U.S. DEPARTMENT OF ENERGY

Nuclear Fuels Storage & Transportation Planning Project
Office of Fuel Cycle Technologies
Nuclear Energy

Current Status of Shutdown Sites Activities

Transportation Infrastructure Near Crystal River

Steve Maheras
Pacific Northwest National Laboratory

SSEB Joint Meeting
New Orleans, LA
December 9-10, 2015

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Three Topics Covered

- Current Status of Shutdown Sites Activities
- Transportation Infrastructure Near Crystal River Based on Recent Site Visit
- Summary of Transportation Alternatives for Shutdown Sites

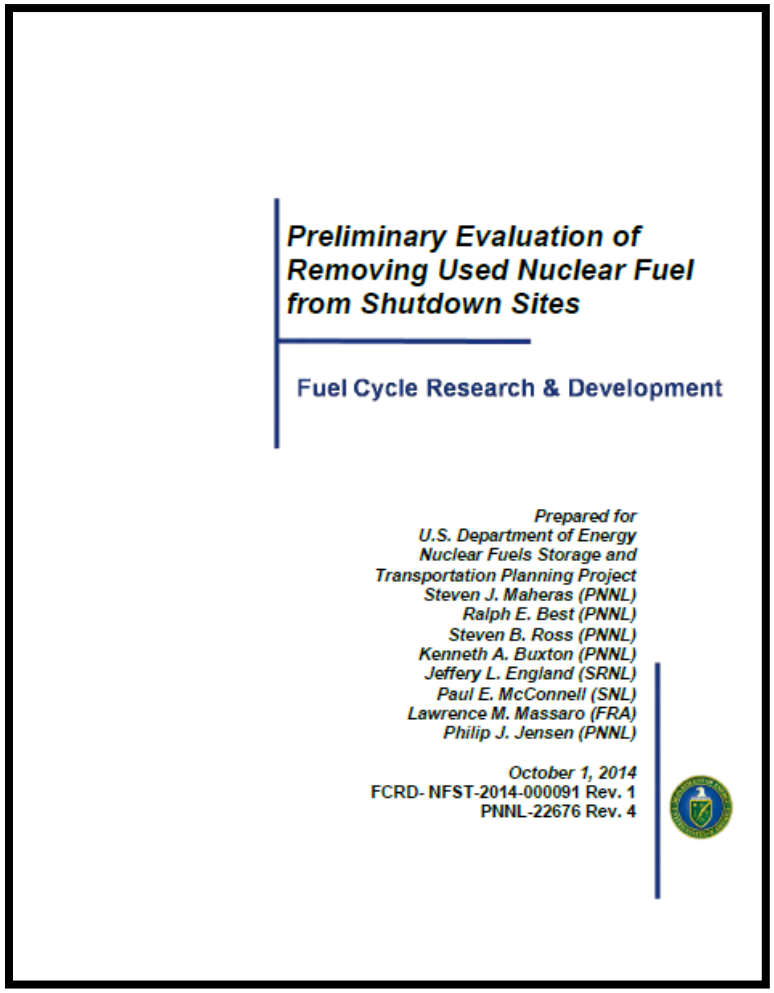
NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Shutdown Sites Evaluation

- **The purpose of the shutdown sites evaluation is to support planning for removing SNF and GTCC waste from shutdown nuclear power plant sites by collecting and documenting information related to**
  - Site inventory
  - Site conditions
  - Near-site transportation infrastructure and experience
- **Identify gaps in information needed to ship SNF and GTCC waste from the shutdown sites**
- **Based on the available information, identify options for transporting SNF and GTCC waste from the shutdown sites**



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 Transportation Planning Project
Steven J. Maheras (PNNL)
Ralph E. Best (PNNL)
Steven B. Ross (PNNL)
Kenneth A. Buxton (PNNL)
Jeffery L. England (SRNL)
Paul E. McConnell (SNL)
Lawrence M. Massaro (FRA)
Philip J. Jensen (PNNL)

October 1, 2014
FCRD- NFST-2014-000091 Rev. 1
PNNL-22676 Rev. 4

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Current Status of Shutdown Sites Activities

- Updated Shutdown Sites Report (SSR) posted on DOE-NE website on 05/28/2015
- Crystal River site visit occurred 02/18-02/19/2015
- San Onofre site visit occurred 06/02-06/05/2015
- State, State Regional Group (SRG), Tribal, and Federal Railroad Administration (FRA) representatives have now participated in 9 of the shutdown site visits
- Revised SSR submitted 09/18/2015
- Revised SSR includes information from Kewaunee, Crystal River, and San Onofre site visits, and includes Vermont Yankee as a new shutdown site
- Arranging Vermont Yankee site visit, anticipated to occur spring 2016

4

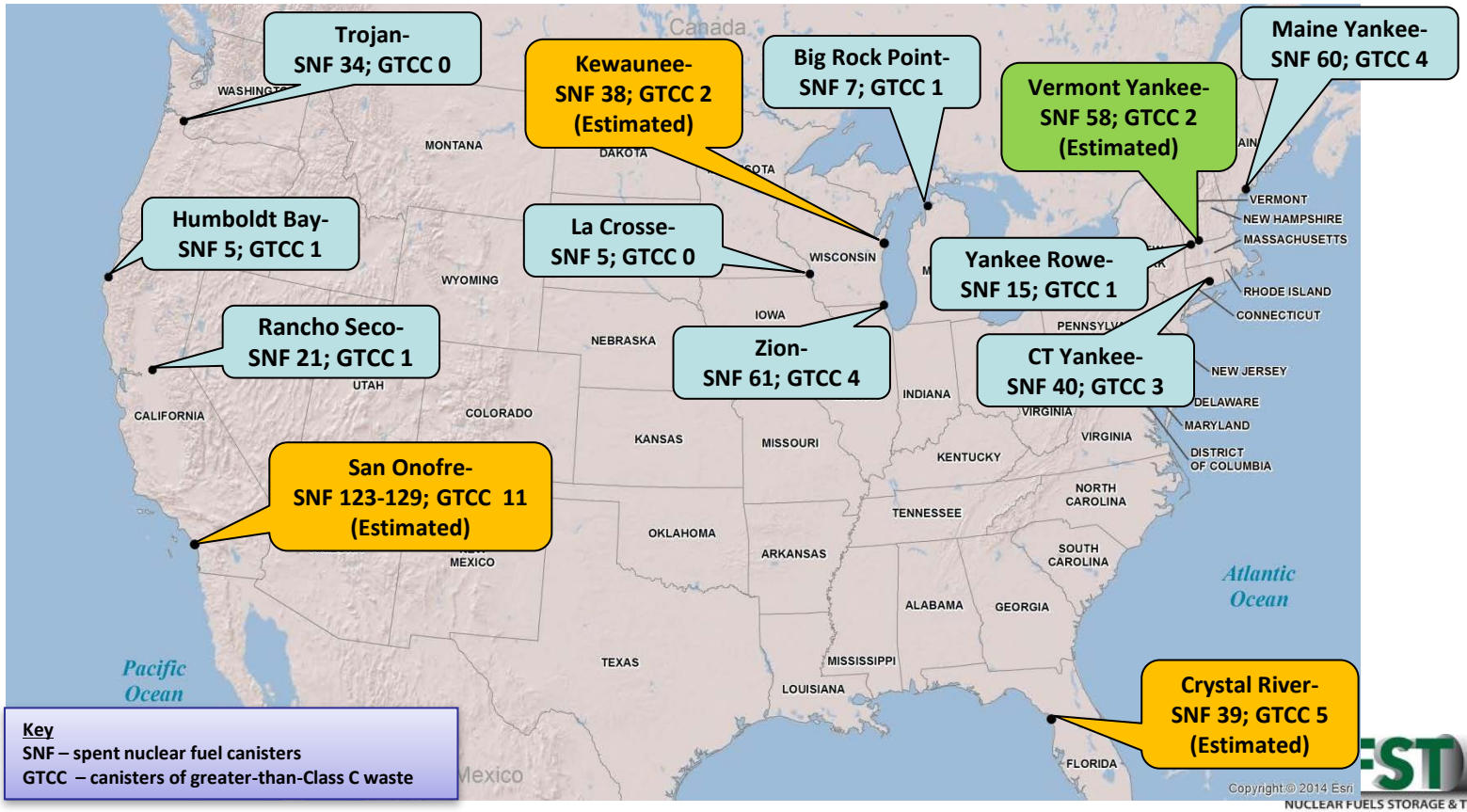
NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Locations of Shutdown Reactor Sites

- 541-547 total canisters [506-512 SNF, 35 GTCC waste] at 13 shutdown sites (estimated and actual)
- 11 dry storage systems
- 9 transportation casks



NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Sources of Information Used in Evaluation

- **Documents and Data Bases – Public Documents, DOE-RW Documents, DOE Used Fuel Disposition Campaign Documents, Data Bases, Nuclear Industry Sources**
  - DOE RW-859 Data Base
  - Facility Interface Data Sheets (FIDS), Services Planning Documents (SPDs), Facility Interface Capability Assessment reports (FICAs), and Near-Site Transportation Infrastructure reports (NSTIs)
- **Independent Spent Fuel Storage Installation (ISFSI) Site Managers**
  - Confirmed information obtained from other sources
  - Clarified current conditions at the shutdown sites
  - Provided photos and other detailed information
- **Heavy Equipment Lifting, Rigging, and Transporting Companies**

MP187 Transportation Cask Heavy Haul to Rancho Seco

Big Rock Point Reactor Pressure Vessel Heavy Haul

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

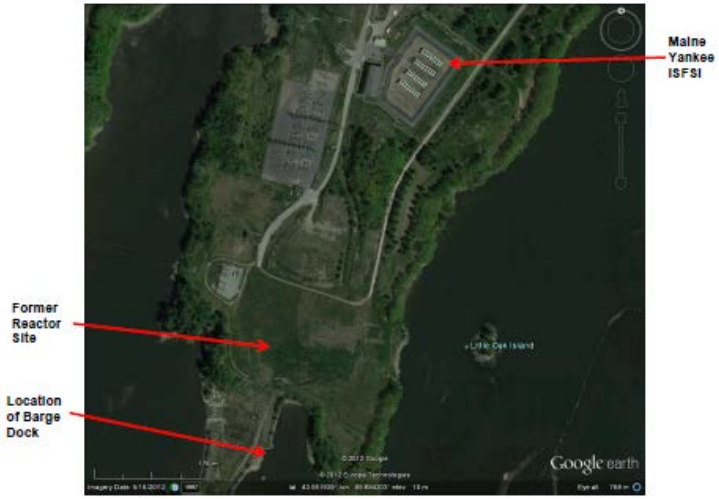
U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Sources of Information Used in Evaluation (continued)

- **Shutdown site visits**
  - Twelve shutdown sites visited from August 2012 through June 2015
  - Confirmed aspects of inventories at the sites, obtained detailed inventory data by canister, and canister load maps
  - Observed transportation infrastructure at and near sites
  - Detailed photos taken at sites
  - State, State Regional Group (SRG), Tribal, and Federal Railroad Administration (FRA) representatives have participated in 9 shutdown site visits
- **Google Earth**
  - Understand layout of shutdown sites
  - Used to provide detailed maps of shutdown sites and ISFSIs
  - Portray transload locations, and rail and heavy haul routes

Current Condition of Onsite Rails at Maine Yankee



Maine Yankee Site

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Site Conditions

- **On-Site Transportation Features**
  - On-Site Rail
  - On-Site Roads for H-H Trucks
  - Barge Access
- **On-Site Equipment to Support Transportation Operations**
  - Transfer Casks
  - Cranes and Rigging
- **On-Site Staging Areas for Transport Vehicles, Equipment and Operations Support**

Photo courtesy of La Crosse

Onsite Rail Spur at La Crosse

Photo courtesy of Trojan

Trojan Transfer Station

Photo courtesy of Big Rock Point

Big Rock Point Horizontal Transfer System

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Near-Site Transportation Infrastructure and Experience

- **Evaluate transportation mode options for the shutdown sites**
- **Near-Site Rail Access**
  - Condition and capacity of near-site rail infrastructure
  - Potential transload locations
  - Site experience with rail shipments
- **Local Roads and Highways**
  - Distance to potential rail transload locations (rail spurs or sidings)
  - Characteristics and condition of roads and associated infrastructure that would be used by heavy haul vehicles
  - Site experience with heavy haul shipments
- **Barge Access**
  - Characteristics of onsite or nearby docks/slips/shorelines
  - Site experience with barge shipments

Junction of Onsite Rail Spur and Union Pacific Railroad at Zion

Low Overhead Bridge Near Big Rock Point

Railroad Grade Crossing at East Portal of Hoosac Tunnel Near Yankee Rowe

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Crystal River

- **Crystal River site visit 02/18-02/19/2015**
- **Crystal River has no SNF in dry storage**
  - 1244 PWR assemblies in pool
  - 428 high burnup (HBU) assemblies
- **Crystal River will use NUHOMS horizontal storage modules (HSMs) for dry storage**
  - 39 32PTH1 canisters estimated, plus 5 canisters of GTCC waste from decommissioning
  - Spent fuel pool will be kept in recoverable condition until all fuel removed from the site
- **Crystal River has direct rail access and barge access**

Future ISFSI Location (Looking North)

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

Loading NUHOMS Horizontal Storage Modules (HSMs)

Photos courtesy of AREVA TN

Crystal River Site Layout

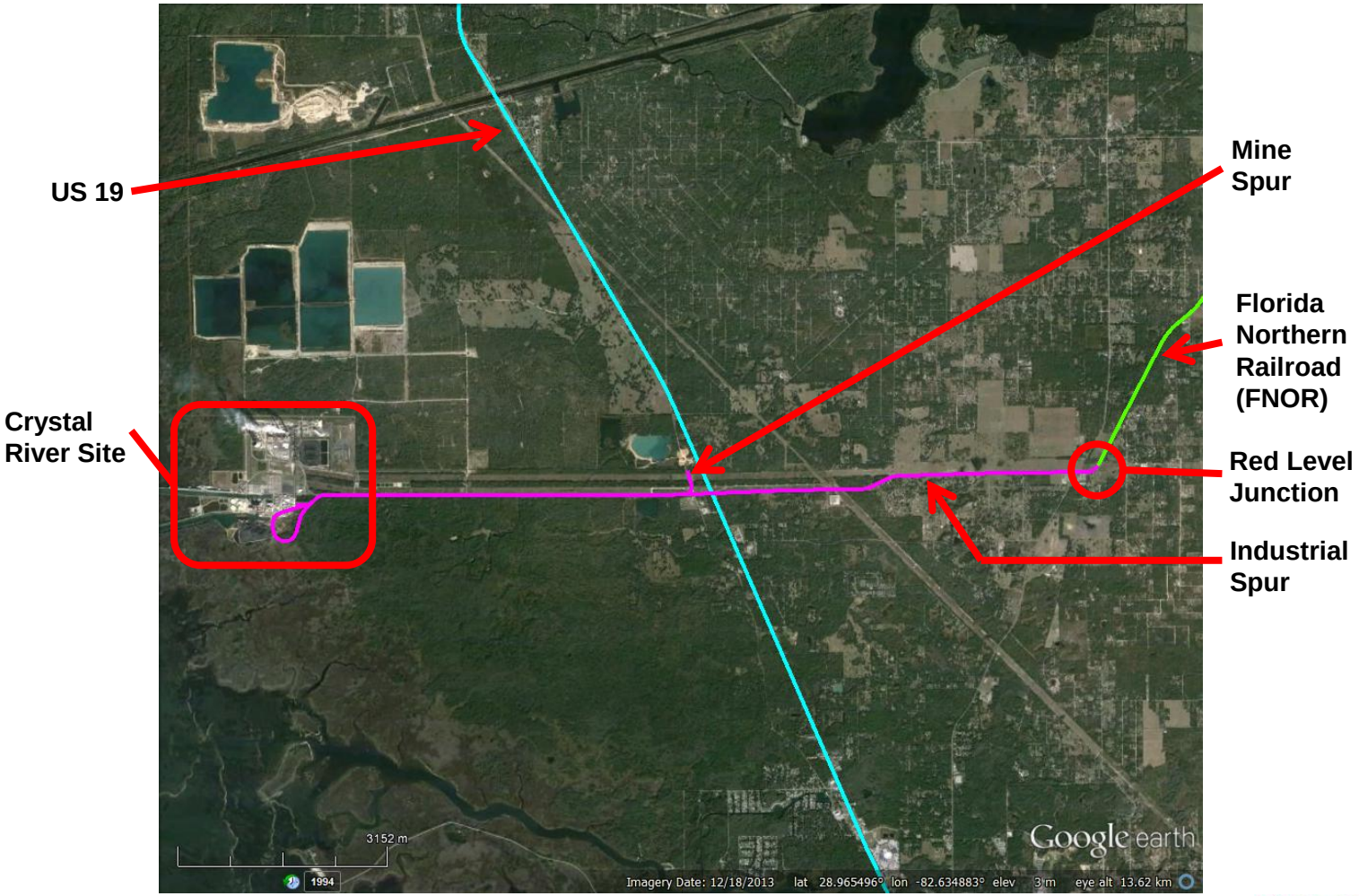
U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Crystal River Future ISFSI Location

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

Industrial Rail Spur to Florida Northern Railroad (FNOR)
(About 7 miles)



Crystal River Onsite Rail in Front of Future ISFSI

Onsite Rail Facing East

Onsite Rail Facing West

More Onsite Rail

Junction of Onsite Industrial Spur and Nuclear Spur

Nuclear Spur

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

More Onsite Rail

Onsite Industrial Spur at Cool Loop Junction

Onsite Industrial Spur Approaching US Highway 19 from the West

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Crystal River Has Shipped and Received Large Components by Rail

Four Moisture Separator Reheaters (MSRs)
300,000 lb. (each)
51’ long x 14’ diameter
(July 2009)

Generator Rotor
395,000 lb.
50’ long x 8’ diameter
(October 2009)

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Crystal River Has Shipped and Received Large Components by Rail (cont.)

Shipping old MSRs offsite (June 2011)

Unloading Generator Rotor

CSX locomotive picking up old MSRs (June 2011)

Unloading New MSRs

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

Receipt of Horizontal Storage Modules by Rail in 2015

Two Horizontal Storage Modules Loaded onto Railcars

Horizontal Storage module Staged for Unloading

Received 12 horizontal storage modules
Each horizontal storage module weighed 189,000 lb.

Receipt of Horizontal Storage Modules by Rail (cont.)

Horizontal Storage Module Being Unloaded from Railcar

Horizontal Storage Modules Staged at Nuclear Spur after Unloading

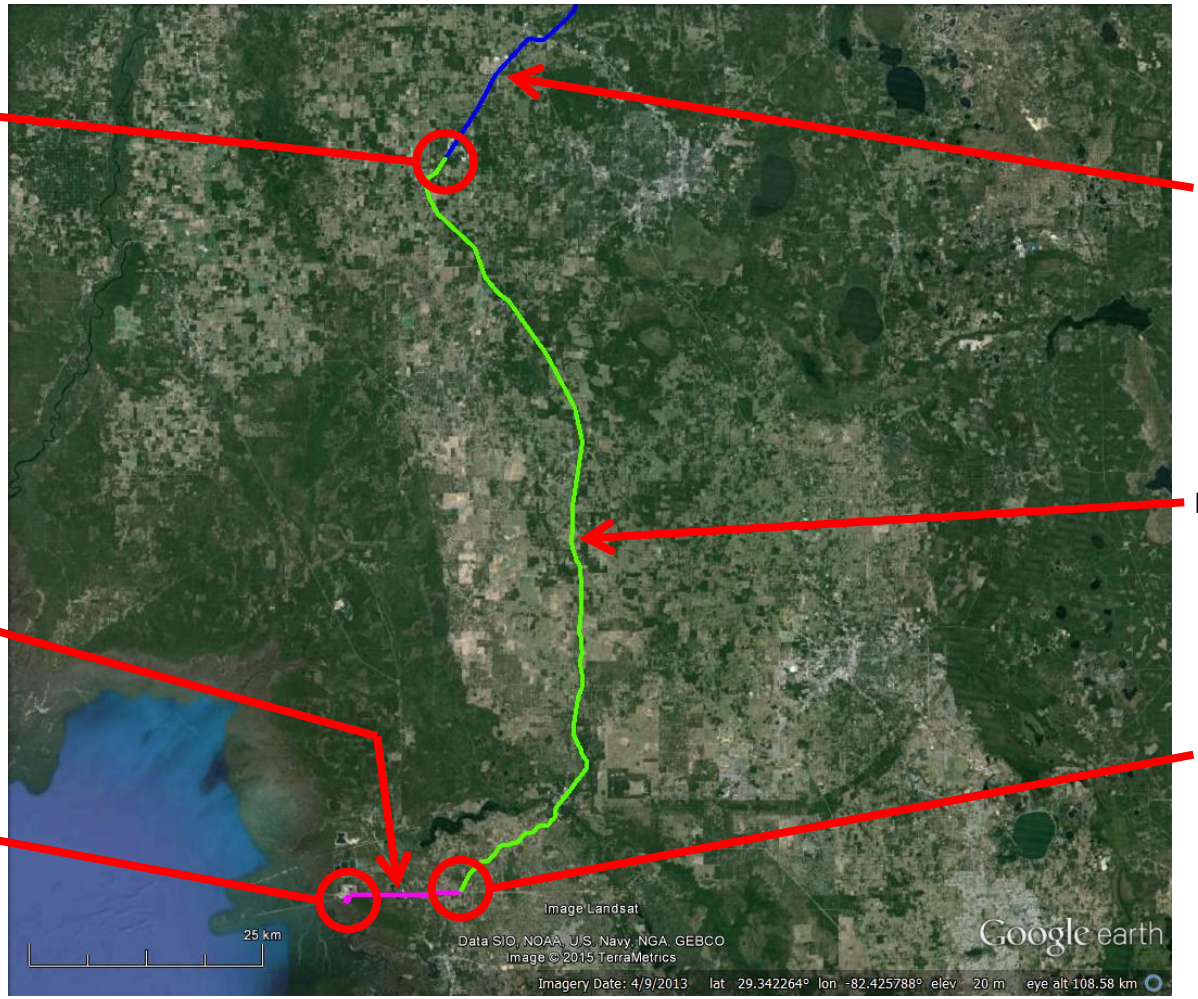
Hi-Railing of Industrial Spur and FNOR Track

- **Crystal River regularly receives shipments of coal by rail**
  - 100-110 tons per car
  - 100 car coal trains
- **During Crystal River site visit, the Shutdown Sites Team rode with FNOR staff during their weekly track inspection**
- **Started on Crystal River industrial spur and ended in Newberry, Florida, a distance of about 65 miles**
  - The industrial spur is not normally part of the FNOR inspection, but we were allowed access so we could photograph the entire route

Track Maintenance Equipment Staged at Mine Spur

Hi-Rail Vehicle Used for Track Inspections

FNOR to CSX in Newberry, Florida (About 58 miles)



Newberry Wye

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

FNOR Infrastructure

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Defect Detectors on FNOR

Wheel Detectors (count # of axles, determine speed, open shutter for hot bearing detector)

Hot Bearing Detector

115 lb. Rail

Dragging Equipment Detector

NUCLEAR FUELS STORAGE & TRANSPORTATION

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

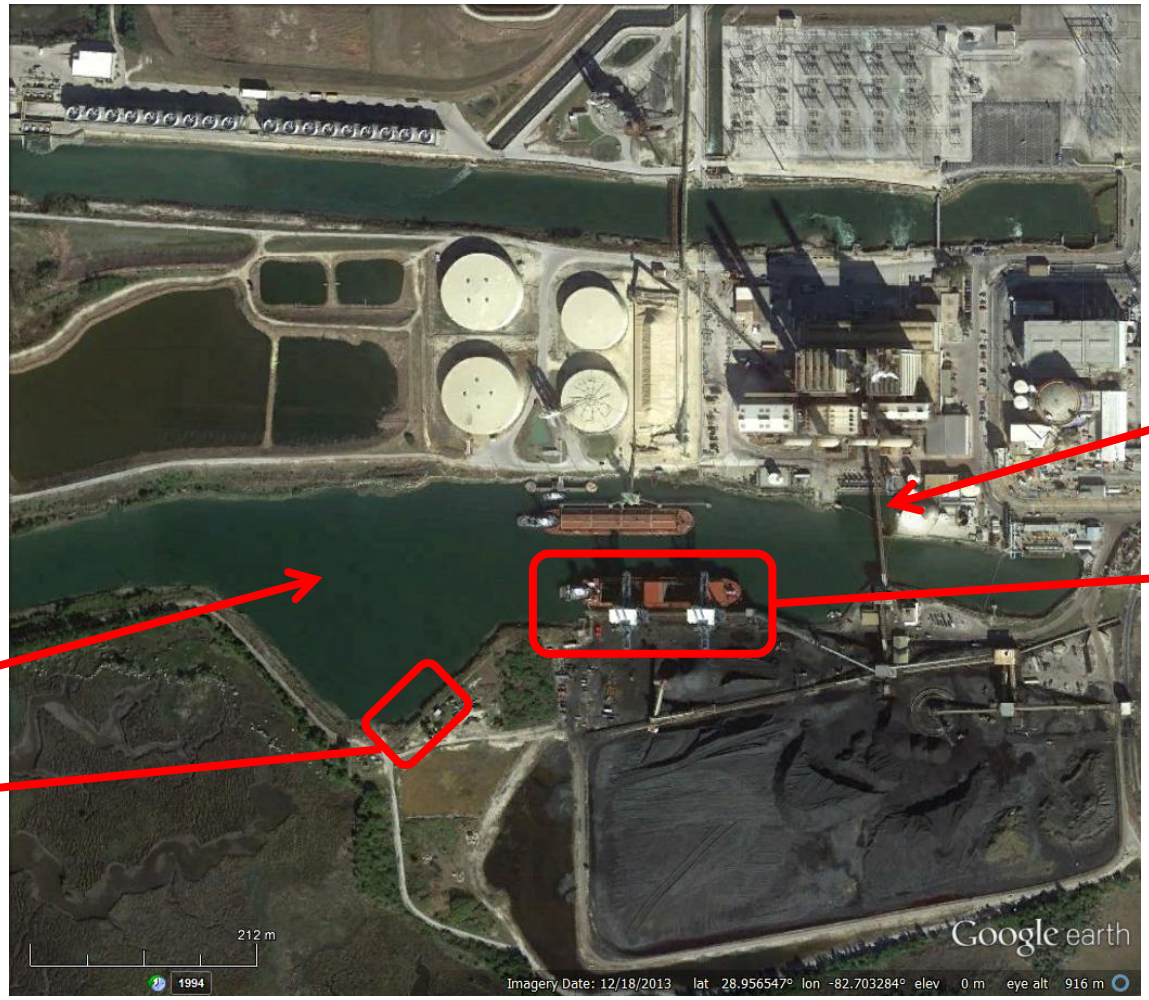
Crystal River Barge

- Crystal River routinely receives coal in 20,000 ton barges
- This coal is unloaded at a specialized barge area
- Crystal River also received turbine components by barge in June 2012, but constructed a specially prepared area in the barge turning basin to receive these components using rollon/rolloff ramps

Two low pressure rotors 353,000 lb. (each)
Two low pressure upper casings 117,000 lb. (each)
Two low pressure lower casings 200,000 lb. (each)

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

Crystal River Barge Area



Coal Conveyer to CR-1 and -2

Coal Barge Unloading Area

Barge Turning Basin

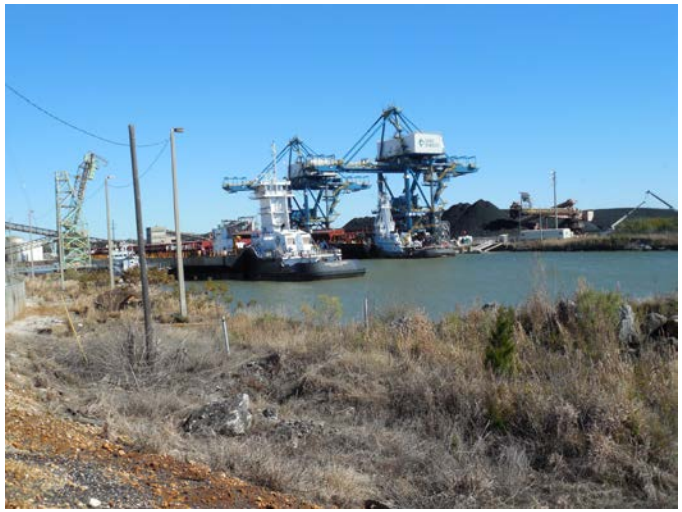
Area Where Turbine Components Offloaded

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Crystal River Barging

Coal Barge Unloading Area (Left) and Coal Conveyer



Coal Barge Unloading Area with Tugboats and Coal Barge

Barge Turning Basin

NFST NUCLEAR FUELS STORAGE & TRANSPORTATION

Crystal River Barging (cont.)

Docking Barge with Turbine Components

Barge with Turbine Components Grounded at Ramp

Turbine Components Being Unloaded Using Self-Propelled Modular Transporter (SPMT)

Crystal River Heavy Haul Truck Transport

High Pressure Turbine Delivered to Crystal River by Heavy Haul Truck

High Pressure Turbine weighed 150,000 lb.

U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Summary of Transportation Mode Options Identified for Shutdown Sites

Reactor Site	Transportation Mode Options		Comments
Maine Yankee	Direct rail	Barge to rail	The condition of the onsite rail spur and Maine Eastern Railroad would need to be verified.
Yankee Rowe	Heavy haul truck to rail	—	Potential rail transload location at east portal of the Hoosac Tunnel (7.5 miles from site).
Connecticut Yankee	Barge to rail	Heavy haul truck to rail	Depth of barge canal uncertain and may require dredging to accommodate barges. Potential rail transload location at Portland rail spur (12 miles from site).
Humboldt Bay	Heavy haul truck to rail	Heavy haul truck to barge to rail	Potential rail transload locations located 160 to 260 miles from site. The condition of the Fields Landing Terminal barge transload location would need to be verified.
Big Rock Point	Heavy haul truck to rail	Barge to rail	Potential rail transload locations in Petoskey, Michigan (13 miles from site) and Gaylord, Michigan (52 miles from site).
Rancho Seco	Direct rail	—	The rail spur is not being maintained.
Trojan	Direct rail	Barge to rail	The onsite rail spur was removed. Barge used to ship reactor pressure vessel and steam generators.
La Crosse	Direct rail	Barge to rail	The onsite rail spur was used to ship reactor pressure vessel.
Zion	Direct Rail	Barge to rail	The onsite rail spur was recently refurbished.
Crystal River	Direct rail	Barge to rail	Extensive onsite rail system. Potential onsite barge area.
Kewaunee	Heavy haul truck to rail	Heavy haul truck to barge to rail	Potential rail transload locations in Bellevue, Luxemburg, Denmark, and Manitowoc. Potential barge transload location in city of Kewaunee.
San Onofre	Direct rail	Heavy haul truck to barge to rail	Onsite rail spur recently refurbished.
Vermont Yankee	Direct rail	—	Have not conducted site visit.

NUCLEAR FUELS STORAGE & TRANSPORTATION