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

Consolidated Interim Storage Facility Design Concepts In the United States

Nuclear Fuels Storage and
Transportation Planning Project

IAEA International Conference on the Management of Spent Fuel from Nuclear Power Reactors

Joe T. Carter
Vienna, Austria.
15-19 June, 2015

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Outline

- **US Commercial Fuel Inventory**
  - Focus on Shutdown Reactor Inventory
- **Pilot Interim Storage Facility Concepts**
  - Currently licensed storage systems
  - Underground storage concepts
  - Vault storage concepts

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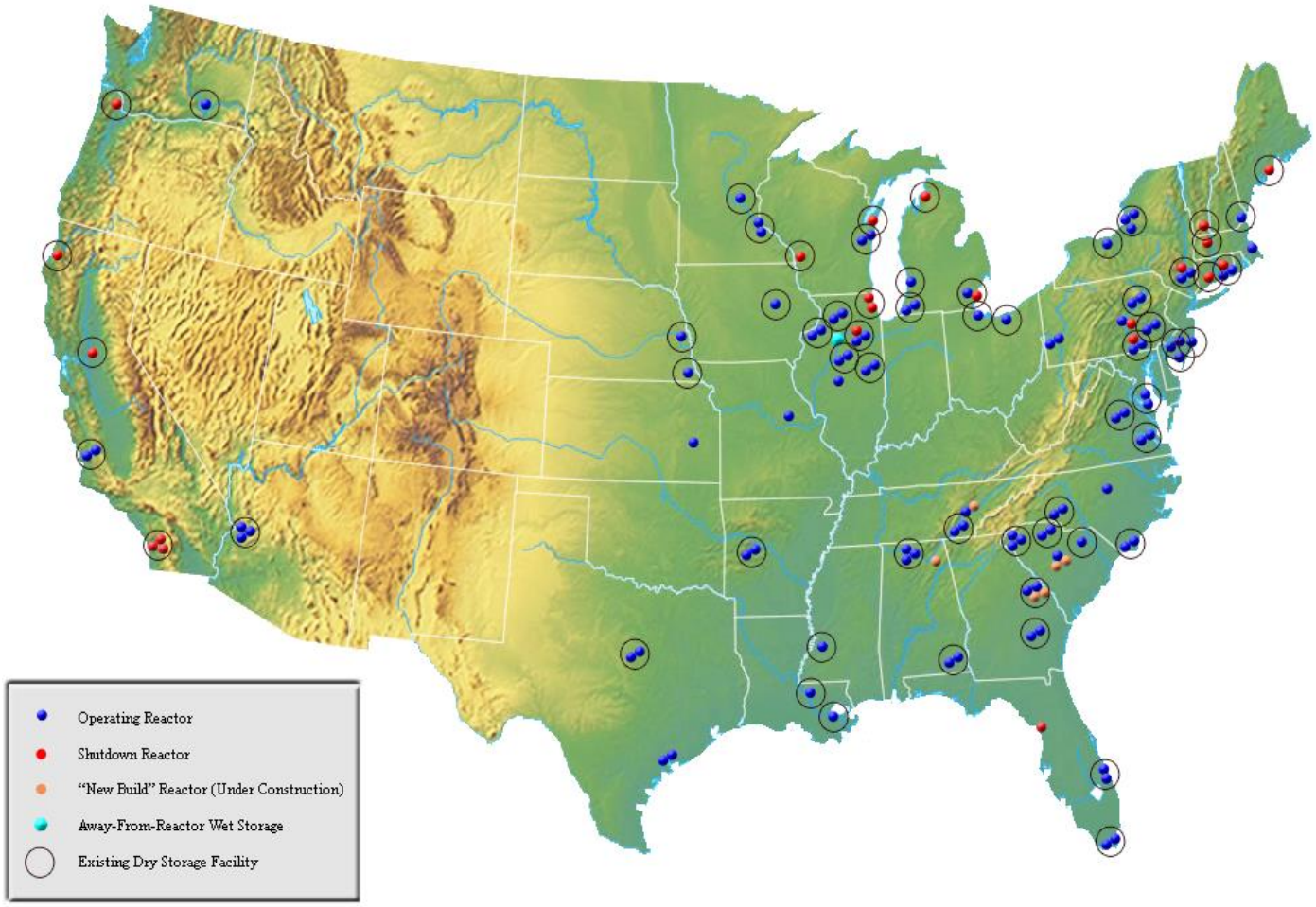
US History of Commercial Power Reactors

130 Nuclear Power Plants Built for Commercial Power Generation



- **9 Early Prototypes**
  - No fuel on site
- **1 Never Operated**
- **1 Disabled**
  - Fuel moved to DOE
- **1 Demonstration High Temperature Gas Reactor**
- **19 Ceased Operations**
  - Fuel on site
  - 3 reactors on sites with on going nuclear operations
  - 16 reactors on 13 sites with no other nuclear operations
- **99 Operating Reactors**
- **6 New Units Under Active Construction**

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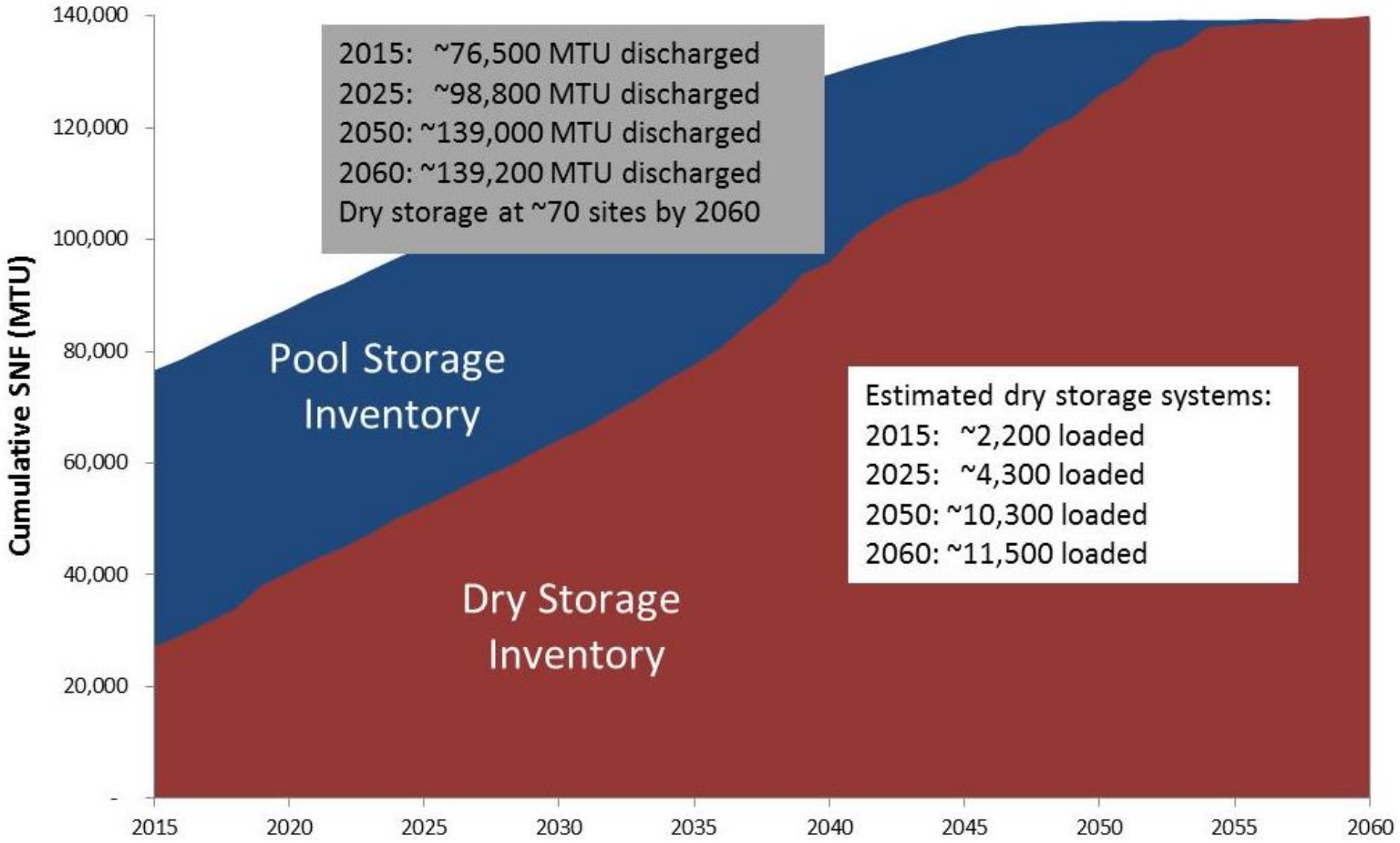
Projected Inventory (Dec 2015 to Dec 2060)



Current Reactors Operate 60 Years, 5 New Builds Operate 40 Years

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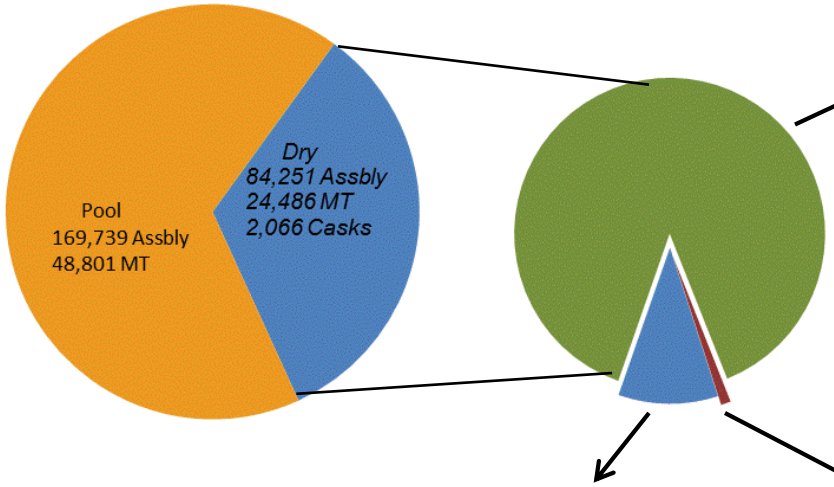
Commercial Dry Storage Inventory is Diverse and Growing

Inventory as of April 7, 2015



1,865 Welded Metal Canisters In Vented Concrete Overpacks
74,627 Assemblies, 84.6% of Dry

Transnuclear (37%)
Holtec (41%)
NAC (20%)

189 Bare Fuel Casks
8,758 Assemblies, 10.4% 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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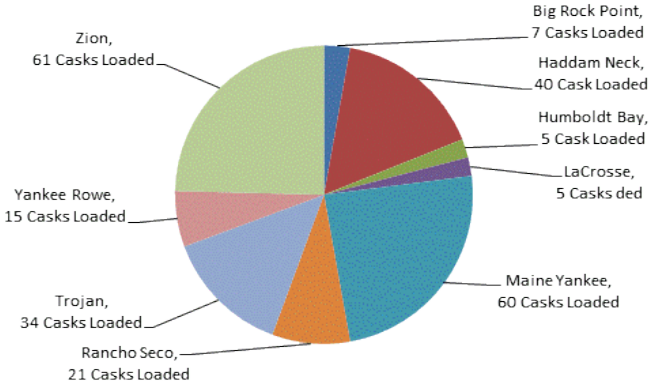
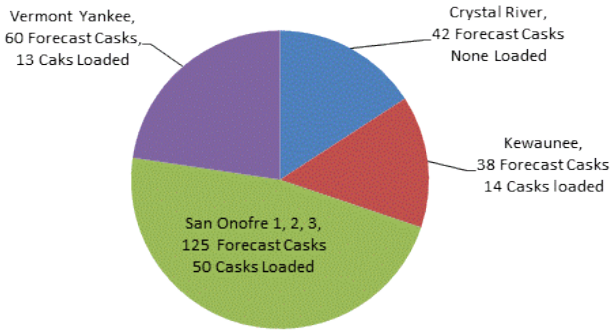
Shutdown Reactor Sites are Increasing in Number

Four Categories of Shutdown Reactor Fuel

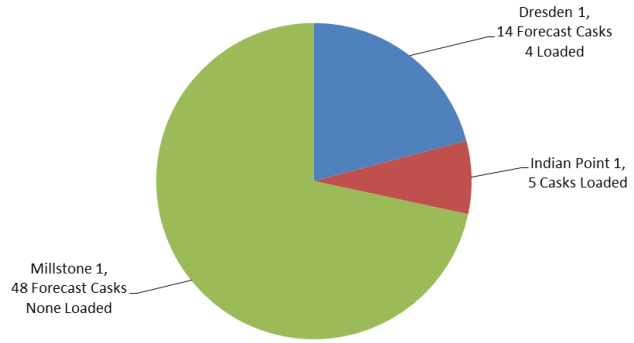
"Stranded" Reactors
248 Fuel Cask, 15 GTCC Casks,
2,813MT, 7,659 Assemblies



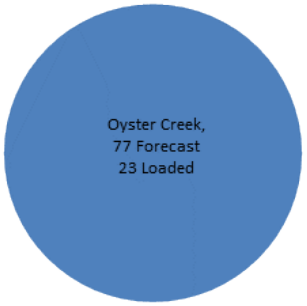
Early Shutdown Reactors
265 Fuel Casks, ~11 GTCC Casks,
3,479MT, 10,648 Assemblies



Shutdown Reactors at Operating Sites
67 Fuel Casks , ~6 GTCC Casks
647MT, 3,933 Assemblies



Announced Early Shutdown Reactor
77 Fuel Casks, ~2 GTCC Casks,
823 MT, 4,660 Assemblies



NFST
NUCLEAR FUELS STORAGE & TRANSPORTATION

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Shutdown Sites
Dual Purpose Canisters

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	5
	MPC-68 (HI-STORM)	MPC-68 (HI-STORM)	HI-STAR 100	70 Forecast, 13 loaded , remainder canister uncertain
		MPC-68F (HI-STORM)	HI-STAR 100	
		MPC-68FF	Not Available	
		MPC-68M	Not Available	
HI-STORM TranStor	MPC-24 (TranStor)	MPC-24E (TranStor)	HI-STAR 100	34, canister uncertain
		MPC-24EF (TranStor)	HI-STAR 100	
HI-STAR 100	MPC-68 (HI-STAR)	MPC-68 (HI-STAR)	HI-STAR 100	4, canister uncertain
		MPC-68F (HI-STAR)	HI-STAR 100	
HI-STAR 100HB	MPC-HB	MPC-HB	HI-STAR 100HB	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	125 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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Shutdown Sites
Dual Purpose Canisters (Con't)

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			75
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**	**9 Transport Cask**	**657 Fuel Casks 34 GTCC Casks**

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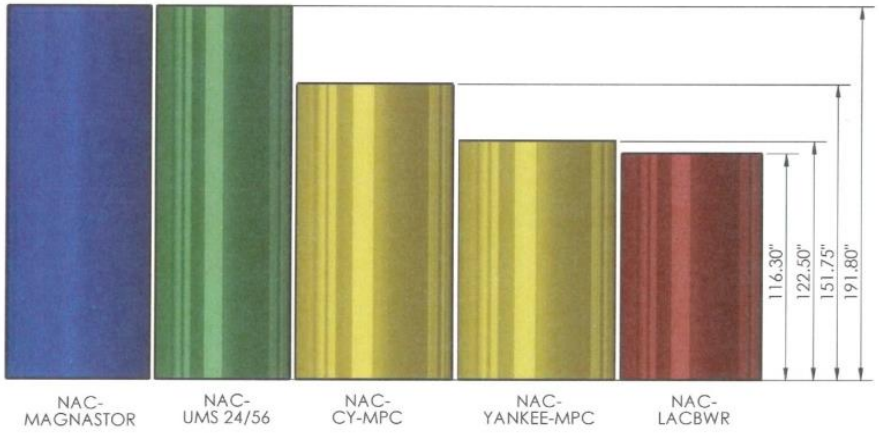
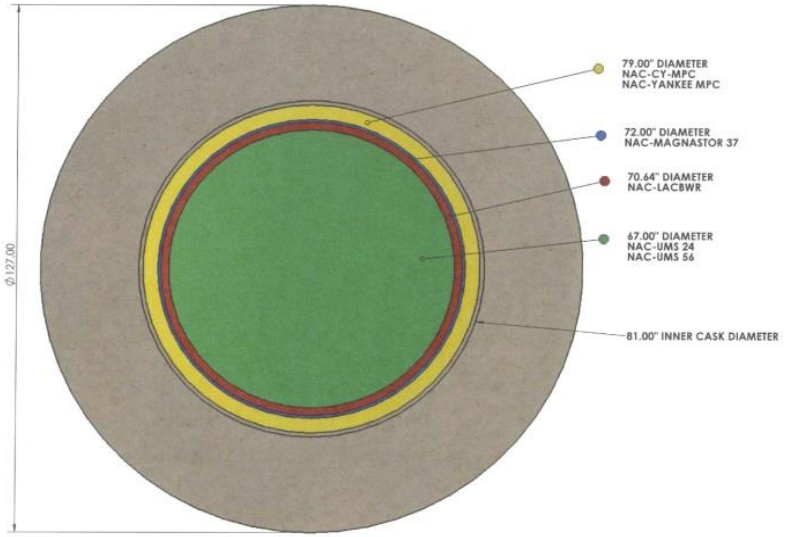
Example of Canister Diversity
NAC Diameters and Lengths Illustrated

NAC UMS System at Maine Yankee





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Pilot Storage Facility Concept

- ***5,000 to 10,000 MT capacity with a design receipt rate of 1,500 MT/year***
  - *Accept dry storage canisters (DSC) from shutdown reactors, see next slide*
  - *Accept Greater-Than-Class C Low Level Waste from decommissioned power reactors, and other approved contents in canisters*
  - *Receive fuel in dual purpose canisters (DPC) in associated transportation casks*
  - *Deployed in modules for storage capacity and additional functional capability*
- ***Fully developed facilities will include:***
  - *Shielded cask-handling building for transfer of the canister from transportation casks to storage overpacks*
  - *Storage pads with multiple vertical and horizontal storage overpack designs*
  - *Infrastructure and balance of plant facilities*
- ***Designed to Meet:***
  - *10CFR72*
  - *10CFR73*
  - *Associated Regulatory Guides (e.g. RG 3.60, 3.48 & 3.62)*
  - *Guidance from NUREG – 1567 and 1927*

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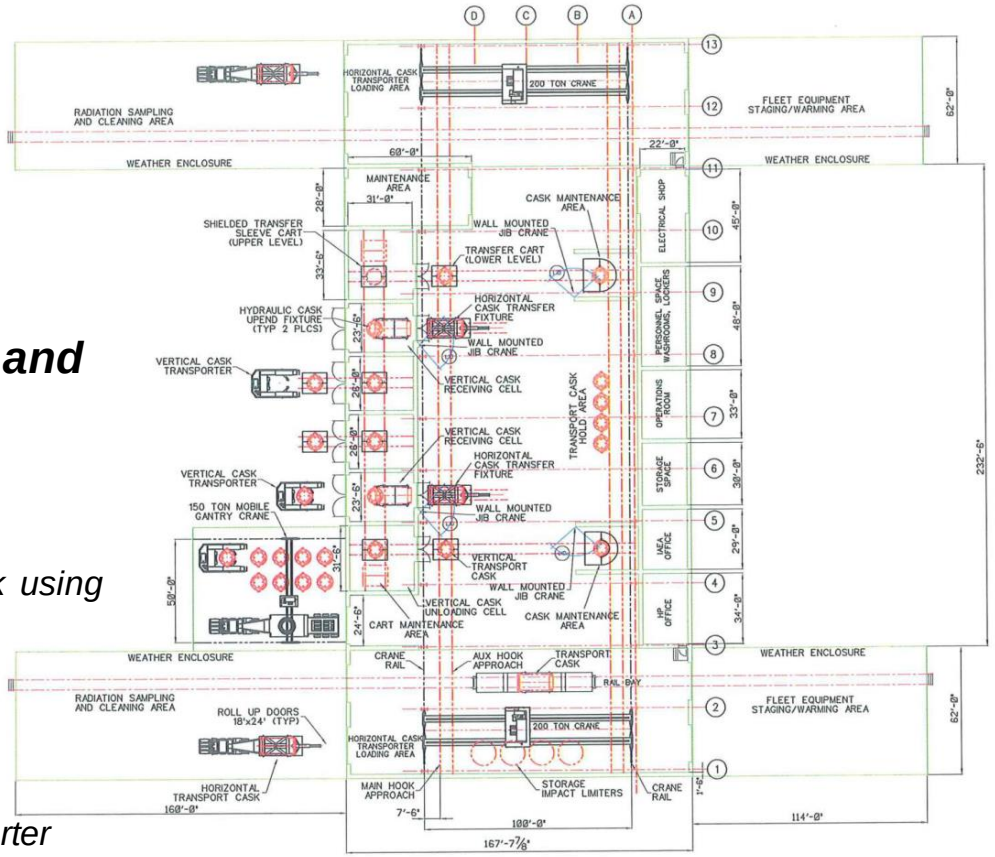
Canister Receipt Design Concept 1

Canister Transfer Building

- ***Perform Post Transportation:***
  - *Inspections,*
  - *Radiological Surveys,*
  - *Decontamination (if necessary)*
  - *Security Receipt Inspections*
- ***Transfer Canister to New Overpack and Relocate to Storage Pad***
  - *Vertical Casks:*
    - *Uprighted*
    - *Transferred to Vertical Storage Overpack using Facility Cask*
    - *Vertical Storage Cask Relocated to Pad*
  - *Horizontal Casks:*
    - *Loaded onto Transporter*
    - *Relocated to Storage Pad using Transporter*
    - *Transferred to HSM using Transport Cask*
- ***Existing Canisters are Placed into Storage w/o Opening***



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Canister Receipt Design Concept 2 & 3

- **Cask Handling Building with Remote Operations**
  - Higher Capital versus Concept 1
  - Additional Complexity versus Concept 1
  - Did NOT Provide Significant Dose Reduction versus Concept 1

- **Commercially Available Transfer Cask Used with:**
  - Mobile Cranes, no weather enclosure
  - Installed Cranes in a weather enclosure
  - Diversity of Canister Types is Challenging
  - Highest Dose of the Alternatives Evaluated
  - Method Being Considered for Early Operations

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Storage Configuration Concept 1 Overpacks on a Pad

Pad Storage Using Currently Licensed Storage Overpacks

- ***New Horizontal or Vertical Concrete Overpacks as required***
  - *Most recent licensed overpack associated with each canister type,*
  - *Limit to the extent possible storage overpack configurations*
  - *Canisters which do not have a current commercial source for new storage casks must be identified and required license actions identified*
  - *Considering Re-use of the Big Rock Point Fuel Solutions overpacks, segmented for transportation*
- ***Metal Storage/Transportation Overpacks can be Re-used***

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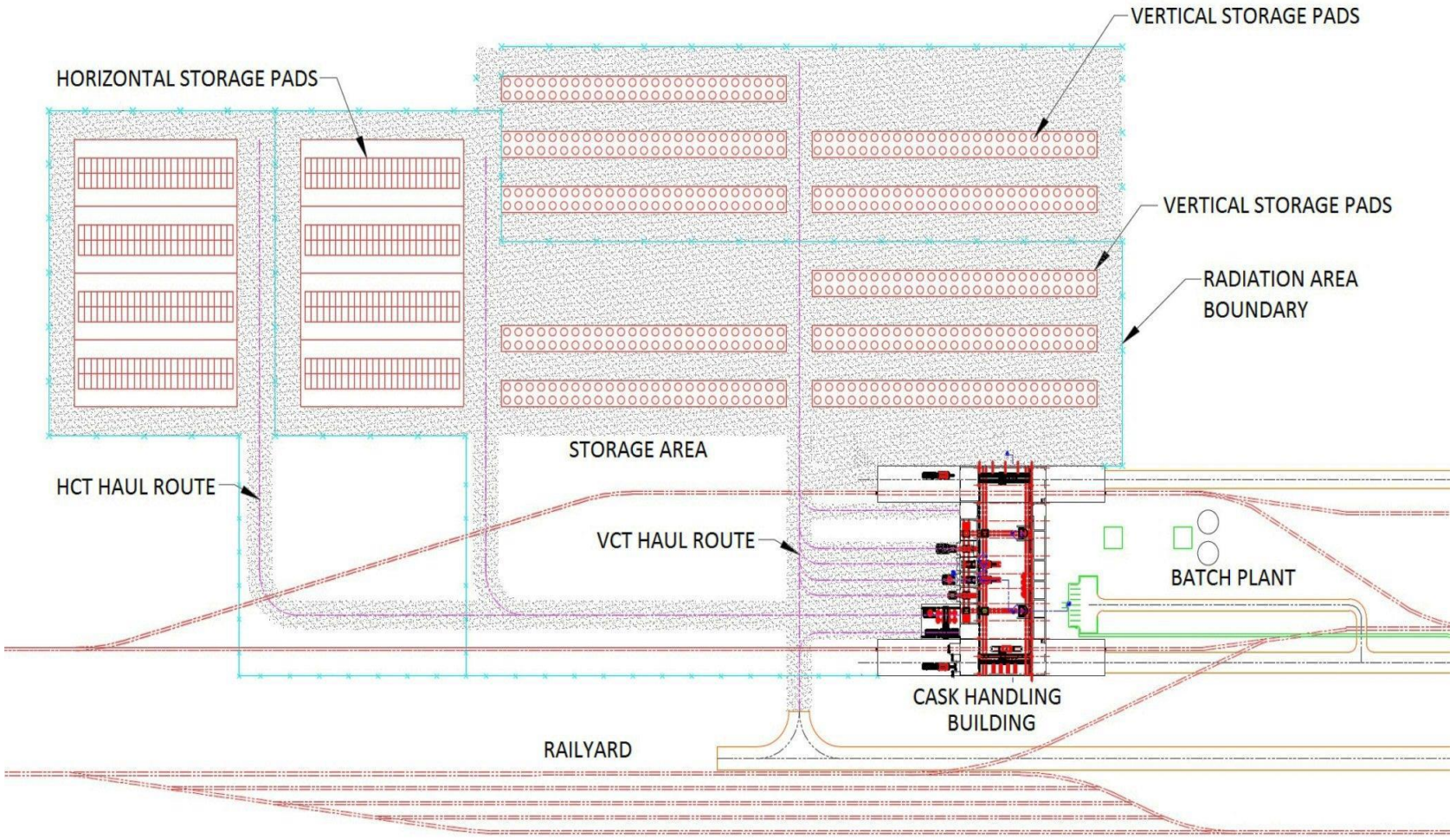
Pilot Conceptual Generic Layout Two 5,000MT Storage Modules



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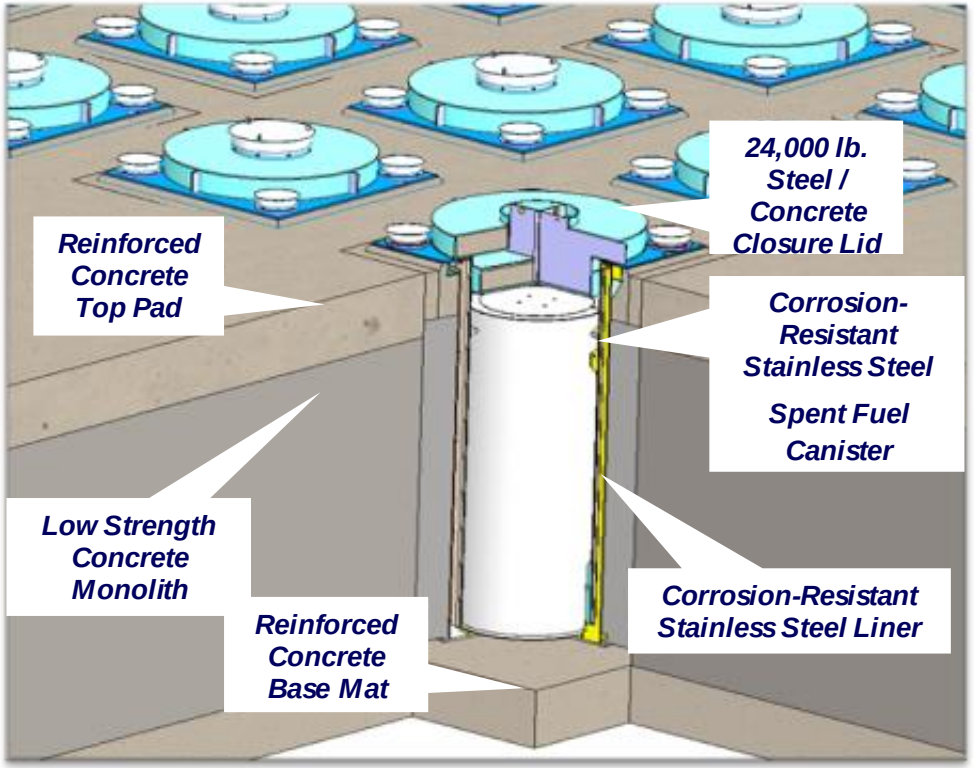
Storage Configuration Concept 2 Underground Silos

Underground Silo Storage

- ***Similar to UMAX deployed at Callaway and announced for San Onofre***
- ***Reduced Security Requirements***
- ***Reduced Storage Area Dose***
- ***Licensing Challenges to Accept all Canister Types in a Vertical Storage Configuration***
  - *Adaptors for the various canister sizes*
  - *Fuel Orientation in currently horizontal configuration canisters*



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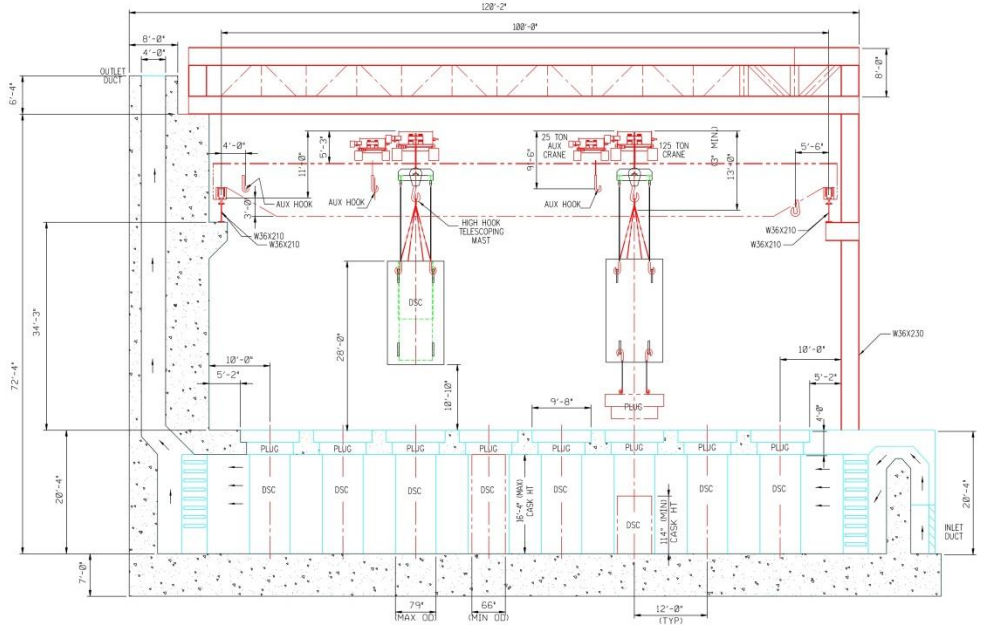
Storage Configuration Concept 3 Vault Configurations



Vertical Configuration

- ***Similar to Ft. St. Vrain***
- ***Passive Air Cooled***
  - *Decay Heat Limited*
- ***Licensing Challenges to Accept all Canister Types in a Vertical Storage Configuration***
  - *Adaptors for the various canister sizes*
  - *Fuel Orientation in currently horizontal configuration canisters*

Horizontal Configuration

- ***Licensing Challenges to Accept all Canister Types in a Horizontal Storage Configuration***
  - *Adaptors for the various canister sizes*
- ***Access Not Available for Every Storage Position***
- ***Decay Heat Removal Extremely Challenging in a Passive Cooling Mode***

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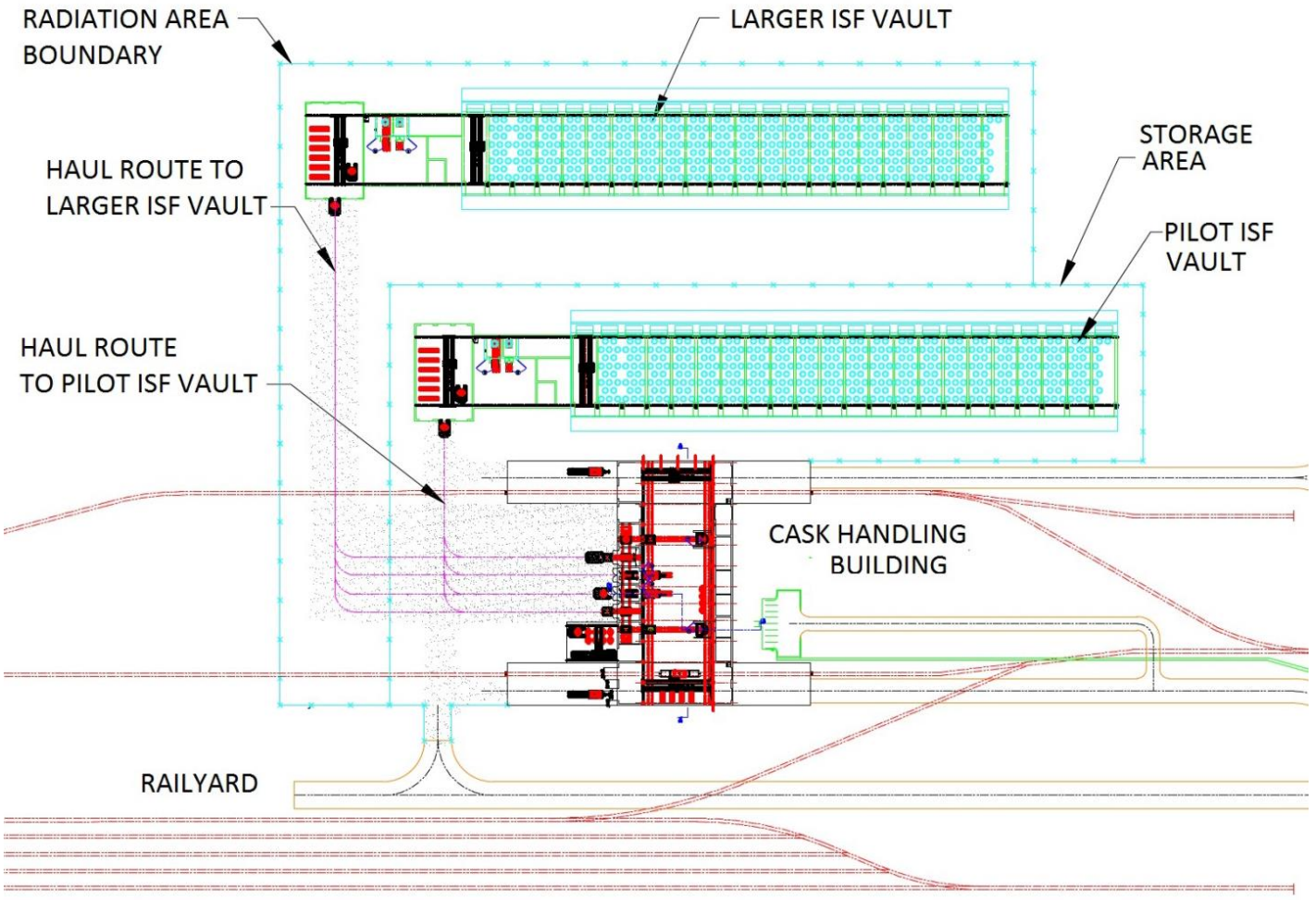
Vault Configuration Generic Layout With Single Cask Handling Building 2 – 5,000MT Modules



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Questions/Discussion