



U.S. DEPARTMENT OF  
**ENERGY**

**Nuclear Energy**

# **Logistical and Operational Issues Associated with the Transport of Stranded Fuel from Shutdown Reactor Sites**

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*U.S. Department of Energy*

**Presented to:**

**Nuclear Waste Technical Review Board**

**Idaho Falls, Idaho**

**17 October 2012**

# Removal of Stranded Used Nuclear Fuel from Shutdown Sites: Status

## ■ Presentation will discuss

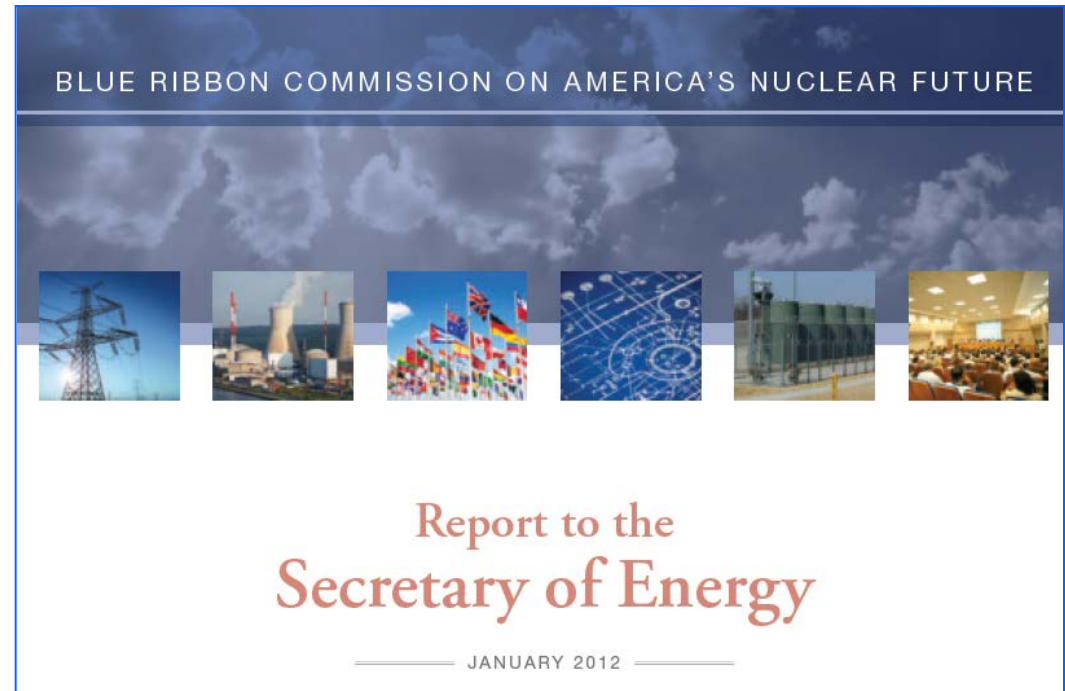
- Why the evaluation is being conducted
- Locations of shutdown sites
- Inventory at shutdown sites
- Scope of current shutdown site project
- Characteristics of Independent Spent Fuel Storage Installations (ISFSIs)
- Transportation infrastructure at and near shutdown site ISFSIs
- Steps required to remove used fuel



# The BRC Recommended: *CSFs, Transportation Preparation, and Shutdown Sites “First”*

***“Prompt efforts to develop one or more consolidated storage facilities”***

***“Early preparation for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities”***



***“Consolidated storage would allow for the removal of “stranded” spent fuel from shutdown reactor sites: ...the Commission recommends that spent fuel currently being stored at shutdown reactor sites be “first in line” for transfer to a consolidated storage facility.”***

# Proposed Legislation

## Nuclear Energy

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- **S.2465 Energy and Water Development and Related Agencies Appropriations Act, 2013**
- **Sponsor: Senator Feinstein (4/26/2012)**
- ***(Sec. 312) Authorizes the Secretary to conduct a pilot program through private sector partners, to license, construct, and operate government or privately owned **consolidated storage facilities to provide interim storage ...for spent nuclear fuel... with priority...given to spent nuclear fuel located on sites without an operating nuclear reactor.*****



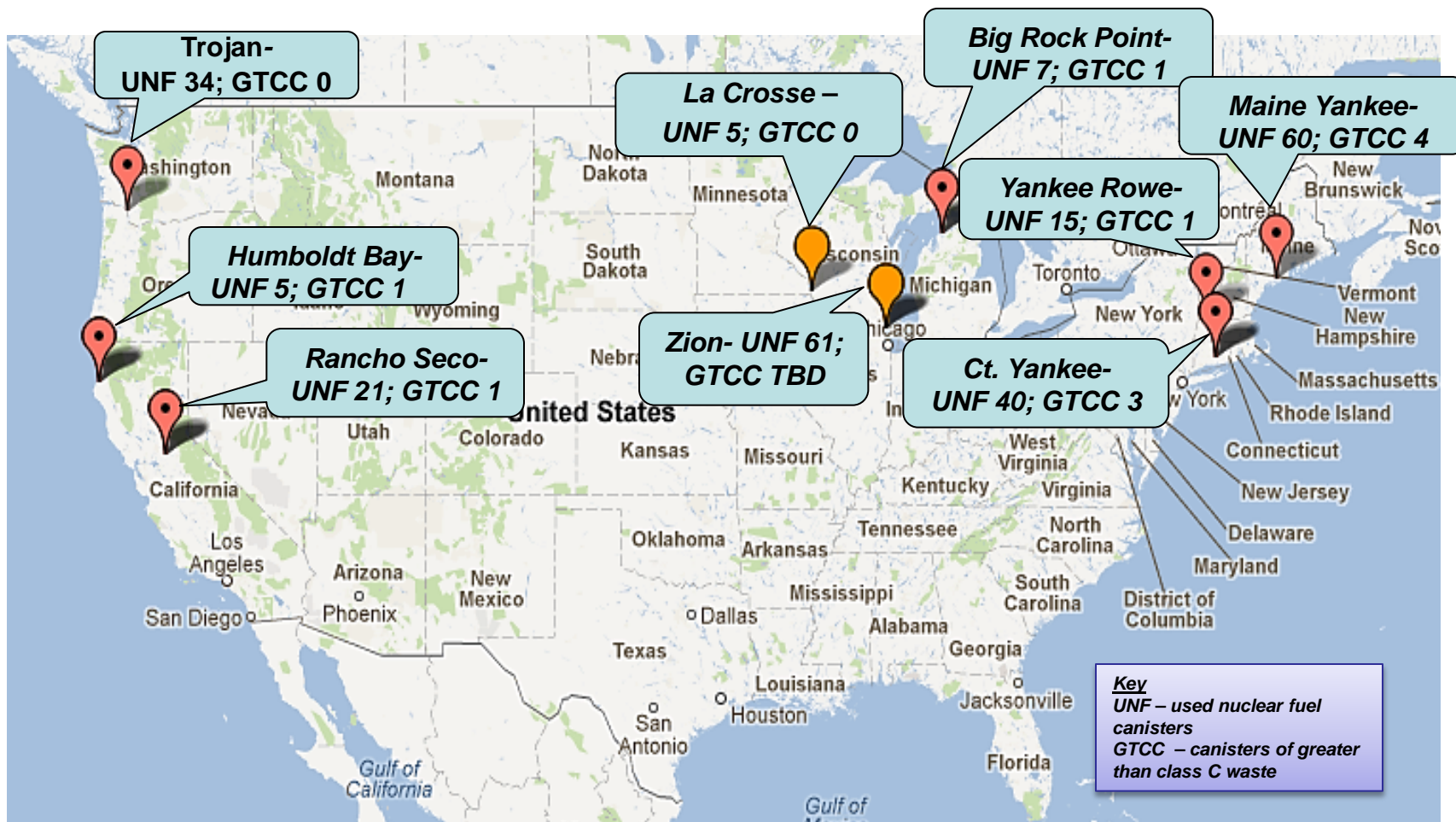
# Objectives of the DOE/NE Shutdown Sites Project

*What do we know about the sites, what are the gaps in our knowledge of the sites, what do we need to start doing now*

- DOE is conducting a preliminary evaluation of the nine stranded sites.
- This project is characterizing the following attributes of the sites:
  - Site Inventory
  - Site Conditions
  - Near-Site Transportation Infrastructure and Experience
- The study will characterize the actions necessary to remove used nuclear fuel from the shutdown sites.
- A report will be issued October 31, 2012 that identifies issues related to the transportation of stranded UNF from shutdown sites.



# Shutdown Sites with no Operating Reactor





# General Layout of an Independent Spent Fuel Storage Installation

- ISFSIs at the nine sites generally consist of a concrete pad with storage overpacks or storage modules.
- Canisters inside of concrete storage overpacks are certified for transportation
- Sites with ongoing D&D may have more infrastructure.





# Storage Systems Used at Shutdown Sites

Reactor Site (Shutdown Date)	ISFSI Load Dates	Storage System /Canister(s)	Transport Cask Status	Total Casks Fuel/GTCC	Total Assemblies
<b>Big Rock Point 8/97</b>	12/02-03/03	Fuel Solutions W150 Storage Overpack / W74 Canister	TS-125 Certificate expires 10/31/12. Never fabricated	7/1	441
<b>Connecticut Yankee 12/96</b>	05/04-03/05	NAC MPC / MPC-26 and MPC-24 canisters	NAC-STC Certificate expires 5/31/14. Foreign use versions fabricated.	40/3	1019
<b>Maine Yankee 8/97</b>	08/02-03/04	NAC UMS / UMS-24 canister	NAC-UMS Certificate expires 10/31/12. Never fabricated	60/4	1434
<b>Yankee Rowe 9/91</b>	06/02-06/03	NAC MPC / MPC-36 canister	NAC-STC Certificate expires 05/31/14. Foreign use versions fabricated.	15/1	533
<b>Rancho Seco 6/89</b>	04/01-08/02	TN NUHOMS/FO-DSC, FC-DSC, FF-DSC	NUHOMS MP-187 Certificate expires 11/30/13. One cask fabricated. No impact limiters.	21/1	493
<b>Trojan 11/92</b>	12/02-09/03	TranStor Storage Overpack Holtec MPC-24E and MPC24-EF canisters	HI-STAR 100 Certificate expires 3/31/14. Units fabricated, No impact limiters.	34	780
<b>Humboldt Bay 7/76</b>	08/08-12/08	Holtec HI-STAR HB / MPC-HB (MPC-80)	HI-STAR HB Certificate expires 3/31/2014. Fuel in fabricated casks. No impact limiters.	5/1	390
<b>La Crosse 4/87</b>	07/12-09/12	NAC MPC-LACBWR / MPC-LACBWR canister	NAC-STC Certificate expires 5/31/2014. Foreign use versions fabricated.	5	333
<b>Zion 1 and 2 7/98</b>	Planned 2013	NAC MAGNASTOR / TSC-37 canister	NAC MAGNATRAN License under review. Never Fabricated	61/TBD (estimated)	2,226

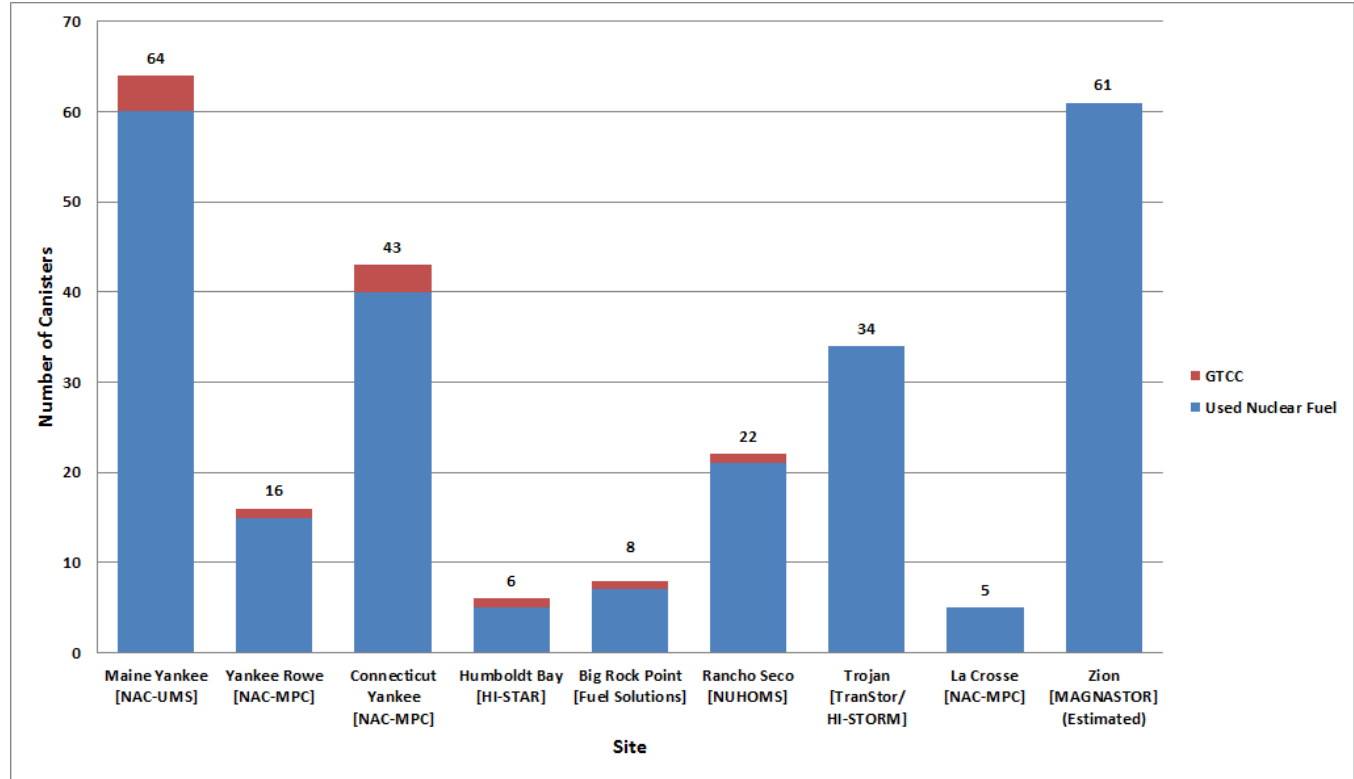




# Inventory at the Shutdown Sites

## Nuclear Energy

- 259 canisters containing used nuclear fuel (248) and greater-than-Class C radioactive waste (11) stored at the nine sites in Independent Spent Fuel Storage Installations (ISFSIs).
- All used nuclear fuel is in canisters; seven canister systems used.



# Attributes of Sites

## ■ Site Conditions

- Characterizing site infrastructure that is available to support removing of fuel from shutdown sites.
- Based on information from site visits and discussions with shutdown site managers.

## ■ Near-Site Transportation Infrastructure and Experience

- Characterizing feasibility of modes that could be used to transport fuel offsite.
- Rail, barge, and heavy haul truck.
- Based on information from site visits and discussions with shutdown site managers.
- Also based on site experience at large equipment removals during decommissioning and decontamination (D&D) of reactor facilities.



# Maine Yankee Site Attributes

- **Reactor type:** PWR
- **Net MWe:** 870 MWe
- **Operated:** 1973-1996
- **Storage system:** NAC-UMS
- **Canisters:** 60 UNF and 4 GTCC
- **Transport cask:** NAC-UMS cask
- **Transport mode:** Rail or barge





# Aerial View of Maine Yankee with Barge Slip



Maine Yankee ISFSI

Former Reactor Site

Location of Barge Slip

October 17, 2012

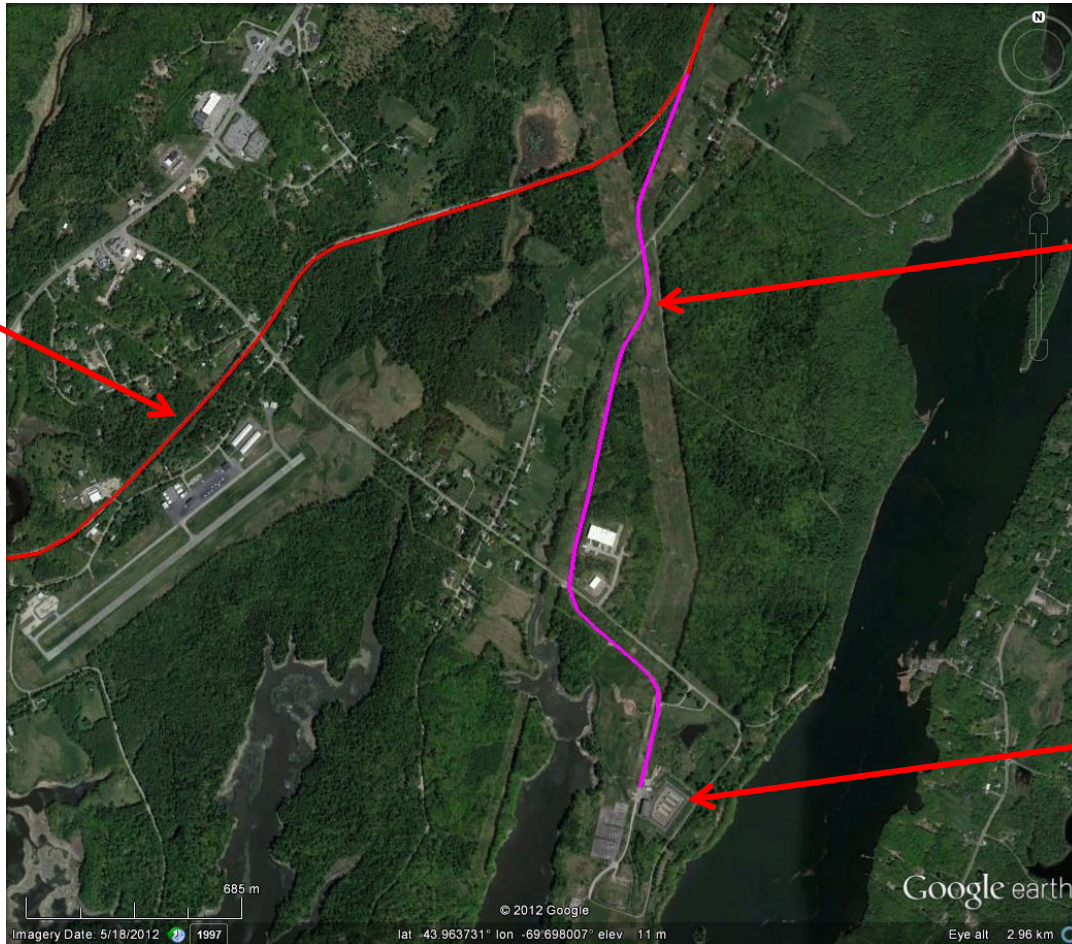


# Aerial View of Maine Yankee with Rail Spur

Maine Eastern Railroad (MERR)

Maine Yankee Rail Spur

Maine Yankee ISFSI





# Maine Yankee Barge Slip and Onsite Rail Line





# Yankee Rowe Site Attributes

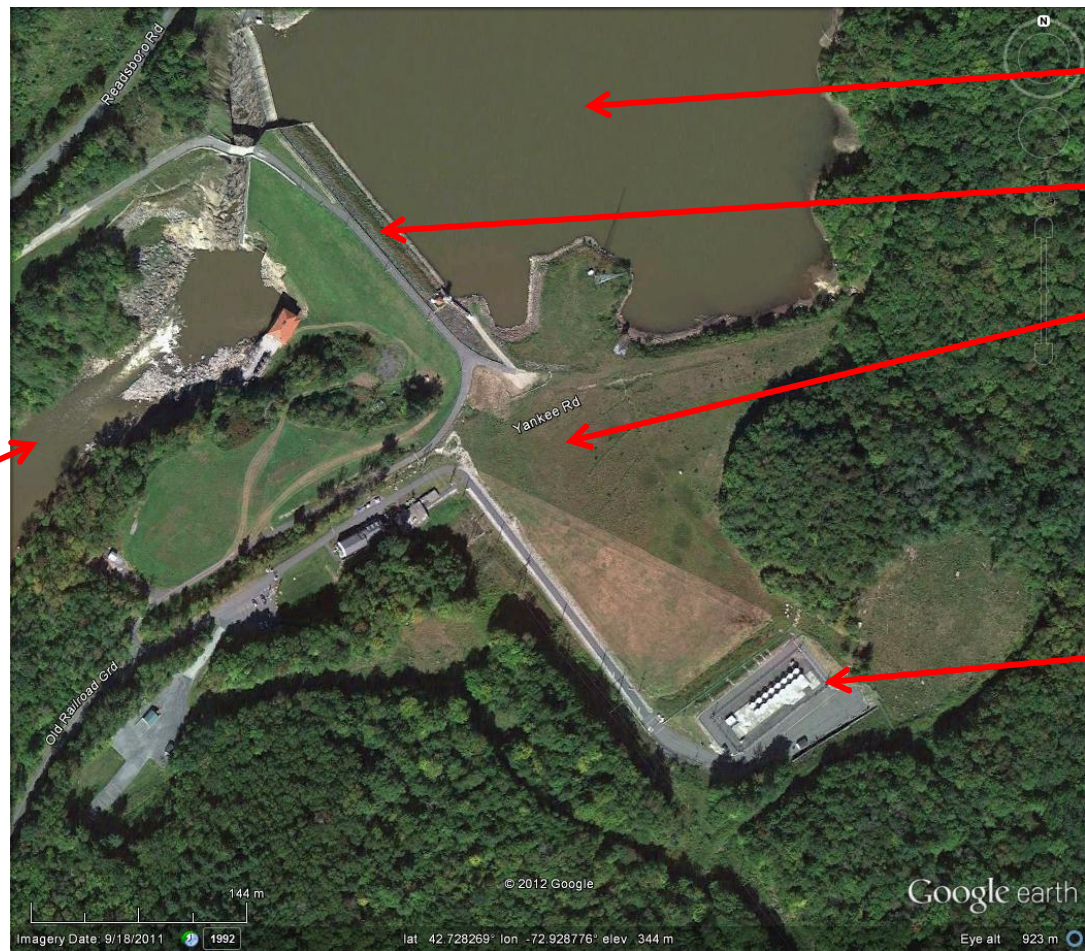
- **Reactor type:** PWR
- **Net MWe:** 175 MWe
- **Operated:** 1961-1992
- **Storage system:** NAC MPC
- **Canisters:** 15 UNF and 1 GTCC
- **Transport cask:** NAC-STC
- **Transport mode:** Heavy-haul truck to rail





# Aerial View of Yankee Rowe

## Nuclear Energy



Deerfield  
River

Sherman  
Reservoir

Sherman Dam

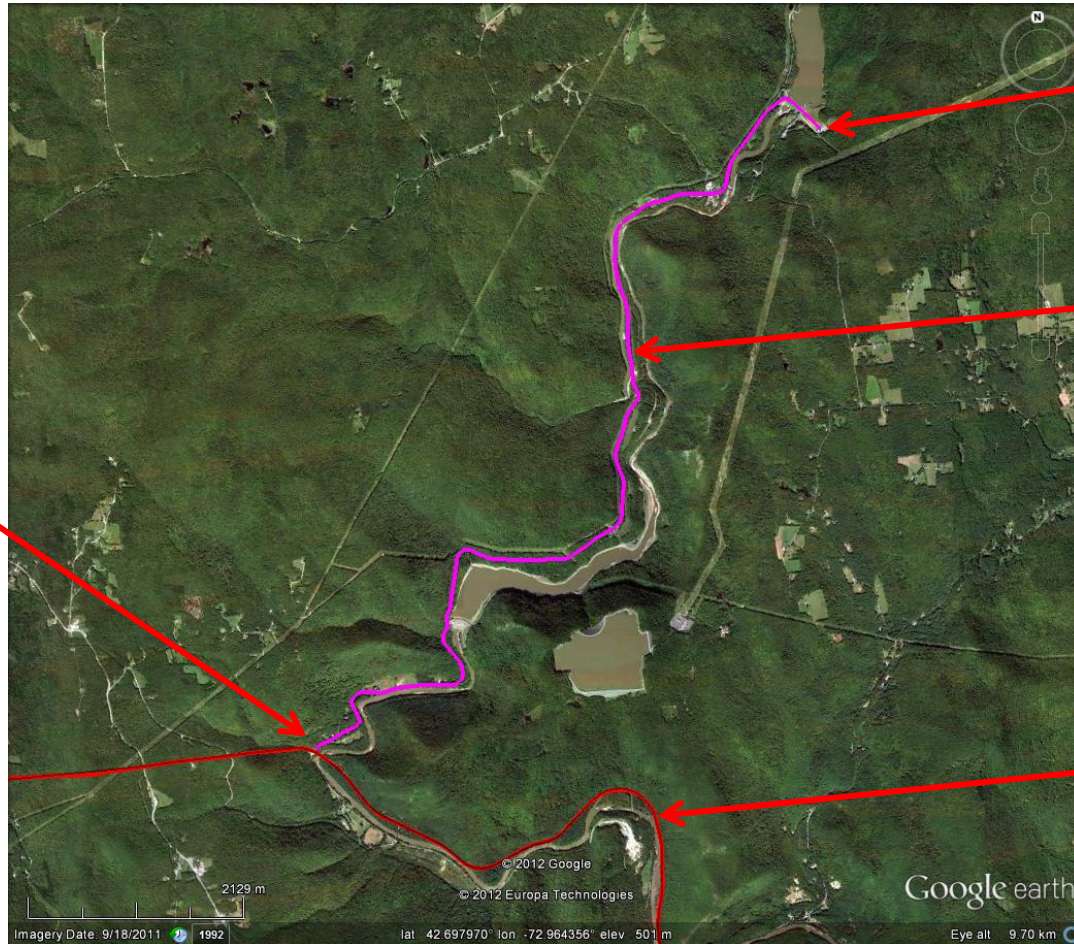
Former  
Reactor Site

Yankee  
Rowe ISFSI





# Yankee Rowe Heavy Haul Route to Rail



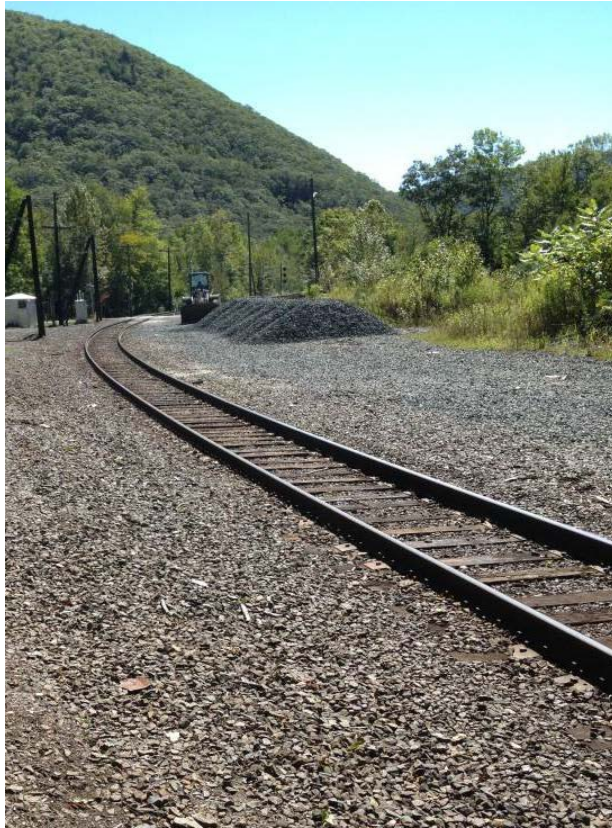
Yankee Rowe ISFSI

Heavy Haul Route

East End of Hoosac Tunnel

Pan Am Southern Railroad

# Offsite Rail Access at Hoosac Tunnel near Yankee Rowe





# Connecticut Yankee Site Attributes

- **Reactor type:** PWR
- **Net MWe:** 582 MWe
- **Operated:** 1974-1996
- **Storage system:** NAC MPC
- **Canisters:** 40 UNF and 3 GTCC
- **Transport cask:** NAC-STC
- **Transport mode:** Barge  
*Heavy-haul truck to rail potentially feasible*





# Aerial View of Connecticut Yankee



Former  
Reactor Site

Location of  
Barge Slip

Cooling water  
discharge canal

Connecticut  
River

Connecticut  
Yankee ISFSI

Onsite  
Road



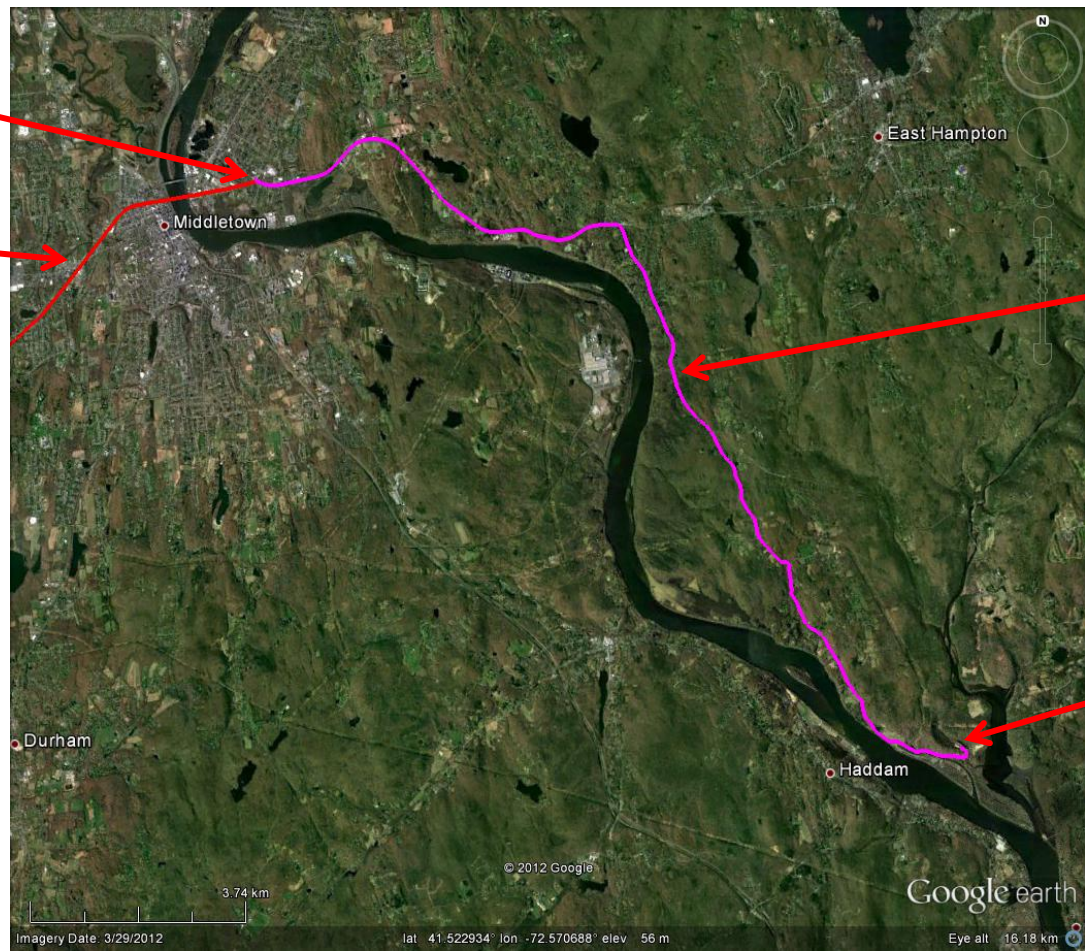
# Connecticut Yankee Heavy Haul Route to Rail

Portland  
Railhead

Providence  
and  
Worcester  
Railroad

Heavy Haul  
Route

Connecticut  
Yankee ISFSI





# Connecticut Yankee Barge Slip and Offsite Rail Access



## Observations at 3 Yankees

- Transfer casks would be need to be obtained or refurbished.
- Maine Yankee – rail or barge shipment are options, refurbishment of onsite rail or barge slip would be necessary.
- Yankee Rowe – heavy haul to rail necessary, some refurbishment of onsite road would be necessary.
- Connecticut Yankee – barge most likely, refurbishment of barge slip and dredging of barge canal would be necessary; heavy haul to rail possible, but in congested area (12 miles) and degraded rail access may require significant refurbishment.

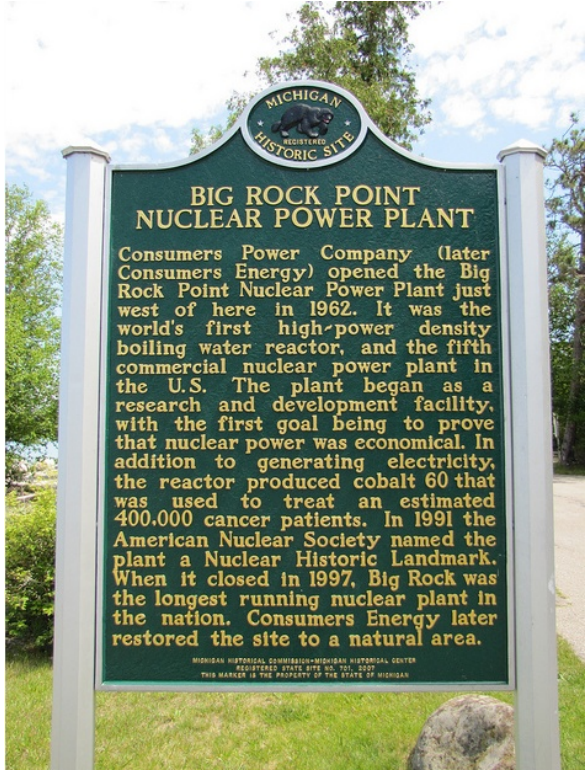




# Big Rock Point Site Attributes

## Nuclear Energy

- **Reactor type:** BWR
- **Net MWe:** 72 MWe
- **Operated:** 1964-1997
- **Storage system:** Fuel Solutions W150
- **Canisters:** 7 UNF and 1 GTCC
- **Transport cask:** Fuel Solutions TS-125
- **Transport mode:** Heavy-haul truck to rail  
*Barge potentially feasible*







# Aerial View of Big Rock Point

Nuclear Energy

**Former  
Reactor Site**



**Big Rock  
Point ISFSI**

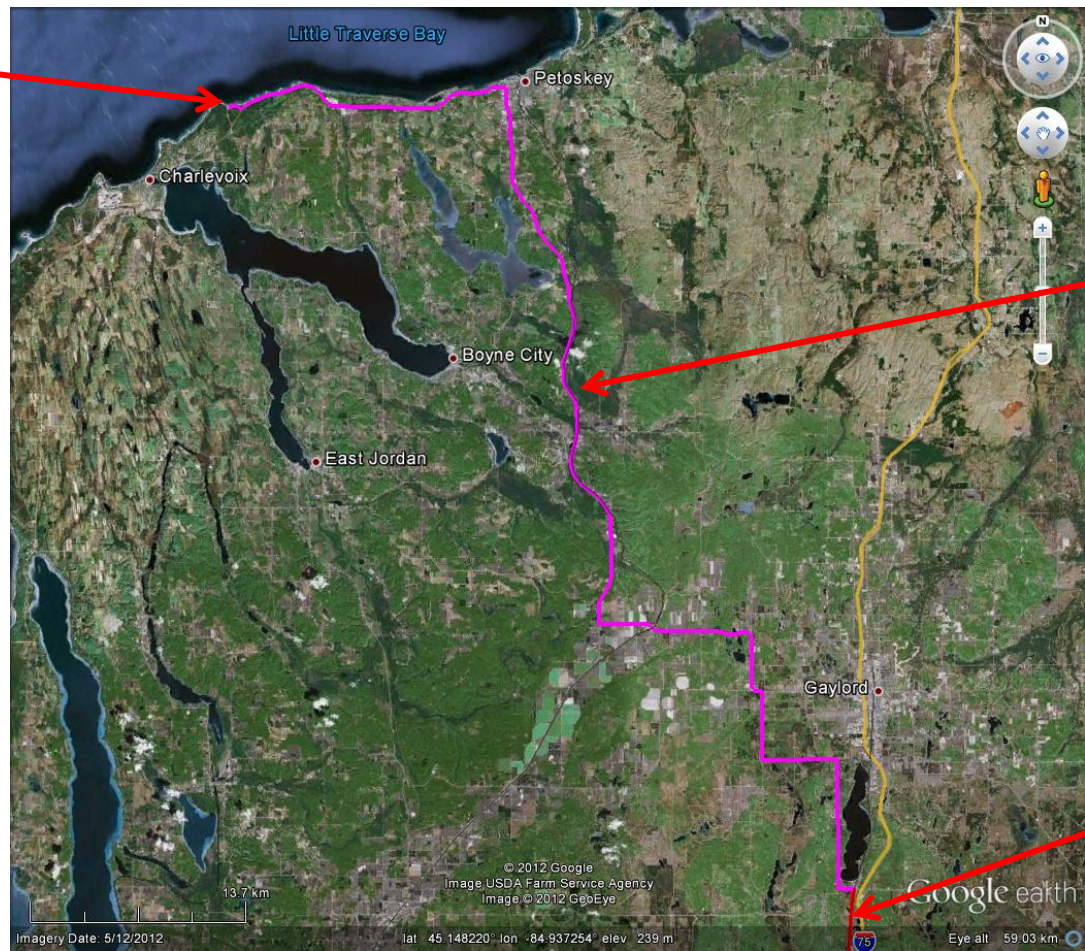


October 17, 2012



# Big Rock Point Heavy Haul Route to Rail

**Big Rock Point Site**



**Big Rock Point Heavy Haul Route**

**Lake State Railway**



# La Crosse Site Attributes

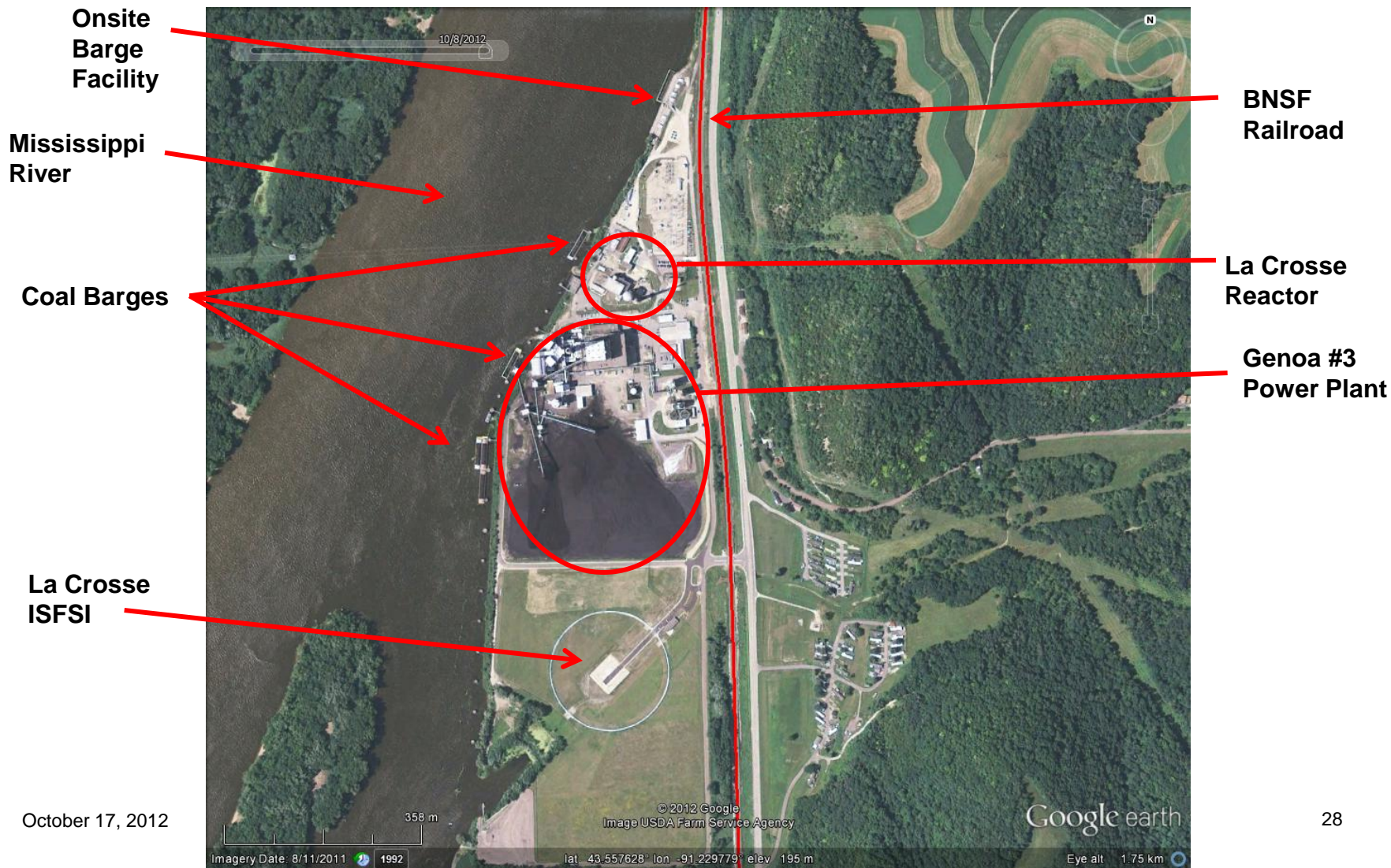
## Nuclear Energy

- **Reactor type:** BWR
- **Net MWe:** 51 MWe
- **Operated:** 1967-1987
- **Storage system:** NAC MPC-LACBWR
- **Canisters:** 5 UNF
- **Transport cask:** NAC-STC
- **Transport mode:** Rail  
*Barge potentially feasible*





# Aerial View of La Crosse with Railroad and Onsite Barge Facility



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# Zion 1 & 2 Site Attributes

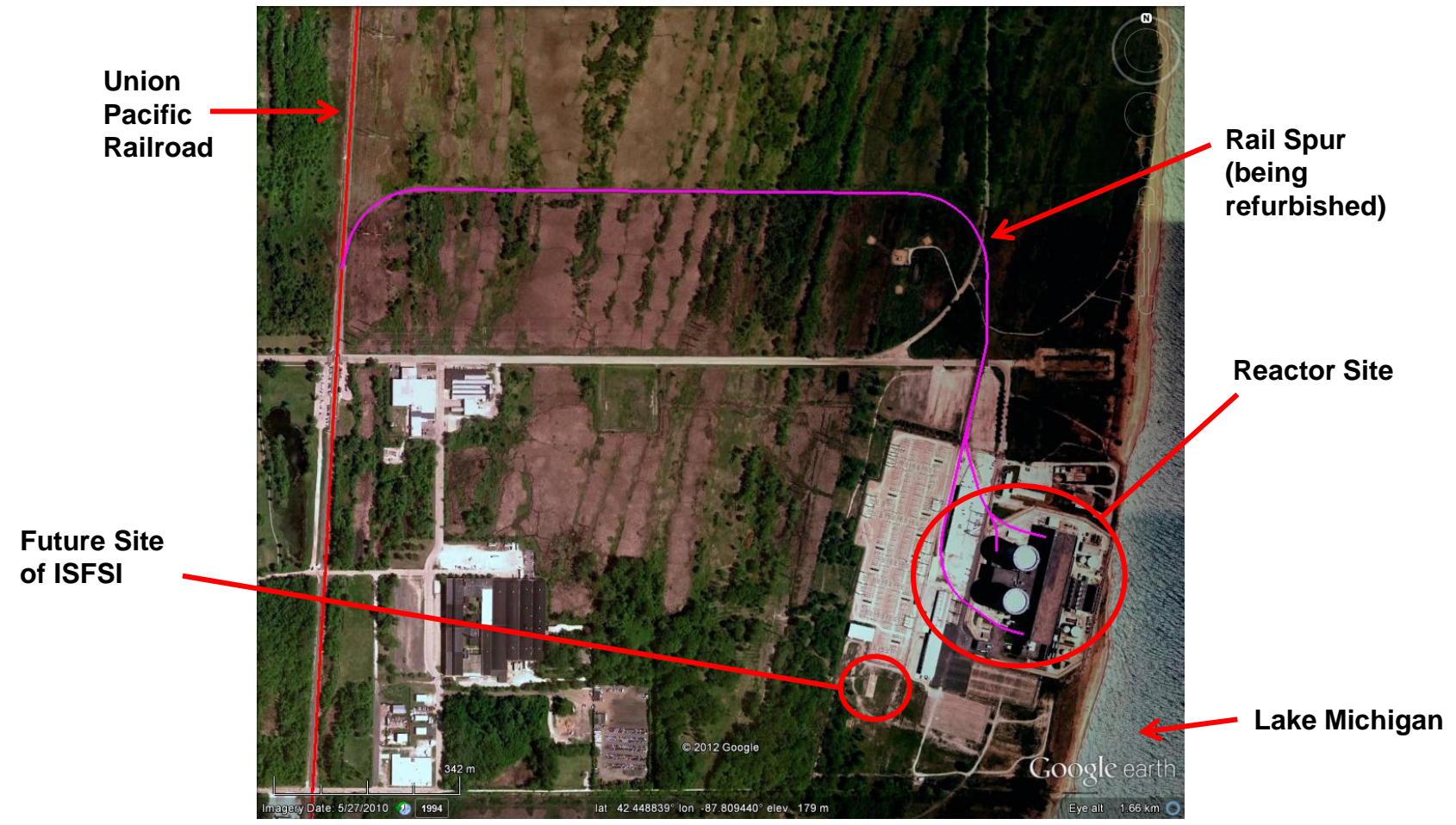
## Nuclear Energy

- **Reactor type:** PWR
- **Net MWe:** 1040 MWe each unit
- **Operated:** 1973-1997 (Unit 1), 1973-1996 (Unit 2)
- **Storage system:** NAC MAGNASTOR
- **Canisters:** 61 UNF (estimated), GTCC TBD
- **Transport cask:** NAC MAGNATRAN
- **Transport mode:** Rail  
*Barge potentially feasible*





# Aerial View of Zion with Rail Spur and Future ISFSI





# Rancho Seco Site Attributes

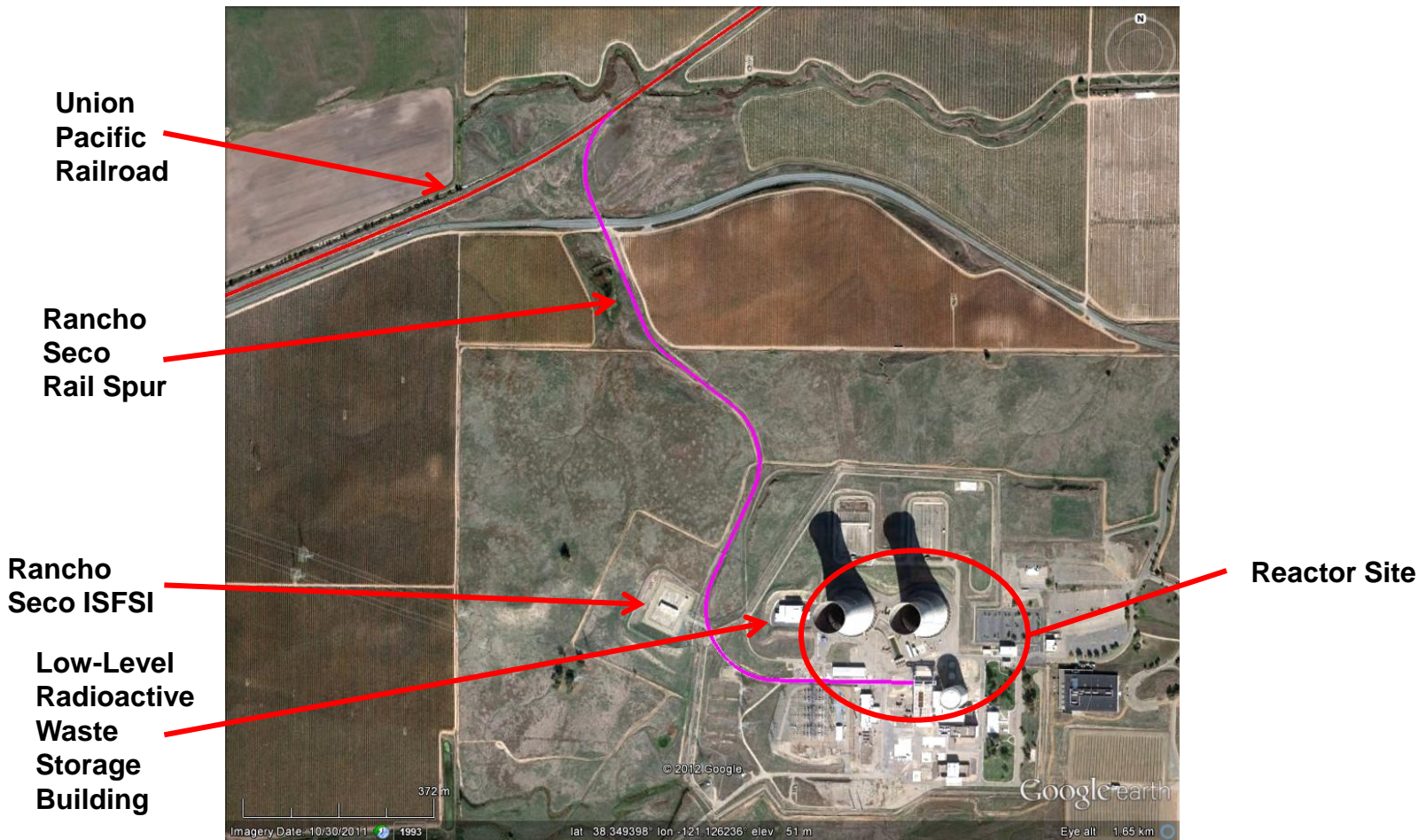
## Nuclear Energy

- **Reactor type:** PWR
- **Net MWe:** 928 MWe
- **Operated:** 1974-1989
- **Storage system:** TN NUHOMS
- **Canisters:** 21 UNF and 1 GTCC
- **Transport cask:** TN MP-187
- **Transport mode:** Rail





# Aerial View of Rancho Seco with Rail Spur







# Humboldt Bay Site Attributes

## Nuclear Energy

- **Reactor type:** BWR
- **Net MWe:** 63 MWe
- **Operated:** 1962-1976
- **Storage system:** Holtec HI-STAR HB (HI-STAR 100)
- **Canisters:** 5 UNF and 1 GTCC
- **Transport cask:** Holtec HI-STAR HB (HI-STAR 100)
- **Transport mode:** Barge  
*Heavy-haul truck to rail potentially feasible (170 miles)*



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# Humboldt Bay Site and Fields Landing Dock





# Trojan Site Attributes

## Nuclear Energy

- **Reactor type:** PWR
- **Net MWe:** 1130 MWe
- **Operated:** 1975-1992
- **Storage system:** TranStor Storage Overpack and Holtec MPC canisters
- **Canisters:** 34 UNF and 0 GTCC
- **Transport cask:** Holtec HI-STAR 100
- **Transport mode:** Rail  
*Barge potentially feasible*





# Aerial View of Trojan



**Portland and  
Western Railroad**

**Trojan ISFSI**

**Former  
Reactor Site**

**Location of  
Barge Slip**

# Evaluation of Shutdown Sites

- Conduct an initial assessment of the key activities that will need to be undertaken by the DOE and by the owners
- Develop a Project Plan and a representative schedule for the key program activities providing durations and sequencing for the activities



*Used Fuel Disposition Campaign*

*STRANDED FUEL TRANSPORTATION PROJECT PLAN*

*Revision B*

- Identify key procurement activities (e.g., railcars, casks)



# Transportation Infrastructure

## Nuclear Energy

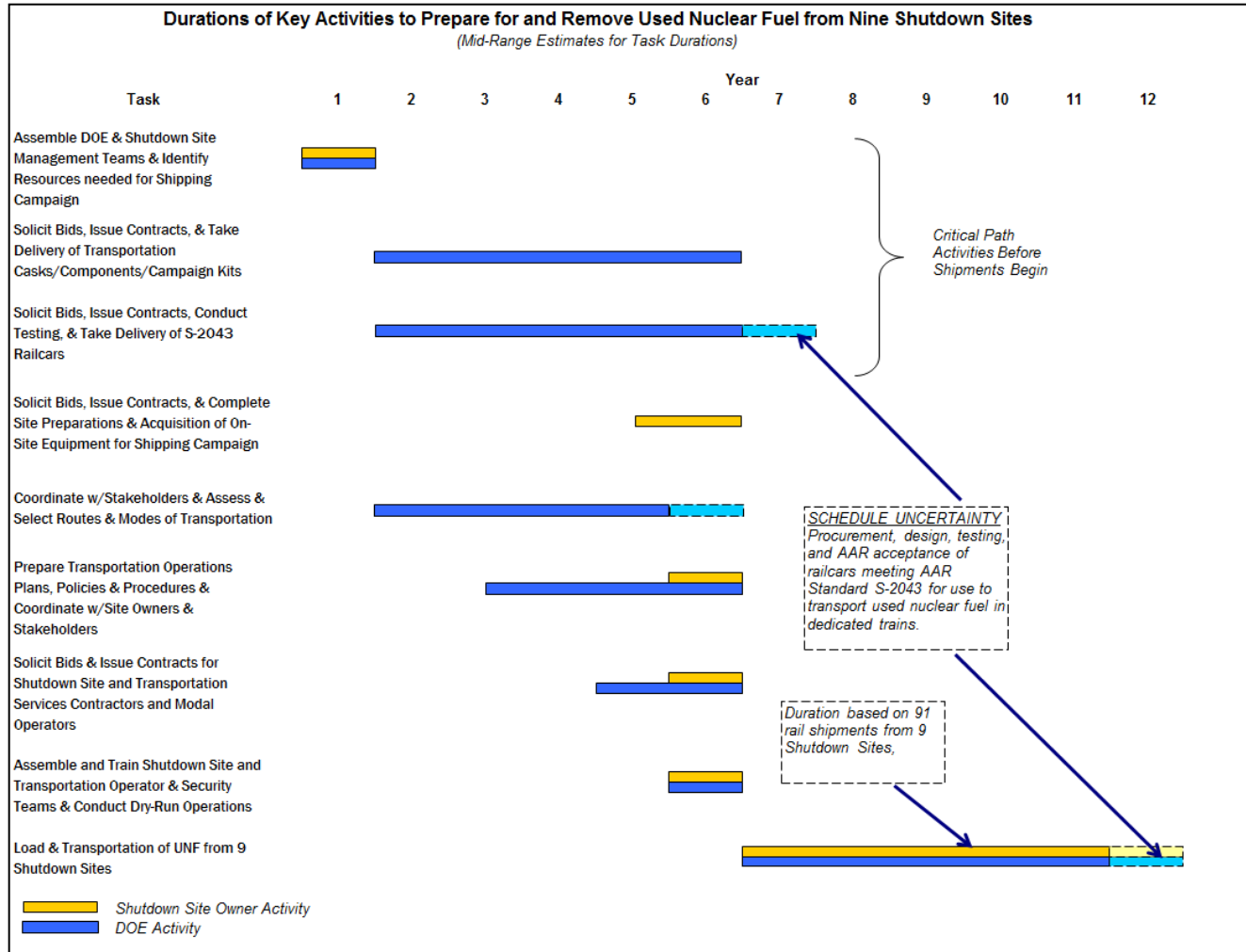
- All nine sites have some form of transportation access for shipping UNF
- In some cases, barge, rail, or heavy haul access would need to be refurbished, upgraded, or reinstalled prior to use
- Shortline railroads serving the shutdown sites will also need to be evaluated prior to shipping
- Large equipment removals associated with D&D provide recent relevant experience





# Durations for Project Activities

## Nuclear Energy



# Schedule: Key Assumptions

- **DOE will provide transportation casks.**
  - Exceptions: Humboldt Bay HI-STAR 100s and MP-187 at Rancho Seco
- **Shutdown Site owners will load casks and prepare them for shipment.**
  - The owners will also procure and use the appropriate transfer casks and other on-site special equipment and services for loading transportation casks
- **Cask-carrying railcars, buffer cars, and security escort cars will be required to meet AAR Standard S-2043.**
  - Acquisition of railcars whose designs comply with S-2043 presents a significant schedule uncertainty
- **Schedule assumes that a destination for the stranded fuel will be completed at the appropriate times.**
- **DOE will engage the states, tribes and other federal agencies in identifying routes and modes to be used from each of the sites.**
- **Railroad line meets minimum standards for rail transportation of used nuclear fuel.**
  - If it is necessary for a serving railroad to make mechanical or other improvements to the track and roadbed that would be used the duration could increase by 6 to 12 months



# Conclusions

- **DOE has initiated a preliminary evaluation of shipping UNF from the shutdown sites.**
  - The study is characterizing the actions necessary to remove used nuclear fuel from the shutdown sites
  - Preliminary site-specific schedules are being developed
- **All sites have fuel in storage configuration with NRC transportation certificates of compliance.**
- **Transportation casks will need to be manufactured but not designed.**
- **Most UNF packaged in canisters; canisters are not included in the Standard Contract.**
  - NRC questions regarding transportability of UNF after initial 20-year storage licensing period are uncertain.