the PSB what conditions of a certificate of public good would be in the best interests of the host region when the plant ceased operation.

The information, knowledge and policy base developed by the WRC over several years and through several dockets enabled it to:

- provide foundational information for a post-VY closure analysis conducted in 2011-12 led by the Brattleboro Development Credit Corporation when there was concern that the state's denial of a certificate of public good would result in the plant's closure regardless of its renewed license by the Nuclear Regulatory Commission (NRC);
- have an established position as to what was in the best socioeconomic and orderly redevelopment interests of the region immediately upon the announcement by Entergy of its intent to close the plant;
- provide detailed information about what communities would be most affected to its counterparts in Massachusetts and New Hampshire, as well as to state and federal elected officials and policymakers;
- present a clear and detailed position and related rationale to state policymakers to establish a clear understanding of what the host region's needs and expectations would be of any negotiations between the state and the plant owner; and establish a clear policy basis for comments on VY's Post Shutdown Decommissioning Activities Report and related Site Assessment, which were submitted to the NRC.

The larger lesson is that any host community should build its knowledge base about the fiscal and socioeconomic role of a major employer in that community and what that employer intends to do if and when it ceases operation.

Nuclear power station host communities may want to meet with plant owners to see what information they might share. They can also research other information such as Decommissioning Cost Estimates, generic environmental impact statements prepared by the NRC, and other public filings with federal and state regulators.

Understand the dynamics of the plant's contribution to the local economy.

Economic impact analyses had been prepared by VY and other parties to Vermont Public Service Board dockets which described in considerable detail the socioeconomic relationships of the plant to the local and state economy and communities. This information helped inform the work

of a Post-Vermont Yankee Working Group led by the Brattleboro Development Credit Corporation which released a study in 2012 about the impacts of a potential VY closure. That study is available here: http://seveds.com/wp-content/uploads/2012/03/PostVY.pdf. These analyses made it clear that the biggest impacts to the economy would result from the loss of the relatively high income of the employees as they departed the area for jobs elsewhere (see below). Upon the announcement that VY would close, the Tri-Region group identified as a priority the need for an independent analysis of what the direct, indirect and induced effects would result from the loss of VY employees and their income. FRCOG was able to fund the UMass Donahue Institute (UMDI) to conduct a study of these effects. That study was released in December, 2014 ahead of the cessation of plant operations and is available here: http://frcog.org/publication/economic-impacts-vy-closure-study/. Both of these studies provided quantitative economic analysis of the effect of closure, which has helped to clearly and realistically plan for the impact.

In our rural area, the greatest impacts will be the out-migration of employees and their families, and the loss of their disproportionately high incomes circulation in the local economy.

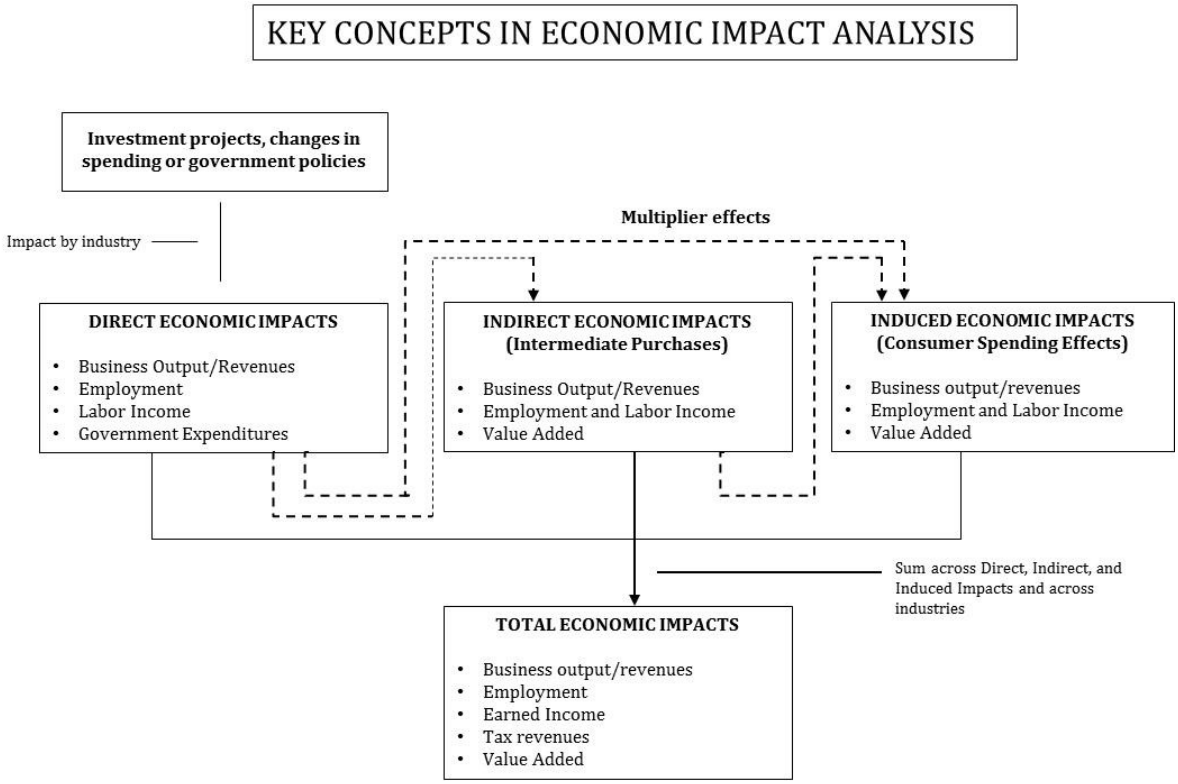
It should be noted that when a nuclear power station closes, many of the employees will be able to find work elsewhere within the nuclear industry if not within the same company. This is not to say that there will not be employment impacts when a plant closes. As noted in the table in the table below the UMDI report, there will be direct, indirect and induced employment impacts. However, unlike the shuttering of a manufacturing facility, mine, distribution center or other large employer where the majority of those being laid off may have limited mobility, many of the professional employees employed by a nuclear plant will be recruited to move

Table 1. The Economic Activity Levels of Vermont Yankee to the Tri-County Region Over Time

	Operational	2015-2016	2017-2020	2021 Plus	2021 Plus (2)
Direct					
Employment	550	318	126	58	24
Labor Income	$82,099,127	$38,564,486	$15,508,264	$2,675,750	$1,100,406
Value Added	$244,286,992	$66,121,377	$26,547,585	$7,849,919	$3,242,067
Output	$402,707,428	$81,769,337	$32,091,293	$10,573,188	$4,328,235
Indirect					
Employment	282	93	37	16	6
Labor Income	$10,425,325	$3,547,281	$1,426,498	$618,522	$246,311
Value Added	$31,131,267	$5,541,555	$2,224,922	$968,233	$386,153
Output	$47,691,302	$10,528,954	$4,227,352	$1,734,171	$692,314
Induced					
Employment	387	165	66	10	4
Labor Income	$14,377,220	$6,106,431	$2,455,631	$361,327	$148,855
Value Added	$26,575,152	$11,297,051	$4,535,741	$667,946	$275,168
Output	$43,008,077	$21,464,397	$8,617,908	$1,081,549	$445,562
Total*					
Employment	1,220	577	229	84	34
Labor Income	$106,901,672	$48,218,198	$19,390,393	$3,655,600	$1,495,572
Value Added	$301,993,411	$82,959,983	$33,308,248	$9,486,099	$3,903,388
Output	$493,406,806	$113,762,689	$44,936,552	$13,388,908	$5,466,111

Source: Results are from simulations run in IMPLAN.
Notes: All economic activity levels shown are annual (e.g., the levels shown in the "2017-2020"column represent the *annual* contributions to the economy that are expected for each individual year during the indicated period; they are *not* multi-year cumulative contributions).
*Total impacts represent the sum of direct, indirect, and induced impacts.

elsewhere. These employees likely earned considerably greater income than their fellow local workers who did not work for the power station. The annual pay of a Vermont Yankee worker was approximately $105,000, which is two and a half times greater than the average pay in the region (about $40,000 in 2010). While VY accounted for only about .7 percent of employment in the Tri-Region area, it accounted for 1.8 percent of the regional payroll. This is described in considerable detail in the aforementioned UMDI study, which used the methodology below:



Don't assume you will have access to plant employees through the employer, or the ability to directly communicate with those employees.

Because of the nature of the work, and the qualifications and clearances required, nuclear power plant workers are in high-demand within the industry. Employees are likely to be offered very significant incentives to stay working at the plant through the closure. They are then likely to be offered similar positions at a different location within the company, or to stay within the industry, but with a different company and at a new location. This is obviously good news for the employee, but the plant owner's interests in retaining its skilled workforce may confound efforts to retain these highly-skilled STEM (science, technology, engineering, mathematics) workers in the area. A region planning to replace the lost jobs should consider planning for more jobs than

those being lost with the plant closure due to the much higher than average wages of plant workers. To replace the lost wages will likely require more jobs at a lower wage level. Workers may also be eligible for Trade Adjustment funding for job retraining through the Department of Labor. These funds often carry a requirement that the training be for jobs paying at least 80% of the wages of the job lost.

The host region has a unique role and responsibility: engagement in decommissioning.

Most of the lessons presented here relate to the Tri-Region's collective understanding of and response to the socioeconomic impacts of the closure of VY. But while the other two regions and the BDCC have an interest in what happens to the plant and the plant site, it is the WRC which has the unique responsibility of engaging in issues related to the decommissioning of the plant, restoration of the plant site, and other land use and orderly redevelopment matters in community advisory and state and federal regulatory forums. This results in capacity issues for the WRC with which its partners do not have to contend. It is much easier to find resources to fund economic development and closure mitigation efforts than it is to find resources to fund activities related to public engagement in closure, decommissioning and site restoration (i.e. orderly redevelopment of the site). We should note, however, that this is the second nuclear plant closure to take place within the Tri-Region area. Yankee Rowe was a pressurized water reactor in Rowe, Massachusetts, which permanently shut down in 1992. Some workers employed at Rowe went on to work at VY. Decommissioning of the plant was completed in 2007. The WRC has benefitted greatly from the experience of FRCOG and through its connections with Massachusetts state agency employees who participated in oversight of the decommissioning. That prior experience has informed questions to ask, expectations of regulatory agencies, and the importance of local engagement in decommissioning.

Understand the role of the plant in the local community and culture, and what the implications of the loss of that employer means.

There is a need to look beyond employment and income and related effects to also understand the role of employees, spouses and children in the community and civic life; financial and in-kind contributions to charitable organizations; and the role of the employer in organizing civic activities (fairs, parades, community picnics, etc.). To what extent was the employer responsible for organizing and convening civic activities that might otherwise be the purview of local civic organizations? To what extent is the employer tied to the way the community identifies itself? Underlying the numbers of employees, spouses and children are relationships. These employees and their families are neighbors, family and friends. They are children in schools, coaches on soccer and baseball fields, volunteers in fire departments, customers in stores, contributors to

causes, and households in neighborhoods. Closure mitigation planning will seek to minimize disruption to these relationships or the effects of the loss of these relationships throughout the social fabric of communities.

Develop a basic understanding of the industry, the financial well-being of the plant within the marketplace and within its family of companies, and any regulatory issues it might be facing.

Fourteen reactor units have been closed at 11 plant sites since October, 2012, and many of these had already obtained 20-year license extensions from the U.S. Nuclear Regulatory Commission (POWER "U.S. Nuclear Plant Closures" June 25, 2016 http://www.powermag.com/u-s-nuclear-power-plant-closures-slideshow/). Regional planning agencies with nuclear power plants in their service region should research the economic performance of these plants relative to other power generators, as well as any regulatory issues that may contribute to a decision to close a reactor prior to the expiration of its license, to understand what the risks of closure might be. It's not too soon to begin discussions with appropriate state agencies and/or legislative delegation now to develop special funding sources for the host region to be actively engaged in decommissioning activities. WRC estimates that they spent more than $125,000 in staff time on critical decommissioning-related work and regional plan policy advocacy between 2009 and 2016 with no dedicated funding source, which has significantly impacted the resources of the organization.

If you have already developed a comprehensive economic development strategy (CEDS), or other economic development plan in which you have confidence, pursue it.

At the risk of stating the obvious, if you have a federally approved economic development strategy in place before the closure, or other well thought out economic development plan, you've already got a path to follow. Ideally, it should contain planning to mitigate the economic and decommissioning impacts expected after the closure. If it doesn't, the economic development plan or strategy should still provide a preliminary foundation for action assuming it reflects other economic development assets to be built upon. While the announcement of a closure may create a greater sense of urgency, it may not necessitate a need for a change in the direction of an established strategy unless that strategy is dependent upon the continued operation and existence of the plant. Economic development strategies should not be overly focused upon one business, industry or sector but should instead focus on the development of a broad economic base. The Windham Region developed its CEDS with the assumption that VY would, at some point, close. This assumption was largely based on myriad possible regulatory decisions, but also knowledge that maintenance issues could impact continued operation decisions. The fortunes of nuclear energy changed dramatically over a very brief period of time (since 2013) when the availability of cheap natural gas made the continued operation of older

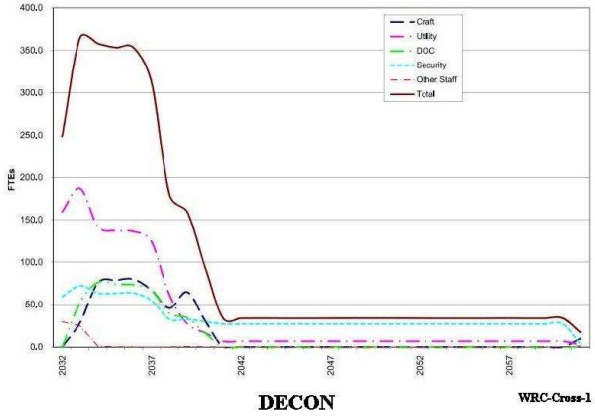
nuclear plants in deregulated power markets economically less-viable. This is within the 5 year update cycle of a CEDS. The energy sector is particularly volatile at this time for a variety of reasons (economic output and energy demand, fuel surpluses, exploration technologies, regulations and incentives, etc.). Would the Windham Region CEDS have assumed the possible closure of VY in the absence of regulatory uncertainty? Perhaps not, but it is our suggestion that communities which host power/fuel stations of any sort consider the place of that facility in the local economy, and how the potential closure of that facility could inform the economic development strategy for the area. The articulation of the closure impacts and the inclusion of mitigation strategies in the Windham CEDS have given us an advantage in reaction time as well as a clear path forward.

Planning for the eventual closure of a plant may be viewed by some, including the employer, as not supporting or otherwise being "against" the employer.

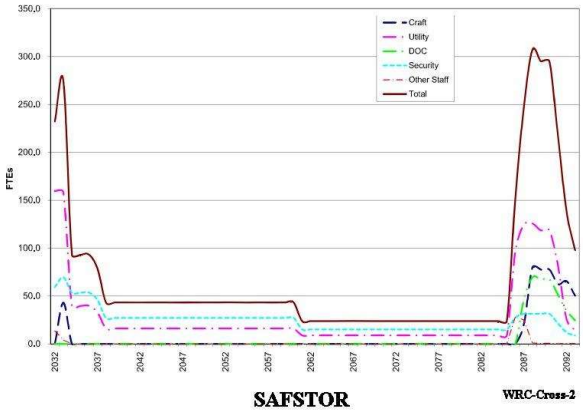
While planning for the eventual closure of a major employer would seem to be a prudent element of economic resilience and impact mitigation planning, what seems objectively rational to the planning and economic development organization may be viewed as a somewhat pessimistic if not hostile act by others. This is most likely to be the case when there is sentiment that the community would be somehow better off without the employer or, more to the point, an organized effort geared towards shutting the employer down. The employer and its supporters may view the effort as being in support of the opposition; that the planning assumes weakness or vulnerability. Conversely, those opposed to the employer may look at the effort to quantify economic impacts from a closure as an attempt to justify or bolster its continued operation and existence. Having an objective conversation about the role of the employer in the economy and what might happen should the employer cease to exist may require trust building, outreach and diplomacy to all sides. In the development of its Windham County Post-Vermont Yankee Economic Mitigation and Growth study, the BDCC was able to convene both supporters and opponents to assess the economic impacts of its closure (http://seveds.com/wp-content/uploads/2012/03/PostVY.pdf).

When it comes to a nuclear plant, how it chooses to decommission will have a major impact on the rate of change.

The graphs below demonstrate changes in employment under two different decommissioning scenarios. These are graphs provided by Entergy Vermont Yankee in a Vermont Public Service Board docket which show the employment profiles under DECON and SAFSTOR. DECON refers to prompt decommissioning while SAFSTOR refers to deferred decommissioning. The NRC allows decommissioning to be deferred up to 60 years.



DECON WRC-Cross-1



SAFSTOR WRC-Cross-2

What the graphs show are assumptions by Entergy that when the station shuts down the workforce would shrink from roughly 620 to about 250 over a 9-12 month period. With SAFSTOR, after a brief ramp up to button up the plant, the workforce would quickly drop further to about 50 people. VY is currently transitioning into SAFSTOR and as was mentioned previously, the number of employees will ramp down to approximately 24 staff, primarily to provide security. With DECON or prompt decommissioning, the station initially employs a larger workforce of approximately 300, which then dissipates more slowly over approximately ten years. Economic impact studies provided by Entergy in the docket suggested that DECON provides a stronger buffer against overall job loss than SAFSTOR.

The more gradual falloff of economic activity associated with DECON offers the region social, economic and fiscal benefits that SAFSTOR does not. Previously, when nuclear power stations operated by public utilities would cease operations, they would go the DECON route as it was less expensive and costs could be passed along to ratepayers. Most of the plants that have closed or have announced their intent to close over the last 4 years are merchant plants, and they are choosing the SAFSTOR option to defer decommissioning until their decommissioning trusts are sufficient to cover the radiological decommissioning costs. Merchant plants do not have the ability to pass on decommissioning costs to ratepayers once they cease operation.

Understand the regulatory context that governs the plant while it is operational and after operations cease.

Who governs the employer? What happens when it ceases operations? What, if any, opportunities do regulators provide for local input into post-closure decision-making. In the case of a nuclear power station, the NRC requires public involvement at specific points in the decommissioning planning process. A public meeting is to be held in the vicinity of the facility after submittal of a post-shutdown decommissioning activities report (PSDAR) to the NRC.

Another public meeting is to be held when the NRC receives the license termination plan (LTP) which could literally be decades after a plant ceases operations. An opportunity for a public hearing is provided prior to issuance of a license amendment approving the LTP or any other license amendment request. In addition, when the NRC holds a meeting with the licensee, members of the public may observe the meeting (except when the discussion involves information that is proprietary, sensitive, safeguarded, or classified). There is no public engagement required beyond these meetings.

The community may want to organize itself to better engage with regulatory authorities at the state and federal levels. When engaging with federal authorities, the local communities may want to explore opportunities for coordination and collaboration with state agencies. Local and state interests may be the same or complementary in many respects but anticipate there will be some differences. In all cases the local communities should communicate their needs and expectations to local, state and federal elected officials and their staffs.

Community Advisory Panels can be very effective, but should operate independent of the plant and should have autonomy from any state entities which it will advise.

The Vermont Nuclear Citizens Advisory Panel was created through a settlement agreement arrived at between the State of Vermont and Entergy Vermont Yankee. It has played an essential role in providing a forum for public engagement in the decommissioning of the VY plant. The panel has allowed for the dissemination of information from all parties involved; allowed the public to express its views and concerns; provided a forum for open and transparent discussion; and has established a working relationship between parties who might not otherwise have worked together. However, it is imperfect. The panel was created to advise the governor, the state legislature and state agencies, but its voting membership includes those it was created to advise. It also has no dedicated funding stream to support its operation. That being said, it remains a good venue for public engagement as well as a means through which the public, stakeholder governments and agencies, and the plant can communicate with one another and work towards areas of common agreement – or agreements to disagree – in an open forum. The panel also includes representatives from the adjoining states, which permits input from other affected communities not in Vermont. The imperfections noted above can be worked out as the panel continues to evolve.

We do suggest that community advisory panels be formed by all communities that host a nuclear power plant, and suggest the formation of such while the plant is still operating and ideally long before a licensee ever announces the intent to cease plant operations. It should, however, operate independent of the plant operators and the state. Our experience has demonstrated

the value of having a panel that certainly includes licensee representatives, but which operates independent of the licensee. And while panels can certainly be organized by states and enabled through state statute, they should function independent of state government. State and local interests often converge, but there must be room for open discussion and divergence. We also suggest that representatives from adjoining regions be given the opportunity to have representation on the panel.

Local entities should have access to their own experts to make sense of information provided by the plant, public agencies, and advocacy organizations.

As might be expected, every party to a discussion will provide its own information and, more likely than not, its own experts. Local economic development and planning entities can be placed at a serious disadvantage as they try to make sense of what is presented. To this end local entities should have resources to access their own experts to process information in a way that allows them to arrive at their own conclusions. Our experience has been marked by the general absence of such resources with the major exceptions being the BDCC's CEDS planning funds and the FRCOG-funded UMDI economic impact study referenced above. The types of discussion that might warrant experts include those dealing with economic impacts and possible impact mitigation funding, site decommissioning and restoration (including spent fuel management and storage, demolition, and high-level nuclear waste disposal), site monitoring (for both radiological and non-radiological contaminants in both soil and water), taxation and assessment, and emergency preparedness and response. And, as stated earlier, advocating in advance for dedicated funding for this type of work is wise as the technical issues to be considered are above and beyond what would normally be expected of a region or community and its capacity to do so.

Support for and opposition to the plant does not go away with its closure.

Positions of opposition to or support for the plant do not evaporate with its closure. If anything positions may harden. Zenia Kotval and John Mullin explore this in their study of the impacts of the closure of Yankee Rowe (https://works.bepress.com/john_mullin/18/). Economic development and planning entities will want to transcend these differences by providing the most objective and defensible information possible and, hopefully, guide the community towards actions that will mitigate or buffer impacts and build up the community and its economic resilience.

There is no national model for economic impact mitigation.

There are currently no consistent models for negotiating financing for the mitigation of the economic impacts of the closure of nuclear power plants. It is important that the host community or region is able to understand and articulate how it will be impacted by using historical data, community input, and impact modeling, and to develop strategies to address those impacts, and to communicate all of the above publicly. It is very important to share that information early and often with the plant, the public and with policymakers, even if they may not be particularly receptive of that information at first. All three audiences will have an equally important role in ensuring balanced economic mitigation and recovery planning.

There is no dedicated funding stream to assist communities with the economic impact mitigation of nuclear plant closures. You'll need to piece together other federal, state and local resources.

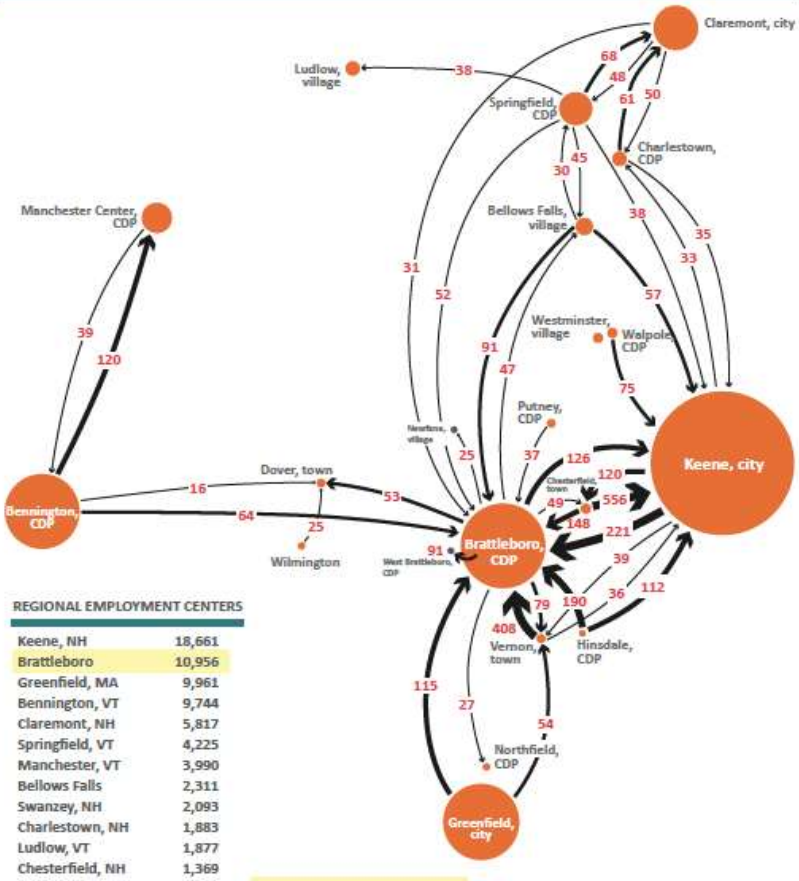
In 2011, the State of Vermont provided seed funding to BDCC to begin to develop strategies to mitigate the economic impacts associated with the closure of the nuclear plant due to the possibility that the plant would not receive approvals from the state to operate beyond 2012.[2] BDCC leveraged those funds to secure additional planning dollars from the U.S. Economic Development Administration which were used to develop the Windham Region's first CEDS**.** The strategies and projects developed in the CEDS were provided to the State of Vermont when they began to negotiate the settlement of several lawsuits and open issues after the closure date was announced. The State of Vermont negotiated $10 million in economic development funding for the region as part of their eventual settlement agreement with Entergy to bring a conclusion to outstanding legal actions. The Governor of the State of Vermont publicly announced he would be the final arbiter in deciding how the funds were spent, meaning the final decision on the use of the funds would not be made within the affected region. Further negotiations between the Administration and the regional organizations settled upon an agreement to fund an additional business development staff person at BDCC and to allow the region to weigh in on funding applications to the state, but the final decision making remains at the state-level. This settlement agreement applies only to the State of Vermont and has no benefit or applicability to the adjacent states impacted by the closure.

Since the announcement of the closure, the Tri-Region team has been fortunate to find support from the U.S. Economic Development Administration (EDA) for immediately acting on implementing established priority projects outlined in the Windham Region CEDS. The EDA

[2] This context may be somewhat unique to Vermont as the state claimed it was not preempted by federal regulations in its ability to approve the continued operation of the plant. Other states may not claim such authority. The state's ability to approve the continued operation of the plant was challenged in federal court.

strongly encouraged Windham Region partners to work to ensure implementation of the priority projects was inclusive of the entire impacted laborshed and that the Tri-Region partners explore

FIGURE 2-28: COMMUTING LINKS BETWEEN THE MAJOR EMPLOYMENT CENTERS IN AND AROUND THE WINDHAM REGION, 2010



REGIONAL EMPLOYMENT CENTERS

Keene, NH	18,661
Brattleboro	10,956
Greenfield, MA	9,961
Bennington, VT	9,744
Claremont, NH	5,817
Springfield, VT	4,225
Manchester, VT	3,990
Bellows Falls	2,311
Swanzey, NH	2,093
Charlestown, NH	1,883
Ludlow, VT	1,877
Chesterfield, NH	1,369
Walpole, NH	1,318
Dover	1,121
Putney	1,073
Vernon	1,056
Wilmington	941
Northfield, MA	901
Westminster, VT	784
Hinsdale, NH	743

opportunities for additional future collaborative ways to mitigate the economic impacts of the closure of VY. The graphic to the left is from the Windham Regional Profile and shows the commuting patterns, and household income connections, among the three regions.

Timing has been important in our ability to fund immediate action as there are presently no federal funds dedicated to mitigating the impacts of nuclear plant closure. There is some evidence that Congressional earmarks had been used by host communities in the past to support mitigation strategies, but the era of earmarks is over. Unless and until a closure mitigation fund is created, economic development planners will need to rely upon existing programs. These include those offered through the U.S. Economic Development Administration, the U.S. Department of Agriculture (Rural Development), and the U.S. Department of Housing and Urban Development (HUD).

There may be a tendency to look for a solution at the plant site.

It is not uncommon for any community to assume that the solution that will help mitigate the impacts of the closure of a major employer and tax generator lies within the site of the business that is closing. This may be a logical approach when the business in question occupies a site and facility that is easily and quickly transferable and adaptable to another use. This is not the case with a nuclear plant. Assume the site will not be available for redevelopment within a time

horizon that will mitigate closure impacts. A possible exception could be a situation where the plant site is extraordinarily large. Precedent indicates that spent fuel storage on the site of the dismantled plant will preclude redevelopment. At a minimum, assume that the site will not be available for redevelopment for a period of at least 10 years after the intent to cease operations is announced. It will take at least this long to complete the dismantlement of the facility. And as was mentioned above, NRC decommissioning rules allow a plant to remain in SAFSTOR for 60 years. There's also the practical reality that the community likely does not own and does not control the site.

There may be a tendency and temptation to look for a single big solution to replace what is lost (e.g., employees, income, tax revenue) that can stymie progress to be had through a series of smaller solutions.

Whether the goal is to replace employees, population, taxes, or all of the above, the community may be inclined to pursue a single big solution that fills the holes left by the closure. This can divert essential energy and effort away from solutions that are more likely to be realized. Particularly in rural areas, the likelihood of replacing the plant with an employer that would hire a similar number of employees at similar wages and which might be assessed at a similar value is low. *This is not to say a community shouldn't have big aspirations.* But it should be conscious of the extent to which it might avoid pursuit of the improbable perfect in lieu of the achievable good. Perhaps a more effective approach is to identify other important economic clusters and find ways to strengthen them. Especially with the closure of a nuclear power plant, it is unlikely that the region will find relevant replacement positions for nuclear scientists and engineers. These employees will probably leave the region and take their incomes and spending with them. Finding ways to enhance and strengthen other clusters can help to stem the loss of dollars from the overall regional economy.

There currently exists no Federal nuclear power plant decommissioning policy, but the NRC is in the process of decommissioning rulemaking. Please get involved!

At present the NRC has rules by which nuclear power stations may decommission, but there is no decommissioning policy. The current process is summarized by the NRC here: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html.Host communities are strongly encouraged to participate in what will likely be a multi-year federal decommissioning rulemaking process. It is essential that federal decommissioning policy take into account and be responsive to the communities that are most directly impacted by nuclear plant closures. Information about the decommissioning rulemaking is available here: https://www.regulations.gov/document?D=NRC-2015-0070-0001

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 28, 2016

MEMORANDUM TO: William M. Dean, Director
Office of Nuclear Reactor Regulation

Marc L. Dapas, Director
Office of Nuclear Material Safety and Safeguards

FROM: Stephen S. Koenick, Acting Chief,
Plant Licensing IV-2 and Decommissioning
Transition Branch
Office of Nuclear Reactor Regulation

Bruce A. Watson, Chief
Reactor Decommissioning Branch
Division of Decommissioning, Uranium Recovery and
Waste Programs
Office of Nuclear Material Safety and Safeguards

SUBJECT: TRANSITION TO DECOMMISSIONING LESSONS LEARNED REPORT

The purpose of this report is to document the U.S. Nuclear Regulatory Commission (NRC) staff's lessons learned associated with recent permanent reactor shutdowns during the period of 2013-2016. In particular, the staff's lessons learned focuses on the transition from reactor operations to decommissioning for the following nuclear power plants: Kewaunee Power Station; Crystal River Unit 3 Nuclear Generating Plant; San Onofre Nuclear Generating Station, Units 2 and 3; and Vermont Yankee Nuclear Power Station (VY). The NRC staff completed reviewing the licensing requests for these plants to modify the operating reactors' licensing bases to reflect those of decommissioning reactors, and transferred the project management and oversight responsibility from the Office of Nuclear Reactor Regulation (NRR) to the Office of Nuclear Material Safety and Safeguards (NMSS). With the transfer of VY on February 1, 2016, regulatory oversight of all four sites was transferred to NMSS.

The report provides a number of best practices that have been or are being implemented during the activities surrounding the nuclear power plants that plan to permanently shut down. Additionally the report contains recommendations to further enhance the staff's ability to perform its licensing and oversight functions for these plants during their transition from operations to decommissioning.

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NRR was the lead organization for the project management and licensing actions associated with the plants that were transitioning to decommissioning. NMSS was the lead for the public meetings and communications with the public, congressional and media inquiries.

Both offices, were supported by the Office of Nuclear Security and Incident Response, Office of the General Counsel, Office of Congressional Affairs, Office of Public Affairs, and the regional offices. In addition, NMSS and NRR worked with the regional offices to transition the inspection programs from the reactor oversight program to the decommissioning reactor inspection programs as the plants permanently shutdown and entered into decommissioning.

This report fulfills an objective of the interoffice Reactor Decommissioning Transition Working Group to report to management on the lessons learned for the transition period up to, and including, the transfer of project management responsibility from NRR to NMSS. Furthermore, with the publication of the report, the activities of the working group are complete.

Enclosure:
Power Reactor Transition from Operations to
Decommissioning Lessons Learned Report

cc: B. Holian, NSIR
D. Dorman, Region I
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C. Pederson, Region III
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cc: Distribution via Listserv

Power Reactor Transition From Operations to Decommissioning Lessons Learned Report

ML16085A029

Enclosure

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

POWER REACTOR TRANSITION FROM OPERATIONS TO DECOMMISSIONING

LESSONS LEARNED REPORT

October 2016

ML16085A029

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EXECUTIVE SUMMARY

The purpose of this report is to document the U.S. Nuclear Regulatory Commission (NRC) staff's lessons learned associated with recent permanent power reactor shutdowns during the period of 2013–2016. In particular, the staff's lessons learned focus on the transition from reactor operations to decommissioning for the following nuclear power plants: Kewaunee Power Station (KPS); Crystal River Unit 3 Nuclear Generating Plant (CR-3); San Onofre Nuclear Generating Station (SONGS), Units 2 and 3; and Vermont Yankee Nuclear Power Station (VY). The NRC staff completed reviewing the licensing requests for these plants to modify the operating reactors' licensing bases to reflect those of decommissioning reactors, then transferred the project management and oversight responsibility from the Office of Nuclear Reactor Regulation (NRR) to the Office of Nuclear Material Safety and Safeguards (NMSS). With the transfer of VY on February 1, 2016, regulatory oversight of all four sites was transferred to NMSS. NMSS will continue to provide the project management support for these decommissioning reactors until termination of the respective licenses. The report also provides a number of best practices that have been or are being implemented during the activities surrounding the nuclear power plants that plan to permanently shut down.

This report fulfills an objective of the Decommissioning Transition Working Group (DTWG) to capture the lessons learned for the transition period up to, and including, the transfer of project management responsibility to NMSS. NRR was the lead organization for the project management and licensing actions associated with the plants that were transitioning to decommissioning. NMSS was the lead for public meetings, communications with the public, and congressional and media inquiries. Both offices were supported by the Office of Nuclear Security and Incident Response (NSIR), Office of the General Counsel (OGC), Office of Congressional Affairs (OCA), Office of Public Affairs (OPA), and the regional offices. In addition, the NRC regional offices supported the transition from the operating Reactor Oversight Process to the decommissioning reactor inspection programs as the plants permanently shut down and entered into decommissioning.

The following highlights some of the challenges experienced by the NRC staff during the decommissioning transition licensing reviews from 2013 to 2016:

- The unexpected shutdown of these reactors prior to the expiration of their operating licenses limited the NRC staff's ability to plan and, consequently, required resources to be reallocated to support the processing of licensing requests to support the transition to decommissioning.
- Given the 15-year interval since conducting the prior decommissioning transition reviews (e.g., Zion Nuclear Power Station, Units 1 and 2 were permanently shut down on February 21, 1997 and September 19, 1996, respectively), the NRC and the licensees both experienced steep learning curves, which constrained the effective processing of the decommissioning transition-related licensing actions.
- Reviews were further challenged because of the limited availability of guidance for processing decommissioning transition licensing actions.

During the processing of the decommissioning transition licensing actions, the NRC staff took numerous actions to address these challenges, including:

- NRR utilized a centralized project management approach under one branch with a focused group of project managers to facilitate consistent licensing reviews for those plants that were transitioning to decommissioning. Furthermore, NMSS concurred on all of the decommissioning transition licensing reviews to help ensure knowledge transfer, consistency, and regulatory effectiveness.

- The NRC established the DTWG to identify and resolve complex technical and policy issues and to serve as a communications platform for the ongoing activities. The DTWG coordinated the efforts of NRR, NMSS, NSIR, OGC, OPA, and the regional offices. This has resulted in improved process controls, timely communications, interim staff guidance documents for emergency preparedness and security, and a more integrated approach to managing and reviewing proposed licensee actions and submissions, as well as addressing oversight issues identified during the course of inspection activities in a timely manner.

- The NRC staff has encouraged, and will continue to encourage, licensees to communicate and coordinate with the NRC staff early in the process regarding:

    - Their planned submittal dates—including submittals in advance of formal cessation of operation—and requested approval dates to support the licensees' established schedules of decommissioning activities. The NRC staff has already had several meetings with the licensees that have announced their intention to shut down before their license ends.

    - The use of regulatory precedent. Efficiency gains have already been realized in the reviews of the Certified Fuel Handler Training and Retraining programs for three Exelon plants that have announced their intention to permanently shut down.

Some additional challenges were addressed as follows:

- External stakeholders expressed significant interest in the NRC staff review of the decommissioning transition licensing activities, especially those associated with SONGS Units 2 and 3 and VY, as represented by media coverage, requests for public hearings and meetings, and questions to the NRC staff. As a result, the NRC staff developed communication plans and communication one-pagers in advance of, or concurrent with, the issuance of most of the licensing actions to timely and effectively inform internal stakeholders of significant actions and to prepare OPA and OCA for inquiries from external stakeholders. These communication plans and communication one-pagers were extremely helpful for SONGS and VY licensing actions.

- Both the operating and decommissioning inspection programs guidance for the oversight of plants as they transitioned from operating to permanently shut down required substantive revisions as the programs were not fully maintained and updated as

changes were made in the regulatory and oversight framework over the years. As a result, the NRC staff revised its inspection procedures to ensure appropriate oversight is maintained at sites whose licensees have announced their intention, and are preparing, to transition to a permanently shutdown condition.

In addition to the lessons learned and best practices discussed above, the report provides detailed project management guidance, lessons learned, recommendations, and documentation of precedent related to the reviews and evaluations specific to the types of licensing actions that are expected to be processed during the decommissioning transition period, including oversight activities and communications. Many of the lessons learned and recommendations described in this report will be considered by the NRC staff for inclusion in the ongoing decommissioning rulemaking (as discussed in the advance notice of proposed rulemaking published in the *Federal Register* on November 19, 2015, at 80 FR 72358). Until the rulemaking is completed, the recently issued exemptions, amendments, and other licensing actions for decommissioning reactors described in this report will be used by the staff to inform its reviews of future decommissioning transition licensing actions.

ACRONYMS AND ABBREVIATIONS

ADAMS	Agencywide Documents Access and Management System
ADM	Office of Administration
ANPR	advance notice of proposed rulemaking
AV	audiovisual
BC	branch chief
BWR	boiling-water reactor
CAB	Community Advisory Board
CAC	Cost Activity Code
CAP	Community Advisory Panel
CAS	central alarm station
CDA	critical digital asset
CEC	California Energy Commission
CEMP	comprehensive emergency management plan
CFH	certified fuel handler
CFR	*Code of Federal Regulations*
CR-3	Crystal River Unit 3 Nuclear Generating Plant
CSP	cyber security plan
DBA	design-basis accident
DBT	design-basis threat
DCE	decommissioning cost estimate
DECON	decontamination and dismantlement
DEF	Duke Energy Florida, Inc.
DEK	Dominion Energy Kewaunee, Inc.
DLR	Division of License Renewal
DNMS	Division of Nuclear Materials Safety
DOC	Division of the Controller
DORL	Division of Operating Reactor Licensing
DPB	Division of Planning and Budget
DRP	Division of Reactor Projects
DRS	Division of Reactor Safety
DTF	decommissioning trust fund
DTWG	Decommissioning Transition Working Group
DUWP	Division of Decommissioning, Uranium Recovery, and Waste Programs
EA	environmental assessment
EAB	exclusion area boundary
EAL	emergency action level
EIS	environmental impact statement
ENS	emergency notification system
Entergy	Entergy Nuclear Operations, Inc.

ENTOMB	encasement of radioactive contaminants in a structurally long-lived material
EP	emergency preparedness
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPW	U.S. Senate Committee on Environment and Public Works
EPZ	emergency planning zone
ERDS	Emergency Response Data System
ERO	emergency response organization
FAQ	frequently asked question
FEMA	Federal Emergency Management Agency
FFD	fitness for duty
FONSI	finding(s) of no significant impact
FR	*Federal Register*
FRN	*Federal Register* notice
FTE	full-time equivalent
FY	fiscal year
G2G	government to government
GDC	general design criterion/criteria
HOO	headquarters operations officer
HP	health physics
ICM	interim compensatory measure
IFIB	Financial Analysis and International Projects Branch
IFMP	irradiated fuel management program
IMC	Inspection Manual chapter
IMP	Insider Mitigation Program
Indian Point Unit 3	Indian Point Nuclear Generating Unit No. 3
IP	inspection procedure
ISFSI	independent spent fuel storage installation
ISG	interim staff guidance
JAF	James A. FitzPatrick Nuclear Power Plant
KPS	Kewaunee Power Station
kWe	kilowatt(s) electric
LAR	license amendment request
LTP	license termination plan
MCR	main control room
MBDBE	mitigation of beyond-design-basis events

NAM	neutron-absorbing material
NCV	non-cited violation
NEI	Nuclear Energy Institute
NGO	nongovernmental organization
NMSS	Office of Nuclear Material Safety and Safeguards
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSIR	Office of Nuclear Security and Incident Response
OCA	Office of Congressional Affairs
OCFO	Office of the Chief Financial Officer
OGC	Office of the General Counsel
OI	office instruction
OPA	Office of Public Affairs
Oyster Creek	Oyster Creek Nuclear Generating Station
P&P	Policy and Procedure
PAA	Price-Anderson Act
PAG	protective action guideline
PDEP	Permanently Defueled Emergency Plan
PDTS	permanently defueled technical specification
PM	project manager
PMDA	Program Management, Policy Development and Analysis
PS	physical security
PSDAR	post-shutdown decommissioning activities report
QA	quality assurance
QFR	Question(s) for the Record
RAI	request for additional information
REP	radiological emergency preparedness
RERB	Environmental Review and Guidance Update Branch
RG	regulatory guide
RIC	Regulatory Information Conference
RIS	regulatory issue summary
ROP	Reactor Oversight Process
RSLO	regional State liaison officer
SAFSTOR	safe storage
SAS	secondary alarm station
SCE	Southern California Edison Company
SE	safety evaluation
SFP	spent fuel pool
SLIV	Severity Level IV
SNM	Special Nuclear Material
SOC	Statement of Considerations
SONGS	San Onofre Nuclear Generating Station

SRI	senior resident inspector
SRM	staff requirements memorandum/memoranda
SRO	senior reactor operator
SSC	structure, system, and component
SSEP	safety, security, and emergency preparedness
TAC	Task Assignment Control
TOP	training, outreach, and planning
TS	technical specifications
UFSAR	updated final safety analysis report
VY	Vermont Yankee Nuclear Power Station

1.0 INTRODUCTION

Background

In 1988, the U.S. Nuclear Regulatory Commission (NRC) promulgated the first comprehensive power reactor decommissioning regulations. Those regulations addressed decommissioning planning, timing, funding, and environmental review responsibilities. The NRC revised the power reactor decommissioning regulations in 1996. The revised rule redefined the decommissioning process and required licensees to provide the NRC notification of planned decommissioning activities starting at or about 5 years prior to the projected end of operations.

The primary rules for decommissioning a nuclear power plant are set forth in several NRC regulations such as Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, Subpart E, and 10 CFR 50.75, 50.82, 51.53, and 51.95. In addition, other regulations in 10 CFR Part 50 (10 CFR 50.59, 50.36(c)(6), 50.65, 50.48(f), and 50.54(y)) are explicitly applicable to decommissioning reactors. Some regulations are no longer applicable to decommissioning reactors once they are in a permanently shutdown and defueled condition. However, many operating reactor regulations continue to be applicable to decommissioning reactors. For decommissioning reactors, the types of potential accidents are fewer and risks of radiological releases are reduced when compared to an operating reactor. Therefore, to reflect this reduction in risk, licensees of decommissioning reactors have requested certain amendments to their licenses and certain exemptions from the NRC's regulations for operating plants. These licensing actions, which were processed during the transition from operation to decommissioning, establish the long-term regulatory framework for reactors that have permanently shut down and defueled. The NRC's transition period typically concludes with the transfer of regulatory responsibility from the operating reactor organization, the Office of Nuclear Reactor Regulation (NRR), to the nuclear materials program organization, the Office of Nuclear Material Safety and Safeguards (NMSS).

The primary NRC regulatory guidance for decommissioning transition is provided by:

- Regulatory Guide (RG) 1.184, "Decommissioning of Nuclear Power Reactors," Revision 1, dated October 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13144A840)
- RG 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report," Revision 1, dated June 2013 (ADAMS Accession No. ML13140A038)
- RG 1.202, "Standard Format and Content of Decommissioning Cost Estimate for Nuclear Power Reactors," dated February 2005 (ADAMS Accession No. ML050230008)
- NUREG-1713, "Standard Review Plan for Decommissioning Cost Estimates for Nuclear Power Reactors," dated December 2004 (ADAMS Accession No. ML043510113)

Other documents pertinent to reactor decommissioning include:

- NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors, Supplement 1, Volume 1: Main Report, Appendices A through M," dated November 2002 (ADAMS Accession No. ML023470304)

- NUREG-1628, "Staff Responses to Frequently Asked Questions concerning Decommissioning of Nuclear Power Plants," dated June 2000 (ADAMS Accession No. ML003726190)
- Inspection Manual Chapter (IMC) 2561, "Decommissioning Power Reactor Inspection Program" (ADAMS Accession No. ML031270502)
- IMC 2202, "Security Inspection Program for Decommissioning Nuclear Power Reactors" (not publicly available)
- NRR Office Instruction (OI) COM-101, "NRR Interfaces with NMSS" (ADAMS Accession No. ML022110316, not publicly available)
- NMSS Policy and Procedure 5.1, "Reactor Decommissioning Program Procedures for Interfacing with the Office of Nuclear Reactor Regulation" (ADAMS Accession No. ML16081A172, not publicly available)

Although the 1996 rulemaking improved regulatory efficiency and effectiveness, decommissioning in the late 1990s indicated that additional regulatory enhancements were needed. Experience revealed that a substantial number of amendments and exemptions had to be processed during the first stage of decommissioning when the reactor transitions from operation to a permanently shutdown condition. A decommissioning rulemaking effort was initiated to address the transition issues but was subsequently suspended because of a shift in agency priorities following the terrorist attacks on September 11, 2001, in conjunction with the determination that no additional reactor licensee had announced any intention to decommission a reactor in the foreseeable future.

Between early 2013 and the end of 2014, five power reactors permanently ceased operation (Dominion Energy Kewaunee, Inc.—Kewaunee Power Station (KPS); Duke Energy Florida, Inc.—Crystal River Unit 3 Nuclear Generating Plant (CR-3); Southern California Edison Co. (SCE)—San Onofre Nuclear Generating Station (SONGS), Units 2 and 3; and Entergy Nuclear Operations, Inc. (Entergy)—Vermont Yankee Nuclear Power Station (VY)). These were the first reactors to transition to decommissioning since 1998—an interval of nearly 15 years without a power reactor permanently shutting down. Apart from VY, these recent power reactor shutdowns were unexpected and involved little preplanning. During an approximate 3-year period, over 70 decommissioning-related licensing actions and other regulatory actions were processed for the five transitioned reactors.

Because it had been 15 years since any reactor had entered decommissioning, licensees and NRC staff initially had limited experience in processing the decommissioning transition-related licensing actions. This was exacerbated by the limited preplanning between licensees and the NRC and limited guidance on regulatory bases for many of the licensing activities. From a knowledge management perspective, the licensee and NRC staff were both working on steep learning curves. The NRC staff was further challenged to review and process multiple concurrent licensing action applications in order to meet the licensees' requested completion dates to support the licensees' efficient and effective use of their decommissioning trust funds.

Interim Staff Actions

In response to these challenges, NRC management consolidated decommissioning transition project management activities into one branch in NRR/Division of Operating Reactor Licensing

(DORL), to help ensure consistency, knowledge management, and regulatory effectiveness. The decommissioning licensing actions were also prioritized over routine operating licensing actions. For the more complex licensing actions related to emergency planning and security plan reviews, the NRC staff developed interim staff guidance to document the methodology used by the staff to perform the reviews and to facilitate future reviews.

The NRC management also directed the formation of the interoffice Decommissioning Transition Working Group (DTWG) with principal members at the branch chief and staff level. The Branch Chiefs representing NRR/DORL and NMSS/Division of Decommissioning, Uranium Recovery, and Waste Programs co-chaired the DTWG; NRR has the lead responsibility for the licensing work, and NMSS has the lead responsibility for public meetings and communications with the public, Congress, State and local governments, and nongovernmental organizations. An objective of the DTWG was to identify, prioritize, and resolve challenges, and to foster communications with both internal and external stakeholders. One of the primary objectives of the DTWG was to enhance reactor decommissioning knowledge management by capturing and documenting the NRC staff experience gained during the transition process and to recommend long-term actions to improve the power reactor decommissioning transition process, such as the development of guidance, rulemaking, and changes to policy or procedures. This report fulfills an objective of the DTWG to provide a final report to document the lessons learned from those plants that recently transitioned from operation to decommissioning.

Interim Findings, Summary Conclusions, and Next Steps

Overall, the NRC staff experience confirms that the current exemption and amendment processes for transitioning plants are sufficient to ensure adequate protection of public health and safety and of the environment, and are consistent with the common defense and security. Most of the licensee exemption and amendment requests do not involve safety issues and are based instead on efficiencies gained and the associated reduction of licensee resources required for a plant that is being decommissioned. The reviews of many of the requested licensing actions were informed by precedents established from the NRC staff review and approvals of amendments and exemptions of earlier plants undergoing decommissioning, where appropriate. Furthermore, reviews and processing of licensing actions became more efficient with time, as both the staff and licensees gained experience. The staff, through conducting the licensing reviews and performing its inspection activities, confirmed and concluded that the licensees of these five reactor units safely transitioned the plants from operation to decommissioning.

As of February 1, 2016, all five of the recently permanently shutdown reactors had been transitioned to decommissioning and transferred to NMSS.

The NRC staff recognizes that the continued need for exemptions by licensees transitioning to decommissioning reflects a gap in the regulatory structure. Use of regulatory exemptions has a number of drawbacks when compared to having explicit regulations applicable to decommissioning plants. The exemption approach is not as efficient or predictable, does not provide for public comment, and does not benefit from the thoughtful examination of an appropriate overall regulatory framework for decommissioning plants that a rulemaking would provide. Consequently, the staff has initiated a Commission-directed rulemaking to expand and enhance the reactor decommissioning regulations, with a specific focus on the transition period

from operation to permanently shut down. As documented in SECY-15-0014, "Anticipated Schedule and Estimated Resources for a Power Reactor Decommissioning Rulemaking," dated January 30, 2015 (ADAMS Accession No. ML15082A089), the staff has initiated this proposed rulemaking with the goal of providing the final rulemaking to the Commission for approval in calendar year 2019.

Additional reactor licensees have announced their intent to permanently cease operations in the next few years:

- By letter dated August 25, 2016 (ADAMS Accession No. ML16242A127), the Omaha Public Power District notified the NRC staff that it plans to permanently cease operations at Fort Calhoun Station, Unit 1 on October 24, 2016.
- By letter dated March 16, 2016 (ADAMS Accession No. ML16076A391), Entergy notified the NRC staff that it plans to permanently cease operations at James A. FitzPatrick Nuclear Power Plant on January 27, 2017[1].
- By letter dated June 20, 2016 (ADAMS Accession No. ML16172A137), Exelon Generation Company, LLC (Exelon) notified the NRC staff that it plans to permanently cease operations at Clinton Power Station, Unit 1 by June 1, 2017.
- By letter dated June 20, 2016 (ADAMS Accession No. ML16172A151), Exelon notified the NRC staff that it plans to permanently cease operations at Quad Cities Nuclear Power Station, Units 1 and 2 by June 1, 2018.
- By letter dated November 10, 2015 (ADAMS Accession No. ML15328A053), Entergy notified the NRC that it plans to cease operations at Pilgrim Nuclear Power Station no later than June 1, 2019.
- By letter dated January 7, 2011 (ADAMS Accession No. ML110070507), Exelon notified the NRC staff of its plan to permanently cease operations at Oyster Creek Nuclear Generating Station no later than December 31, 2019.

Based on current economic factors, it is reasonable to assume that additional nuclear power plants might permanently shut down over the next few years. The NRC reactor decommissioning rulemaking, currently in the early stages, could potentially benefit licensees of reactors that will permanently shut down after 2020; however, the NRC staff expects that the benefits of the anticipated regulatory changes will likely not be realized for reactors that shut down before 2020. In the interim, the NRC staff will continue to implement the best practices and address the recommendations contained in this report.

[1] At the time of this report, Exelon was in negotiations with Entergy to transfer ownership of FitzPatrick to Exelon with the intention to continue operation of the reactor.

2.0 SCOPE AND IMPLEMENTATION OF THE REPORT

The NRC staff has produced this lessons learned report to enhance the effectiveness and efficiency of future licensing activities related to the transition from the operating reactor phase to the decommissioning phase.

Decommissioning activities can be divided into three phases: (1) transition from reactor operation to decommissioning; (2) long-term storage, active dismantlement, and decontamination activities; and (3) license termination activities. This report focuses on the NRC regulatory processes for the first phase of decommissioning during the transition from operation to a permanently shutdown and defueled condition.

The main body of the report discusses the core regulatory functions (licensing, oversight, rulemaking) relative to the transition to decommissioning, as well as support functions (e.g., communications). Within each function, the report summarizes the various activities, the most comprehensive being the licensing actions. Key lessons learned and notable recommendations—many of which have already been implemented during this round of reactors that transitioned—are listed in Sections 4 and 5 of the body of the report. Appended to the report are more detailed discussions to assist NRC staff in preparing for and processing future requests for regulatory action by the licensees. The lessons learned and recommendations are provided in the specific topic sections of the appendices. The staff anticipates that the proposed decommissioning rulemaking will address most of the longer term recommendations.

The information provided in this report does not preclude alternate approaches and may be superseded by future changes to NRC policy, regulation, inspection, licensing, or understanding of decommissioning risk.

3.0 DISCUSSION

All operating reactor licensees will eventually cease operation, decommission their reactors, and terminate their 10 CFR Part 50 and other licenses. A licensee may elect to enter into decommissioning at any time before the expiration of the operating license or at the end of the operating license period. However, a licensee may also request to renew its operating license, in which case the licensee would begin the transition to decommissioning at the end of the renewal period.

Recently, the forecasted long-term supply of less-expensive power, together with plant modification, maintenance, and repair costs, have led some reactor licensees to reexamine the economics of nuclear power. As a result, several licensees have opted to permanently shut down their plants earlier than anticipated. Each licensee for these permanently shutdown plants submitted plant-specific exemption requests for those regulations that it believes are no longer applicable to its facility and amendment requests to its licenses that reflect the decommissioning status of its facilities. The preparation and subsequent reviews of these exemption and amendment requests represent a large level of effort for both the licensees and the NRC staff.

Because the early closure of a nuclear facility can happen relatively quickly, it is important that the NRC project managers (PMs) encourage licensees to begin planning for permanent reactor shutdown and decommissioning as early as reasonably practicable. Because all operating reactors will eventually shut down, this preplanning will serve to provide for a smoother transition from reactor operation to decommissioning.

As noted in the introduction, the NRC staff is working on a decommissioning rulemaking with the goal of enhancing the efficiency and effectiveness of the decommissioning transition process. Until that rule is completed, this report should help provide practical guidance to NRC staff in addressing licensing activities associated with operating reactor licensees contemplating or implementing a permanent cessation of operation, permanent removal of all fuel from the reactor vessel, and transition to decommissioning.

3.1 LICENSING

REGULATORY PROCESS FOR POWER REACTOR DECOMMISSIONING TRANSITION

The primary reactor decommissioning requirements are codified in 10 CFR 50.82, "Termination of License." The associated primary decommissioning planning requirements are codified in 10 CFR 50.75, "Reporting and Recordkeeping for Decommissioning Planning." A nuclear power reactor licensee formally begins the decommissioning process when it certifies permanent cessation of operation and permanent removal of fuel from the reactor vessel under 10 CFR 50.82(a)(1). Once these certifications are docketed with the NRC, the 10 CFR Part 50 license no longer authorizes operation of the reactor. Despite this withdrawal of authority to operate, a decommissioning nuclear power plant continues to retain a 10 CFR Part 50 operating license. As such, the decommissioning plant continues to be subject to many of the requirements that apply to plants authorized to operate pursuant to 10 CFR Part 50.

Regulations that are designed to protect the public against reactor operation-related design basis events that include conditions of normal operation, anticipated operational occurrences,

and design-basis accidents (DBAs) are no longer applicable at a permanently shutdown and defueled reactor. For example, certain accident sequences, such as loss-of-coolant accidents and anticipated transient without scram, are no longer relevant to a permanently shutdown and defueled reactor. In addition, some regulations may not be relevant to certain structures, systems, and components (SSCs) since the SSCs are no longer required to be maintained, to operate, or to mitigate certain accidents, events, or transients, whether they are safety-related or security-related. Other regulations, although based on power operation of the plant, may continue to be applicable to the permanently defueled facility until an exemption is granted, such as the need for offsite radiological emergency preparedness (REP) plans under 10 CFR Part 50. Typically, the scope of these requirements can be reduced to those regulations and requirements that primarily pertain to the safe storage of the spent fuel in the spent fuel pool (SFP) as described in the site's final safety analysis report.

Upon a licensee's permanent cessation of reactor operation and permanent removal of fuel from the reactor vessel, the licensee will typically submit a significant number of requests for licensing actions based on the reduced risk profile. Licensees will likely seek amendments to their licenses, as well as exemptions from certain regulatory requirements that they have determined to have no beneficial contribution to safety or security when the reactor is permanently shut down and defueled. Licensees will also use the 10 CFR 50.59, "Changes, tests, and experiments," process and other specific change processes to make additional changes to the plant that do not require NRC approval. Such changes to the decommissioning design-basis analyses, SSCs, and licensee organizations, processes, and procedures would be reflected in the licensee's updated final safety analysis report. Licensees will also be using the provisions (among others) set forth in 10 CFR 50.54(p), and 10 CFR 50.54(q) to change the facility licensing bases.

The timing and implementation for some decommissioning licensing actions are based on an approach that recognizes further reduction in risk after cessation of power operations and removal of fuel from the reactor vessel. These risk reductions can be tied to several factors, including, but not limited to: (1) the radiological source term after cessation of power operations and removal of fuel from the reactor vessel; (2) elapsed time after permanent shutdown; and (3) type of long-term onsite fuel storage. The two areas where these additional risk reductions are considered in the early decommissioning transition process are emergency preparedness (EP) and facility insurance and indemnity. Exemptions in EP and insurance coverage requirements will not be approved until qualifying analyses confirm that there are no DBAs that would require protective actions for the public due to a release of radioactive material with a dose exceeding the U.S. Environmental Protection Agency (EPA) protective action guidelines (PAGs). The qualifying analyses also assess a postulated, very low probability, beyond-design-basis zirconium fire scenario. The analyses show that the decay heat generated by the spent fuel stored in the SFP would not reach the zirconium ignition temperature in less than 10 hours, conservatively assuming no water or air cooling of the fuel. The NRC staff has concluded that if 10 hours were available to initiate mitigative actions or, if needed, to implement offsite protective actions using a comprehensive emergency management plan (CEMP),[2] formal

[2] A CEMP in this context, also referred to as an emergency operations plan (EOP), is addressed in the Federal Emergency Management Agency's (FEMA's) Comprehensive Preparedness Guide (CPG) 101, "Developing and Maintaining Emergency Operations Plans." CPG 101 is the foundation for State, territorial, Tribal, and local EP in the United States. It promotes a common understanding of the fundamentals of risk-informed planning and

offsite radiological emergency plans would not be necessary for permanently defueled nuclear power reactor licensees.

Additional risk reductions will occur when the spent fuel is removed from the SFP into dry cask storage at an independent spent fuel storage installation (ISFSI). Most decommissioning reactors will have an ISFSI licensed under the general license provisions of Subpart K, "General License for Storage of Spent Fuel at Power Reactor Sites," of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste," and the licensees may opt to make changes to their emergency plans and security programs to align with the requirements of 10 CFR Part 72. This lessons learned report does not address licensing actions and changes to the 10 CFR Part 50 regulatory framework more than approximately 2 years after permanent shutdown. Removal of all fuel from the SFP will typically occur well after the initial decommissioning transition process ends and will be part of the long-term project management and regulatory oversight provided by NMSS.

The amount of licensing activity will vary throughout the entire decommissioning process until license termination. However, the largest amount of licensing activity is expected to occur during the transition from operation to decommissioning when the long-term regulatory framework for decommissioning is typically established.

TRANSITION ROADMAP

Based on power reactor decommissioning experience from the 1990s, the NRC staff developed several reference documents that provide a general roadmap of the regulatory transition process from the operating phase to the decommissioning phase.

- NRR OI COM-101 defines the interactions, licensing program management responsibilities, and support functions for NRC staff regulatory oversight of decommissioning commercial nuclear power plants as project management responsibility transitions from NRR to NMSS. The instructions in COM-101 identify the regulatory milestones that are expected to be requested while project management is still maintained by NRR. Upon completion of the milestones, the licensing and regulatory basis of the facility is more representative of a materials licensee temporarily storing and processing radioactive waste than a commercial nuclear power reactor facility authorized to operate. Once these milestones are achieved, project management oversight and responsibility will be transferred to NMSS.

- NMSS Policy and Procedure 5.1 defines the NMSS responsibility for decommissioning transition and mirrors the requirements in COM-101.

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decisionmaking and helps planners at all levels of government in their efforts to develop and maintain viable, all-hazards, all-threats emergency plans. An EOP is flexible enough for use in all emergencies. It describes how people and property will be protected; details who is responsible for carrying out specific actions; identifies the personnel, equipment, facilities, supplies and other resources available; and outlines how all actions will be coordinated. A CEMP is often referred to as a synonym for "all hazards planning."

- NSIR/DPR-ISG-02, "Emergency Planning Exemption Requests for Decommissioning Nuclear Power Plants." This interim staff guidance (ISG) provides guidance to NRC staff for conducting the technical review of requests for exemptions from the EP requirements for nuclear power reactors based on the projected or actual permanently shutdown and defueled condition of the facility. The ISG also provides guidance for the staff's review of associated changes to the licensee's emergency plan for a permanently shutdown and defueled reactor that reflects the as-granted EP exemptions.

- NSIR/DSP-ISG-03, "Review of Security Exemptions/License Amendment Requests for Decommissioning Nuclear Power Plants." The purpose of this ISG is to provide guidance to NRC staff on conducting technical reviews and safety evaluations of a licensee's requests for license amendments, alternative measures, and requests for exemption from security regulations for nuclear power plants that are undergoing the process of decommissioning.

The licensing activities a PM can anticipate during the decommissioning transition phase are generally grouped into the following main categories:

Decommissioning Planning	Post-shutdown decommissioning activities report (PSDAR) and related site-specific decommissioning cost estimate (DCE)
Operations Staff Qualifications	Certified fuel handler (CFH) training and retraining program, under which nonlicensed operators can qualify as a CFH and any necessary technical specification (TS) amendments to utilize CFHs in lieu of licensed operators at decommissioning reactors
Financial	Decommissioning trust fund (DTF) and offsite/onsite insurance
Emergency Preparedness	Regulatory exemptions and amendments to the emergency plan and emergency action level (EAL) scheme
TS	Defueled TS amendments
Security Related	Site-specific security plan changes and exemptions
License Conditions	Amendments to align conditions in the reactor operating license to a decommissioning facility
Order Rescissions	Requests to rescind various security or Fukushima-related orders

A more detailed listing of the expected decommissioning licensing activities is provided in Table 3-1 below. The order of the actions does not necessarily reflect the order that the licensee may submit its requests. With sufficient preplanning, many licensing actions can be submitted to the NRC prior to permanent shut down (see items marked with asterisk).

The appendix to this report provides additional discussions of specific topical areas encountered during the processing of the decommissioning licensing actions that were subject to regulatory evaluation issues, lessons learned efficiencies, or other NRC staff consideration. Most of the information provided in the appendix will contribute to the staff's decommissioning transition process knowledge management and knowledge transfer until a reactor decommissioning rulemaking is completed. Note that some areas addressed in the appendix (e.g., fitness for duty or aging management) present staff positions during decommissioning reviews but were not directly related to specific licensee-requested actions.

Table 3-1 Expected Decommissioning Transition Licensing Activities

Licensing and Regulatory Actions	Exemption	Amendment	Other Actions	NRC Approval Required	NRC Assessment Only
5 years prior to license expiration (or 2 years after permanent shutdown, whichever occurs first) -- irradiated fuel management program (IFMP) 10 CFR 50.54(bb) IFMP			X	X	
5 years prior to projected end of plant operation -- Preliminary DCE 10 CFR 50.75(f)(3)			X		X
Licensee communication regarding possibility of shutdown			X		
Licensee public announcement of permanent shutdown			X		
Public meeting with licensee on decommissioning planning			X		
Certification of permanent shutdown 10 CFR 50.82(a)(1)(i)			X		
Certification of permanent fuel removal 10 CFR 50.82(a)(1)(ii)			X		
Public information meeting on decommissioning transition			X		
Annual fee reclassification 10 CFR 171.15(c)(1)			X		

Licensing and Regulatory Actions	Exemption	Amendment	Other Actions	NRC Approval Required	NRC Assessment Only
PSDAR *					
PSDAR public meeting 10 CFR 50.82			X		
PSDAR meeting summary with transcripts			X		
PSDAR assessment closeout letter			X		X
Site-specific cost estimate 10 CFR 50.82(a)(8)(iii)			X		X
Final safety analysis report revision/update to reflect shutdown status 10 CFR 50.71(e)			X		
CFH training and retraining program *			X	X	
TS *					
TS section, "Administrative controls" amendment (CFH and other staffing changes)		X		X	
Amendment to remove irradiated fuel handling-related TSs		X		X	
Defueled TS—comprehensive amendment to all TSs		X		X	
Financial					
Use of DTF for spent fuel management *	X			X	
Insurance indemnity exemption 10 CFR 140.11(a)(4) and 10 CFR 50.54(w)	X			X	
Modifications to parent company guarantee support agreement			X	X	

Licensing and Regulatory Actions	Exemption	Amendment	Other Actions	NRC Approval Required	NRC Assessment Only
EP					
Emergency plan changes in the on-shift and Emergency Response Organization (ERO) staffing based on permanent shutdown and defueled condition of facility *		X		X	
EP exemptions 10 CFR 50.47 and 10 CFR Part 50, Appendix E *	X			X	
Commission approval of EP exemption per SECY-08-0024			X	X	
Permanently defueled emergency plan and associated changes to the EAL scheme implementing EP exemption, as granted*		X		X	
Termination of Emergency Response Data System (ERDS)			X		X
Permanently defueled emergency plan and EAL schemes reflecting removal of all spent fuel from the SFP to an onsite ISFSI (ISFSI only)		X		X	
Security					
Security plan changes 10 CFR 50.54(p) review and acknowledgement letter			X		X
Security plan amendment		X		X	
Site-specific security exemptions* 10 CFR 73.55(p)(i) & p(ii), 10 CFR 73.55(j)(4)(ii), etc.	X			X	
Amendments to license conditions (material possession, fire protection, license renewal, etc.)		X		X	

Licensing and Regulatory Actions	Exemption	Amendment	Other Actions	NRC Approval Required	NRC Assessment Only
Order Rescissions					
Security EA-02-026, EA-06-137			X	X	
Fukushima EA-12-049, EA-12-051, EA-13-109			X	X	
Miscellaneous					
Quality assurance (QA) program 10 CFR Part 50, Appendix B		X		X [a]	
Exemption from certain recordkeeping regulations	X			X	

[a] NRC approval required only if change is a decrease in commitments.
* action that can be submitted to the NRC prior to permanent shutdown

DECOMMISSIONING PLANNING

The following information provides a high-level summary of the licensing actions processed as the reactors recently transitioned to decommissioning. More detailed information on these topical areas is provided in the appendix to this report.

The current 10 CFR Part 50 regulations for reactor decommissioning were designed for plants that were expected to be permanently shut down after their operating licenses expired, as opposed to plants that shut down prematurely. The decommissioning planning process is expected to start 5 years before the end of the license. The first five items in Table 3.1 would typically be performed in the planning period. Regardless of when the plant permanently shuts down, the certification of permanent shutdown and the certification of permanent fuel removal are required to be submitted to the NRC. The PSDAR is also required to be submitted to the NRC and is considered the key communication to the NRC, and the public, on the decommissioning plan for the reactor. To date, no licensee has operated a power reactor to the end of its licensed operating period.

Post-Shutdown Decommissioning Activities Report

The regulation in 10 CFR 50.82(a)(4)(i) requires the licensee, prior to or within 2 years after permanent cessation of operations, to submit a PSDAR to the NRC and to send a copy to the affected States. RG 1.185 provides guidance on the contents of the PSDAR. The PSDAR must contain a description of the planned decommissioning activities, a schedule for the completion of these activities, an estimate of expected costs, and a discussion of the reasons for concluding that the environmental impacts associated with the site-specific decommissioning activities will be bounded by appropriate, previously issued environmental impact statements.

The NRC staff is required to notice the licensee's submission of the PSDAR in the *Federal Register* (FR) and make it available for public comment. In addition, the staff is required to hold

a public meeting in the vicinity of the site. Although the regulations do not require that the NRC staff approve the licensee's PSDAR, the NRC staff does perform a review of the PSDAR's content against the requirements in 10 CFR 50.82(a)(4)(i), and guidance and acceptance criteria in RG 1.202 and NUREG-1713, as they pertain to the estimate of expected costs contained in the PSDAR.

The NRC staff coordinates several activities immediately following submittal of the PSDAR. There is a 90-day waiting period from the date that the licensee's certifications under 10 CFR 50.82(a)(1) and PSDAR have been submitted until the licensee can perform any major decommissioning activities as defined in 10 CFR 50.2, "Definitions." During this period, the NRC staff reviews the contents of the PSDAR to ensure it meets the requirements of 10 CFR 50.82(a)(4)(i), as well as guidance and acceptance criteria in RG 1.202 and NUREG-1713, and holds the public meeting on the PSDAR. If the NRC staff cannot determine whether the PSDAR meets the requirements, they would issue a letter to the licensee with questions related to the specific requirements. The PSDAR closeout letter is then issued as soon as practical following the completion of the staff's review.

See Appendix Section 1.1.1 for additional information.

Irradiated Fuel Management Program

One licensing action related to decommissioning planning is the licensee's submittal of an IFMP for preliminary staff approval as required in 10 CFR 50.54(bb). Specifically, 10 CFR 50.54(bb) requires licensees to submit an IFMP to the NRC for preliminary approval within 2 years following permanent cessation of operation of the reactor or 5 years before expiration of the reactor operating license, whichever occurs first. Licensees have, on occasion, satisfied this requirement by submitting an IFMP together with the preliminary DCE.

The purpose of the IFMP is to provide reasonable assurance that the licensee has a program or strategy to manage and fund the management of irradiated fuel during decommissioning in a manner that is consistent with NRC requirements and that will be timely implemented. In addition to the decommissioned plant submittals, licensees requesting to renew their operating licenses should have also submitted an IFMP within 5 years of the expiration date of the original operating license. While the IFMP may have been previously submitted by a decommissioning licensee and received preliminary approval 5 years before permanent shutdown (or during license renewal), the licensee will have to update the program upon permanent shutdown. As required by 10 CFR 50.82(a)(4)(i), the PSDAR includes a site specific DCE, including the projected cost of managing irradiated fuel. The IFMP may also be used to support an exemption request to permit use of the DTF for irradiated fuel management expenses.

See Appendix Section 1.1.2 for additional information.

Decommissioning Cost Estimate

Another licensing action required to be submitted 5 years prior to the end of projected operation is a "preliminary" DCE pursuant to 10 CFR 50.75(f)(3). The purpose of the preliminary DCE is to provide the NRC with an up-to-date estimate of decommissioning costs and identify major factors that may impact the cost to decommission a facility. In addition, the comparison of this

estimate against the minimum decommissioning trust fund amount required in 10 CFR 50.75(b) and (c) provides reasonable assurance that the licensee's decommissioning trust will have sufficient funding to accomplish radiological decommissioning of the facility. Like the IFMP, there are many examples of the preliminary DCE reviews and evaluations since every licensee that has received a license renewal should have submitted its preliminary DCE within 5 years of the expiration date of the original license, as well as the licensees that have decommissioned their facilities. Guidance in RG 1.202 provides the standard format and content of decommissioning cost estimates for nuclear power reactors.

FINANCIAL

Decommissioning Trust Fund Exemption Requests

The NRC regulations in 10 CFR 50.82 and 10 CFR 50.75 restrict use of the trust funds to legitimate decommissioning activities—removal and decontamination of radioactive materials and license termination activities, but not irradiated fuel management (commonly referred to as spent fuel management)—and require 30 days' notice to the NRC for withdrawals for purposes other than legitimate decommissioning activities. Thus, licensees have requested exemptions to use these funds for spent fuel management and, in some cases, site restoration activities. The exemption will usually request that such withdrawals from the trust be done without prior notification to the NRC.

The NRC staff will review the licensee's DTF, the decommissioning approach and costs in the PSDAR and DCE, and the licensee's updated IFMP, in order to determine whether there is reasonable assurance that adequate funds will be available in the trust to complete decommissioning and license termination as well as perform the requested activities. In previously granted exemptions, the NRC concluded that using a portion of the trust for spent fuel management would not prevent the licensee from completing radiological decontamination and cleanup of the decommissioning reactor site through license termination.

Some licensees have also requested this exemption to support the accelerated transfer of spent fuel from the SFP to dry cask storage.

See Appendix Section 1.2.1 for additional information.

Granting of Exemption from Offsite Liability Insurance Requirements

Most licensees of permanently shutdown reactors will request exemptions from certain requirements in 10 CFR 140.11(a)(4) during the decommissioning transition period. The exemption reduces the required amount of primary offsite liability insurance coverage from $375 million (increasing to $450 million effective January 2017) to $100 million. In addition, the exemption will permit the licensee to remove the facility from participation in the secondary insurance pool. Consistent with precedent, this exemption is based on demonstrating that the spent fuel in the SFP is air coolable (and is similar to the type of beyond design basis zirconium fire accident scenario analyses that are used to assess offsite EP exemptions). Consequently, this exemption would be processed after the site has been granted a reduction in offsite EP.

See Appendix Section 1.2.2 for additional information.

Granting of Exemption from Onsite Property Damage and Cleanup Insurance Requirements

Most licensees of permanently shutdown reactors will request exemptions from certain requirements in 10 CFR 50.54(w)(1) to reduce the required level of onsite property damage insurance from $1.06 billion to $50 million. Consistent with precedent, this exemption is based on demonstrating that the spent fuel in the SFP is air coolable (and is similar to the type of beyond design basis zirconium fire accident scenario analyses that are used to assess offsite EP exemptions). Consequently, this exemption would be processed after the site has been granted a reduction in offsite EP.

See Appendix Section 1.2.2 for additional information.

STAFFING

Approval of Certified Fuel Handler Training and Retraining Program

A nuclear power reactor that has permanently ceased operations and no longer has fuel in the reactor vessel does not require a licensed individual to monitor core conditions. In lieu of licensed operators, decommissioning reactors will utilize a CFH as the senior on-shift operations representative on site. The CFH is a nonlicensed operator position that was formalized as part of a 1996 rulemaking for power reactors that have permanently shut down and transitioned to decommissioning. The CFH will be the on-shift management representative responsible for supervising and directing the monitoring, storage, handling, and cooling of irradiated nuclear fuel, and responding to facility emergencies, in a manner consistent with ensuring adequate protection of the health and safety of the public. The CFH has the requisite knowledge and experience to evaluate plant conditions and make these judgements. As specified in 10 CFR 50.2, the CFH training and retraining program used to qualify a nonlicensed operator as a CFH must be approved by the NRC. As such, the NRC staff will review the CFH training and retraining program to verify that it contains the necessary training elements to provide the nonlicensed operator with the requisite knowledge and experience to qualify as a CFH, and thereby be qualified to make decisions and take actions to protect the health and safety of the public, provide appropriate oversight of decommissioning activities, and respond to plant emergencies.

Besides approval of the CFH training and retraining program, implementation of the CFH staffing position for decommissioning reactors, NRC has approved amendments to the staffing requirements in the Administrative Controls section of the licensee's TSs.

See Appendix Section 1.3.1 for additional information.

CHANGES TO THE LICENSE

Defueled Technical Specifications—Comprehensive Amendment to All Technical Specifications

All of the licensees of recently permanently shutdown reactors have proposed comprehensive amendments to their facilities' TSs to reflect their permanently shutdown and defueled status.

Most of the TSs for an operating power reactor specify modes of applicability that correspond to conditions of operation for the reactor or apply only when fuel is emplaced in the reactor vessel. For a permanently shutdown and defueled reactor, these modes refer to conditions that are no longer possible because the reactor cannot be operated and fuel cannot be placed in the core. In such cases, TSs with modes of applicability can be removed from the license without affecting the safety of the facility. In addition, substantial changes are also made to the Administrative Controls section of the TSs, including changes to facility staff responsibilities, staffing organization, and staffing levels. Some program and reporting requirements only applicable to operating reactors are also deleted or modified.

In addition to decommissioning-related amendments to the operating reactor TS described above, two narrow-in-scope TS license amendments may be requested early in the decommissioning transition process. One involves the use of the certified fuel handler, as discussed above. Another amendment may be needed to support irradiated fuel handling. The irradiated fuel handling amendment would remove the TS limiting conditions of operations related to certain safety-related systems that are typically required for irradiated fuel handling, such as the control room habitability systems, fuel handling building ventilation systems, actuation instrumentation, and supporting safety-related electrical systems.

See Appendix Section 1.4.1 for additional information.

LICENSE CONDITIONS

All 10 CFR Part 50 reactor licenses contain license conditions that the NRC has imposed on licensees whenever it was deemed appropriate and necessary, in accordance with 10 CFR 50.50, "Issuance of Licenses and Construction Permits." When the licensee submits the 10 CFR 50.82 letters asserting that the reactor is permanently shut down and defueled, many of the license conditions are no longer relevant and can be modified or removed from the license.

Section 1 of a facility operating license should not be amended, because it documents the Commission's findings at the time of initial licensing. Some licensees have requested amendments to the license conditions in Section 2 of the reactor's facility operating license; however, since the licensee is not authorized to operate the plant or load fuel in the vessel, many of these license conditions are not relevant—even if left in place. In most circumstances, the Fire Protection Program license condition can be removed because it ensures protections are in place to reach safe shutdown in the event of a fire. The fire protection requirements for decommissioning reactors specified in 10 CFR 50.48 require the licensee to maintain fire protection capabilities for the rest of the plant to address fire events that may have radiological consequences. Removal of the operating reactor fire protection license condition should not impact fire protection at a decommissioning reactor. The license condition related to mitigating strategies for large fires and explosions should remain for the SFP. Based on recent experience with this license condition, licensees have elected to leave the condition unchanged and implement it as appropriate for site-specific conditions. It should be noted that the NRC staff's evaluation of the exemptions related to EP regulations relies heavily on the licensee's prompt implementation of the mitigating strategies license condition for the SFP. For reactors that have received renewed operating licenses, there may be some license conditions that need modification or removal depending on site-specific conditions.

See Appendix Section 1.4.4 for additional information.

EMERGENCY PREPAREDNESS

During the decommissioning transition period, licensees have requested several EP licensing actions, including: an initial post-shutdown amendment to the emergency plan modifying the licensee's on-shift and ERO staffing under the existing regulatory requirements of 10 CFR Part 50; an exemption request for many of the EP regulations; and an amendment approving a permanently defueled emergency plan (PDEP) and EAL scheme implementing the EP regulatory exemptions. The NRC staff will also acknowledge the licensee's termination of the ERDS, if requested. Subsequently, the licensee may also submit a license amendment reflecting a further reduction in ERO staffing under the EP requirements, as exempted, to reflect the transferring of spent fuel from the SFP to an ISFSI.

Changes in the On-Shift and Emergency Response Organization Staffing upon Permanent Shutdown and Defueling

Early in the decommissioning transition period, licensees may request an amendment to their emergency plans to remove certain on-shift and augmented ERO positions, based on the permanently shutdown and defueled condition of the facility, which no longer requires certain positions (e.g., core or thermo-hydraulic engineer) to respond to an event at an operating facility. These on-shift and augmented ERO positions would no longer be necessary after the licensee has certified under 10 CFR 50.82(a)(1) that the reactor has permanently ceased operation and fuel has permanently been removed from the reactor vessel, and the licensee has determined that credible accidents no longer exist that would require these functions. However, adequate on-shift and augmented ERO staffing must be maintained to support the prompt implementation of SFP mitigation strategies and the timely and effective communication and coordination with offsite response organizations in accordance with Federal Emergency Management Agency (FEMA)-approved State and local REP plans.

EP Exemptions and Permanently Defueled Emergency Plan and EAL Scheme Amendment

For some period of time after the licensee permanently ceases reactor operations (normally 15–18 months), FEMA-approved offsite REP plans are required to be maintained under 10 CFR 50.47, "Emergency Plans." This period of time depends on the decay time of spent fuel stored in the SFP, as well as site-specific considerations to meet the EP exemption criteria. The EP exemption can be granted when the NRC staff determines that: (1) a postulated radiological release would not exceed the EPA PAGs at the exclusion area boundary for DBAs applicable to a permanently shutdown and defueled reactor, and (2) sufficient time would exist to take prompt mitigative actions in response to a postulated zirconium fire accident scenario in the SFP and, if warranted, for offsite officials to take offsite protective actions to protect public health and safety using a CEMP. If the EP exemption is granted, the NRC will no longer require a formal determination by FEMA of the adequacy of offsite REP plans.

Permanently shutdown and defueled power reactor licensees will likely request regulatory exemptions from certain standards as set forth in 10 CFR 50.47 and requirements of Appendix E to 10 CFR Part 50, "Emergency Planning and Preparedness for Production and

Utilization Facilities." Decommissioning licensees will submit site-specific analyses supporting requested exemptions from emergency plan regulations, based on the criteria above. The licensee will also submit a corresponding license amendment request (LAR) to revise its emergency plan to implement the exemptions listed above, as part of a PDEP. In conjunction with, or as part of, the PDEP amendment, the licensee will also submit changes to the EAL scheme.

The PDEP, once implemented, would no longer require under 10 CFR 50.47 that State and local authorities maintain formal FEMA-approved, offsite REP plans, including the 10-mile Plume Exposure Pathway and 50-mile Ingestion Pathway emergency planning zones (EPZs), as well as a public alert and notification system. The licensee will continue to maintain an onsite emergency plan and response capabilities, including the notification of local government officials of an emergency declaration. If needed, offsite authorities may implement protective measures for the public using a CEMP (all-hazard) approach. The licensee will continue to notify the NRC and designated offsite agencies following the declaration of an emergency classification and maintain communications and interface responsibilities with offsite response organizations that may be called upon to provide assistance on site in the event of an emergency declaration. Provisions for fire, ambulance, and medical services will continue to be agreed upon via letters of agreement with local entities.

An important consideration in processing the EP licensing actions is the need to prepare a Commission paper requesting approval of the proposed exemptions from the EP regulations in accordance with the staff requirements memorandum (SRM) to SECY-08-0024, "Delegation of Commission Authority to Staff to Approve or Deny Emergency Plan Changes That Represent a Decrease in Effectiveness."

ISFSI-Only Emergency Plan and EAL Scheme Amendment

Based on the projected or actual permanent removal of all spent fuel from the SFP to dry cask storage at an onsite ISFI, a license may submit an LAR requesting further changes to its emergency plan, consistent with the requirements of 10 CFR 73.32(a) and the guidance in SFST-ISG-16, "Emergency Planning."

Termination of the Emergency Response Data System

The ERDS is a direct near real-time electronic data link between the licensee's onsite computer system and the NRC Operations Center that provides for the automated transmission of a limited data set of selected parameters.

Appendix E to 10 CFR Part 50, Section VI, "Emergency Response Data System," details the requirements for ERDS as they apply to operating power reactors. Once a reactor has permanently ceased operation and the licensee has permanently removed fuel from the reactor vessel, the licensee is no longer required to maintain the ERDS data link to the NRC. Therefore, the licensee may remove ERDS from service without prior NRC approval under

10 CFR 50.54(q). The licensee is required under 10 CFR 50.54(q)(5) to retain a record of each change to its emergency plan made without NRC approval for a period of 3 years.

Following notice from the licensee of its intent to terminate the ERDS data link, the NRC staff will issue a letter to the decommissioning reactor licensee acknowledging termination of the ERDS data link. In some cases, the State will have a memorandum of understanding with the NRC on the use of ERDS for monitoring emergency conditions at a reactor site. In this situation, the NRC will issue a letter to the State(s) within the 10-mile EPZ of the site informing them of the licensee's intent to terminate ERDS (see ADAMS Accession No. ML15117A520 as an example).

See Appendix Section 1.5 for additional information on EP licensing actions.

SECURITY

The physical security (PS) requirements of 10 CFR 73.55, "Requirements for Physical Protection of Licensed Activities in Nuclear Power Reactors against Radiological Sabotage," and Appendix B, "General Criteria for Security Personnel," and Appendix C, "Licensee Safeguards Contingency Plans," to 10 CFR Part 73, "Physical Protection of Plants and Materials," continue to apply to a nuclear power reactor after permanent cessation of operations and removal of fuel from the reactor vessel. Currently, there are no explicit regulatory provisions distinguishing PS requirements for a power reactor that has been shut down from those for an operating power reactor. These security requirements are designed to protect against the design-basis threat of radiological sabotage as stated in 10 CFR 73.1.

Licensees have sought NRC approval of exemptions to reduce PS requirements for permanently shutdown reactors because the security-risk profile presented by a decommissioning plant is much less than when it was operating. The PS-related exemptions that were requested by the recent licensees to transition to decommissioning include areas such as severe weather and emergency authority of certified fuel handlers, communications between the central alarm station (CAS) and control room, number of armed responders, requirements for force-on-force (FOF) exercises, and combination of the CAS and secondary alarm station (SAS). Several of these exemptions requested by a decommissioning licensee were site specific and may not have been generically applicable.

Many of the PS program changes at decommissioning reactor sites can be accomplished without NRC approval under the provisions of 10 CFR 50.54(p) provided the licensees demonstrate no reduction in the effectiveness of the PS program. Experience has shown that, although the PS program changes may not require NRC approval, exemption, or a license amendment, significant NRC staff effort will be expended in the review and verification that the security plan remains effective.

See Appendix Section 1.6 for additional information on security-related licensing actions.

ORDER RESCISSIONS

Orders related to the Fukushima Dai-ichi facility accident (EA-12-049, Mitigating Strategies; EA-12-051, Reliable SFP Instrumentation; EA-13-109, Hardened Vents) may be subject to

requests to be rescinded. However, the NRC expects that most licensees will comply with these orders within the next few years and the need for action in this area may be minimal depending on the timing of a licensee's reactor shutdown.

In addition, licensees may request the NRC rescind security-related orders that are no longer applicable to those licensees.

See Appendix Section 1.4.4 for additional information.

MISCELLANEOUS LICENSING ACTIONS

Exemption from Certain Recordkeeping Regulations

Licensees that are transitioning to decommissioning may request exemptions from certain parts of the following recordkeeping requirements that require records to be retained until termination of the license: Appendix B to 10 CFR Part 50, Criterion XVII, "Quality Assurance Records"; 10 CFR 50.59(d)(3); and 10 CFR 50.71(c). Licensees that have previously been granted these exemptions used the justification that, when the associated SSCs are removed from the licensing basis documents, the SSCs will no longer serve any function regulated by the NRC. Therefore, the need to retain the records will be, on a practical basis, eliminated.

The NRC staff has previously determined that the records subject to removal under these exemptions are associated with SSCs that had been important to safety during power operation but are no longer important operationally or capable of causing an event, incident, or condition that would adversely impact public health and safety, as evidenced by their appropriate removal from licensing basis documents. If the SSCs no longer have the potential to cause an event, incident, or other problem that would adversely impact public health and safety, then it is reasonable to conclude that the records associated with these SSCs would not be necessary to assist the NRC in determining compliance and noncompliance, taking action on possible noncompliance, and examining facts following an incident. Therefore, their retention would not serve the underlying purpose of the requirements.

Records associated with SSCs that maintain compliance and protect public health and safety are excluded from exemptions from certain recordkeeping regulations. Examples of these SSCs include those associated with programmatic controls, such as controls pertaining to residual radioactivity, security, QA, and SSCs associated with spent fuel assemblies or the SFP (while assemblies are still in the pool) and ISFSIs (see ADAMS Accession No. ML15344A243).

Approval of Changes to the Licensee's Quality Assurance Program

A reactor licensee transitioning to decommissioning may elect to simplify and revise its current QA program commensurate with the permanently shutdown and defueled condition of the reactor, given the fewer number of SSCs for a decommissioning facility and the fewer number of quality standards that would apply. There are two types of changes: those that do not reduce commitments in the program description as accepted by the NRC and those that do reduce commitments.

- Changes to the QA program that do not reduce commitments must be submitted to the NRC, but do not require prior approval. Such changes include administrative improvements and clarifications; spelling corrections, punctuation or editorial corrections, the use of a QA standard approved by the NRC that is more recent than the QA standard in the licensee's current QA program, the use of a quality assurance alternative or exception approved by a previous NRC safety evaluation (SE), and others. All such changes are described in 10 CFR 50.54(a)(3).

- Changes that do reduce the commitments must be submitted to the NRC and receive approval prior to implementation, in accordance with 10 CFR 50.54(a)(4). Changes to the QA program description are considered accepted by the Commission upon receipt of a letter to this effect from the appropriate reviewing office of the Commission or 60 days after submittal to the Commission, whichever occurs first.

See Appendix Section 1.7 for additional information.

Preplanning of Decommissioning Licensing Actions

If a licensee has sufficient time to preplan its decision to permanently cease operations, many of the licensing actions discussed above can be prepared and requested well in advance of permanent shutdown. By coordinating the submission schedule of these licensing actions with the NRC, significant gains in efficiency can be achieved in the NRC staff review effort and completion of the reviews to support implementation during decommissioning without delays. To facilitate timely staff review, licensees are encouraged to conduct presubmittal meetings with staff.

An example of advance decommissioning licensing action planning is provided in Table 3-2 below. This table shows an example of a decommissioning licensing action submission schedule for a reactor that has several years remaining in its license term. The decommissioning planning provides a window to process most of the licensing actions that will be needed during the decommissioning transition phase. It should be noted that this schedule also includes several ISFSI licensing actions that would be needed once all spent fuel has been removed from the SFP. While the ISFSI licensing actions are not typically processed during the decommissioning transition period, there is no reason why they cannot be processed in advance.

Table 3-2 Example of a Decommissioning Licensing Action Submission Schedule with Several Years Preplanning

Licensing Action Type	Licensing Action Description/Title	Proposed Submittal Date
Other	CFH training and retraining Program	24 months prior to SD*
License Amendment	Submit EP changes to on-shift and augmented ERO staffing based on permanent shutdown and defueled condition of facility	18 months prior to SD
License Amendment	Staffing and training requirement changes to TSs Section 6	18 months prior to SD
Exemptions	Exemptions to certain 10 CFR 50.47 and 10 CFR Part 50, Appendix E, EP requirements	18 months prior to SD
License Amendment	Proposed PDEP and EAL scheme implementing EP exemption, as granted	18 months prior to SD
License Amendment	PDTSs/Bases and revised license conditions	18 months prior to SD
Exemptions	Permit suspension of certain security measures during severe weather conditions	12 months prior to SD
Exemptions	Exemption request(s) from certain security requirements (10 CFR Part 73)	12 months prior to SD
License Amendment	Changes to security plan for permanently defueled facility	12 months prior to SD
Exemptions	Use of the DTF for spent fuel management expenses	12 months prior to SD
Exemptions	Exemption from offsite liability insurance	6 months prior to SD
Exemptions	Exemption from onsite property damage insurance	6 months prior to SD
License Amendment	Deletion of license renewal condition for permanently defueled license	6 months prior to SD
Other	PSDAR and site-specific DCE	3 months prior to SD
	Permanent Shutdown of the Plant	
Exemptions	Maintenance of records	18 months after SD
Other	Changes to Offsite Dose Calculation Manual	18 months after SD

Licensing Action Type	Licensing Action Description/Title	Proposed Submittal Date
License Amendment	Additional changes to Security Plan (supports ISFSI)	18 months after SD
License Amendment	PDEP and EAL scheme reflecting removal of all spent fuel from the SFP to an onsite ISFSI	18 months after SD
License Amendment	Operating license/TS "Clean-up" once all fuel is transferred to ISFSI	18 months after SD

*SD is projected date of permanent shutdown

Use of Precedent

Most licensing actions processed during decommissioning transition are based on precedent. The information in Table 3-3 provides the NRC staff a directory of the SEs and other related evaluations associated with the transition licensing action. Based on lessons learned, the NRC staff is strongly encouraged to review and understand the precedent developed by the staff in these referenced evaluations when assessing any decommissioning transition activities. The NRC staff should share this table with licensees as appropriate.

Table 3-3 Key Licensing Action Evaluations for Future Reference

Licensing and Regulatory Actions	KPS	CR-3	SONGS	VY
5 years prior to license expiration (or 2 years after permanent shutdown, whichever occurs first)—IFMP 10 CFR 50.54(bb)	ML092321079	ML14344A408	ML15182A256	ML15274A379
5 years prior to projected end of plant operation— Preliminary DCE 10 CFR 50.75(f)(3)	ML092321079	ML14344A408	N/A	ML14357A110
Licensee preliminary notification of intention to permanently shut down	ML12312A018	N/A	N/A	ML13273A204
Certification of permanent shutdown (10 CFR 50.82(a)(1)(i))	ML13058A065	ML13056A005	ML131640201	ML15013A426
Certification of permanent fuel removal (10 CFR 50.82(a)(1)(ii))	ML13135A209	ML13056A005	ML13204A304 ML13183A391	ML15013A426
Annual Fee Reclassification 10 CFR 171.15(c)(1))	ML13162A401	N/A	N/A	ML15014A041

Licensing and Regulatory Actions	KPS	CR-3	SONGS	VY
PSDAR submittal *	ML13063A248	ML13343A183	ML14272A121	ML14357A110
PSDAR meeting summary with transcripts	ML13168A570	ML14034A026	ML14352A063	ML15082A327
PSDAR assessment closeout letter	ML15036A528	ML14321A751	ML15204A383	ML15343A210
CFH training and retraining program *	ML14104A046	ML14155A181	ML13268A165	ML14162A209
TSs *				
TS section, "Administrative Controls" amendment (CFH and other staffing changes)	N/A	ML14097A145	ML14183B240	ML14217A072
Amendment to remove irradiated fuel handling-related TSs	ML14111A234	N/A	N/A	ML14304A588
Defueled TS—comprehensive changes to all TSs	ML14237A045	ML15224B286	ML15139A390	ML15117A551
Financial				
Site-specific cost estimate (10 CFR 50.82(a)(8)(iii)) SE input (not publicly available)	ML13135A169	ML14183B636	ML15008A096	ML15085A226
Use of DTE for spent fuel management *	ML13337A287	ML14247A545	ML14101A132	ML15128A219
Insurance and indemnity exemptions				
10 CFR 140.11(a)(4) Offsite Liability Protection	ML15026A522	ML14183B338	N/A	ML16012A144
10 CFR 50.54(w) Onsite Property Cleanup	ML15033A245	ML16020A432	N/A	ML16012A193
Modifications to parent company guarantee, support agreement, lines of credit	ML15294A304	N/A	N/A	ML15097A361 ML15107A074

Licensing and Regulatory Actions	KPS	CR-3	SONGS	VY
EP				
EP changes in the on-shift and augmented ERO * staffing based on the permanent shut down and defueled condition of the facility	N/A	N/A	N/A	ML14346A065
EP exemptions (10 CFR 50.47 and 10 CFR Part 50, Appendix E)	ML14261A223	ML15058A906	ML15082A204	ML15180A054
Commission approval SECY of EP exemption per SECY-08-0024	ML14072A257	ML14219A444	ML14251A554	ML14227A711
PDEP and EAL scheme implementing EP exemption, as granted	ML14279A482	ML15027A209	ML15126A461 (PDEP) ML15105A349 (EAL)	ML15233A166
Termination of ERDS	ML14363A302	ML15040A473	ML15040A428	ML15117A520 ML15274A084
Security				
Security plan changes (10 CFR 50.54(p)) review and acknowledgement letter	ML15247A022	ML15224A539	ML15288A469	ML16008B103
Security plan amendment	N/A	N/A	N/A	N/A

Licensing and Regulatory Actions	KPS	CR-3	SONGS	VY
Site-specific security exemptions, 10 CFR 73.5				
– 10 CFR 73.55(p)(i) & (p)(ii) Severe weather and emergency authority of CFH	ML14176A980	ML14176B078	N/A	ML14266A387
– 10 CFR 73.55(j)(4)(ii) Communications between CAS and control room	ML14217A228	N/A	N/A	N/A
– 10 CFR Part 73, Appendix B, Section VI, C.3, Exemption from licensee-conducted FOF	ML14190B127 (W)	ML14184A019 (W)	N/A	N/A
- Exemption from Minimum Number of Armed Responders	ML14349A416 (W)	N/A	N/A	N/A
– Exemption request to combine CAS and SAS	ML14282A519 (D)	N/A	N/A	N/A
Amendments to license conditions (material possession, fire protection, license renewal, etc.)	ML14008A297 Also see Defueled TS SE	See Defueled TS SE	See Defueled TS SE	See Defueled TS SE
Order rescissions				
Security				
– EA-02-026	ML14154A406		N/A	ML14227A912
– EA-06-137	N/A		N/A	ML14227A912
Fukushima				
– EA-12-049 Modifications to Mitigation Strategies	ML14059A411	ML13212A366	ML14113A572	ML14321A685
– EA-12-051 Reliable SFP Instrumentation	ML14066A204	ML13203A161	ML14111A069	ML14321A696
– EA-13-109 Hardened Vents	N/A	N/A	N/A	ML14055A323
Partial exemption from recordkeeping	N/A	N/A	N/A	ML15344A243
QA program (10 CFR Part 50, Appendix B)	N/A	N/A	ML15191A461	N/A
(W) Indicates requested action withdrawn. (D) Indicates requested action was denied. * Licensing actions can be submitted to the NRC prior to permanent shutdown.				

3.2 INSPECTION AND OVERSIGHT

The Reactor Oversight Process (ROP) for reactors licensed to operate ends and the Decommissioning Power Reactor Inspection Program begins when a licensee provides written certification under 10 CFR 50.82(a)(1) that the reactor has permanently ceased operation and permanently removed fuel from the reactor vessel. Specifically, the NRC transitions from IMC 2515, "Light-Water Reactor Inspection Program—Operations Phase," to IMC 2561, "Decommissioning Power Reactor Inspection Program," following the certification date for the permanent removal of all nuclear fuel from the reactor vessel in accordance with 10 CFR 50.82(a)(1)(ii). When this occurs, NRC oversight responsibilities within the regional offices typically transfer from the Division of Reactor Projects (DRP) to the Division of Nuclear Material Safety (DNMS). Based on the reorganization of NRC Regional responsibilities in 2003[3], inspection oversight for power reactors located in Region II is transferred to Region I once the reactor permanently shuts down and defuels (as was the case for CR-3). The Reactor Decommissioning Inspection Program will remain in place until the license is terminated. NRR and NMSS coordinate with the regional offices on the transfer from IMC 2515 to IMC 2561, including resources and budget issues. The inspection program transfers are generally made within a few months of the permanent defueling. The decommissioning inspection and oversight program consists of core and discretionary inspection activities. The core inspection activities can be found in Appendix A of IMC 2561 and are performed on an annual basis. The non-core inspection activities are listed in Appendix B of IMC 2561 and implemented as needed based on licensee performance or activities being performed.
The NRC oversees decommissioning of nuclear reactors through inspections that emphasize radiological controls, management, procedures compliance, spent fuel pool operations, and the safety review program. Many activities that occur during decommissioning are very routine and occur frequently in operating plants. These include decontamination of surfaces and components, surveys for radioactive contamination, waste packaging and disposal, and other activities. The overall inspection effort at plants being decommissioned is significantly less than at an operating reactor site.
Core inspections include:

- Organization and Management Control;
- Quality Assurance;
- Spent Fuel Wet Storage and Handling;
- Maintenance and Surveillance;
- Radiation Protection;
- Emergency Preparedness;
- Security; and
- Safety Evaluations.

Decommissioning activities are grouped into the following six categories:

1. Post-Operation Transition Phase
2. SAFSTOR, Fuel in the Pool
3. SAFSTOR, No Fuel in the Pool

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[3] NRC Regulatory Issue Summary 2003-15: Consolidation of the Region I and Region II Materials Program (ADAMS Accession No. ML032480409)

4. Actively Decommissioning, Fuel in the Pool
5. Actively Decommissioning, No Fuel in Pool
6. Final Surveys Underway, No Fuel in Pool

Inspection hour estimates are based on decommissioning activities and will vary from site to site. During active decommissioning, NRC inspectors may be at the facility 2 or 3 weeks of the month. During a long-term storage period, they would be present several times a year. Usually only one Resident Inspector will typically remain onsite for a period of 6 to 12 months after the 50.82(a)(1)(ii) certification is submitted. During this period, decommissioning inspections are performed by both the onsite resident inspector and regional inspectors specialized in decommissioning. After the Resident Inspector leaves the site, all inspection activities are completed by regional inspectors.

In general, during the most recent reactors that were transitioning to a decommissioning state, the NRC regional inspectors found that IMC 2561 and the associated Appendix A and B inspection procedure had not been maintained up-to-date with the various regulatory and oversight changes that had occurred since the last set of plants underwent decommissioning. Inspection procedures such as for adverse weather, SFP safety, and fire protection, were either not available or lacked adequate guidance for inspectors. In particular, security and emergency preparedness inspection procedures for a shutdown plant were initially unavailable. As a result NSIR created a series of physical security and EP inspection procedures.

Based on the reorganization of NRC regional responsibilities in 2003, Region I assumes oversight and inspection responsibility for power reactors in NRC Region II that have transitioned to decommissioning. However, there was no guidance in IMC 2561 on how this should be accomplished. Region I coordinated a highly successful and seamless transfer of oversight responsibility, including allegations, enforcement, and emergency response, from Region II to Region I for the first plant from Region II to transition into a decommissioning status.

The Regions also encountered issues with the lack of guidance on how the transition from IMC 2515 to IMC 2561 should be communicated and documented to the licensee and public.

The NRC staff also determined that additional guidance should be added to IMC 2515 to ensure appropriate oversight is maintained at sites whose licensees have announced their intention, and are preparing, to transition to a permanently shutdown condition. A revision to IMC 2515 was issued in February 2016. The revision included new ROP framework guidance (Section 15 and Appendix G) to adjust baseline inspection effort (e.g., hours and samples) when licensees begin the transition to permanent shutdown and decommissioning.

See Appendix Section 2 for additional information regarding the decommissioning reactor inspection and oversight program.

3.3 RULEMAKING

By issuing a power reactor decommissioning rule, the NRC would be able to establish regulations that would maintain safety and security at sites transitioning to decommissioning without the need to grant specific exemptions or license amendments in certain regulatory areas. Specifically, the decommissioning rulemaking would have the following goals:

(1) continue to provide reasonable assurance of adequate protection of the public health and safety and common defense and security at decommissioning power reactor sites, (2) ensure that the requirements for decommissioning power reactors are clear and appropriate, (3) codify those issues that are found to be generically applicable to all decommissioning power reactors and have resulted in the need for similarly worded exemptions or license amendments, and (4) identify, define, and resolve additional areas of concern related to the regulation of decommissioning power reactors.

In the SRM to SECY-14-0066, "Request by Dominion Energy Kewaunee, Inc. for Exemptions from Certain Emergency Planning Requirements," dated August 7, 2014 (ADAMS Accession No. ML14219A366), the Commission directed that the staff should, based on lessons learned from the most recent operating plant closures, report to the Commission its views on the need for an integrated rulemaking for decommissioning and, as appropriate, provide the potential schedule and resources required for completion.

In the SRM to SECY-14-0118, "Request by Duke Energy Florida, Inc., for Exemptions from Certain Emergency Planning Requirements," dated December 30, 2014 (ADAMS Accession No. ML14364A111), the Commission provided further direction to the NRC staff to proceed with rulemaking on reactor decommissioning and set an objective of early 2019 for its completion.

Within this SRM, the Commission directed the staff to address the following:

- issues discussed in SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning," such as the graded approach to EP;
- lessons learned from the plants that have already (or are currently) going through the decommissioning process;
- the advisability of requiring a licensee's PSDAR to be approved by the NRC;
- the appropriateness of maintaining the three existing options (DECON, SAFSTOR, and ENTOMB) for decommissioning and the timeframes associated with those options;
- the appropriate role of State and local governments and nongovernmental stakeholders in the decommissioning process; and
- any other issues deemed relevant by the NRC staff.

In SECY-15-0014, "Anticipated Schedule and Estimated Resources for a Power Reactor Decommissioning Rulemaking," dated January 30, 2015 (ADAMS Accession No. ML14357A177; not publicly available, although a redacted version of SECY-15-0014 is available in ADAMS under Accession No. ML15082A089), the NRC staff committed to proceed with a rulemaking on reactor decommissioning and provided an anticipated schedule and estimate of the resources required for the completion of a decommissioning rulemaking. In SECY-15-0127, "Schedule, Resource Estimates, and Impacts for the Power Reactor Decommissioning Rulemaking," dated October 7, 2015 (ADAMS Accession No. ML15211A095, not publicly available), the staff provided further information to the Commission on resource

estimates and work that will be delayed or deferred in fiscal year (FY) 2016 to enable the staff to make timely progress consistent with Commission direction to have a final rule submitted to the Commission by the end of FY 2019.

On November 19, 2015, the NRC published an advance notice of proposed rulemaking (ANPR) in the *Federal Register* (80 FR 72358) (ADAMS Accession No. ML15334A269) to obtain input from stakeholders on the development of a draft regulatory basis for Regulatory Improvements for Decommissioning Power Reactors rulemaking.

On December 9, 2015, the NRC conducted a public meeting to promote full understanding of the questions contained in this ANPR and facilitate public comment. The meeting summary was issued on January 5, 2016 (ADAMS Accession No. ML15362A099).

Based on numerous requests from the States and other stakeholders, the NRC published a notice in the *Federal Register* on December 28, 2015 (80 FR 80709), that extended the comment period for the ANPR from January 4, 2016, to March 18, 2016, thereby providing the public with a total of 120 days to submit comments on the ANPR.

The NRC received 161 comments representing various members of the public, including private citizens; community advisory panels; citizen advocacy groups; the nuclear industry and associated licensees; local, State, and Federal government agencies; and nongovernmental organizations (NGOs).

The milestones and associated opportunities for public interaction throughout the rulemaking process include the following:

Rulemaking Milestones / Public Interaction

- The ANPR was published on November 19, 2015.
  The public comment period ended on March 18, 2016.

- The Draft Regulatory Basis is estimated to be completed in November 2016 and will be published for public comment.
  A public meeting will be held to discuss the Draft Regulatory Basis.

- The Final Regulatory Basis is estimated to be completed in the fall of 2017.

- The Proposed Rule/Draft Regulatory Guidance is estimated to be completed in the summer of 2018 and will be published for public comment.
  A public meeting will be held to discuss the Proposed Rule/Draft Regulatory Guidance.

- The Final Rule/Final Regulatory Guidance is expected to be provided to the Commission in calendar year 2019.
  An implementation public meeting will be held at an appropriate time.

The NRC recognizes that it will take several years to issue a final rule. When additional reactors begin decommissioning before implementation of the final rule, the NRC anticipates

that licensees will continue to use existing regulatory processes described in this lessons learned report to establish their decommissioning regulatory framework.

3.4 COMMUNICATIONS

Openness is one of the five principles of good regulation. The NRC recognizes the public's interest in the proper regulation of nuclear activities and provides various opportunities for citizens to share their opinions. The NRC seeks to elicit public involvement early in its regulatory processes, including decommissioning, so that members of the public can raise safety concerns for the NRC to consider during its deliberations of regulatory actions.

Public Meeting Requirements

The NRC regulations currently offer the public several opportunities to review and provide comments on licensees' documents during the decommissioning process. Specifically, under the NRC regulations in 10 CFR 50.82, the NRC is required to publish a notice of the receipt of the PSDAR, make the PSDAR available for public comment, schedule a meeting in the vicinity of the location of the licensed facility to discuss the PSDAR, and publish a notice of the meeting in the *Federal Register* and another forum readily accessible to individuals in the vicinity of the site. This meeting typically addresses three areas: (1) the decommissioning regulatory process, (2) the licensee's proposed post-shutdown plans and schedule, and (3) the NRC's continuing oversight throughout the transition and decommissioning phases.

Of note, licensees are prohibited from performing any major decommissioning activities until 90 days after the NRC has received the PSDAR and certifications of permanent cessation of operations and permanent removal of fuel from the reactor vessel, as required under 10 CFR 50.82(a)(1), have been submitted. For licensees that submit their PSDARs after the certifications have been submitted, the 90-day condition is based on the receipt of the PSDAR. In these cases, the public meetings are typically held within 30–60 days of receipt of the PSDAR such that the public can provide comments on the PSDAR prior to the start of major decommissioning activities. As discussed in the licensing section above, coordination with the licensee on the submittal schedule of the PSDAR is necessary to ensure the NRC can conduct the meeting within 30–60 days of receipt.

The other opportunity for public participation is near the end of the decommissioning when the license termination plan (LTP) is submitted for approval. The LTP is submitted to the NRC as a license amendment request pursuant to 10 CFR 50.90, "Application for Amendment of License, Construction Permit, or Early Site Permit." As such, pursuant to 10 CFR 50.91, "Notice for Public Comment; State Consultation," the NRC will provide a notice in the *Federal Register* that the LTP is available for comment and will provide an opportunity for hearing on the request. The NRC staff's review of the LTP will follow the normal license amendment process. In addition, all specific requests to amend the operating license during decommissioning follow the 10 CFR 50.90 amendment process and provide opportunity for public comment and request for hearing.

Stakeholder Involvement

Also, consistent with the NRC's principle of openness, the NRC frequently interacts with interested stakeholders, including both NGOs and local and State government officials, in order to discuss any decommissioning topics that may be of interest to the public, interested stakeholders, and the surrounding community. These interactions include participation at existing community forums, government-to-government meetings, end-of-cycle plant performance meetings, congressional staff briefings, meetings with State and local officials, media boards and press briefings, and correspondence related to nuclear plant decommissioning. These meetings are scheduled and conducted in cooperation with the appropriate organizations (e.g., Office of Congressional Affairs (OCA) for congressional briefings and Office of Public Affairs (OPA) for media interest). A listing of many of the reactor decommissioning stakeholder outreach meetings is provided at the end of Appendix Section 3.

The NRC staff acknowledges the desire for and value of community involvement in the decommissioning of a nuclear power plant. Power plant decommissioning is a complex project, and the NRC believes that the impact of decommissioning and termination of a nuclear power reactor license needs to be communicated to the local community. As an independent regulator, the NRC ensures that all members of the public are given a fair and equal opportunity to comment on a licensee's decommissioning plans, commensurate with the risks involved. Therefore, the NRC does not officially recognize or endorse any specific special interest group, public or private organizations, community groups, coalitions, or individuals. This approach ensures that one or more organizations do not dominate a public forum and allows members of the public to provide alternative and differing viewpoints and comments to the NRC.

While not required, for many years the NRC has strongly recommended that licensees involved in decommissioning activities form a community committee to obtain local citizen views and concerns regarding the decommissioning process and spent fuel storage issues. The NRC has observed that the licensees who actively engage the community maintain better relations with the local citizens. The only NRC requirement to have a site-specific community board is for licensees that are seeking to terminate the license with restricted release.

It is important to note that community interest in reactor decommissioning activities can vary depending on the location and historical relationship between the licensee and State and local governments, labor unions, members of the public, and other stakeholders. The DTWG supported NRC staff development of a strategy that could be employed, when circumstances warrant, for enhancing public awareness and understanding of the activities surrounding the transition to decommissioning for power reactors within the existing regulatory framework. To accomplish these objectives, the staff developed or updated the following communication tools:

- "Communication Strategy for the Enhancement of Public Awareness regarding Power Reactors Transitioning to Decommissioning," dated February 2015 (ADAMS Accession No. ML15013A068). This document outlines the NRC strategy for communicating the key messages regarding the NRC process and practices for public and stakeholder engagement during the decommissioning of nuclear power plants as well as providing a resource for addressing related frequently asked questions (FAQs). This document is supplemented by other communication documents assembled NSIR related to the

exemptions from certain EP requirements requested by the four reactors that recently transition to decommissioning.

- FAQs have been made publicly available online at http://www.nrc.gov/waste/decommissioning.html.

- NMSS collected public questions from the recent transitioning reactors and is completing a revision to NUREG-1628, "Staff Responses to Frequently Asked Questions concerning Decommissioning of Nuclear Power Plants."

- An NRC brochure on decommissioning was updated and is available to the public at http://www.nrc.gov/reading-rm/doc-ollections/nuregs/brochures/br0521/ as well as the NRC backgrounder on decommissioning at http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html. Both of these information sources will also be updated and maintained as appropriate to ensure that decommissioning information available to the public is accurate and readily available.

- Communication one-pagers supporting issuance of regulatory decisions on specific regulatory requests. These one-pagers were developed for most of the decommissioning licensing actions to provide timely information to NRC internal stakeholders of significant actions and to prepare OPA and OCA for inquiries from external stakeholders. The NRC staff recognizes that strong internal communications through the use of one-pagers are an effective means of ensuring internal stakeholders are well informed regarding sometimes complex regulatory requirements and decommissioning activities. These communication one-pages have been collected and captured in ADAMS for future decommissioning transition activities (ADAMS Accession No. ML16082A165, not publicly available).

- Communication plans were developed for certain complex licensing actions to coordinate the public release, provide consistent key messages, and anticipate likely questions. These communication plans have been collected and captured in ADAMS with the communication one-pagers for future decommissioning transition activities (ADAMS Accession No. ML16082A165, not publicly available).

The NRC staff observed that, as part of the NRC's decommissioning communication strategy, communications promoting public awareness have had a positive benefit in the overall decommissioning process. The communication process begins with early engagement with the licensee regarding decommissioning planning and the NRC's advocacy of licensee-sponsored advisory panels, followed by the staff's continued development of communication tools and its ability to proactively interact with members of the public, NGOs, and affected State and local officials.

The NRC staff recognizes that strong internal communications and use of one-pagers and communication plans are effective means of ensuring internal stakeholders are well-informed. In addition, the communication tools enabled the staff to promptly support OPA and OCA in responding to external request for information.

Finally, extensive feedback was received from affected States and NGOs regarding the inability to provide public comment as part of the exemption process. The NRC staff is considering whether to change the current role of States, members of the public, or other stakeholders in the decommissioning process as part of the integrated decommissioning rulemaking effort.

4.0 LESSONS LEARNED

(1) The premature permanent shutdown of a power reactor, without sufficient preplanning, can limit the NRC staff's ability to plan and allocate resources to support the licensees' licensing requests. The decommissioning licensees often requested expedited reviews of its decommissioning licensing actions in an attempt to minimize facility staffing levels and reduce expenditures from the DTFs. Premature unplanned shutdowns also impact other key stakeholders, such as the States, local governments, and communities. Planned early submission of decommissioning transition licensing actions, as demonstrated by VY, can increase the efficiency of the transition process. The NRC completed the transition of the project management function of VY from NRR to NMSS nearly a year earlier than the other recent decommissioning reactors, in part because of VY's submission of several licensing actions while it was still operating.

(2) As experienced with the previous decommissioning reactors in the 1990s, the recent decommissioning reactor licensees submitted a large number of exemption requests and LARs to modify their licensing bases. Commensurate with the reduced risks of decommissioning, over 70 decommissioning-related licensing actions were received and processed by the NRC staff in less than 3 years. Where it is possible, staff with previous decommissioning transition licensing experience should be engaged in the review process for these licensing actions.

(3) Due to the 15-year interval since conducting prior decommissioning transition reviews, a learning curve existed for both the NRC and the licensees to effectively process the decommissioning transition-related licensing actions. Furthermore, limited and, in some cases, outdated guidance was available in processing decommissioning transition licensing actions. For example, NRR OI COM-101 has not been revised since 2002. While it was still generally useful and applicable to the recent reactor decommissioning transitions, it is out-of-date in many areas, including document processing and office structure. In addition, although principal decommissioning regulatory guidance document RG 1.184 was revised in 2013, the experience gained in the recent decommissioning transitions could be used to further improve this guidance document.

(4) The NRC staff has gained considerable experience in evaluating decommissioning EP exemption requests that resulted in the development of NSIR/DPR-ISG-02. For these exemptions, the staff continues to request Commission approval in accordance with the SRM for SECY-08-0024. The staff is considering whether to propose future changes to this process to the Commission to enhance overall efficiency and effectiveness.

(5) Several decommissioning exemption requests were not adequately supported by documentation provided in the licensee's submittal. The NRC staff did not require an acceptance review on the decommissioning actions since the scope of applicability of NRR OI LIC-109, "Acceptance Review Procedures" (ADAMS Accession No. ML091810088), specifically excludes decommissioning reactors. Performing an acceptance review may have led to licensees supplementing their applications or nonacceptances, or both, instead of more requests for additional information. In some cases, the NRC staff expended resources evaluating licensing requests that were ultimately withdrawn.

(6) NMSS has different practices regarding the distribution of documents. NRR uses electronic distribution, while NMSS uses paper. Continuing electronic distribution of documents would provide continuity in reaching the interested public stakeholders within the local vicinity of reactors that are currently preparing to transition to decommissioning.

(7) The resources expended in project management of the decommissioning licensing actions were directly related to external stakeholder interest and involvement in the process. The staff resources expended in addressing stakeholder petitions, State concerns, and Congressional questions related to VY far exceeded similar activities for other decommissioning reactors.

(8) In certain cases, licensees may determine, through an evaluation under the 10 CFR 50.59 process, that plant systems, equipment, or instruments may no longer be required after cessation of operation. However, in the past, some licensees have inappropriately used the 10 CFR 50.59 process in determining whether a reduction in effectiveness in the emergency plan exists without appropriately evaluating the impact on EALs under 10 CFR 50.54(q). While various EALs are linked to operating modes, which may no longer apply to a permanently shutdown and defueled reactor, a licensee should submit a proposed EAL scheme change for prior NRC approval as required under Appendix E to 10 CFR Part 50.

(9) Many NRC staff evaluations are contingent on defined accidents. Typically, the accidents might include fuel handling accidents, cask drop accidents, radioactive release due to a fire, radioactive release due to a radioactive waste storage accident, or other site-specific accidents. These accidents are cited in many of the decommissioning transition licensing actions and are evaluated by the staff to determine the potential for offsite releases in excess of EPA PAG limits. Some of the previous decommissioning reactor transition reviews were not well communicated internally resulting in the same accidents being evaluated multiple times by different reviewers. Better coordination is needed to ensure technical staff reviews are not duplicative or redundant.

5.0 BEST PRACTICES

(1) NRR utilized a centralized project management approach under one branch with a focused set of project managers to facilitate consistent licensing reviews for those plants that were transitioning to decommissioning. NRR plans to continue centralized project management for the recently announced planned decommissioning reactors.

(2) The NRC staff continues the practice of early engagement and encouragement of submission of decommissioning transition licensing actions well ahead of permanent shutdown.

a. Early submission of licensing actions allows for greater schedule margin to critical decommissioning milestones when licensing action processing could delay expected staffing reductions and result in significant unnecessary expenditures from the DTF.

b. Early submission of licensing actions increases the NRC's options and flexibility in scheduling reviewers in parallel with higher priority operating reactor licensing actions.

c. Early submission of licensing actions allows for the use of the licensee's staff resources supporting an operating reactor that are typically not available after the reactor has permanently shut down.

d. When a licensee submits the PSDAR well in advance of permanent shutdown, the NRC staff can conduct its required public meeting and inform public stakeholders on the decommissioning process in a proactive manner that is unconstrained by the 90-day limit. This will also permit licensee access to the DTF for major decommissioning activities following the submittal of the 10 CFR 50.82(a)(1)(ii) certification.

(3) Both licensees and NRC staff are encouraged to consider precedent safety evaluations when preparing and evaluating future decommissioning licensing action requests.

(4) The NRC staff should continue to encourage licensees to engage with local community leaders and sponsor advisory panels to allow for local involvement.

(5) The NRC staff initiated performing acceptance reviews on decommissioning related licensing requests.

(6) The NRC staff issued two ISGs related to EP and security reviews.

(7) The NRC staff revised its inspection procedures to ensure appropriate oversight is maintained at sites whose licensees have announced their intention, and are preparing, to transition to a permanently shutdown condition.

(8) The NRC staff should continue the practice of using communication plans and informal communication one pagers in advance of or concurrent with the issuance of most of the

licensing actions. The use of these internal communications was very effective in informing internal stakeholders of significant events and preparing OPA and OCA for inquiries from external stakeholders. These communication plans and communication one-pagers were extremely helpful for SONGS and VY licensing actions.

6.0 RECOMMENDATIONS

(1) NRR should revise NRR OI COM-101 to reflect the lessons learned and best practices documented in this report.

(2) NMSS should adopt an electronic distribution service for NRC-initiated correspondence for reactors that have been transferred to NMSS for project management responsibility. NMSS management has begun using electronic distribution for the recently transitioned decommissioning reactors. The NRC staff recommends that this policy be formally documented.

(3) The NRR staff should consider performing an acceptance review on all decommissioning licensing actions (both amendments and exemptions) consistent with LIC-109 and formalize this in the next revision of the OI.

(4) The NRC should assess how best to proceed with the update to RG 1.184, "Decommissioning of Nuclear Power Reactors," in coordination with the decommissioning rulemaking effort.

(5) In the SRM to SECY-08-0024, dated May 19, 2008 (ADAMS Accession No. ML081400510), the Commission provided direction that the staff should request Commission approval for any licensing request for an exemption from the EP requirements of 10 CFR 50.47(b) and Appendix E to 10 CFR Part 50. Therefore, each EP exemption request submitted by a decommissioning licensee requires the development and submittal of a Commission paper requesting approval of the proposed EP exemptions. Given the now routine nature of these requests, which are expected to follow the format and content guidance of NSIR/DPR-ISG-02, the NRC staff should consider ways to gain efficiency in this process, such as by requesting that the Commission delegate authority to approve decommissioning EP exemption requests to the Office Director of NRR. If pursued, this delegation would be for decommissioning EP exemptions only and would be contingent on the requested decommissioning EP exemptions being consistent with previous decommissioning EP exemptions and following the guidance of NSIR/DPR-ISG-02. Before proposing such a change, the staff would need to consider Commission precedent on the topic to ensure its recommendation is fully informed and does not revisit previous Commission decisions without an appropriate basis.

(6) The NRC staff should communicate with the licensee, as part of presubmittal discussions, previous issues concerning the abandonment of EP-related equipment and whether the licensee can use the 10 CFR 50.54(q) change process to retire the equipment or will need an amendment to the licensee's emergency plan.

(7) A licensee planning for decommissioning should include a review of active licensing requests and determine whether to request formal withdrawals of these requests. As a courtesy, following an informal notification by the licensee of its intention to withdraw certain active licensing requests, the project manager should contact the NRC staff and request that it stop work.

(8) Other recommendations for the NRC staff to consider include:

a. Develop an inspection procedure (IP) for oversight of aging management of long-lived, passive structures and components (e.g., neutron-absorbing materials, SFP liner) during decommissioning while fuel is in the SFP.

b. Develop a regulatory issue summary or some other type of generic communication that defines permissible decommissioning activities for which expenditures can be withdrawn from the DTF.

c. Encourage industry to submit a decommissioning Technical Specifications Task Force traveler that removes all MODE-related TSs for permanently shutdown and defueled reactors. Such changes should be applicable to all decommissioning reactors since there will no longer be a MODE at these facilities once they have permanently ceased operation and permanently defueled the reactor vessel. This would save a significant level of effort in the license amendment preparation by the licensee and review hours by the NRC staff.

d. Continue to engage the Nuclear Energy Institute (NEI) to develop industry standards for decommissioning topical areas as appropriate.

e. Develop a way to capture and characterize the potential risk of DTF shortfalls for reactors that may prematurely cease operation well before their license expiration dates.

f. Update NMSS Policy and Procedure 5.1 to reflect any changes made to NRR OI COM-101.

g. Revise Inspection Manual Chapter 2561 to reflect new EP and security decommissioning IPs in support of the decommissioning inspection program.

h. To the extent possible, consider additional options to complete the decommissioning licensing and rulemaking activities in a more efficient and effective manner, while continuing to ensure that the plants decommission safely.

APPENDIX TO POWER REACTOR TRANSITION FROM OPERATIONS TO DECOMMISSIONING LESSONS LEARNED REPORT

(ML16302A022)

NRR was the lead organization for the project management and licensing actions associated with the plants that were transitioning to decommissioning. NMSS was the lead for the public meetings and communications with the public, congressional and media inquiries.

Both offices, were supported by the Office of Nuclear Security and Incident Response, Office of the General Counsel, Office of Congressional Affairs, Office of Public Affairs, and the regional offices. In addition, NMSS and NRR worked with the regional offices to transition the inspection programs from the reactor oversight program to the decommissioning reactor inspection programs as the plants permanently shutdown and entered into decommissioning.

This report fulfills an objective of the interoffice Reactor Decommissioning Transition Working Group to report to management on the lessons learned for the transition period up to, and including, the transfer of project management responsibility from NRR to NMSS. Furthermore, with the publication of the report, the activities of the working group are complete.

Enclosure:
Power Reactor Transition from Operations to
Decommissioning Lessons Learned Report
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