U.S. DEPARTMENT OF ENERGY

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

Nuclear Energy

Overview of DOE-NE's Nuclear Fuels Storage and Transportation Planning Project (NFST)

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(Argonne National Laboratory)

Nuclear Decommissioning & Used Fuel Strategy Summit
October 5, 2015
Charlotte, NC

Overview

- Background
- Mission, Objectives, and Current Portfolio
- Review of Selected Accomplishments
- Concluding Remarks

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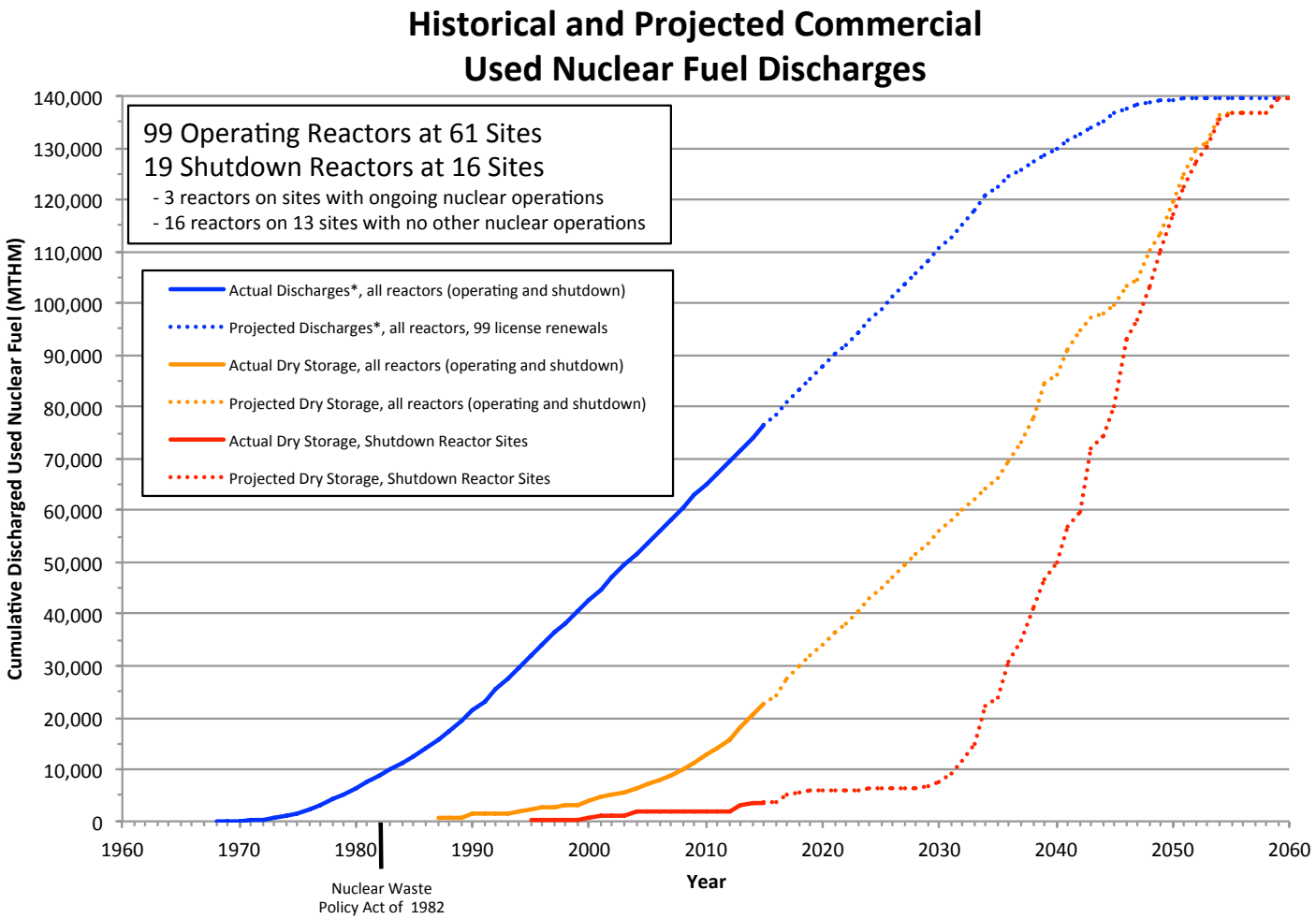
Commercial UNF in Storage Continues to Increase by ~2,000 MTHM Annually; 150 – 200 Dry Storage Canisters are Loaded Annually



Source: *Based on actual discharge data as reported on RW-859s through 12/31/2002 and projected discharges, in this case for 99 license renewals

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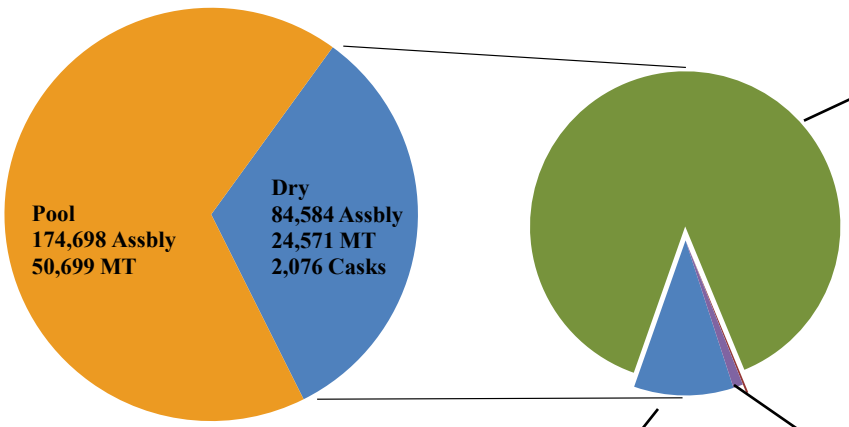
Commercial Dry Storage System Inventory is Diverse and Growing

Inventory as of May, 2015



1,870 Welded Metal Canisters In Vented Concrete Overpacks 74,920 Assemblies, 84.9% of Dry

Transnuclear (37%)
Holtec (47%)
NAC (14%)

198 Bare Fuel Casks 8,798 Assemblies, 10.2% of Dry

12 Welded Metal Canisters in Transport Overpacks 866 Assemblies, 1.0% of Dry

- *Majority is in Large Welded Canisters*
- *Current dry storage inventory is diverse*
- *Trend toward higher capacities*

Transnuclear TN-32

Holtec Hi-Star 100

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A Variety of Dual Purpose Canisters at the Shutdown Sites

Inventory as of August, 2015

Cask System	Canister Family	Canister	Transportation Cask	Total Canisters Generated in Reference Scenario[a]
Fuel Solutions	W74	W74T	TS125	7
HI-STORM 100	MPC-32 (HI-STORM)	MPC-32 (HI-STORM)	HI-STAR 100 or 190	5
	MPC-68 (HI-STORM)	MPC-68 (HI-STORM)	HI-STAR 100 or 190	68 Forecast, 13 loaded, remainder canister uncertain
		MPC-68F (HI-STORM)	HI-STAR 100 or 190	
		MPC-68FF	Not Available	
		MPC-68M	Not Available	
HI-STORM TranStor	MPC-24 (TranStor)	MPC-24E (TranStor)	HI-STAR 100 or 190	34, canister uncertain
		MPC-24EF (TranStor)	HI-STAR 100 or 190	
HI-STAR 100	MPC-68 (HI-STAR)	MPC-68 (HI-STAR)	HI-STAR 100 or 190	4, canister uncertain
		MPC-68F (HI-STAR)	HI-STAR 100 or 190	
HI-STAR 100HB	MPC-HB	MPC-HB	HI-STAR 100HB or 190	5
Standardized NUHOMS	NUHOMS 32PT	NUHOMS 32PT-L100	MP197 or MP197HB	14, Canister uncertain
		NUHOMS 32PT-L125	MP197 or MP197HB	
		NUHOMS 32PT-S100	MP197 or MP197HB	
		NUHOMS 32PT-S125	MP197 or MP197HB	
	NUHOMS 32PTH1	NUHOMS 32PTH1-L	MP197 or MP197HB	42, None loaded canister uncertain
		NUHOMS 32PTH1-M	MP197 or MP197HB	
		NUHOMS 32PTH1-S	MP197 or MP197HB	
	NUHOMS 61BT	NUHOMS 61BT	MP197 or MP197HB	121 Forecast, 23 loaded, Remainder uncertain
	NUHOMS 61BTH	NUHOMS 61BTH Type 1	MP197HB	
		NUHOMS 61BTH Type 2	MP197HB	
	NUHOMS FC-DSC	NUHOMS FC-DSC	MP187	18
	NUHOMS FF-DSC	NUHOMS FF-DSC	MP187	1
	NUHOMS FO-DSC	NUHOMS FO-DSC	MP187	2

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A Variety of Dual Purpose Canisters at the Shutdown Sites

Inventory as of August, 2015

Cask System	Canister Family	Canister	Transportation Cask	Total Canisters Generated in Reference Scenario[a]
Advanced NUHOMS	NUHOMS 24PT1	NUHOMS 24PT1	MP187	17
	NUHOMS 24PT4	NUHOMS 24PT4	MP197HB	33
UMAX	MPC-37			72
NAC-MPC	CY-MPC, 26 Assy	CY-MPC, 26 Assy	NAC-STC Transport Cask	40
	LACBWR	MPC-LACBWR	NAC-STC Transport Cask	5
	Yankee-MPC	Yankee-MPC	NAC-STC Transport Cask	15
NAC-UMS	UMS-PWR	TSC-Class 1	Universal Transport Cask	60, Canister uncertain
		TSC-Class 2	Universal Transport Cask	
		TSC-Class 3	Universal Transport Cask	
NAC-MAGNASTOR	TSC PWR	TSC PWR	MAGNATRAN	85 Forecast, 61 loaded
Total Potential Casks	**20 Canister Families**	**33 Potential Canisters**	**11 Potential Transport Cask**	**648 Fuel Casks 35 GTCC Casks**

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DOE-NE's NFST Program is Planning for Interim Storage and Transportation as Part of an Integrated Waste Management System

- **Mission**
  - Lay the groundwork for implementing interim storage, including associated transportation, per the Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste*
  - Develop the foundation for a new nuclear waste management organization

- **Purpose**
  - Make progress on this important national issue within existing legislative and budget authorizations

- **Activities**
  - Provide a foundation for a new nuclear waste management organization
  - Lay ground work for implementing the *Strategy,* which is aligned with the recommendations of the Blue Ribbon Commission for America's Nuclear Future
    - Consistent with budget direction and authorization

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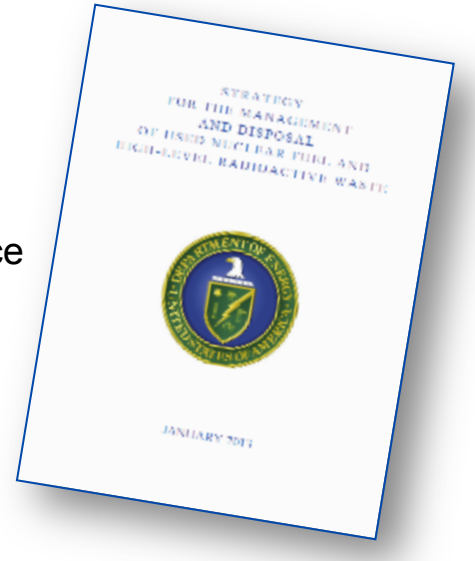
Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste Guides NFST's Activities

- **"With the appropriate authorizations from Congress, the Administration currently plans to implement a program … that:"**
  - "Sites, designs and licenses, constructs and begins operations of a **pilot interim storage facility …** with an initial focus on accepting used nuclear fuel from shut-down reactor sites"
    - "Development of transportation capabilities…to facilitate the acceptance of used nuclear fuel at a pilot interim storage facility"
  - "Advances toward the siting and licensing of a **larger interim storage facility …** that will have sufficient capacity to provide flexibility in the waste management system and allows for acceptance of enough used nuclear fuel to reduce expected government liabilities"



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Near-Term Objectives to Lay the Groundwork for *Strategy* Implementation

- Develop and maintain an integrated plan to accomplish the *Strategy* goals
- Improve integration of storage as a planned part of the waste management system, including evaluating standardization of dry cask storage systems
- Develop and evaluate facility design options for an integrated waste management system
- Develop and apply systems analyses to provide quantitative estimates of system impacts of utility and federal actions and inform future decisions
- Establish the basis and identify options for management decisions on an integrated waste management system
- Prepare for the large-scale transportation of SNF and HLW, with an initial focus on removing SNF from the shutdown reactor sites
- Establish and maintain a unified and integrated SNF database and analysis system to characterize the input to the waste management system

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DOE-NE's NFST Program is Organized into Four Key Elements

Consent-Based Siting

- Siting process design
- Communication products
- Site evaluation and selection*
- Site acquisition*

Storage

- Design
- NEPA
- Regulatory
- Construction*
- Operations*

Transportation

- Institutional
- Operational
- Hardware

Strategic Crosscuts

- Project management
- Systems analyses
- Data/document access
- Standardization/ integration
- Characterization and Assessment

* Indicates areas that are not currently active

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High-Level Strategic Planning to Meet *Strategy* Goals

Strategic Crosscuts
- Project management
- Systems analyses
- Data/document access
- Standardization/ integration
- Characterization and Assessment

- **Revised the NFST Near-Term Implementation Plan**
- **Developed a multi-year Integrated Priority List (IPL) and integrated, milestone-based schedule**
- **Evaluating alternative implementation strategies**

Current and Potential NFST Activities

Planning / Preparation	Implementation
Consent-Based Siting • **Performing public perception surveys** • **Maintaining siting experience database** Storage • **Developing systems functions and requirements** • **Developing and evaluating generic alternative interim storage facility design concepts for canistered fuel** • **Evaluating aging management needs** • Develop and evaluate generic design concepts for additional ISF facilities Transportation • **Supporting cooperative agreements with State Regional Groups and Tribes** • **Developing a Transportation Planning Framework** • **Performing NWPA Section 180(c) implementation exercise to support revision to the implementation policy** • **Planning for removal of UNF from shutdown reactor sites** • **Preparing requirements, etc., for long-lead time hardware items** Standardization and Integration • **Performing a quantitative assessment of options to inform future decision makers relative to the potential benefits and impacts** • **Evaluating cask/operational design innovations to improve integration** Regulatory • **Identifying/evaluating regulatory issues related to transportation and interim storage and development of licensing strategy** • **Engagement with NRC on ISF and transportation licensing issues** Communications • **Developing of an initial communications and outreach plan** • Development of generic educational materials NEPA • **Developing NEPA compliance approaches and strategies**	Consent-Based Siting • Develop principles and framework for consent–based siting process • Engage with interested potential host communities/states Storage • **Preparing a Topical Safety Analysis report for generic pilot interim storage (dry) facility to support resolution of licensing issues, licensing schedule, and siting** • Development of generic pilot ISF design to accommodate the UNF and GTCC from shutdown reactor sites • Development of Topical Safety Analysis reports for additional ISF facilities and functions Transportation • **Developing AAR-S2043 prototype railcar for future testing** • Testing, certification and procurement of AAR S-2043 compliant rail cars • **Development of site-specific campaign plans for removing UNF and GTCC from reactor shutdown sites** • **Developing design concepts for re-useable bare fuel transportation casks** • Design and licensing of re-useable bare fuel transportation casks • Procurement of transportation overpacks and ancillary equipment needed to de-inventory shutdown reactor sites • Plan and initiate Package Performance Study program Standardization and Integration • **Developing generic, enveloping standardized canister designs** • Development of standardized storage and/or transportation overpacks Regulatory • Engagement with NRC on key licensing issues through meetings and Topical Safety Analysis reports • Notify NRC of intent to submit TSAR and/or license application for ISF Communications • Development of communication materials, e.g., brochures, images, scale models, and web-based materials to support stakeholder interactions
Foundational	
Waste Management System Analyses • **Developing project execution and decision support capabilities** • **Establishing systems analysis capabilities and supporting data** • **Developing a modern routing decision-support capability** • **Applying capabilities to evaluate system impacts of utility and federal actions and inform decision-making** • **Performing targeted analyses to evaluate options and opportunities for improved integration of storage into the waste management system**	UNF Characterization and Assessment • **Establishing a unified UNF database and integrated analysis capabilities** • **Updating DOE Characteristics Database (last updated in 1987)** • **Characterizing the input to the waste management system** • **Assessing issues/uncertainties related to the extended storage and subsequent transportation of UNF, including transport of casks from shutdown reactor sites** Data and Document Access • **Developing and maintaining a data and document access system to support current and future waste management activities and preserve relevant information**

*Activities in bold font are underway

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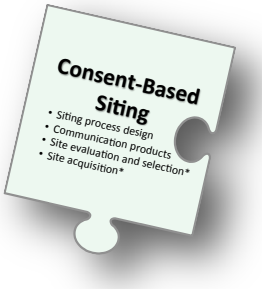
Preparing to Support Publicly Accepted Consent-Based Siting Process



- **Continued populating and maintaining a database of prior siting efforts**
  - http://curie.ornl.gov/SED/pages/sed-homepage
- **Continued gaining additional insights on consent-based siting of waste management facilities through public preference surveys**
- **Continuing laying the groundwork for the development of a consent based siting process that reflects input received from interested parties at the community, county, state, and Tribal level**

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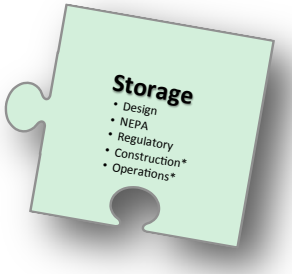
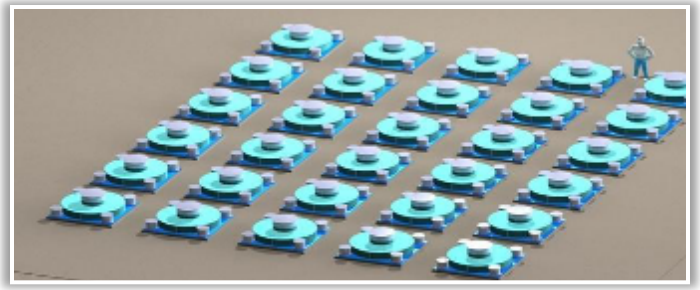
Laying the Groundwork for Consolidated Interim Storage



- **Evaluated interim storage design concepts, with input from industry contractors**
  - Generic Design Alternatives for Dry Storage of Used Nuclear Fuel (CB&I)
- **Preparing to develop a generic pilot ISF design and Topical Safety Analysis Report**
  - Procurement underway
- **Initiated development of a draft licensing strategy for a pilot ISF**
- **Initiated development of an environmental considerations document**
- **Initiated efforts related to Aging Management at an ISF**
  - Continued participation in EPRI ESCP
  - ASME code case: Examination Requirements and Acceptance Standards for Spent Fuel Storage and Transportation Canisters



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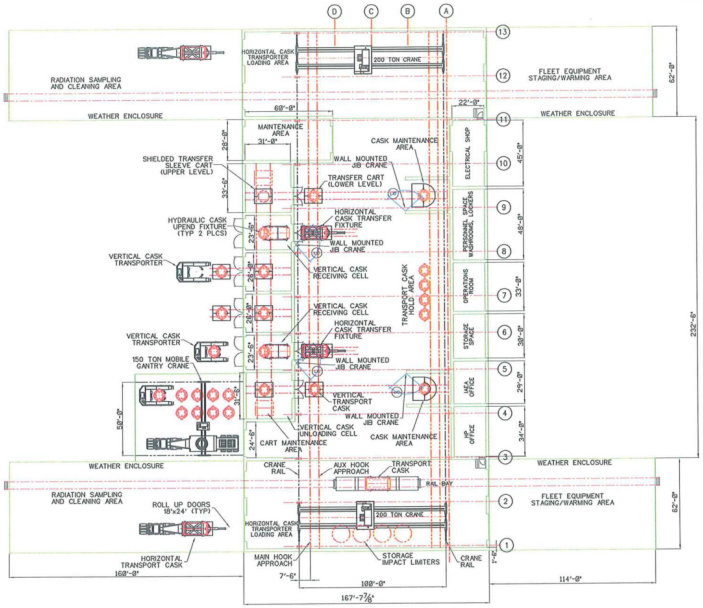
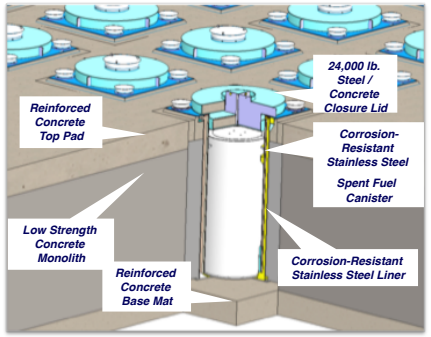
Dry Storage Design Concepts for Consolidated Interim Storage (Flexible, Adaptable, and Expandable)

- **Dry Storage Alternatives**
  - Pad storage using currently licensed storage overpacks
    - New concrete overpacks
  - Vault configurations
    - Horizontal, vertical
    - Above and below grade
- **Canister Receipt**
  - Commercially available transfer systems
    - Mobile cranes, no weather enclosure
    - Installed cranes, weather enclosure
  - Canister transfer building
  - Canister transfer building with remote operations
- **Tradeoffs associated with each concept**
- **Input to integrated waste management system analysis**





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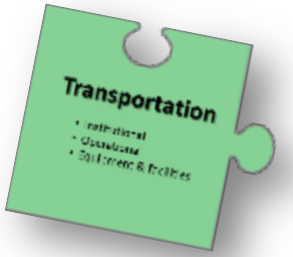
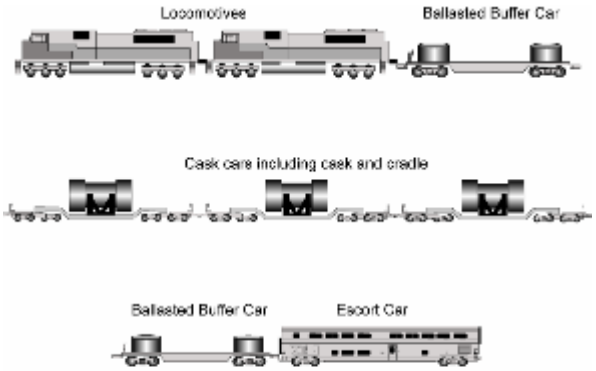
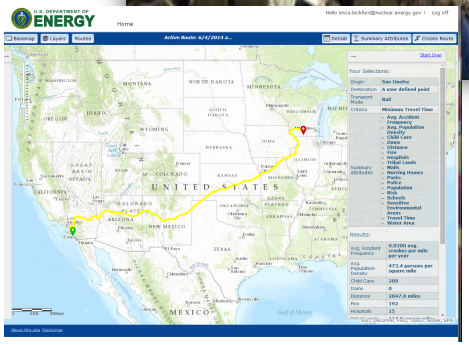
Developing the Large-Scale Transportation System



- **Contract to develop prototype cask and buffer railcars has been awarded**
  - Association of American Railroads (AAR) Standard S-2043 compliant cask and buffer railcars
  - Design/analysis → fabrication for testing
- **Interaction and collaboration with stakeholders**
  - Developing a Transportation Planning Framework
  - NWPA 180(c) Policy Implementation Exercise
  - Methodology for selecting routes for future shipments of SNF and HLW
- **Development of the Stakeholder Tool for Assessing Radioactive Transportation (START)**





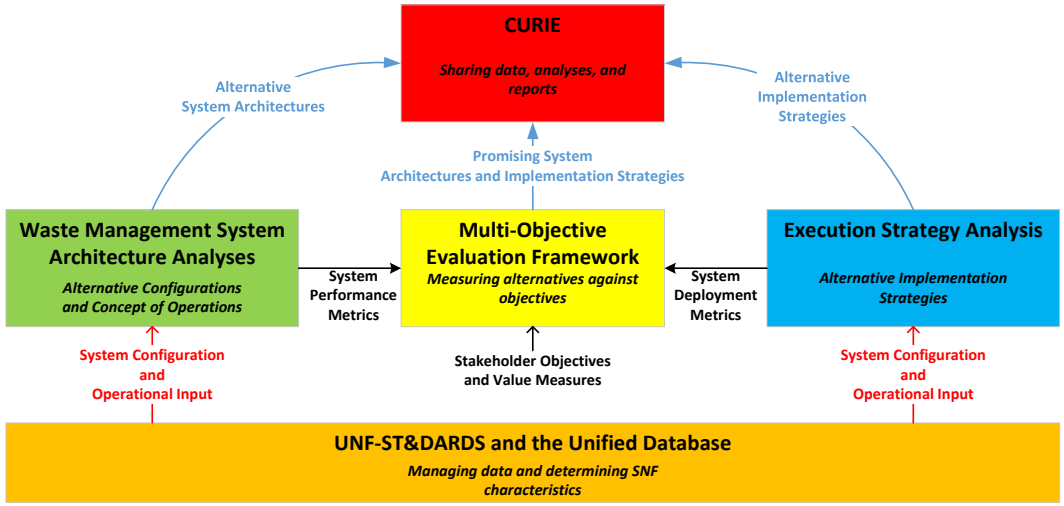
Developing the Large-Scale Transportation System

- **Planning efforts to remove SNF from shutdown reactor sites**
  - Collecting and documenting information related to site inventory, site conditions, and near-site transportation infrastructure and experience
  - Visited 12 of the 13 shutdown sites: San Onofre visited in June 2015
  - Updated the shutdown sites report
  - Preparing initial site-specific de-inventory analysis for three shutdown sites
    - Understanding of the tasks and interfaces necessary for the complete de-inventory

MP187 Transportation Cask Heavy Haul to Rancho Seco

Developing and Evaluating Options for an Integrated Waste Management System

- **Developing and using a number of tools to support decision-making and stakeholder engagement**
  - Multi-Objective Evaluation Framework (MOEF)
  - Waste Management System Architecture Analysis
    - Advanced Integrated Architecture Analysis Tool (NGSAM)
  - Execution Strategy Analysis (ESA)
  - Unified Database and UNF-ST&DARDS
  - Stakeholder Tool for Assessing Radioactive Transportation (START)



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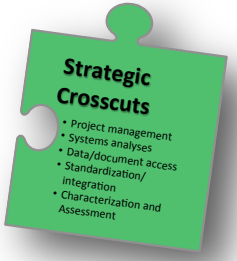
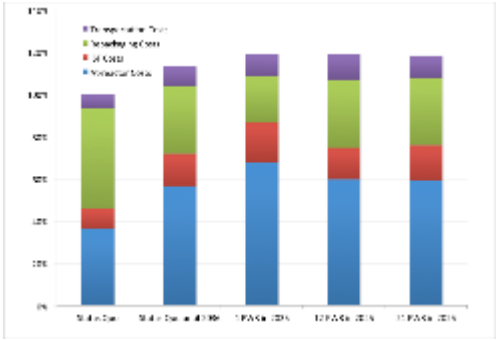
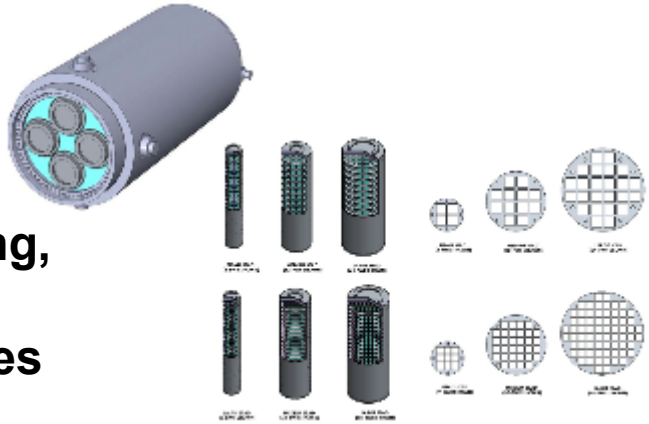
Laying the Groundwork for Standardization



- **Furthered the quantitative assessment of relevant options to establish basis for future decision making**
  - Standardization at an ISF and alternative SNF acceptance approaches
  - Included representative repository concepts
- **Utilized industry contracts to obtain needed additional information**
  - Generic design for small size STAD canister system (EnergySolutions)
  - Investigated operational aspects for implementation of STAD canister systems at operating reactors (EnergySolutions)
- **Developed a Standardized Transportation, Aging, and Disposal (STAD) canister specification and specification rationale to support system studies and potential research, development, and demonstration activities**



Comparison of ROM system cost of different initial canister loading strategies and disposal in small (4 PWR) canisters



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Concluding Remarks and Issues – Making Progress on this Important National Issue

- **DOE-NE's NFST program is making progress in laying the groundwork towards meeting the goals in the Administration's *Strategy***
  - ✓ Siting Experience Database completed (now being maintained)
  - ✓ ISF design concepts developed/evaluated, analyzing alternatives
  - ✓ Planning to develop a Generic Pilot ISF Design and TSAR
  - ✓ Continued collaboration with SRGs and Tribes through cooperative agreements
  - ✓ Developing Draft Transportation Planning Framework
  - ✓ Performing a NWPA 180(c) Policy Implementation Exercise
  - ✓ Awarded contract design cask and buffer railcars that meet AAR Standard S-2043
  - ✓ Continued work to prepare for de-inventory of shutdown sites
  - ✓ Waste management system analyses capabilities being established and applied
  - ✓ Unified database and analysis system being established and applied
  - ✓ Assessment of standardization and performance specification completed

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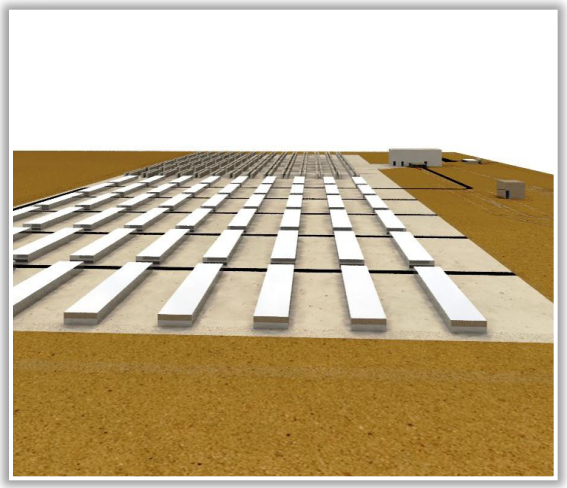
Questions & Discussion

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