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# DOE Nuclear Fuel Storage and Transportation (NFST) Planning Project: System Analysis and Integration Activities

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***NEI Used Fuel Management Conference***

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# Topics of Discussion

- NFST System Analysis Activities
- System Considerations
- Examples of Results from Recent System Analyses
- Updating Decision Support Tools

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# Standard Contract between utilities and DOE (10 CFR 960)

- This is a technical presentation that does not take into account the contractual limitations under the Standard Contract
- Under the provisions of the Standard Contract, DOE does not consider spent fuel in canisters to be an acceptable waste form, absent a mutually agreed to contract modification
- To ensure the ability to transfer spent fuel to the government under the Standard Contract, the individual spent fuel assemblies must be retrievable for packaging into a DOE-supplied transportation cask.

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# Objectives of NFST System Analysis Efforts

- Provide quantitative information to inform decisions concerning development and deployment of the waste management system
- Develop an integrated approach to evaluating storage, transportation, and disposal options, with emphasis on flexibility
- Evaluate impacts of storage choices on disposal options
- Identify alternative strategies and evaluate with respect to performance objectives
- Considerations include emplacement capability, thermal constraints, repackaging needs, storage and transportation alternatives, impacts on utility operations, etc.

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# System Considerations for a Future UNF Management System

- **Used nuclear fuel (UNF) inventory and configuration establish the boundary conditions for the downstream UNF management system**
- **When, how, and at what rate the UNF is accepted from the reactors affect how the UNF management system is designed, constructed, procured, and operated**
  - Allocation: Oldest-Fuel First per the Standard Contract, shutdown reactors, site-specific allocation
  - Acceptance: All UNF in large canisters, some UNF as bare fuel in re-useable transportation cask
- **Decisions made can affect down-stream flexibility and at-reactor management**
  - Magnitude of re-packaging effort for direct disposal
  - Thermal constraints can limit rate fuel could be transported off site

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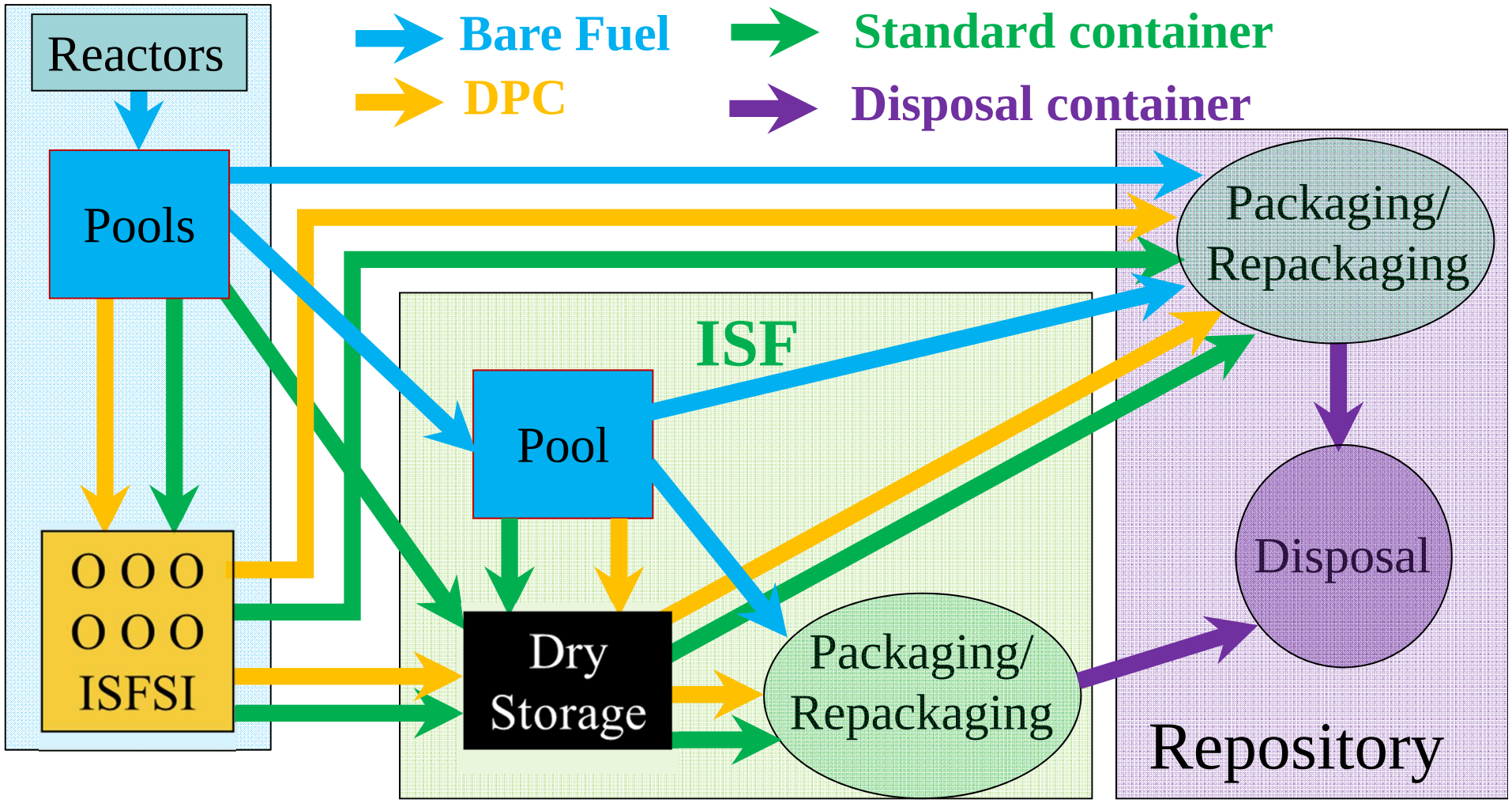
# Commercial UNF Management System Options



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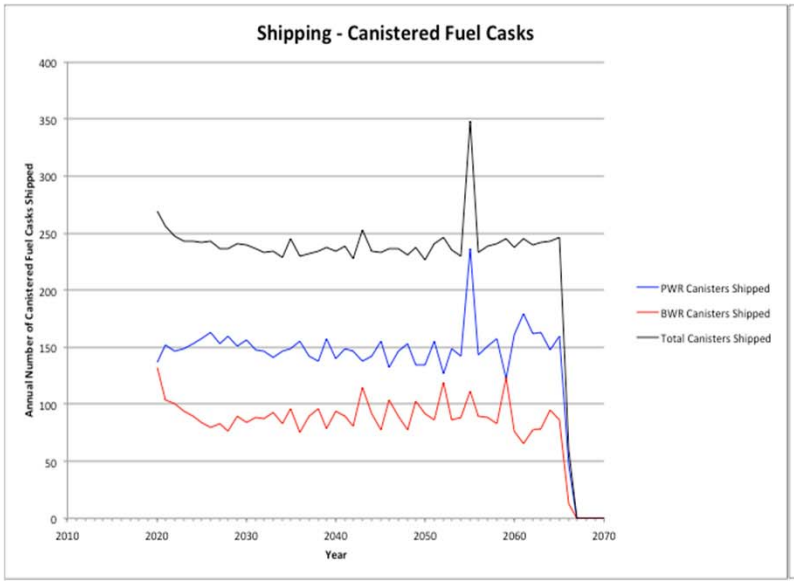
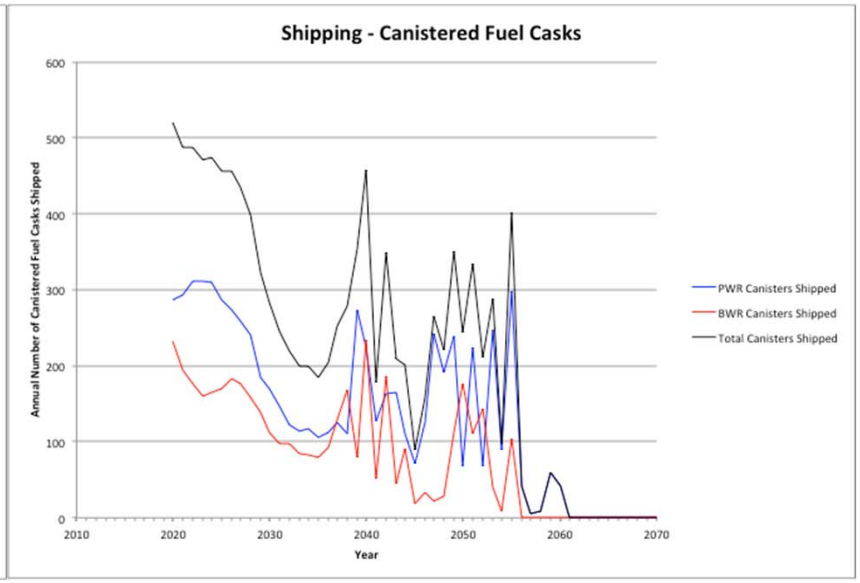
# Insights Gained from Initial System Architecture Analyses – Acceptance Capacity

- **High acceptance rates (i.e., 6000 MT/yr) lead to large facilities and supporting infrastructure**
  - Large capacity storage facilities
  - High processing capability and large transportation fleet that may only be needed for a relatively short time; under-utilized facilities
  - Investigating intermediate acceptance rate (4500 MT/yr)

**3000 MTU/year**




**6000 MTU/year**



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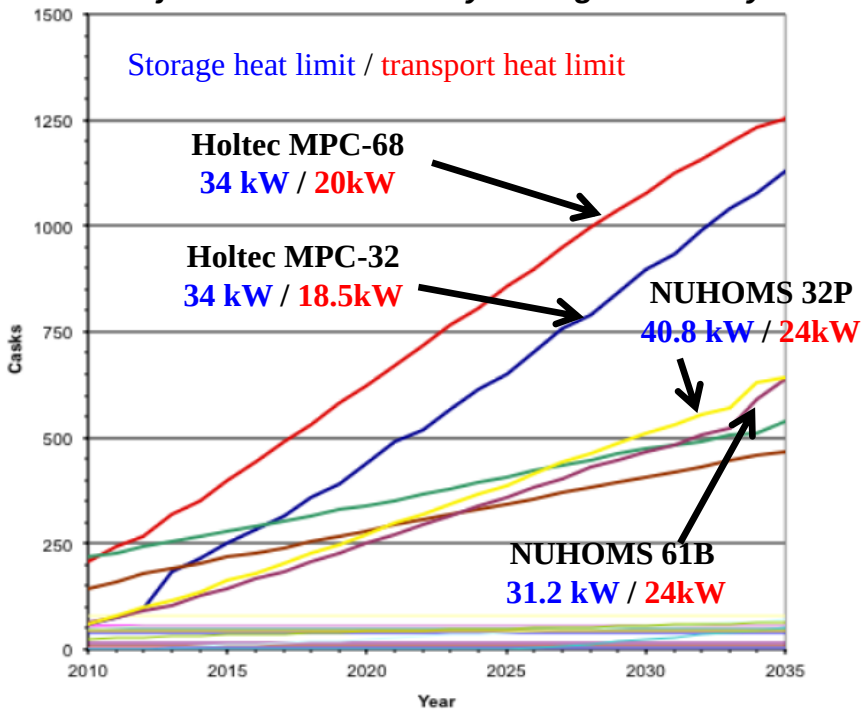
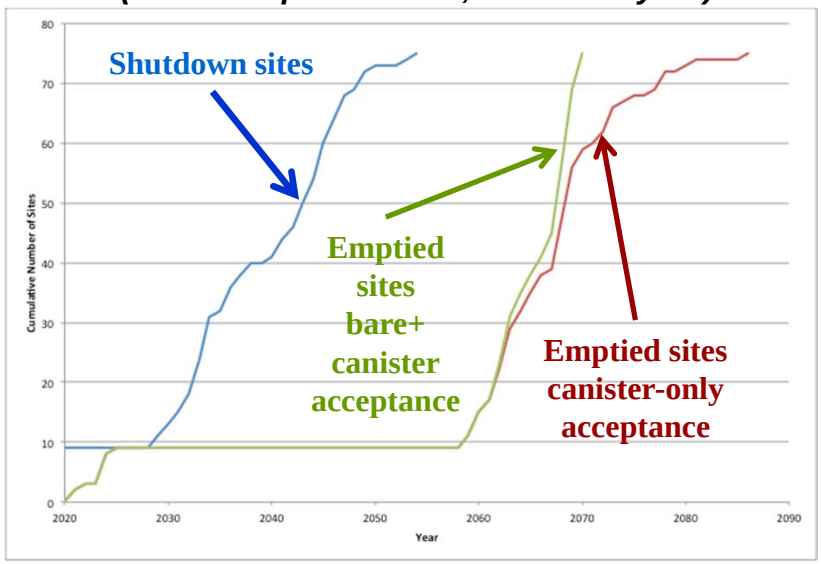
# Thermal constraints can affect rate that UNF is removed from reactor sites

- Thermal constraints are more stringent on transportation overpacks than dry storage canisters/overpacks
- Largest dry storage canisters will stay on-site for an extended period of time (perhaps decades)

*Projected At-Reactor Dry Storage Inventory*




*Number of Emptied Shutdown Sites*
*(2025 acceptance start, 3000 MTU/year)*




- Acceptance of bare fuel in re-useable transportation casks that can accommodate higher heat loads could allow for earlier transport of UNF

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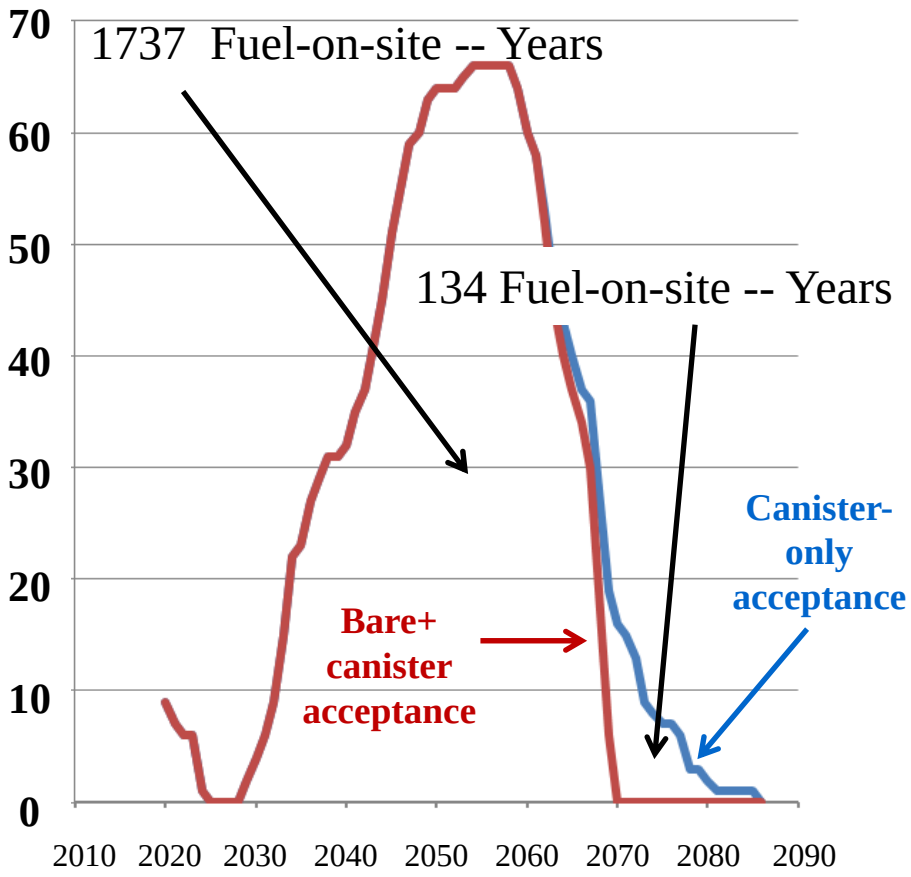
# Thermal constraints can affect rate that UNF is removed from reactor sites (cont)

- **Acceptance of bare as well as canistered fuel could allow earlier clearance of shutdown sites even with no priority for shutdown sites**
- **Priority for acceptance from shutdown sites could increase the benefit from acceptance of bare fuel**

***Number Shutdown Sites With Fuel***
***(2025 acceptance start, 3000 MTU/year, OFF)***



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# DOE Is Updating System Analysis Tools To Support Future Decisions

- **Objective: To develop and utilize a decision-support tool for evaluating transportation, storage and disposal options in the waste management system**
  - Using an integrated approach capable of representing a wide range of facility and operating scenarios and performance objectives
  - With an emphasis on providing flexibility

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# Performance Evaluation Measures Must Address All Issues of Concern

- Number of dry storage casks required (annual, cumulative, peak) at waste origin, consolidated storage and disposal facilities
- Total dry storage cask-years at each system facility
- Cost by facility and life cycle phase (construction, operations, shutdown)
- Worker and other population risk - exposure/dose (temporal, spatial, at various stages cycle)
  - Incident-free radiological exposure
  - Accident-related radiological exposure
  - Non-radiological consequences of accidents
- Risk to environmentally sensitive areas
- Length of operating period, years
- Facility utilization (peak, average)
- Volume of UNF and LLW generated (annual, cumulative)
- Other measures of concern to utilities
- Fleet requirements (rolling stock)
- Shipping schedule (year, site, destination number of casks, number of shipments, rail shipment miles)

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# Getting Waste Origin Facility Attributes Right is Crucial

- General site data: name (and unit no., if applicable), location, owner, beginning & end of life (with extensions), operating status (active, inactive, shutdown)
- Waste type generated (commercial UNF - BWR or PWR, shutdown site, HLW, GTCC, DOE-owned UNF, Navy UNF)
- Fuel data: core size, fuel projections (burn-up, discharge amounts, enrichments)
- Storage data
  - **Pool and dry storage pad capacity and utilization (assemblies, MTU, dry casks)**
  - **Dry storage systems details**
- Operational constraints (re-fueling, other maintenance, decrease in reactor capacity due to aging, upset conditions, seasonal restrictions, etc.)
- Processing times and operating rules associated with various activities
- On-site handling capabilities - crane capacity, available work space, etc.
  - **Wet to dry storage**
  - **Wet and dry storage to transportation**
- On-site transportation access/egress
  - **Available modes (road, rail, water, intermodal)**
  - **Transportation infrastructure condition**

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# Importance of Broad Acceptance of Results of Analyses

- To be effective, analyses need to be broadly accepted as valid by the affected stakeholders (not just by DOE)
  - Those who doubt the value-added of central storage
  - Those who might not be convinced that changes like adoption of standardized components would achieve claimed system benefits
- Stakeholder input to development and implementation of the decision support tools may help focus discussion on the issues, rather than the adequacy of the analysis
- DOE would like to develop an effective way to obtain such inputs from the nuclear industry

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# Suggestions?

- Mechanisms for industry inputs
- Measures of impacts at reactors
- Incorporation of reactor operational constraints
- Contingencies to consider for evaluating system flexibility
- Acceptance scenarios to consider
- Thoughts about evaluation of standardized components

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