



U.S. Department of Energy



Systems Integration and Total System Model

Presented to:

Nuclear Waste Technical Review Board

Presented by:

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and Strategy Development**

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Las Vegas, Nevada

Overview

- **Systems Integration Approach**
- **Total System Model Overview**
- **Topics Requested by NWTRB**
 - **Key Assumptions**
 - **Key Insights**
 - **Constraints and “Choke Points”**
 - **Thermal Management Parameters**
 - **Use of TSM**
- **Summary**

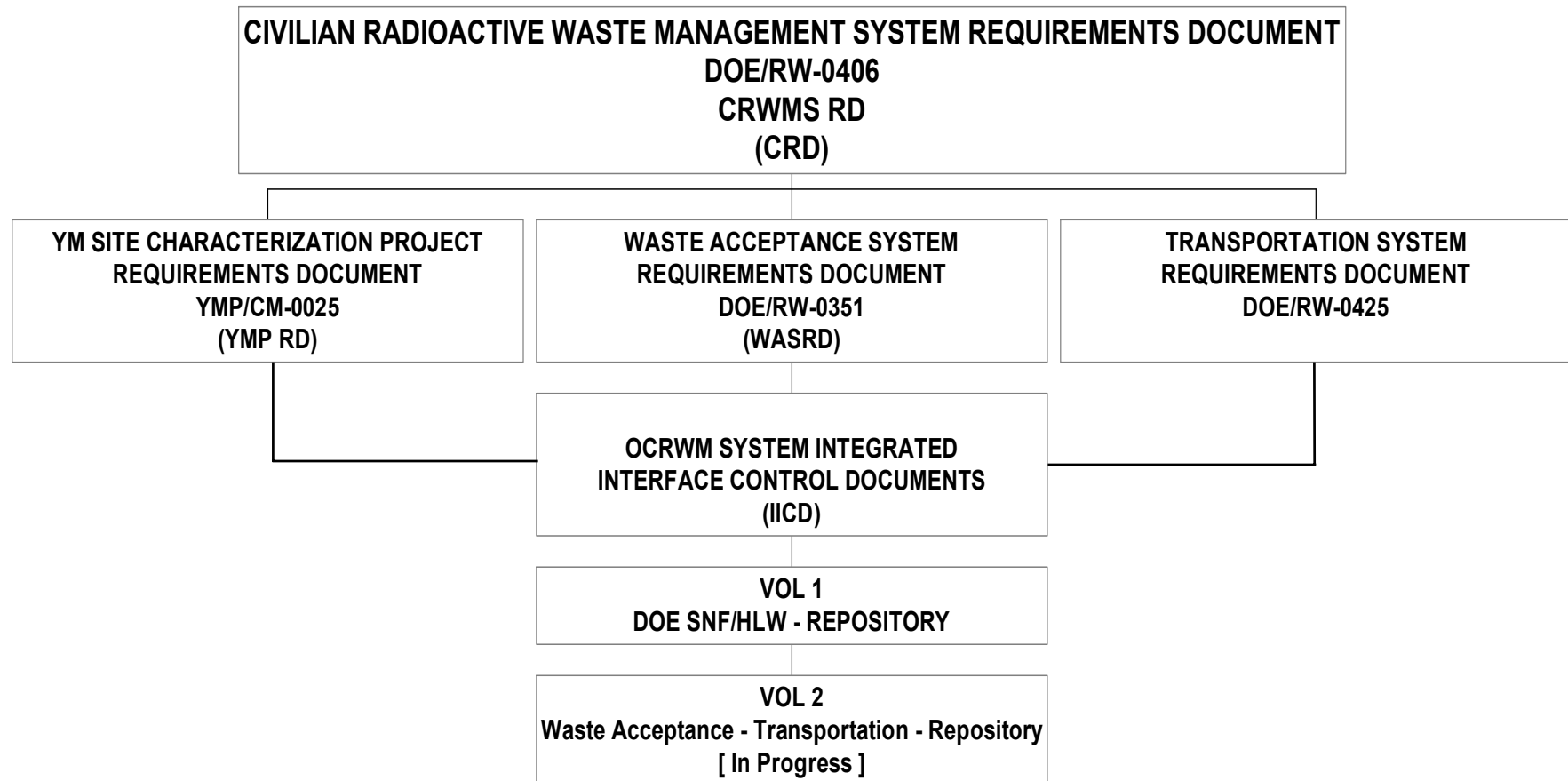


Systems Integration Approach: An Integrated Solution to Waste Disposal

- **The Program continues to develop an integrated solution to accept, transport and dispose of spent nuclear fuel**
 - Receipt, handling and disposal based on 10CFR Part 63 will be contained in the License Application
 - Waste Acceptance and Transportation based on Standard Contracts and 10 CFR Part 71 is evolving
- **As with any large undertaking, this Program has resource, institutional interface, and existing technological constraints**
 - The Program has cross-cutting issues in a dynamic environment
 - This environment requires a continuing evaluation process to provide integrated solutions



Systems Integration Approach: Requirements Hierarchy and Interface Control Documents

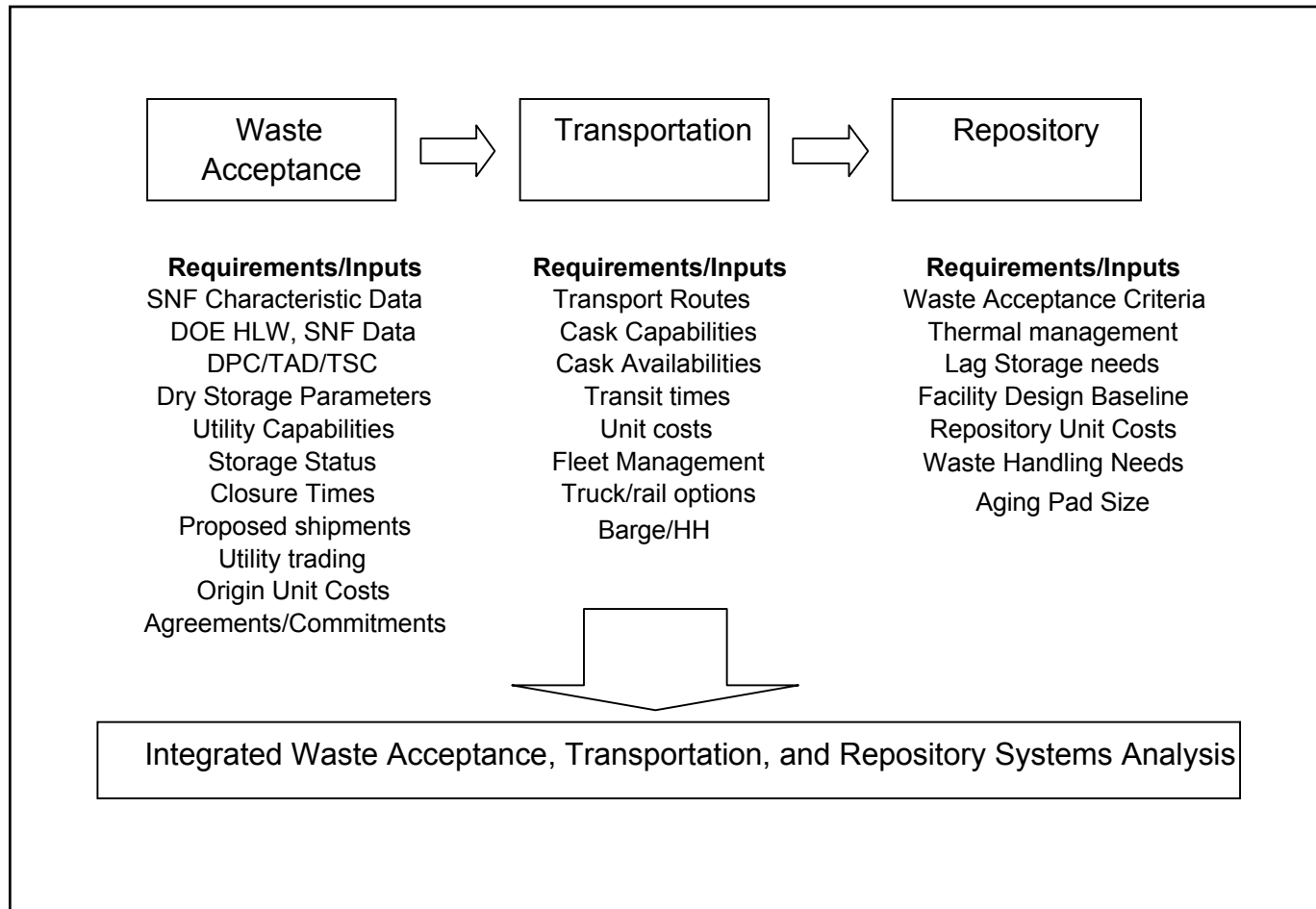


Systems Integration Tools: Total System Model Overview

- **The Total System Model (TSM) is one tool to analyze the linkages, interactions, synergies between waste acceptance, transportation, and the repository**
- **With the TSM, we will continue an integrated system analysis approach to assess:**
 - **Baseline performance**
 - **Alternative analysis**
 - **System solutions**
 - **Program and policy impacts**



Systems Integration Tools: Total System Model Overview



Systems Integration Tools: Total System Model Overview

Integrated Waste Acceptance, Transportation, and Repository Systems Analysis

SYSTEM ANALYSIS RESULTS

Truck/rail selection

Shipping Schedule/Meets Waste Acceptance?

Cask Parameters (type, number, when)

Transportation Origin, Route, Time

Transportation Resources

Dose

Life Cycle Cost

Total Project Cost

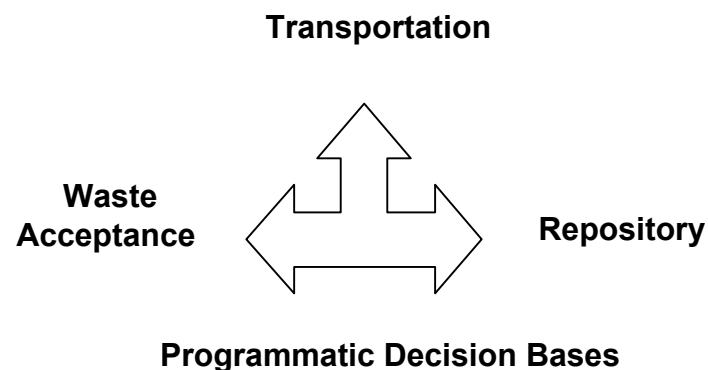
Aging Requirements/Schedule

Emplacement Schedule

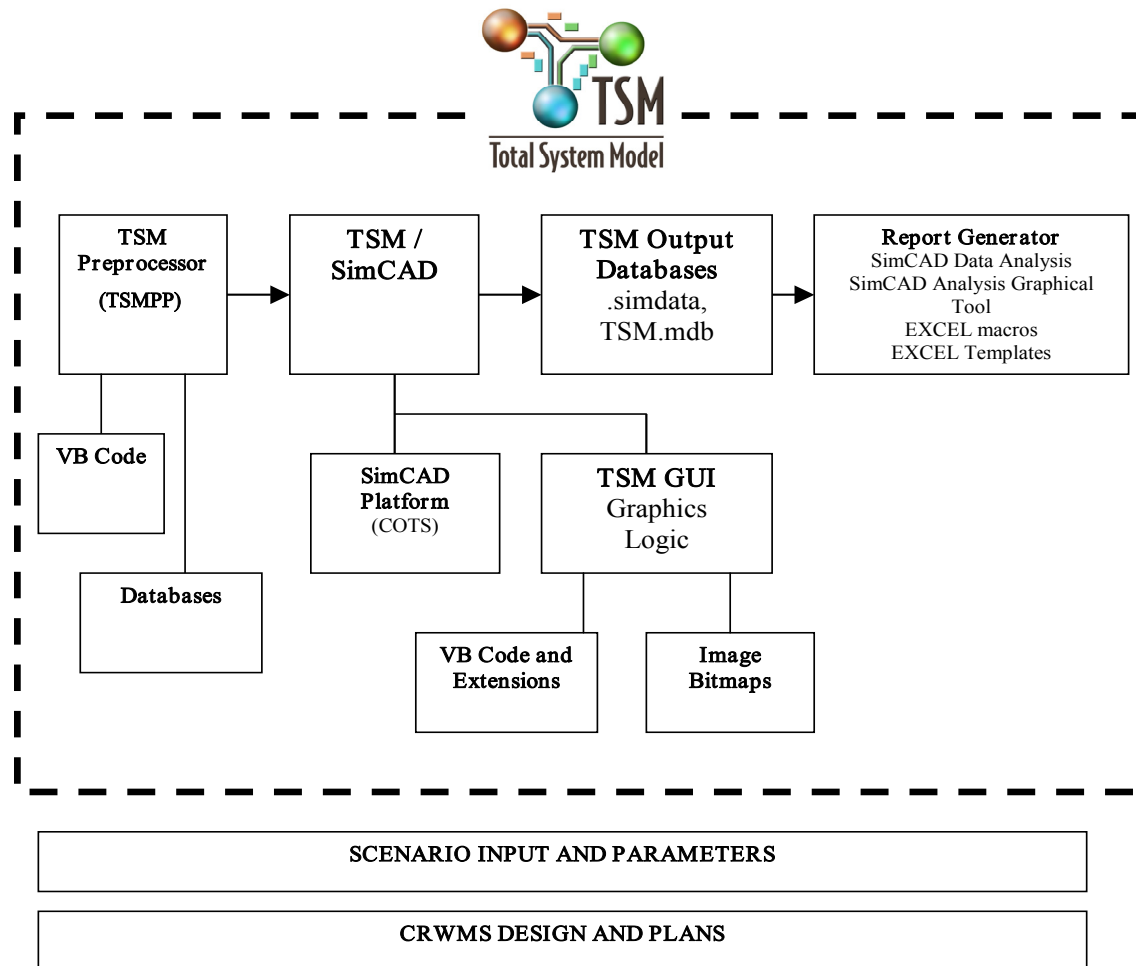
Meet Design Basis Assumptions?

Uncertainties and Sensitivities

The TSM will analyze the interactions and optimization of all project elements and provide an integrated decision tool.



Systems Integration Tools: Total System Model Overview



Systems Integration Tools: Total System Model Overview

Waste Acceptance Module:

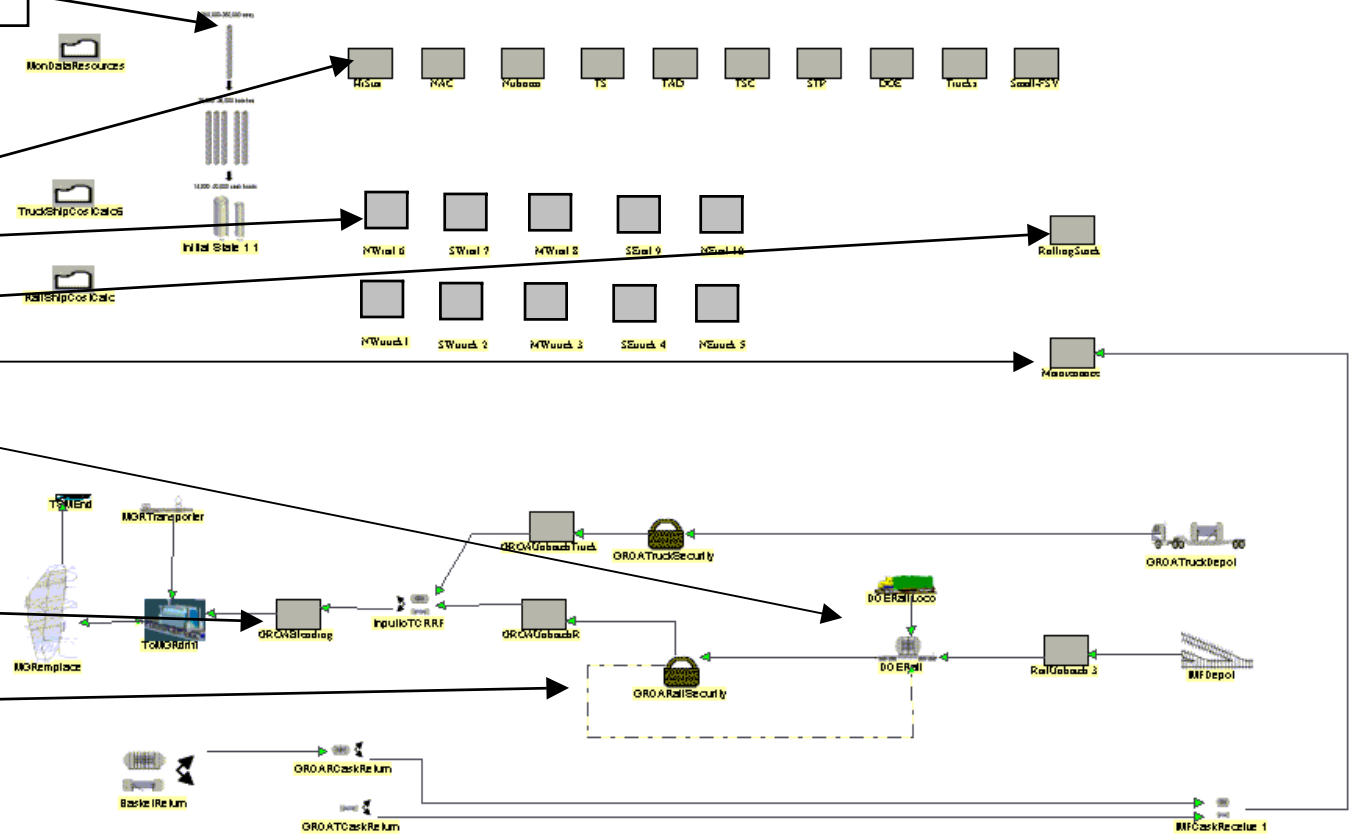
- Initial State (IS) calculation

Transportation Module:

- cask allocation functions
- routing maps
- rolling stock functions
- cask maintenance functions
- repository interface

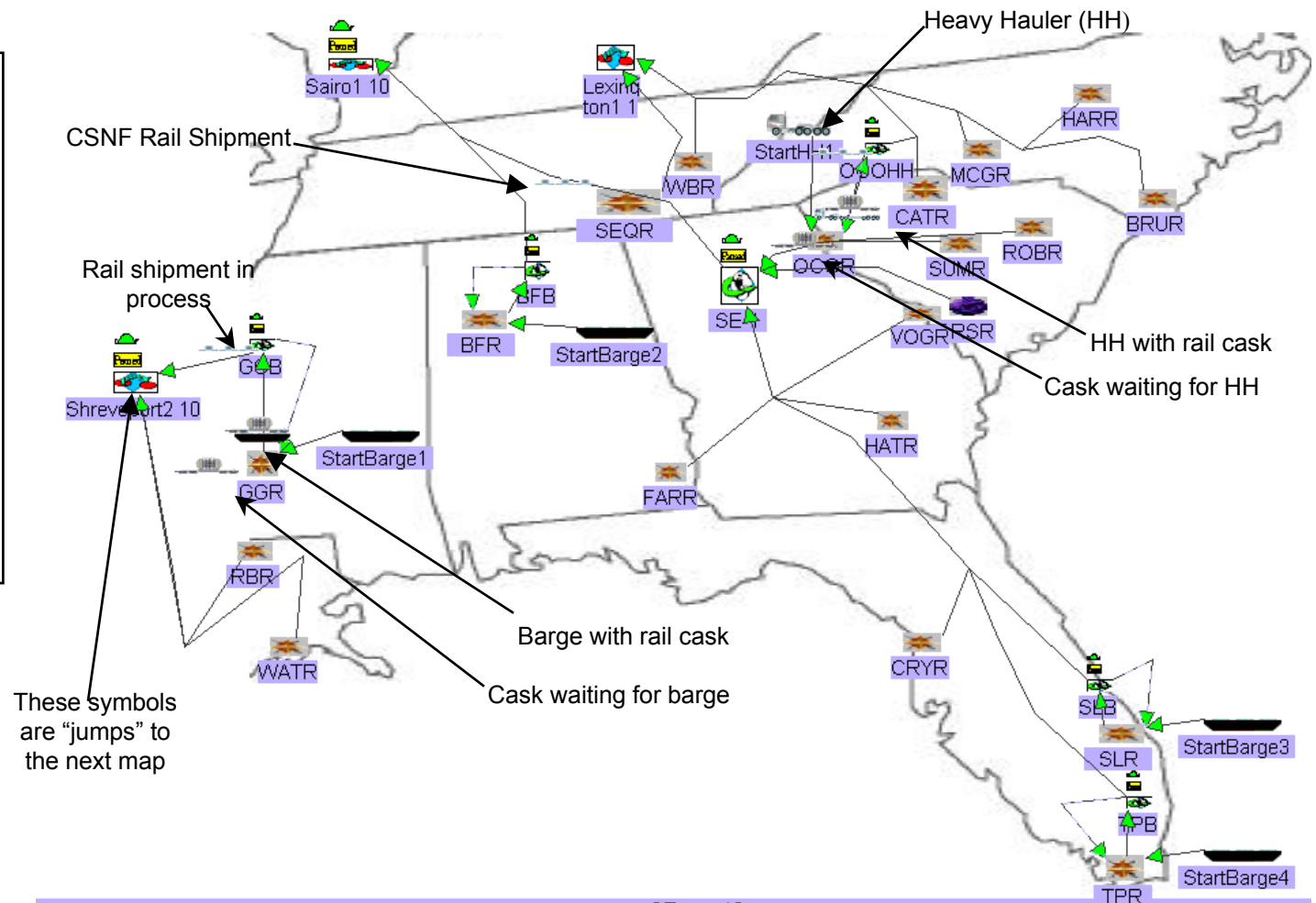
Repository Module:

- GROA facility functions
- Transportation link into the GROA
- Waste Package fuel loading/emplacement
- Fuel Aging and return



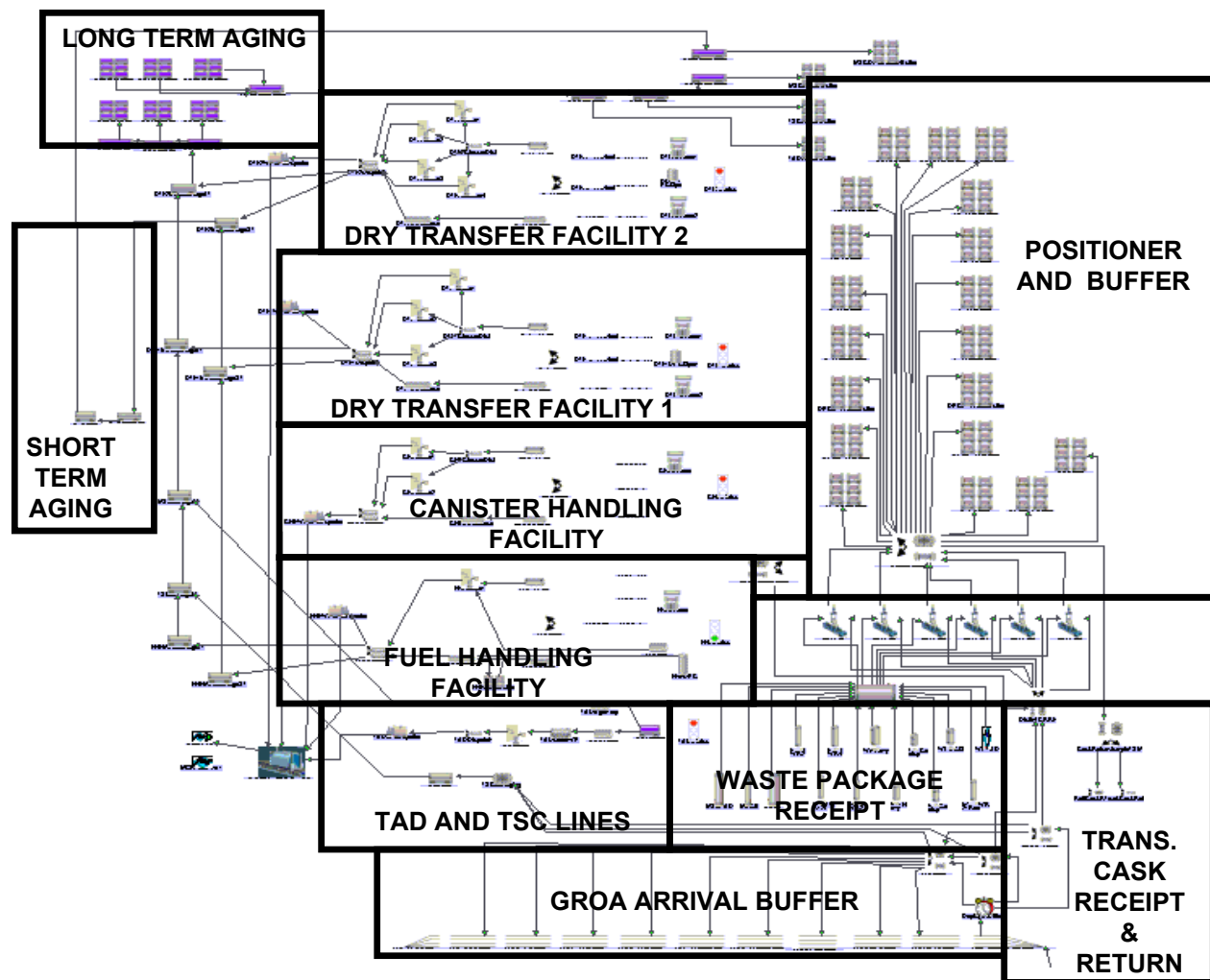
Systems Integration Tools: Total System Model Overview

- Use representative routes and modes from repository FEIS
- Simulate rail, truck, and intermodal transportation
- Can simulate specific routing scenarios such as seasonal routes
- Overall system impacts from ONT inputs can now be analyzed to see affects on Waste Acceptance or GROA performance



Systems Integration Tools: Total System Model Overview

- GROA simulated by Process Lines
- Process Lines simulate a variety of scenarios
- Process lines can represent the DTF, CHF, and FHF facilities

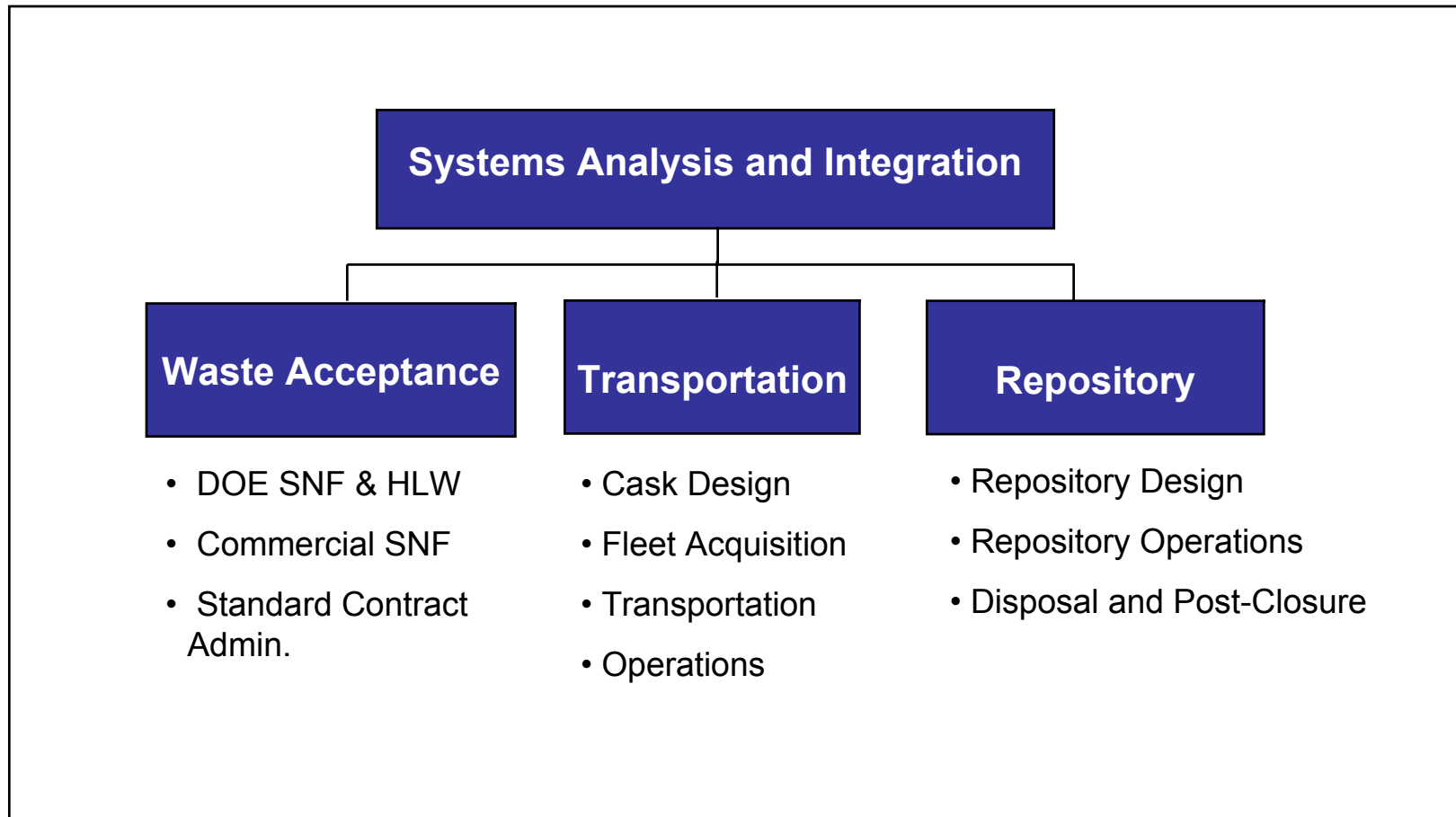


Topics Requested by NWTRB

- **Key Assumptions**
- **Key Insights**
- **Constraints and “Choke Points”**
- **Thermal Management Parameters and Insights**
- **Use of TSM**



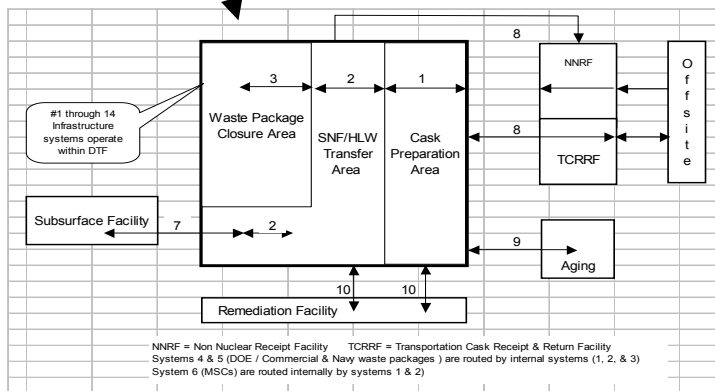
TRB Topics: Key Assumptions



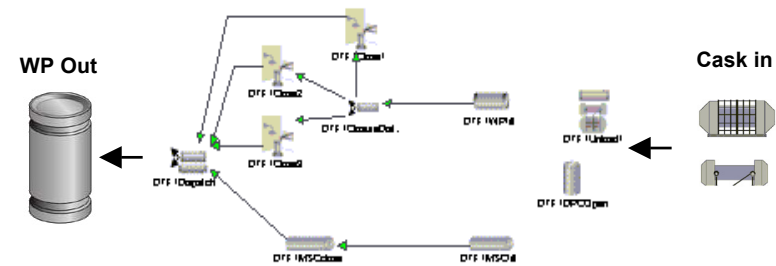
Key Inputs Example: GROA Processing Times



- **TSM GROA processing times are based on detailed sub-systems analyses by the repository design and analyses team**



Roll Up



The repository design and analysis team performs detailed simulations of the facility operation using time steps of 10-30 minutes to understand the detailed facility process times including interfaces to other facilities .

The TSM rolls up the sub-system processes analyses to simulate higher steps to unload cask, prep MSC, load MSC/WP, and weld WP that are based on 8-hour time steps.



Key Inputs Example: Transportation Routes

- Inputs are consistent with the published sources. For example, the national transportation routes are those described in the Yucca Mountain Final Environmental Impact Statement (FEIS).

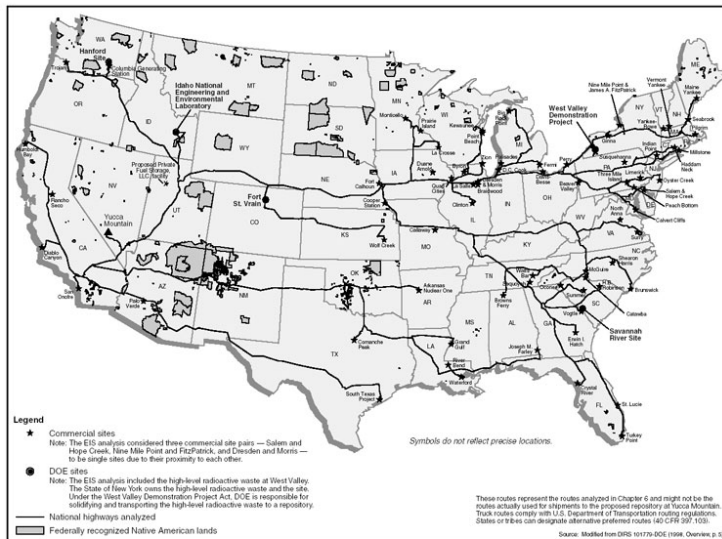
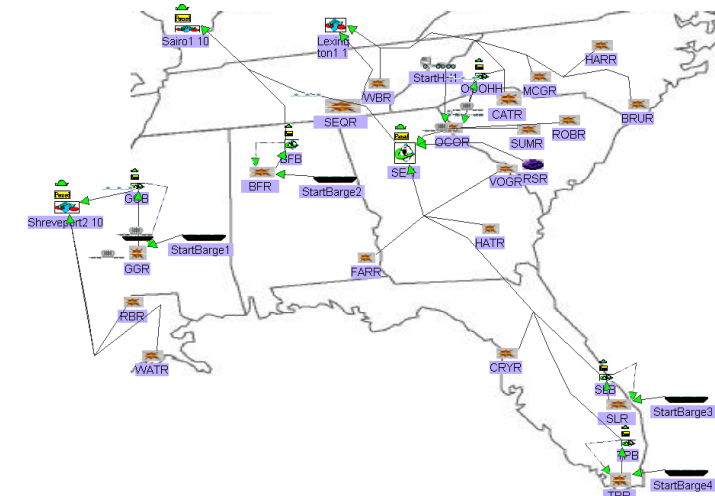
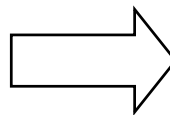


Figure J-5. Representative truck routes from commercial and DOE sites to Yucca Mountain analyzed for the Proposed Action and Inventory Modules 1 and 2.



TSM rail routes for each region

FEIS rail transportation routes

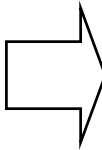


Key Inputs Example: Revised Site Capabilities

- Inputs are made to be consistent with current industry trends and practices and incorporated into the TSM

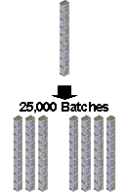


General Information	
Site: Watts Bar Nuclear Plant	Unit: 1 Docket Numbers: 50-390
Site Status: <input checked="" type="checkbox"/> Operating <input type="checkbox"/> Shutdown <input type="checkbox"/> Decommissioned	Contact Name: _____
Address: _____	Organization/Position: _____
Site Operator: Tennessee Valley Authority	Phone Number: _____
NSSS Vendor: Westinghouse	Fac Number: _____
Unit Type: <input checked="" type="checkbox"/> PWR <input type="checkbox"/> BWR <input type="checkbox"/> Other	DCSS: No spent fuel currently in dry storage.
Site/Plant Cask Handling Information	
Roads	
Nearest Truck Route to Nearest Interstate: Watts Bar Access Road/ SR-68/175 (17.7 miles from the plant)	Weight Limit: Permit at 80,000 lbs to 150,000 lbs
Bridges: _____	Height: _____
Underpasses: _____	Description: On-site roads are capable of supporting heavy haul transporters.
Rail	
Access to Site: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Servicing Railroad Company: Norfolk Southern Railways
On Site Rail: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Last Use: 1989
Length of Rail Inside Protected Area: 2900' 0"	Road Distance to Off-Site Rail Head: NA
Description: 0.5 miles of on-site track. 1989 use was for 234,000 lb rotor. Spur to receiving area has never been used and it currently has temporary buildings over the rails.	Some on-site rails have been paved over.
Water	
Water Way: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Name: Tennessee River
Barge Access: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Last Use: early 1990s
Road Distance to Off-Site Barge Terminal: NA	Description: On-site barge slip and dock exist, but are not maintained and would require some refurbishment. No crane available.
Crane	
Capacity: 125 tons	Single Failure Proof: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Rating: 125 tons	Submersible Hook: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Pain of Hook to Highest Obstruction Distance: 29' 8"	Description: Extension arm installed at intermediate loading area to avoid hook submergence.
Cask Receiving Area Information	
Truck Access: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Access Through Airlock/Access Bay: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Rail Access: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Dimensions: L 57' 6" W 15' 6" H 20' 4"
Floor Load Limits: Maximum Total Load _____ Maximum Area Load _____	Hatchway: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Dimensions: L 68' 3" W 15' 3"	
Center Point of Hatchway in Relationship to _____	

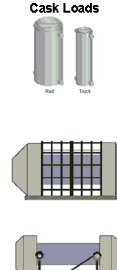


Initial State

250,000 As sy.



7,000-17,000 Cask Loads

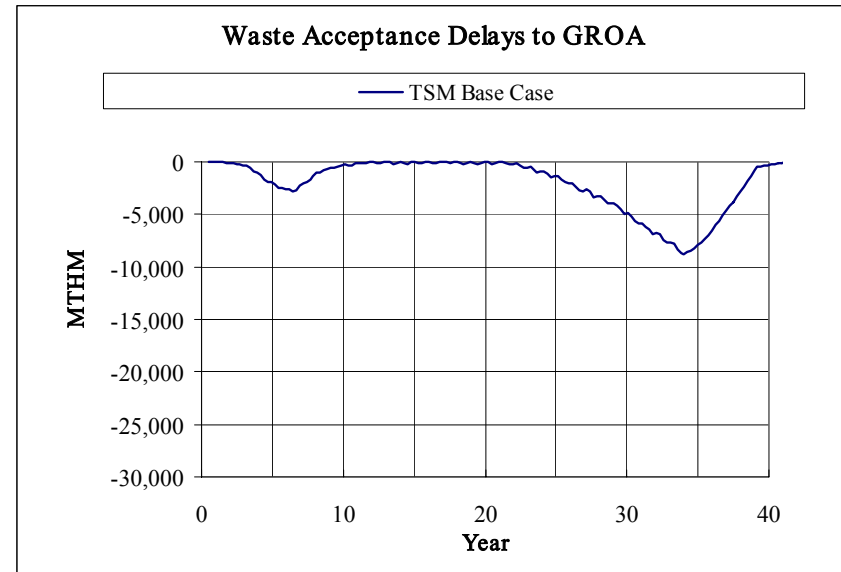
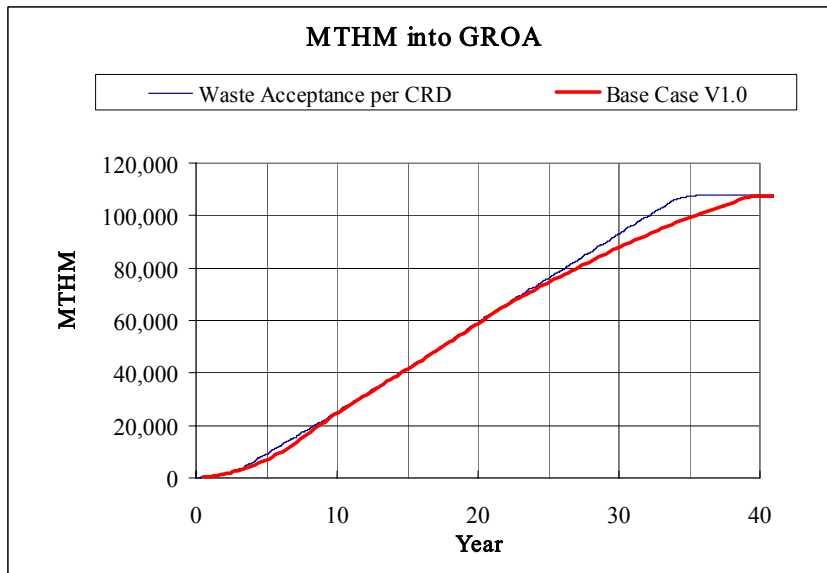


In 2005, the Facility Interface Data Set (FIDS) provided updated general information on site and plant cask handling information.

TSMPP input was revised to realize new cask load projections and hardware utilization effect on system performance.



Key Insights: Project System Performance and Hardware Assumptions



Representative Data:

The blue curve represents the CRD target cumulative MTHM. Red curve represents CRWMS receipt.

What are the causes and effects?

Key Insight and Understanding:

The first valley is impact of truck casks before all process facilities are online.

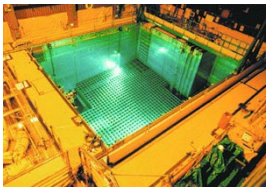
The second valley is assuming large number of DPCs from shut down sites with dry storage.



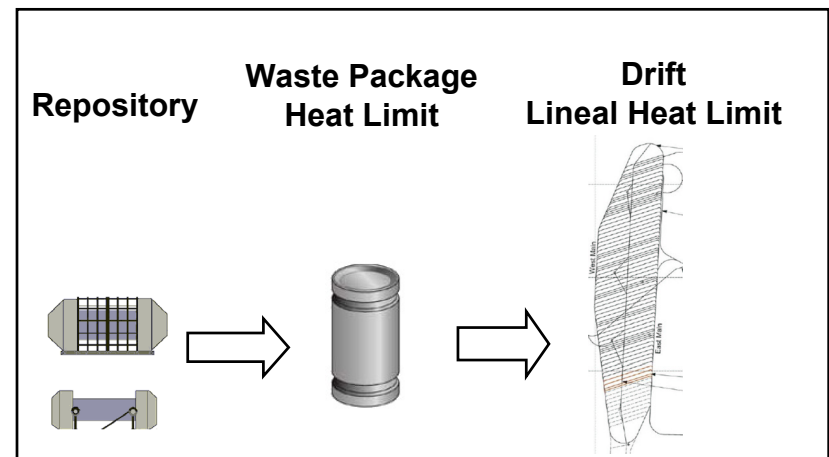
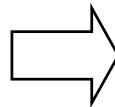
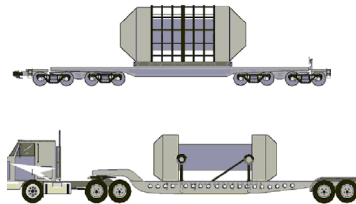
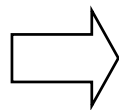
Key Insights: TSM Thermal Management Parameters

- TSM tracks SNF thermal properties from discharge through Waste Acceptance, through Transportation, and through GROA processing and emplacement. Thermal behavior is modeled in each step of the TSM.

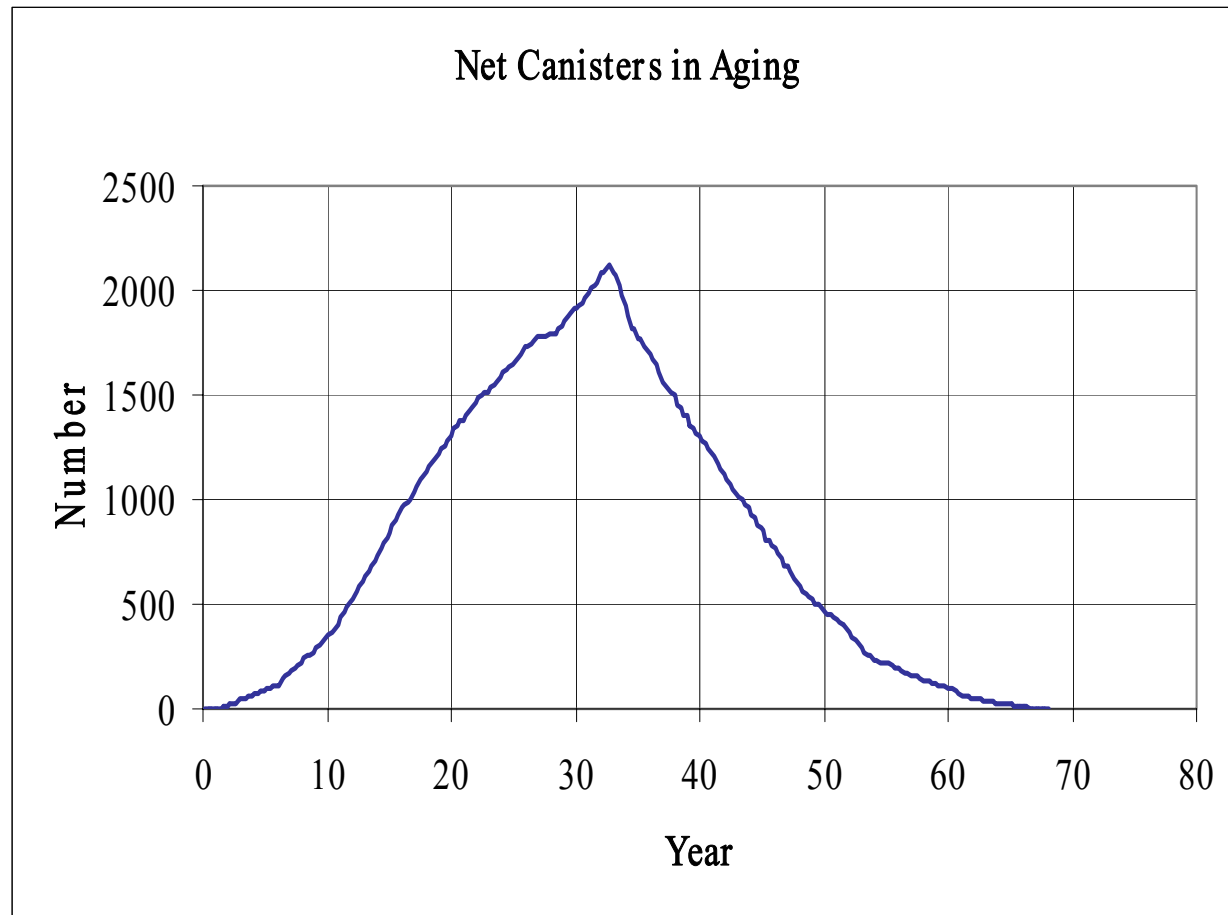
Waste Acceptance
Hot: YFF5
Cold: OFF



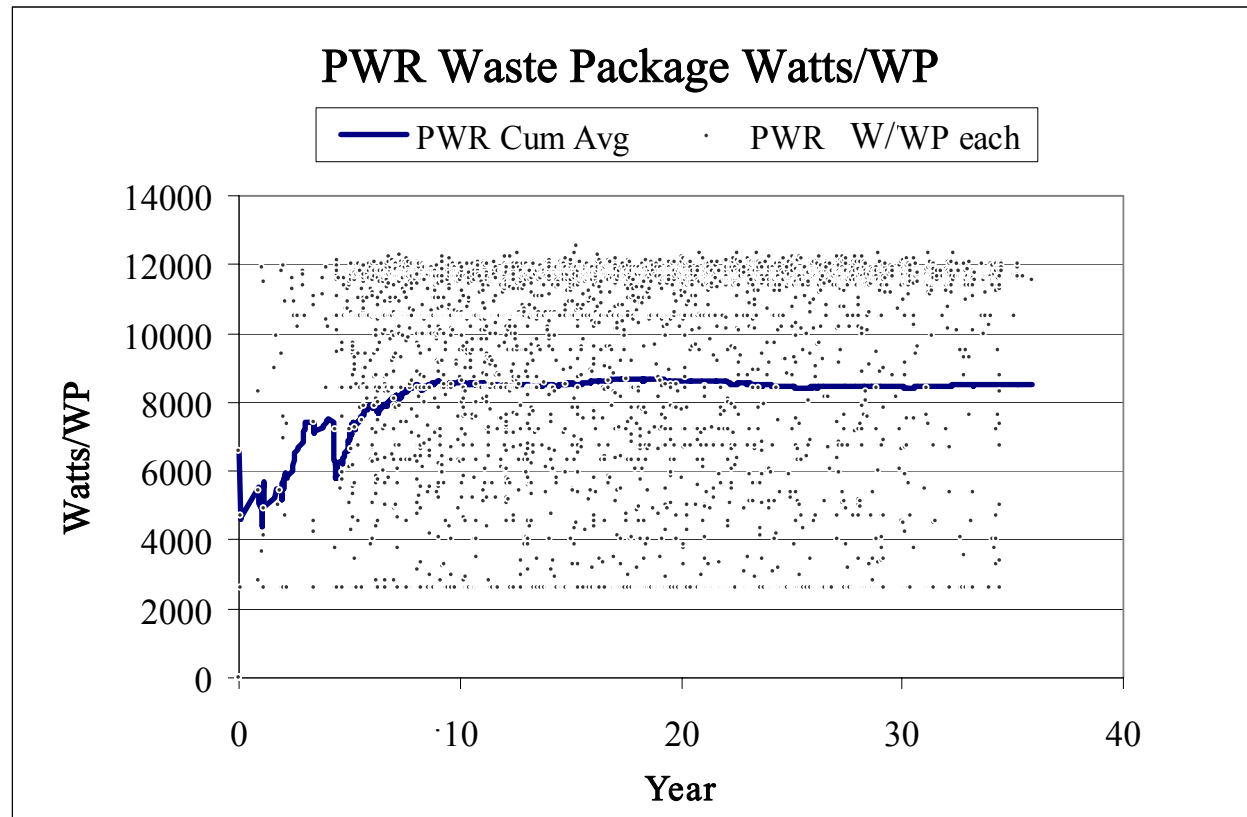
Transportation Cask
Heat Limit



Key Insights: TSM Thermal Management Parameters: “Aging”



Key Insights: TSM Thermal Management Parameters: “Waste Package Loading”



Total System Model Summary

- **The Total System Model is a systems tool to study the complex interactions among the Program elements**
- **The TSM will challenge Program design assumptions, requirements, and operational assumptions**
- **RW will proceed through a systematic approach to support the major Program and policy issues ahead**
- **The TSM will incorporate new data or inputs as they become available in a controlled and documented process**

