Nuclear Power Plant Infrastructure Evaluations for Removal of Used Nuclear Fuel – Supplement 22, Duane Arnold

March 2026

U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY | SPENT FUEL & HIGH-LEVEL WASTE DISPOSITION

Photo courtesy of the Duane Arnold Site

NPP Site Evaluation – Supplement 22 – Duane Arnold

Office of Storage and Transportation

Prepared for
U.S. Department of Energy
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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).

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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 (ISFSI), the Indian Point Energy Center, and the Palisades Nuclear Generating Station. Two additional sites were evaluated in 2023: the Three Mile Island Nuclear Station and the Duane Arnold Energy Center. This report discusses the Duane Arnold site evaluation, which occurred in September 2023.

The Duane Arnold NPP site is located in Linn County, Iowa, on the on the western bank of a north-south reach of the Cedar River, approximately 3 km north-northeast of the town of Palo, Iowa. The major towns located within a 50-mile (80-km) radius of the site are Waterloo, approximately 34 miles (55 km) to the northwest; Iowa City, approximately 32 miles (51 km) to the southeast; and Cedar Rapids, approximately 5.7 miles (9 km) to the southeast

The Duane Arnold site contains a 1,912 megawatt thermal (MWt)/601 megawatt electric (MWe) boiling water reactor that began operation in 1974. The Duane Arnold site had stated its intention to permanently cease power operations in October 2020, but the reactor permanently shut down on August 10, 2020, when a derecho (a land-based hurricane) damaged non-safety related portions of the plant, including the cooling towers. NextEra, the owner and former operator of the nuclear power plant has announced that they are considering restarting Duane Arnold.[2]

All UNF has been removed from the Duane Arnold spent fuel pool. This UNF is stored in twenty 61BT and forty 61BTH dry storage canisters in the Standardized NUHOMS System (Docket No. 72 1004). This system consists of transportable 61BT and 61BTH dry storage canisters, reinforced concrete horizontal storage modules, and a transfer cask. The 61BT and 61BTH dry storage canisters are certified for transport in the MP197HB transportation cask (Docket No. 71-9302).

The Duane Arnold site has direct rail access and is served by the Canadian National Railway (CN)[3] via a 3.5 mile (6 km) rail spur. No barge facilities are located within 25 miles (40 km) of the Duane Arnold site.

The Duane Arnold site evaluation took place over 3 days. The first day was spent at the Duane Arnold site meeting with site staff and evaluating the independent spent fuel storage installation, as well as onsite and near-site transportation infrastructure. The second day was spent evaluating the rail infrastructure in the vicinity of the Duane Arnold site. The third day was spent meeting with local government officials and Tribal government representatives. Participants in the site visit included staff from the DOE Office of Storage & Transportation, the Federal Railroad Administration, Pacific Northwest National Laboratory, Idaho National Laboratory, the State of Iowa, the Tribal Radioactive Materials Transportation Committee (TRMTC), the Council of State Governments-Midwest, and other organizations.

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[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] https://www.ans.org/news/article-6248/nextera-energy-considering-duane-arnold-plant-restart/ (July 26, 2024)

[3] At the time of the site evaluation, the Duane Arnold site was served by the Iowa Northern Railway (IANR). The IANR was acquired by the Canadian National Railway (CN) in 2025.

DOE 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.

ACKNOWLEDGMENTS

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ACRONYMS

CN	Canadian National Railway
DOE	U.S. Department of Energy
IANR	Iowa Northern Railway
ISFSI	Independent Spent Fuel Storage Installation
GWd/MTHM	gigawatt day per metric ton heavy metal
MTHM	metric ton heavy metal
MWe	megawatt electric
MWt	megawatt thermal
NPP	nuclear power plant
NRC	U.S. Nuclear Regulatory Commission
TRMTC	Tribal Radioactive Materials Transportation Committee
UNF	used nuclear fuel

1.0 INTRODUCTION

The Duane Arnold nuclear power plant site is located in Linn County, Iowa, on the western bank of a north-south reach of the Cedar River, approximately 2 miles (3 km) north-northeast of the town of Palo, Iowa (NAC 1991, TOPO 1994, TriVis Incorporated 2005, NRC 2010). The major towns located within a 50-mile (80-km) radius of the site are Waterloo, approximately 34 miles (55 km) to the northwest; Iowa City, approximately 32 miles (51 km) to the southeast; and Cedar Rapids, approximately 5.7 miles (9 km) to the southeast (NAC 1991, TOPO 1994, TriVis Incorporated 2005, NRC 2010). The Duane Arnold site evaluation was conducted using the guidance in Rodman et al. (2020).

2.0 SITE INVENTORY

Duane Arnold is a 1,912 MWt/601 MWe boiling water reactor that began operation in 1974. The Duane Arnold site had stated its intention to permanently cease power operations in October 2020, but the reactor permanently shut down on August 10, 2020 (Curtland 2020a), when a derecho (a land-based hurricane) damaged non-safety related portions of the plant, including the cooling towers. Removal of all UNF from the reactor vessel was completed on October 12, 2020 (Curtland 2020b). NextEra, the owner and former operator of the nuclear power plant has announced that they are considering restarting Duane Arnold.[1]

All UNF has been removed from the Duane Arnold spent fuel pool. This UNF is stored in twenty 61BT (1220 UNF assemblies) and forty 61BTH (2428 UNF assemblies) dry storage canisters in the Standardized NUHOMS System (Docket No. 72 1004). This system consists of transportable 61BT and 61BTH dry storage canisters, reinforced concrete horizontal storage modules, and a transfer cask. The 61BT and 61BTH dry storage canisters are certified for transport in the MP197HB transportation cask (Docket No. 71-9302). An additional 2-3 canisters of greater-than-Class C low-level radioactive waste are estimated to be stored at Duane Arnold after decommissioning.

Figure 1 illustrates the number of UNF assemblies and metric tons heavy metal (MTHM) at Duane Arnold based on their discharge year. There are a total of 3648 UNF assemblies (659.5 MTHM) at the Duane Arnold site. The oldest fuel was discharged in 1975 and the last fuel was discharged in 2020. All UNF assemblies at the Duane Arnold site are zirconium alloy clad.

Figure 2 illustrates the number of UNF assemblies and MTHM at Duane Arnold based on their burnup. There are 118 UNF assemblies at Duane Arnold that have burnups greater than 45 gigawatt day per metric ton heavy metal (GWd/MTHM). These 118 fuel assemblies are classified by the U.S. Nuclear Regulatory Commission (NRC) as high burnup UNF.

[1] https://www.ans.org/news/article-6248/nextera-energy-considering-duane-arnold-plant-restart/ (July 26, 2024)

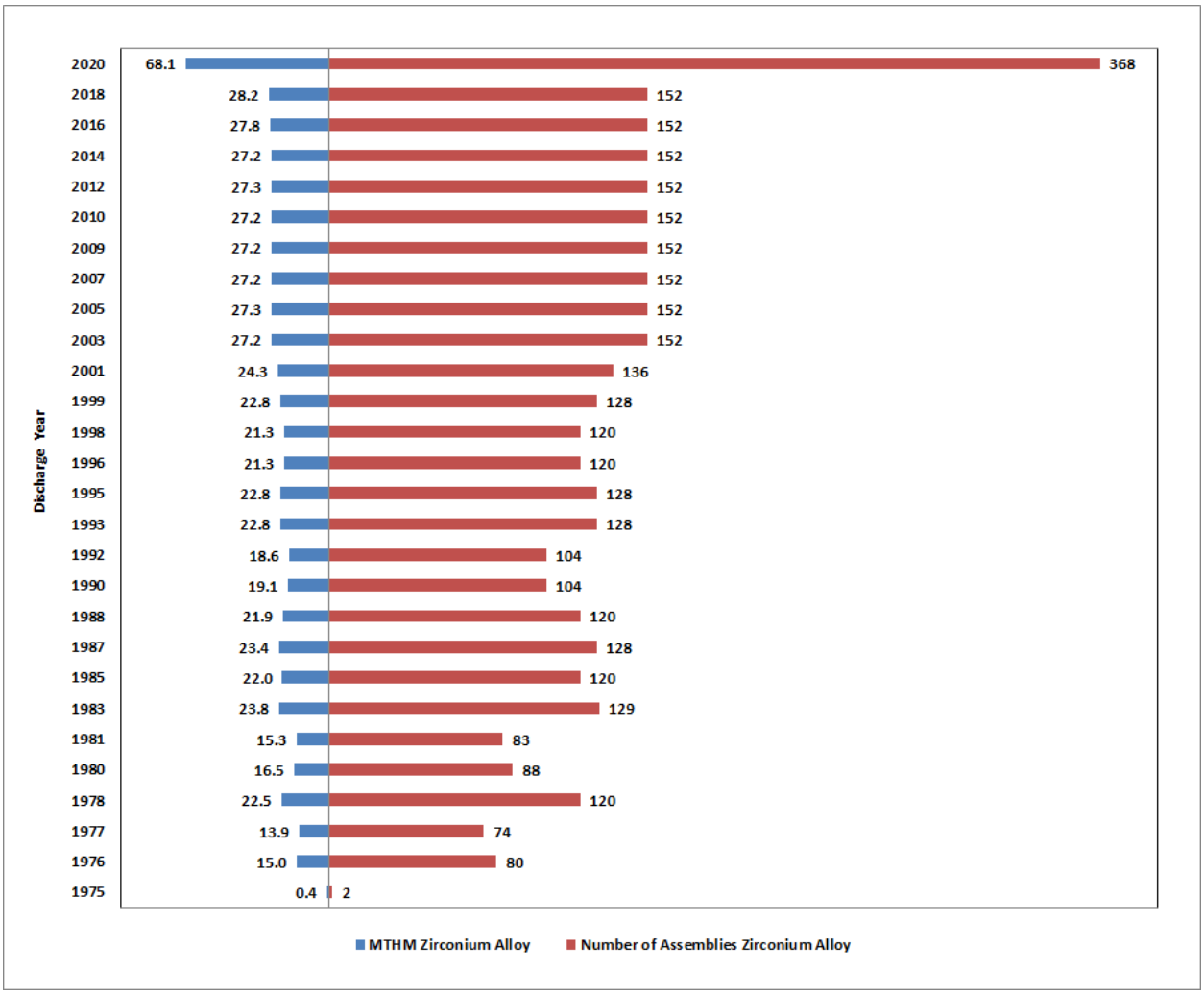

Figure 1. MTHM and Number of Assemblies Versus Discharge Year at the Duane Arnold Site

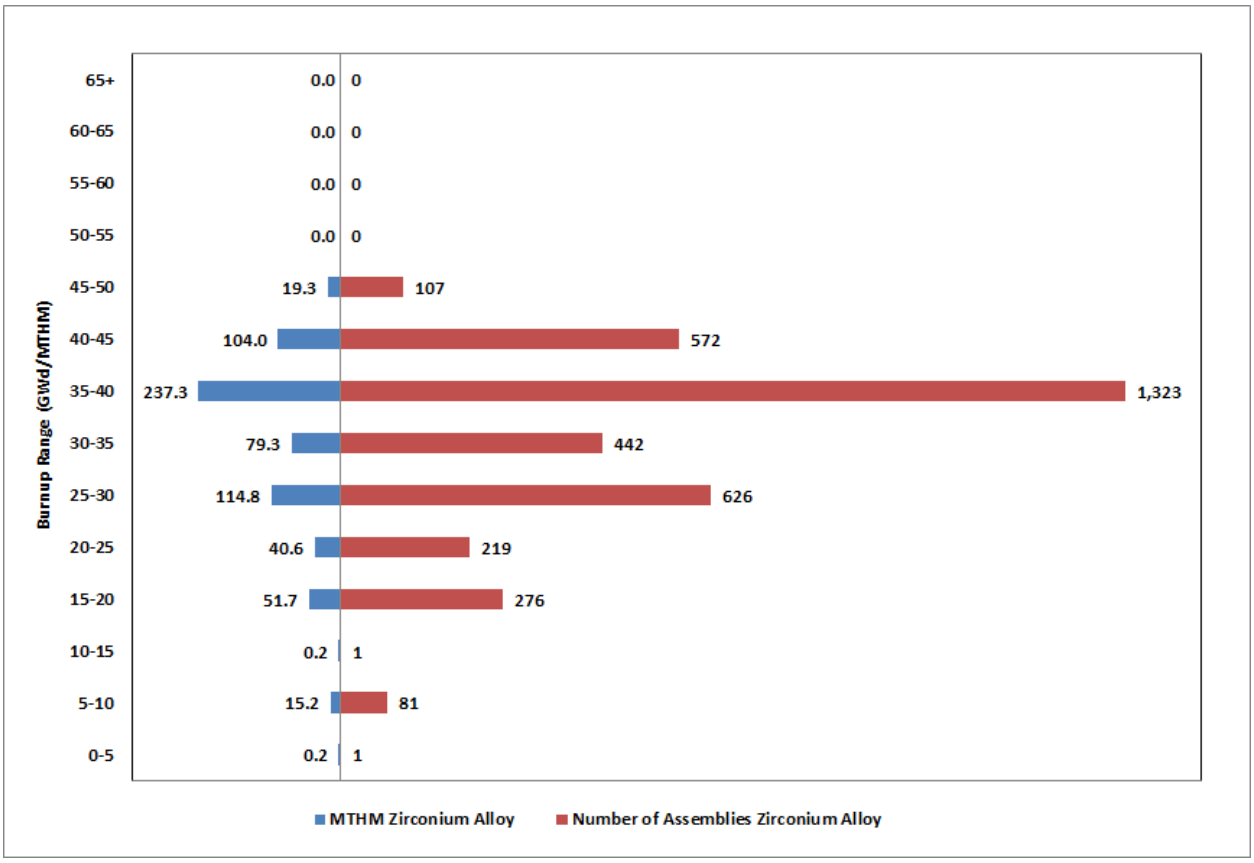

Figure 2. MTHM and Number of Assemblies Versus Burnup Year at the Duane Arnold Site

3.0 SITE CONDITIONS

Figure 3 shows an aerial view of the Duane Arnold site, including Duane Arnold Unit 1 and the Duane Arnold ISFSI. Figure 4 shows an aerial view of the ISFSI. Figure 5 shows the Standardized NUHOMS dry storage systems at the ISFSI. In Figure 5, the original 30 dry storage systems loaded over the period 2003-2020 are shown on the left and the additional 30 dry storage systems loaded over the period 2021-2022 are shown on the right.

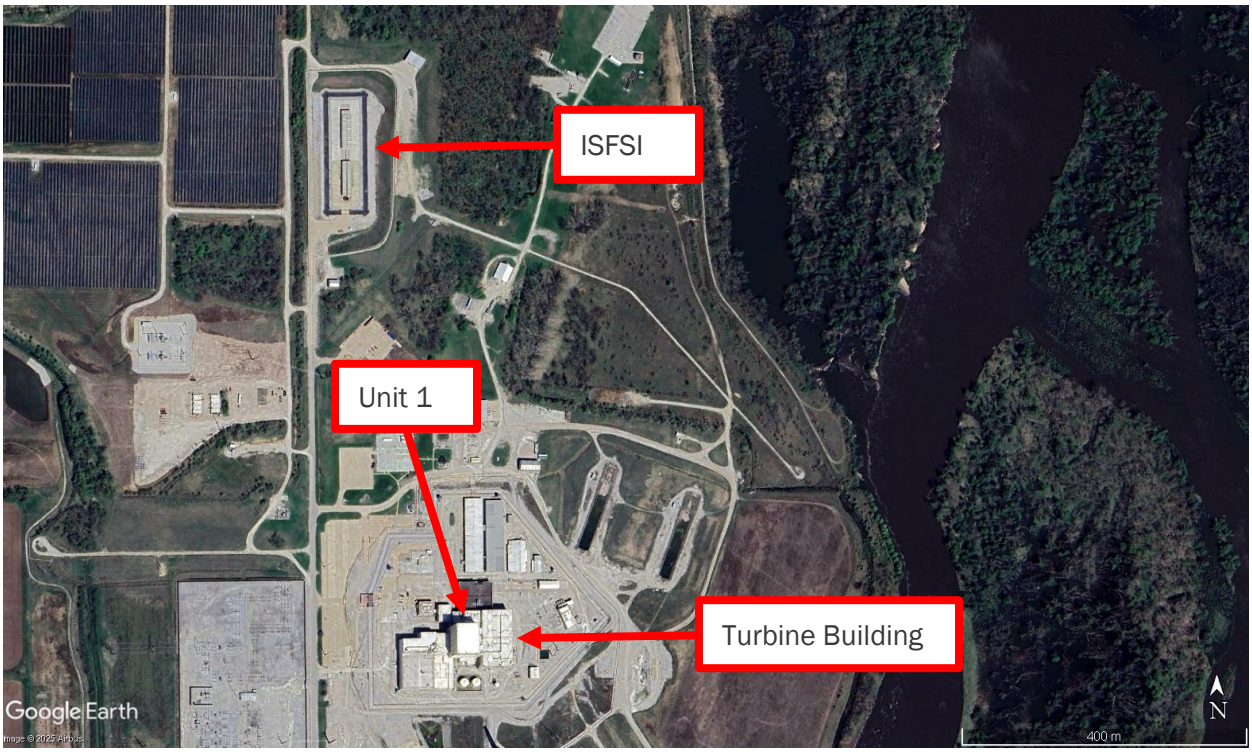

Figure 3. Aerial View of the Duane Arnold Site

Figure 4. Aerial View of the Duane Arnold ISFSI

Figure 5. NUHOMS Dry Storage Systems at the Duane Arnold ISFSI

The Duane Arnold site has direct rail access and is served by the CN[1] via a 3.5 mile (6 km) rail spur (see Figure 6). Two potential onsite heavy haul truck to rail transload locations were identified (see Figure 7). Location No. 1 was used to transload 40 horizontal storage modules from rail to a Goldhofer self-propelled modular transporter for transport to the Duane Arnold ISFSI and Location

[1] At the time of the site evaluation, the Duane Arnold site was served by the Iowa Northern Railway (IANR). The IANR was acquired by the Canadian National Railway (CN) in 2025.

No. 2 was used to transload 20 horizontal storage modules rail to a Goldhofer self-propelled modular transporter for transport to the ISFSI.

Figure 8 and Figure 9 show the current condition of these potential transload locations. 90-lb. rail is used at both these locations (see Figure 10). Figure 11 shows the rail spur looking west and east, Figure 12 shows a trestle on the onsite rail spur, and Figure 13 shows the 85-lb. rail at the trestle.

At the Duane Arnold site, the Cedar River is not navigable and there are no barge facilities located within 25 miles (40 km) of the Duane Arnold site.

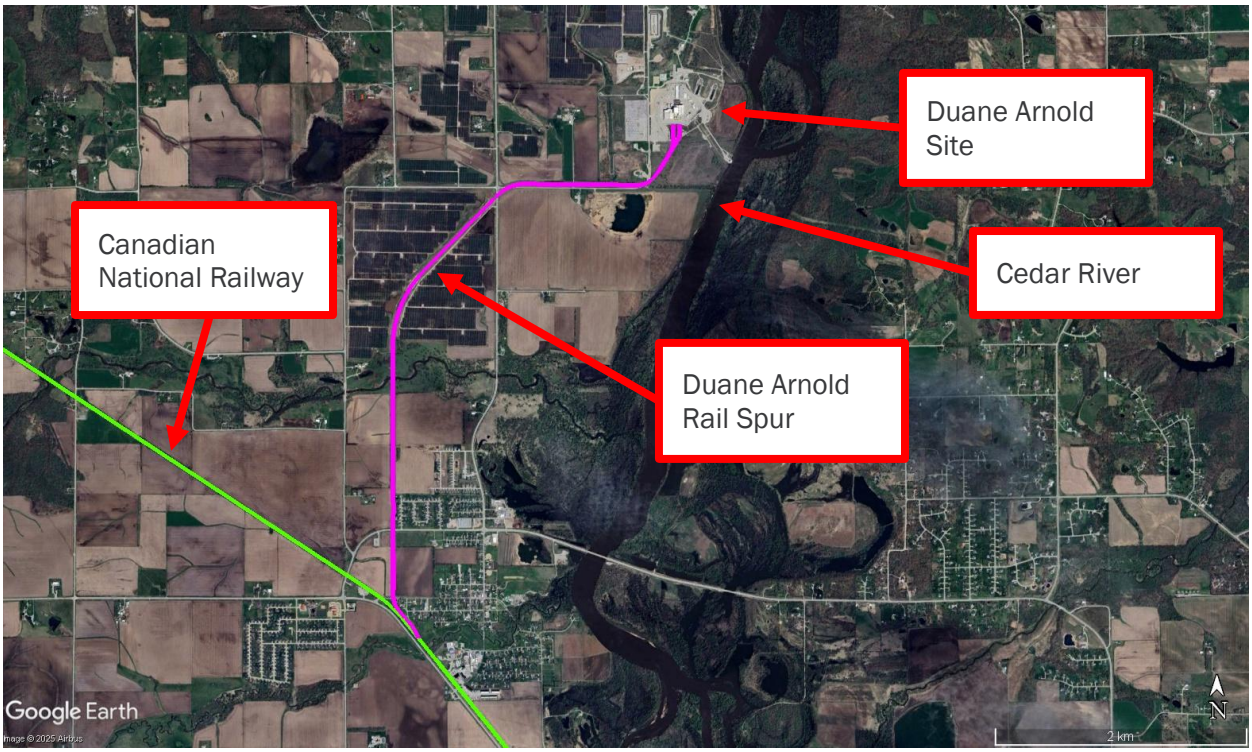

Figure 6. Duane Arnold Rail Spur

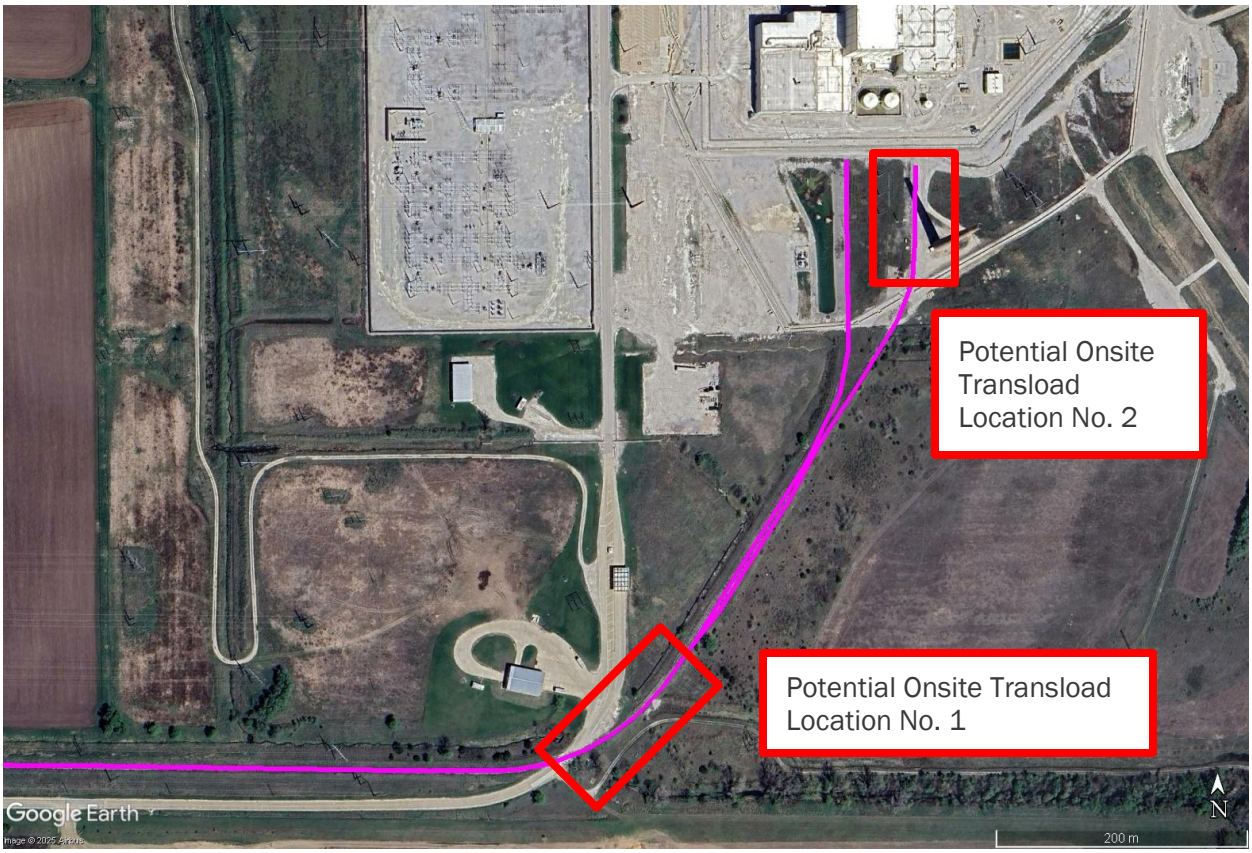

Figure 7. Potential Onsite Heavy Haul Truck to Rail Transload Locations

Figure 8. Potential Transload Location No. 1 (2023)

Figure 9. Potential Transload Location No. 2 (2023)

Figure 10. 90-lb Rail at Transload Locations

Figure 11. Onsite Rail Spur Looking West (L) and East (R)

Figure 12. Trestle on Onsite Rail Spur

Figure 13. 85-lb Rail at Trestle on Onsite Rail Spur

4.0 NEAR-SITE TRANSPORTATION INFRASTRUCTURE AND EXPERIENCE

The Duane Arnold rail spur connects to the CN[1] in Palo, Iowa (see Figure 14). Figure 15 shows the CN mainline looking southeast and northwest, Figure 16 shows the 115-lb. rail on the CN mainline, Figure 17 shows the Duane Arnold spur looking away from the CN mainline and towards the CN mainline, and Figure 18 and Figure 19 shows the Duane Arnold spur approaching the Vinton Street grade crossing and at the Vinton Street grade crossing.

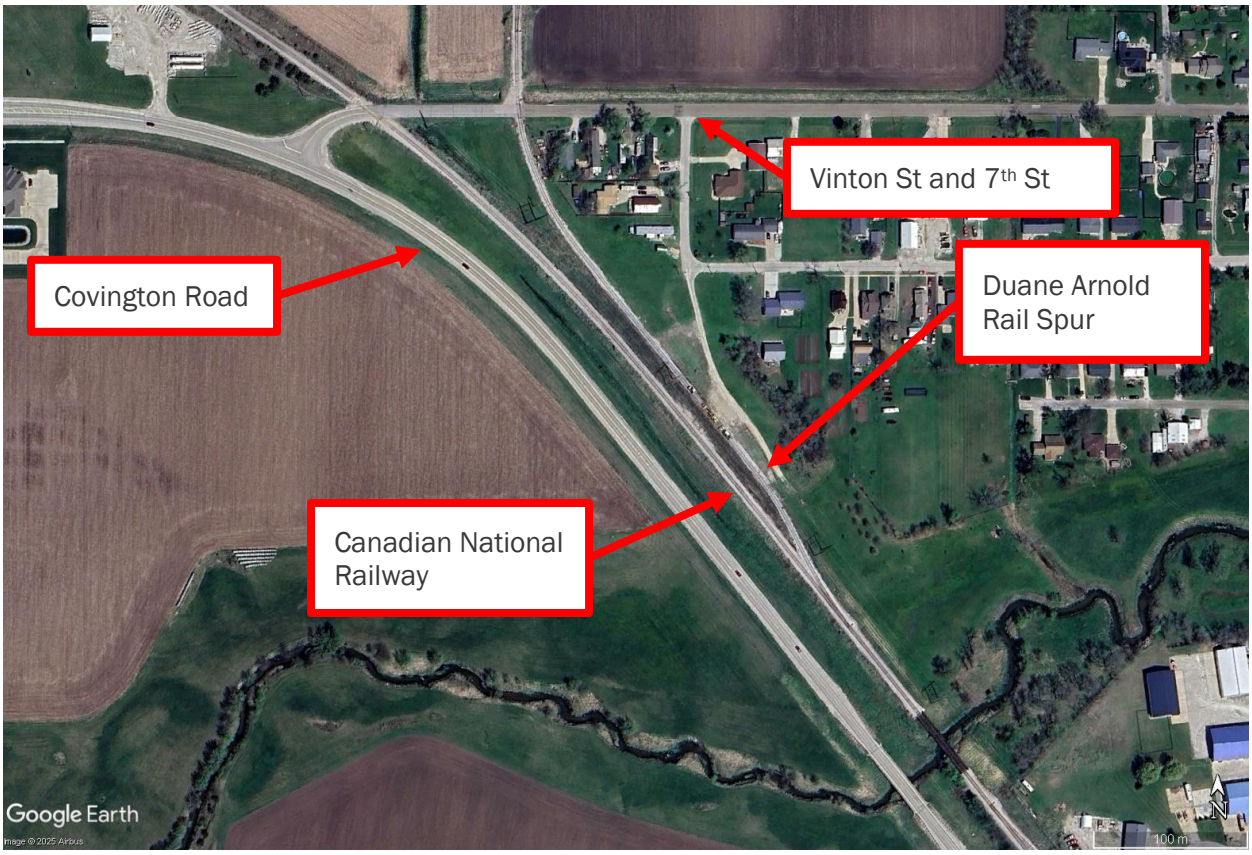

Figure 14. Connection of Duane Arnold Rail Spur and CN in Palo, Iowa

[1] At the time of the site evaluation, the Duane Arnold site was served by the Iowa Northern Railway (IANR). The IANR was acquired by the Canadian National Railway (CN) in 2025.

Figure 15. CN Mainline Looking Southeast (L) and Northwest (R)

Figure 16. 115-lb Rail on CN Mainline

Figure 17. Duane Arnold Rail Spur Looking Away from CN Mainline (L) and Towards CN Mainline (R)

Figure 18. Duane Arnold Rail Spur Approaching Vinton Street Grade Crossing

Figure 19. Duane Arnold Rail Spur at Vinton Street Grade Crossing

5.0 FUTURE INFORMATION NEEDS

Figure 20 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 Duane Arnold site, one option is available, direct rail. The rail infrastructure at the Duane Arnold site has not been maintained and would require refurbishment prior to use.

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 20. Transportation Mode Options

6.0 REFERENCES

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