

Power Reactor Decommissioning: U.S. Perspective on Regulatory Insights and Challenges

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Agenda

- Impact of Recent Reactor Shutdowns
- Inspections During Decommissioning
- Costs of Decommissioning
- Waste Storage Considerations
- Key Decommissioning Improvements

Decommissioning Challenges

- Significant time has elapsed since the last wave of reactor shutdowns in the 1990s
- Several regulatory areas have changed or been updated since last round of decommissioning
- Many NRC regulations do not have a clear path for transitioning from operation to a decommissioning status

Recent Reactor Shutdowns

- **Crystal River Unit 3** - Crystal River, Florida (February 2013)
- **Kewaunee Power Station** - Kewaunee Wisconsin (May 2013)
- **San Onofre Nuclear Generating Station, Units 2 & 3** - San Clemente, California (June 2013)
- **Vermont Yankee Nuclear Power Station** - Vernon, Vermont (December 2014)
- **Oyster Creek Nuclear Generating Station** - Forked River, New Jersey (Announced Shutdown in 2019)

Reactor Operation to Decommissioning Transition Activities

- Notification of permanent cessation of operations and permanent removal of fuel from the reactor
- Submittal of Post Shutdown Decommissioning Activities Report (PSDAR) and associated public meeting
- Inspection oversight continues
- Program oversight responsibility
- Licensing basis

Impact of Recent Shutdowns

- Multiple changes to the licensing basis are required and need NRC approval
- Staff resources challenged by lack of notice for change from operation to decommissioning
- Formed a working group to create guidance and lessons learned while giving timely support to the workload for transition

NRC Working Group on Decommissioning Transition



- **Short Term Goal**
 - Improve efficiency and effectiveness of current transition process through guidance development and templates
- **Long Term Goal**
 - Rulemaking to improve the reactor decommissioning process with a completion objective of 2019
- **Coordination and Communications**
 - Public and intergovernmental meetings and outreach
 - Consistent and effective communications with public, Federal partners, States, and local communities

Objectives of the NRC Inspection Program

- Objectively verify safe conduct of licensee's decommissioning activities
- Verify adequacy of licensee controls
- Ensure safety problems and violations are promptly identified and corrected, and effective actions are taken to prevent recurrence
- Examine trends in licensee safety performance

Inspection Activities

- Dedicated reactor inspection program for decommissioning (40+ inspection procedures)
- Inspections of spent fuel pool safety
- Inspections of decommissioning activities
 - Scheduled during periods of higher risk activities and most procedures are conducted at least annually
 - During and after remediation activities, NRC conducts independent radiological measurements to confirm licensee survey methodologies
- Inspections of physical security and emergency planning

Costs Influencing Decommissioning

- The Electric Power Research Institute Report on Decommissioning Experiences and Lessons Learned: Decommissioning Costs
 - Generating capacity of the plant does not significantly influence decommissioning costs
 - A major cost is staffing during decommissioning
 - Radiological waste disposal costs are also a significant portion of decommissioning

Funding Challenges

- Potential fluctuations in the decommissioning fund due to market variations
- Need to remediate subsurface contamination (addressed by a decommissioning planning rule)
- New decommissioning business model – transferring license to a decommissioning contractor for dismantlement

Zion Decommissioning

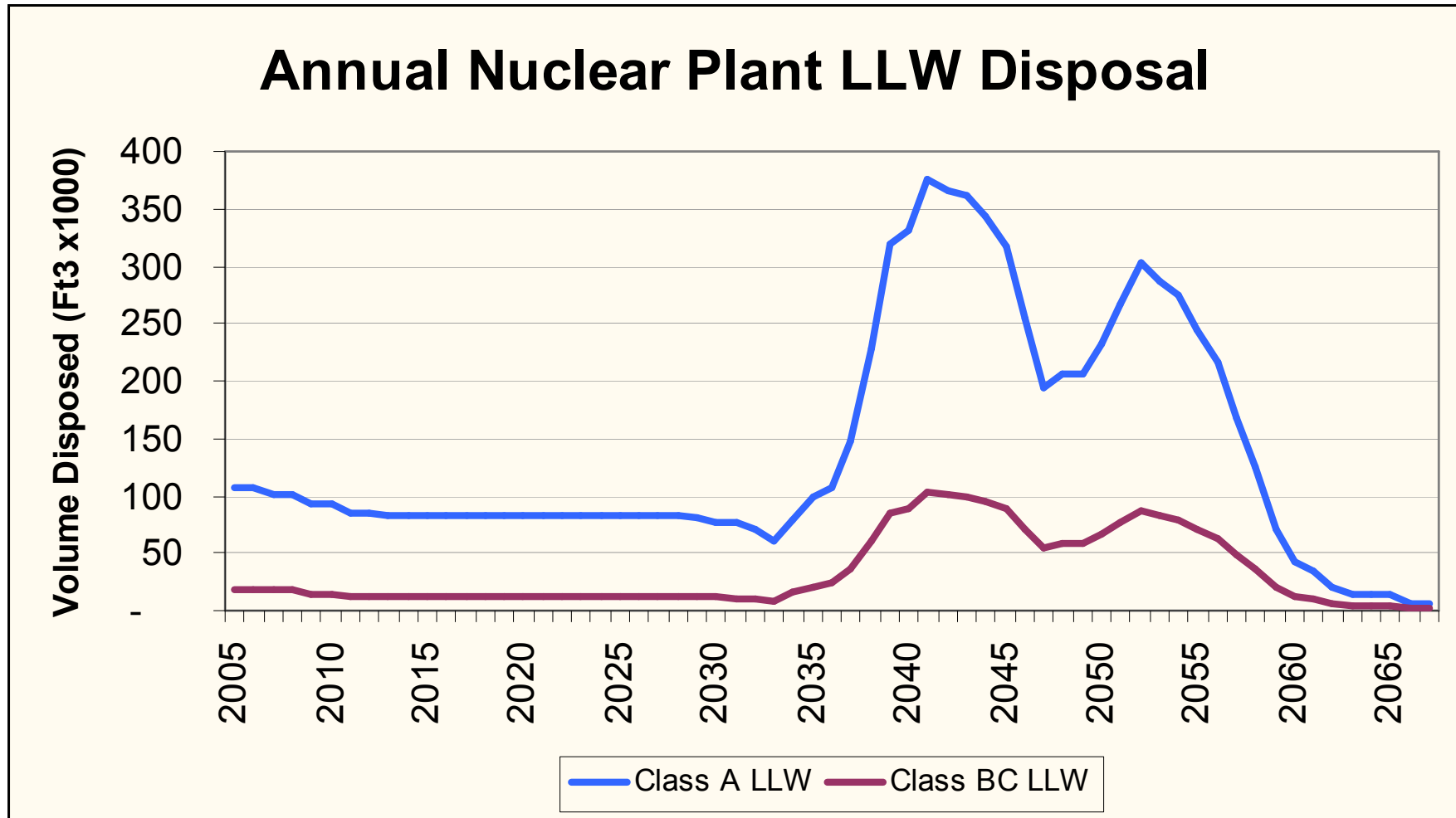
- First of its kind business solution to decommissioning
- Below: removing, packaging, and transporting of the Zion reactor vessel head



Waste Disposal Challenges

- Status of current high and low level waste disposal options
 - no disposal pathway for greater-than-class C LLW
 - high disposal cost of bulk LLW relative to its hazard
- Disposal of large components
 - segmentation
 - transportation
 - disposal options

Future Power Reactor Waste Volumes

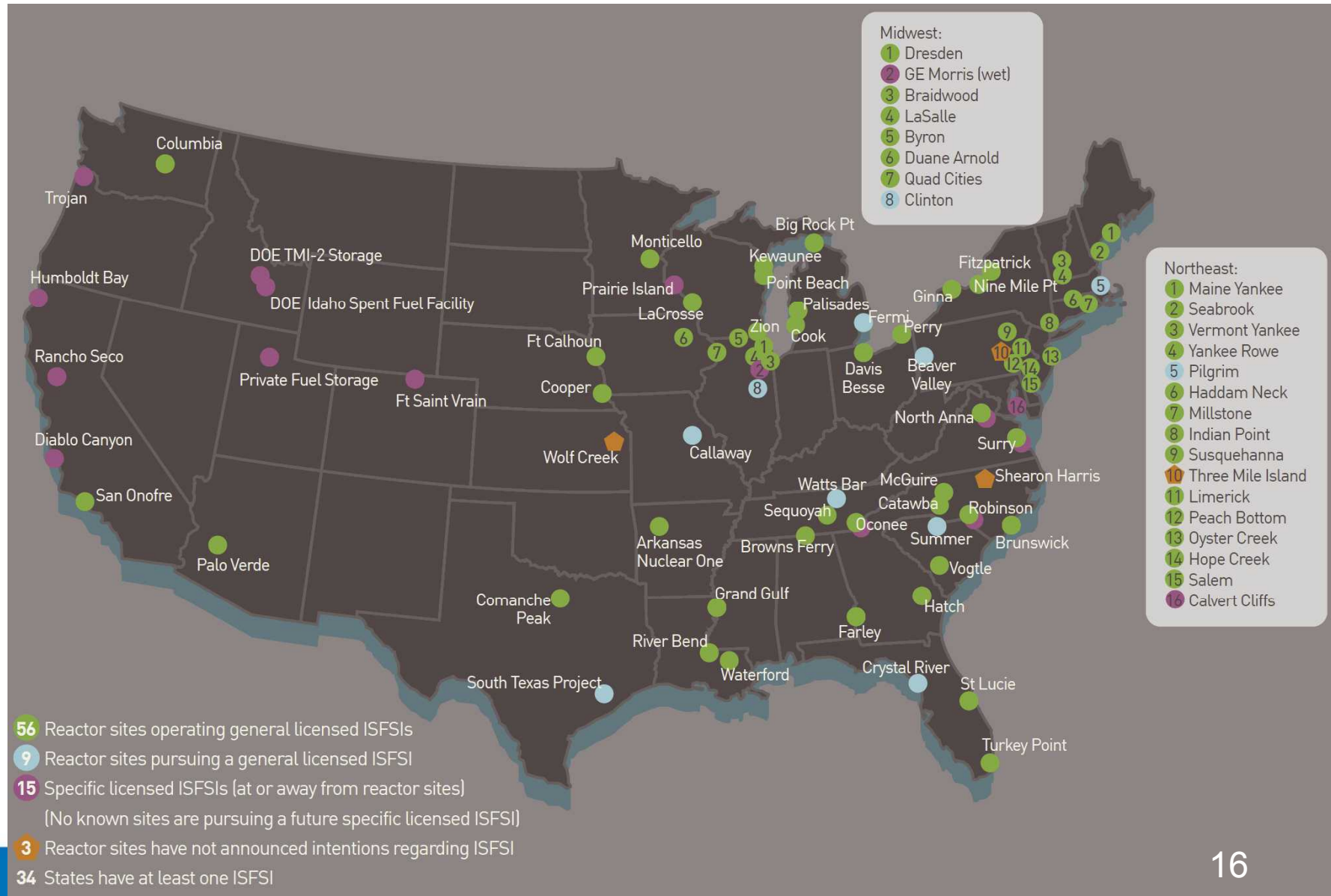


Graphic from "EPRI Low Level Waste and Radiation Management Program Overview", Sean Bushart, December 2006

Spent Fuel Issues

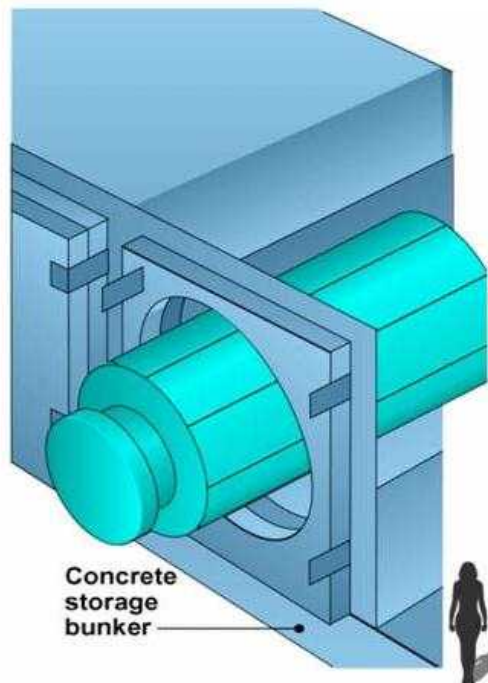
- Wet storage versus dry storage of spent nuclear fuel
- Independent Spent Fuel Storage Installations (ISFSI) – long term storage and surveillance issues
- High burn-up fuel storage safety
- Creation of a high level waste permanent repository
- ISFSI impact on future use of the site

Status of U.S. ISFSIs

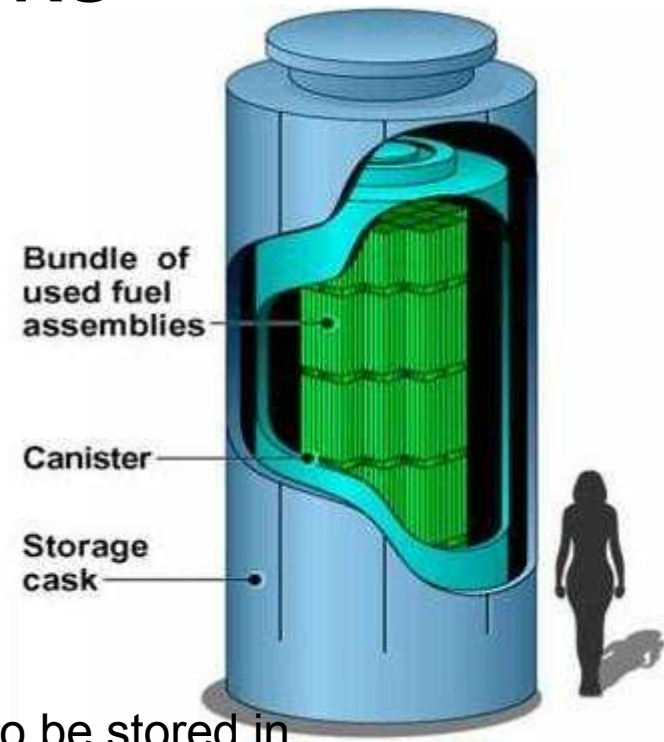


ISFSI Components: Spent Fuel Storage Casks

Once the spent fuel has cooled, it is loaded into special canisters which are designed to hold Pressurized Water Reactor or Boiling Water Reactor assemblies. Canisters are filled with inert gas, welded, and rigorously tested for leaks. They may then be placed in casks for storage or transportation.



The canisters can also be stored in above-ground bunkers, each of which is about the size of a one-car garage. Eventually they may be transported elsewhere for storage.



Keys to Decommissioning

- Plan for decommissioning before facility construction and consider decommissioning throughout operations
- Have early and frequent consultations between regulators and licensees throughout the decommissioning process
- Ensure flexibility and transparency in regulatory implementation emphasizing safety and environmental protection
- Use realistic approaches in selecting post termination land use scenarios (e.g., based on foreseen land use) and parameters
- Involve stakeholders throughout the decommissioning process
- The unexpected will happen. Be ready to accept it and address the problem

Process Improvements Based on Decommissioning Lessons Learned

- Implement guidance updates and improvements
- Maintain communications throughout decommissioning
- Encourage community involvement and interaction
- Incorporate improvements and lessons learned in an integrated decommissioning rulemaking activity

Summary

- The Transition Activities for Recently Shutdown Reactors Can Create a Regulatory Burden
- Pay Attention to the Costs of Decommissioning
- Ongoing Waste Storage Considerations are an Important Aspect of the Decommissioning Process
- Decommissioning Challenges Can be Addressed with Continuous Process Improvements