Nuclear Power Plant Infrastructure Evaluations for Removal of Used Nuclear Fuel – Supplement 21, Three Mile Island

March 2026

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Photo courtesy of the Pacific Northwest National Laboratory

NPP Site Evaluation – Supplement 21 – Three Mile Island

Office of Storage and Transportation

Prepared for
U.S. Department of Energy
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By Pacific Northwest National Laboratory

Steven J. Maheras[1]
Miriam Juckett[1]
Virgil O. Peoples[2]
Veronica M. Wilson[1]
Jeffrey Moore[3]
Kathy Langan[4]

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[1] Pacific Northwest National Laboratory
[2] Idaho National Laboratory
[3] Federal Railroad Administration
[4] Consultant

DISCLAIMER

This is a technical report that does not take into account contractual limitations or obligations under the Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (Standard Contract) (10 CFR Part 961).

To the extent discussions or recommendations in this report conflict with the provisions of the Standard Contract, the Standard Contract governs the obligations of the parties, and this report in no manner supersedes, overrides, or amends the Standard Contract.

This report reflects technical work which could support future decision making by the U.S. Department of Energy (DOE or Department). No inferences should be drawn from this report regarding future actions by DOE, which are limited both by the terms of the Standard Contract and Congressional appropriations for the Department to fulfill its obligations under the Nuclear Waste Policy Act including licensing and construction of a used nuclear fuel[1] repository.

[1] The term "used nuclear fuel" is intended to be synonymous with the term "spent nuclear fuel" as used and defined in the Nuclear Waste Policy Act of 1982, as amended, and the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961).

CONTENTS

Acknowledgments vii
Acronyms viii
1.0 Introduction 1
2.0 Site Inventory 2
3.0 Site Conditions 5
4.0 Near-Site Transportation Infrastructure and Experience 15
4.1 Three Mile Island Unit 2 Core Debris Transportation Campaign 17
5.0 Future Information Needs 19
6.0 References 21

FIGURES

Figure 1. MTHM and Number of Assemblies Versus Discharge Year at the Three Mile Island Site 3
Figure 2. MTHM and Number of Assemblies Versus Burnup Year at the Three Mile Island Site 4
Figure 3. Aerial View of the Three Mile Island Site 6
Figure 4. Aerial View of the Three Mile Island ISFSI 7
Figure 5. MAGNASTOR Dry Storage Systems at Three Mile Island Site ISFSI (Looking Southwest) 8
Figure 6. MAGNASTOR Dry Storage Systems at Three Mile Island Site ISFSI (Looking East) 9
Figure 7. Area Designated for ISFSI Pad Expansion 10
Figure 8. Aerial View of the Three Mile Island Onsite Rail Spur 11
Figure 9. Views of the Three Mile Island Onsite Rail Spur 12
Figure 10. Aerial View of the Three Mile Island Onsite Rail Bridge 13
Figure 11. Three Mile Island Onsite Rail Bridge Looking Toward Site 13
Figure 12. Three Mile Island Onsite Rail Bridge at Entrance to Site 14
Figure 13. Three Mile Island Onsite Truck Bridge Looking Away From Site (L) and Toward Site (R) 14
Figure 14. Three Mile Island Onsite Rail Spur Approaching Norfolk Southern Rail Line 15
Figure 15. Norfolk Southern Rail Line at Entrance to the Three Mile Island Site 16
Figure 16. Norfolk Southern Rail Line at Entrance to the Three Mile Island Site Looking North (R) and South (L) 16
Figure 17. Norfolk Southern 136-lb Rail at Entrance to the Three Mile Island Site 17
Figure 18. Rail Route of the TMI Unit 2 Core Debris Shipments to INL 18
Figure 19. Transportation Mode Options 20

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Storage & Transportation continues to conduct evaluations of removing used nuclear fuel (UNF)[1] from nuclear power plant (NPP) sites and away-from-reactor sites that store commercial UNF. The sites included in the evaluations to date are Maine Yankee, Yankee Rowe, Connecticut Yankee, Humboldt Bay, Big Rock Point, Rancho Seco, Trojan, La Crosse, Zion, Crystal River, Kewaunee, San Onofre, Vermont Yankee, Fort Calhoun, Oyster Creek, Pilgrim, Dresden Nuclear Power Station, the Morris Independent Spent Fuel Storage Installation, the Indian Point Energy Center, and the Palisades Nuclear Generating Station. Two additional sites were evaluated in 2023: the Three Mile Island (TMI) Nuclear Station and the Duane Arnold Energy Center. This report discusses the TMI site evaluation, which occurred in August 2023.

The TMI site[2] is unique because it is arguably the most widely-recognized nuclear power facility in the U.S. due to the partial meltdown of TMI Unit 2 on March 28, 1979 – the most significant commercial nuclear accident in U.S. history. The event occurred about one year after TMI Unit 2 was issued its operating license on February 8, 1978, and the unit never operated again. Approximately 99% of the damaged fuel, core debris, and contaminated reactor vessel components from TMI Unit 2 were removed from the site by DOE and placed into storage on the Idaho National Laboratory (INL) site. These removal actions were completed by January 1990. The TMI-2 site recently transitioned to active decommissioning. However, the co-located TMI Unit 1, which was issued its operating license in 1974, continued operations until it was permanently shut down on September 20, 2019. The DOE team's evaluation focused on TMI Unit 1 because it is the only unit with remaining UNF on site. Nevertheless, because they are collocated, both TMI Unit 1 (owned by Constellation Energy Generation, LLC) and TMI Unit 2 (owned by TMI-2 Solutions, a wholly-owned subsidiary of Energy Solutions) transportation infrastructure information was considered.

The TMI site has direct rail access to Norfolk Southern rail lines. However, the site rail spur's connection to the main rail line crosses a bridge that has not been maintained and would need refurbishment in order to service heavy loads such as loaded UNF transportation casks, whether by rail spur or heavy-haul truck. The Susquehanna River is non-navigable near the TMI site, so short-haul transportation by barge is not feasible.

DOE's Office of Storage & Transportation intends to conduct site infrastructure evaluations for additional nuclear power plant sites and continues to update inventory and site condition information and imagery for sites that have already been evaluated.

[1] The term "used nuclear fuel" is intended to be synonymous with the term "spent nuclear fuel" as used and defined in the Nuclear Waste Policy Act of 1982, as amended, and the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961).

[2] The TMI site was renamed the Crane Clean Energy Center in 2025.

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ACRONYMS

DOE	U.S. Department of Energy
GTCC waste	greater-than-Class C low-level radioactive waste
INL	Idaho National Laboratory
ISFSI	Independent Spent Fuel Storage Installation
MWe	megawatt electric
MWt	megawatt thermal
GWd/MTHM	gigawatt day per metric ton heavy metal
MTHM	metric ton heavy metal
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
TMI	Three Mile Island
UNF	used nuclear fuel

1.0 INTRODUCTION

The TMI site is located in Londonderry Township of Dauphin County about 3 miles (4.8 km) south of Middletown, Dauphin County, and about 1.25 miles (2 km) east of the community of Goldsboro, York County. The site is approximately 10 miles (16 km) southeast of Harrisburg, Pennsylvania (NAC 1991, TOPO 1994, TriVis Incorporated 2005, NRC 2009). The TMI site evaluation was conducted using the guidance in Rodman et al. (2020).

The TMI site[1] is unique because it is arguably the most widely-recognized NPP site in the U.S. due to the partial meltdown of TMI Unit 2 on March 28, 1979 – the most significant commercial nuclear accident in U.S. history. The event occurred about one year after TMI Unit 2 was issued its operating license on February 8, 1978, and Unit 2 never operated again. Approximately 99 percent of the damaged fuel, core debris, and contaminated reactor vessel components from TMI Unit 2 were removed from the site by DOE and placed into storage at the INL site. The shipments from TMI to INL[2] took place between July 1986 and April 1990 (Schmitt et al. 1993).

[1] The TMI site was renamed the Crane Clean Energy Center in 2025.
[2] At the time that the shipments were made, the Idaho National Laboratory was referred to as the Idaho National Engineering Laboratory.

2.0 SITE INVENTORY

TMI-1 is a 2,568 megawatt thermal (MWt)/819 megawatt electric (MWe) pressurized water reactor that began operation in 1974 and was shut down in 2019 (Fewell 2017). All UNF has been removed from the TMI-1 spent fuel pool (Gallagher 2019). Constellation, the owner and most recent operator of TMI-1, has announced that they are considering restarting TMI.[1] In May 2025, the TMI site was renamed the Christopher M. Crane Clean Energy Center.

The UNF at the TMI site is stored in 46 TSC-37 dry storage canisters in the MAGNASTOR dry storage system (Docket No. 72-1031). The MAGNASTOR dry storage system consists of a transportable storage canister, a vertical concrete storage cask, and a transfer cask. There is also one canister of greater-than-Class C low-level radioactive waste (GTCC waste) stored at the TMI site, and an additional 4 canisters of GTCC waste are estimated to be stored at the TMI site after decommissioning of Unit 1. The MAGNATRAN transportation cask is certified to transport TSC-37 dry storage canisters and GTCC waste.

Figure 1 illustrates the number of UNF assemblies and metric tons heavy metal (MTHM) at TMI based on their discharge year. There are a total of 1663 UNF assemblies (786.5 MTHM) at the TMI site. The oldest fuel was discharged in 1976 and the last fuel was discharged in 2019. All UNF assemblies at the TMI site are zirconium alloy clad.

Figure 2 illustrates the number of UNF assemblies and MTHM at TMI based on their burnup. There are 887 UNF assemblies (423.7 MTHM) at TMI that have burnups greater than 45 gigawatt day per metric ton heavy metal (GWd/MTHM). These 887 fuel assemblies are classified by the NRC as high burnup UNF.

In addition to the UNF from TMI-1, an additional 14-15 canisters of waste from the decommissioning of TMI Unit 2 will also be generated. These canisters will be stored in MAGNASTOR dry storage systems at the TMI Independent Spent Fuel Storage Installation (ISFSI).

[1] https://www.ans.org/news/article-6402/constellation-announces-tmi1-restart-power-purchase-agreement-with-microsoft/ (September 20, 2024)

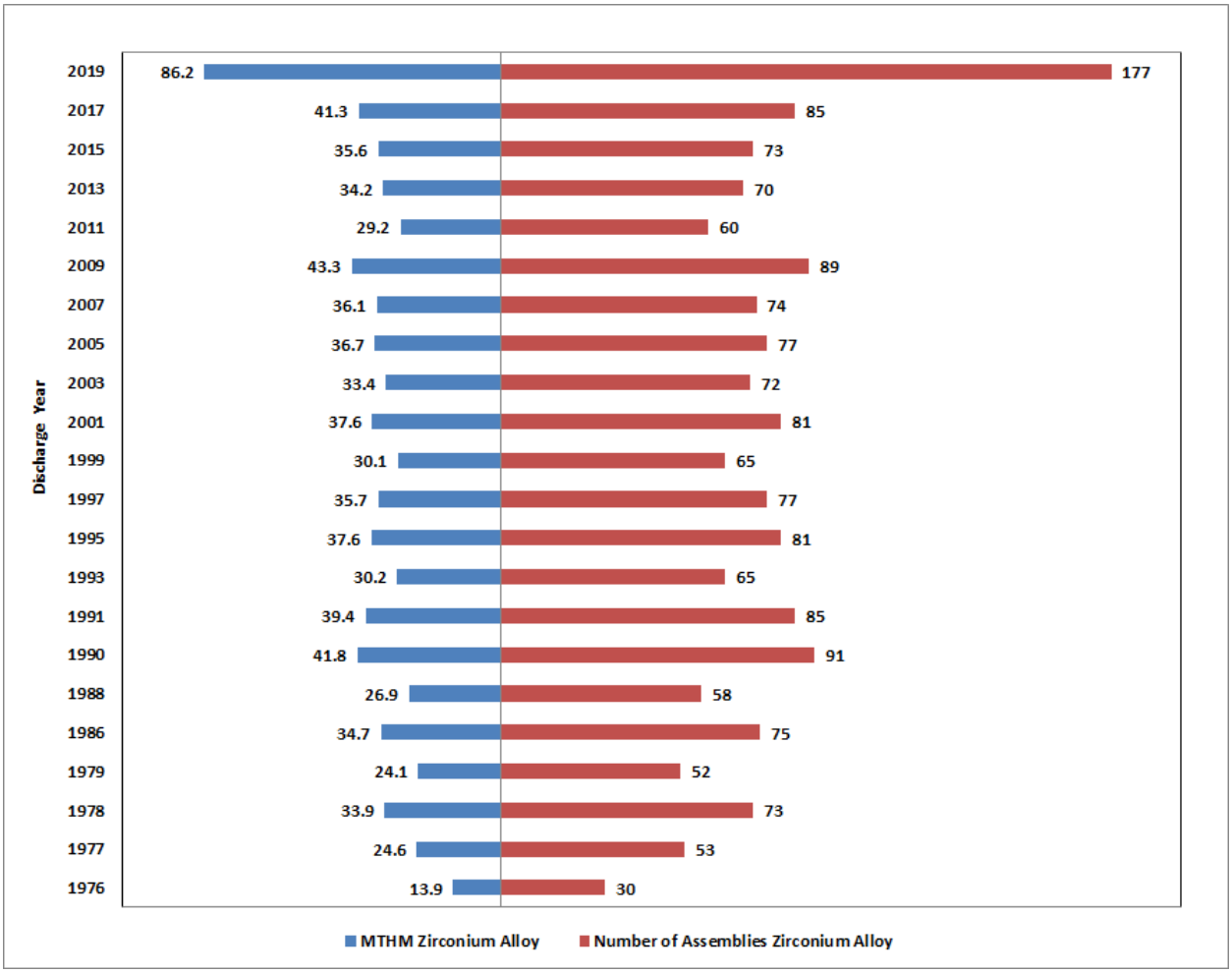

Figure 1. MTHM and Number of Assemblies Versus Discharge Year at the Three Mile Island Site

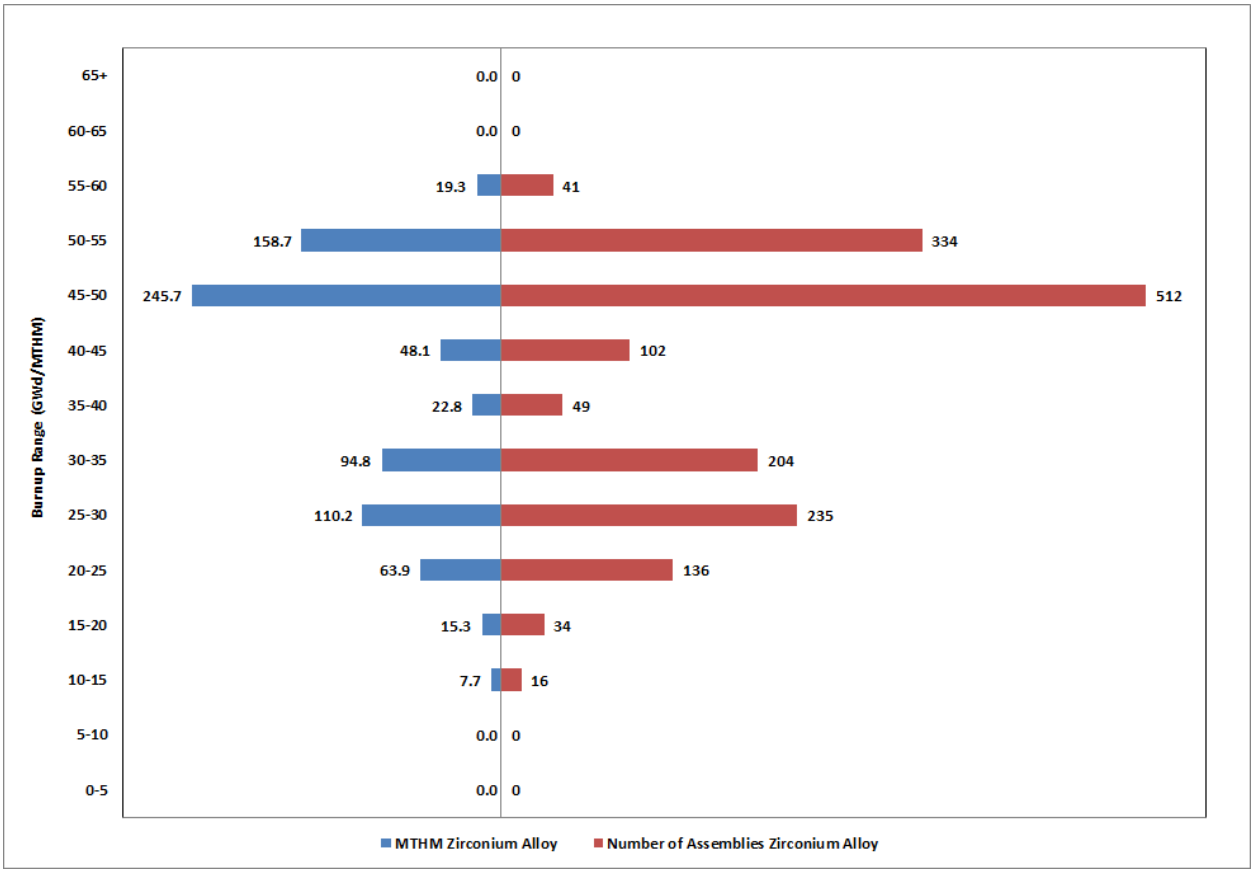

Figure 2. MTHM and Number of Assemblies Versus Burnup Year at the Three Mile Island Site

3.0 SITE CONDITIONS

Figure 3 shows an aerial view of the TMI site, including Units 1 and 2, the onsite rail spur that runs over the North Bridge, the South Bridge, and the area occupied by the TMI ISFSI. Figure 4 shows an aerial view of this area.

Figure 5 and Figure 6 show the TMI site ISFSI looking southwest and east, respectively. Figure 7 shows the area that has been designated for expansion of the ISFSI pad to accommodate storage of TMI Unit 2 decommissioning waste.

The TMI site is served by the Norfolk Southern Railroad via an onsite 0.78 mile (1.25-km) rail spur (see Figure 8). The onsite spur is 115-lb rail. Figure 9 shows the onsite rail spur.

The rail bridge (the North Bridge) on this spur (see Figure 10) also carries vehicular traffic. The North Bridge was originally constructed in the 1960s to support construction of the TMI site and has both rail and vehicle surfaces. However, the North Bridge is currently rated only for up to 40-ton loads, and any loads greater than 40 tons would require an engineering evaluation prior to being allowed to cross the bridge. Because TMI-2 Solutions plans to use the North Bridge for removing decommissioning waste by heavy-haul truck, they are planning to upgrade the bridge as necessary to support decommissioning activities. These upgrades are currently planned to include partial deck replacement, repairs to the steel superstructure, and rail rehabilitation efforts to support upgrades to Cooper E80 rail standards, for a duration required to support transportation activities during decommissioning of TMI-2. However, at this time, neither TMI-2 Solutions nor Constellation are considering upgrades that would support UNF removal from the TMI site.

Figure 11 shows the onsite rail (north) bridge looking towards the site, Figure 12 shows the onsite rail (north) bridge at the entrance to the site, and Figure 13 shows the onsite truck (south) bridge looking away from the site and towards the site.

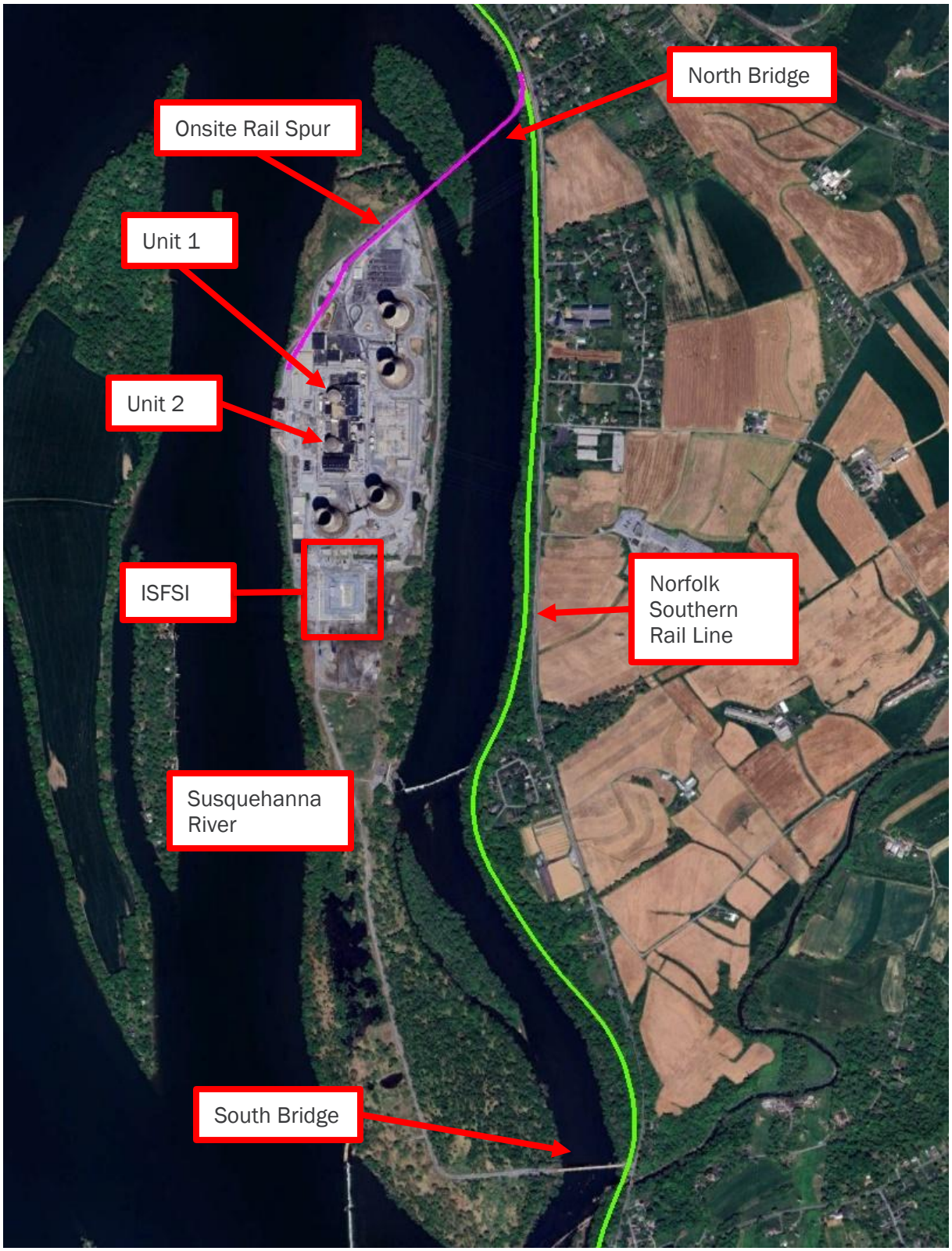

Figure 3. Aerial View of the Three Mile Island Site

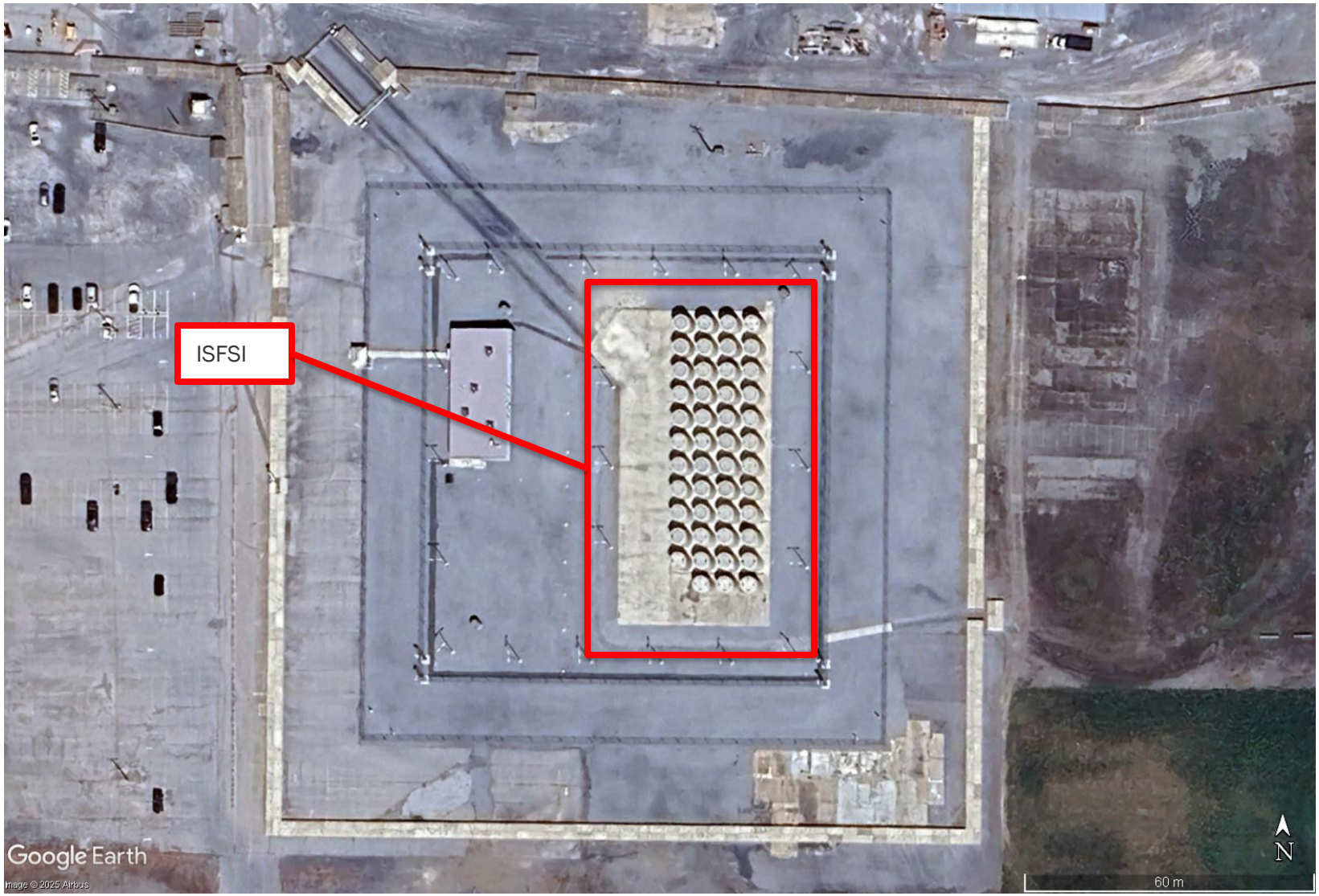

Figure 4. Aerial View of the Three Mile Island ISFSI

Figure 5. MAGNASTOR Dry Storage Systems at Three Mile Island Site ISFSI (Looking Southwest)

Figure 6. MAGNASTOR Dry Storage Systems at Three Mile Island Site ISFSI (Looking East)

Figure 7. Area Designated for ISFSI Pad Expansion

Figure 8. Aerial View of the Three Mile Island Onsite Rail Spur

Figure 9. Views of the Three Mile Island Onsite Rail Spur

Figure 10. Aerial View of the Three Mile Island Onsite Rail Bridge

Figure 11. Three Mile Island Onsite Rail Bridge Looking Toward Site

Figure 12. Three Mile Island Onsite Rail Bridge at Entrance to Site

Figure 13. Three Mile Island Onsite Truck Bridge Looking Away From Site (L) and Toward Site (R)

4.0 NEAR-SITE TRANSPORTATION INFRASTRUCTURE AND EXPERIENCE

The TMI onsite rail spur connects to the Norfolk Southern at the north entrance to the TMI site. Figure 14 shows the TMI onsite rail spur approaching the Norfolk Southern rail line at the entrance of the TMI site. Figure 15 shows the Norfolk Southern rail line at entrance to the TMI site. Figure 16 shows the Norfolk Southern rail line at entrance to the TMI site looking north and south. Figure 17 shows the 136-lb. rail at the entrance to the TMI site.

Figure 14. Three Mile Island Onsite Rail Spur Approaching Norfolk Southern Rail Line

Figure 15. Norfolk Southern Rail Line at Entrance to the Three Mile Island Site

Figure 16. Norfolk Southern Rail Line at Entrance to the Three Mile Island Site Looking North (R) and South (L)

Figure 17. Norfolk Southern 136-lb Rail at Entrance to the Three Mile Island Site

4.1 THREE MILE ISLAND UNIT 2 CORE DEBRIS TRANSPORTATION CAMPAIGN

Over the period July 1986 to April 1990, TMI Unit 2 core debris was shipped from the TMI site to INL.[1] The transportation campaign consisted of 22 rail shipments (trains) which resulted in the transport of 49 transportation casks containing 342 canisters of TMI Unit 2 core debris (Schmitt et al. 1993). Although there were no serious incidents or accidents involving damage to the transportation casks or trains during the campaign, public interest in the shipments was substantial (Schmitt et al. 1993).

The NuPac 125-B transportation cask (Docket No. 71-9200) was used to ship the core debris. The transportation cask held 7 core debris canisters. The canisters were 150 in. in length and 14 in. in diameter. The NuPac 125-B transportation cask was 279.5 in. long and had a diameter of 120 in. The weight of a fully loaded NuPac 125-B transportation cask containing 7 canisters was 181,500 lb. Three NuPac 125-B transportation casks were fabricated.

[1] At the time that the shipments were made, the Idaho National Laboratory (INL) was referred to as the Idaho National Engineering Laboratory (INEL).

The gross weight on the railcar, including the transport skid, which mounted on the railcar and supported the cask in transit, was about 203,000 lb. The total weight on the rails, including railcar, was about 310,000 lb. An 8-axle 167-ton railcar was used to transport the NuPac 125-B transportation casks, yielding a per axle weight of 38,750 lb. At the time, the onsite rail bridge at the TMI site had a 25 ton (50,000 lb.) per axle weight limit. The length of the railcar was 58 ft. (length over strikers). Figure 18 illustrates the rail route for the TMI Unit 2 shipments to INL.

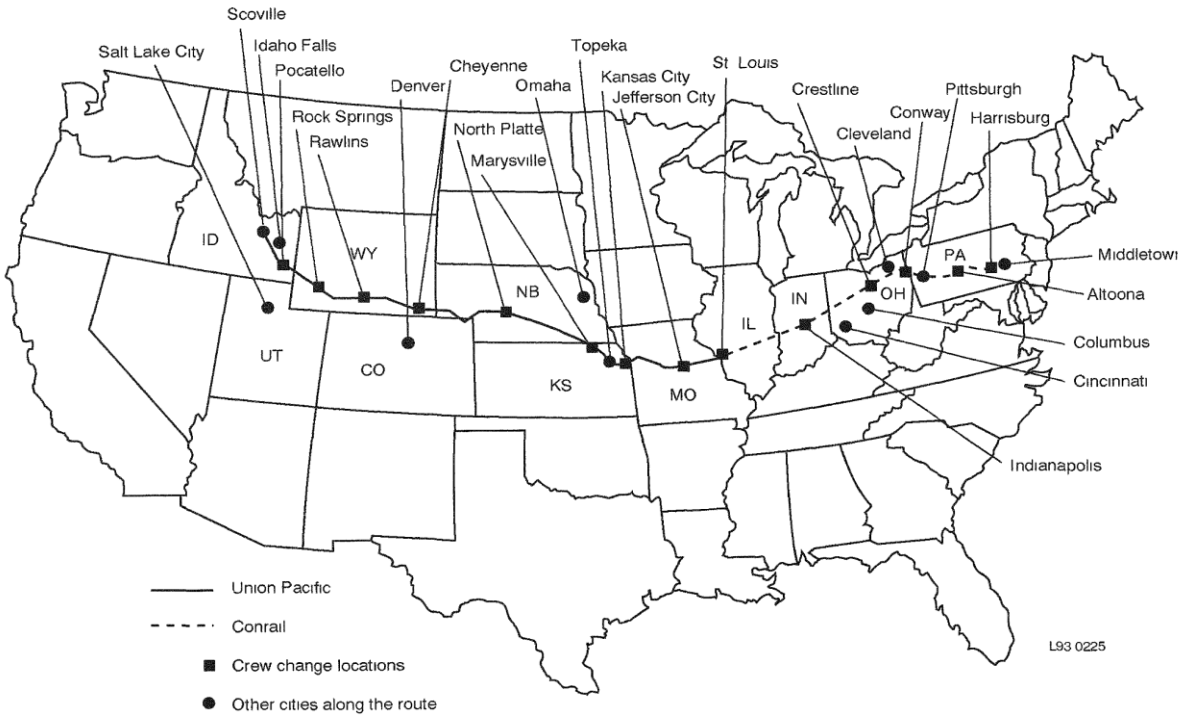

Figure 18. Rail Route of the TMI Unit 2 Core Debris Shipments to INL

5.0 FUTURE INFORMATION NEEDS

Figure 19 illustrates the transportation mode options for the NPP site evaluations that have been conducted. All NPP sites have at least one option, and these options range from direct rail access to options that would require a heavy haul truck to rail transload or a barge to rail transload. Some sites may require multiple transloads, such as heavy haul truck to barge to rail. At the TMI site, one option is available, direct rail.

The rail infrastructure at the TMI site has not been maintained and would require refurbishment prior to use. In addition, the onsite rail bridge at the TMI site would also require refurbishment prior to being used to transport UNF.

DOE's Office of Storage & Transportation intends to conduct site infrastructure evaluations for additional nuclear power plant sites and continues to update inventory and site condition information and imagery for sites that have already been evaluated.

SITE	TRANSPORTATION MODE OPTIONS	
Maine Yankee	DIRECT RAIL	BARGE to RAIL
Yankee Rowe	HEAVY HAUL TRUCK to RAIL	
Connecticut Yankee	BARGE to RAIL	HEAVY HAUL TRUCK to RAIL
Humboldt Bay	HEAVY HAUL TRUCK to RAIL	HEAVY HAUL TRUCK to BARGE to RAIL
Big Rock Point	HEAVY HAUL TRUCK to RAIL	BARGE to RAIL
Rancho Seco	DIRECT RAIL	
Trojan	DIRECT RAIL	BARGE to RAIL
La Crosse	DIRECT RAIL	BARGE to RAIL
Zion	DIRECT RAIL	BARGE to RAIL
Crystal River	DIRECT RAIL	BARGE to RAIL
Kewaunee	HEAVY HAUL TRUCK to RAIL	HEAVY HAUL TRUCK to BARGE to RAIL
San Onofre	DIRECT RAIL	HEAVY HAUL TRUCK to BARGE to RAIL
Vermont Yankee	DIRECT RAIL	
Fort Calhoun	DIRECT RAIL	BARGE to RAIL
Oyster Creek	BARGE to RAIL	HEAVY HAUL TRUCK to RAIL
Pilgrim	BARGE to RAIL	HEAVY HAUL TRUCK to RAIL
Morris	DIRECT RAIL	HEAVY HAUL TRUCK to BARGE to RAIL
Dresden	DIRECT RAIL	BARGE to RAIL
Indian Point	HEAVY HAUL TRUCK to RAIL	BARGE to RAIL
Palisades	HEAVY HAUL TRUCK to RAIL	BARGE to RAIL
Three Mile Island	DIRECT RAIL	
Duane Arnold	DIRECT RAIL	

Figure 19. Transportation Mode Options

6.0 REFERENCES

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