U.S. Department of Energy

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Total System Model Analyses Supporting the TAD Concept

Presented to:
Nuclear Waste Technical Review Board

Presented by:
Christopher Kouts
Director, Waste Management Office
Office of Civilian Radioactive Waste Management
U.S. Department of Energy

May 9, 2006
McLean, VA

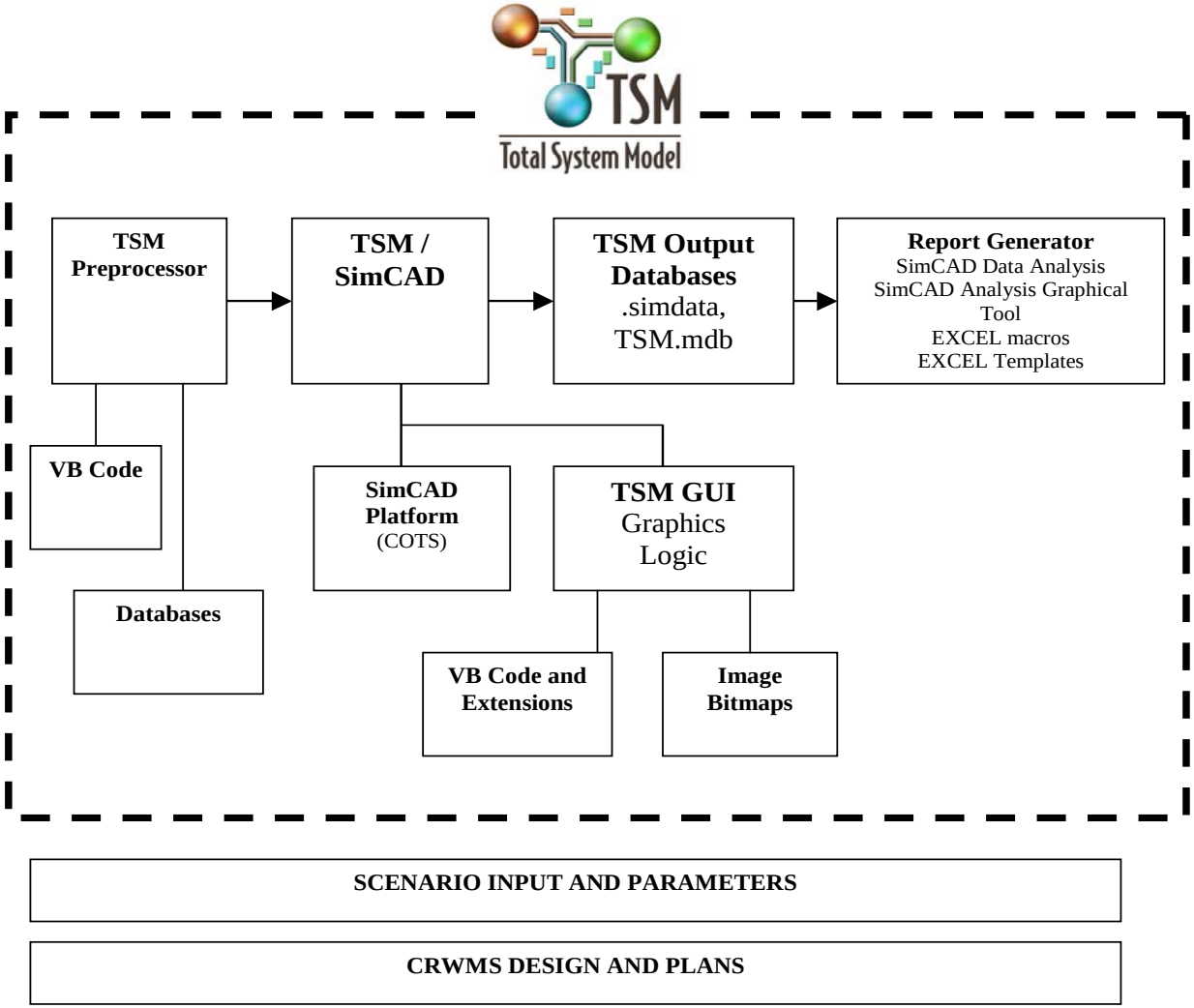
Overview

- **Total System Model Overview**
- **Phase 1 Transportation, Aging, and Disposal (TAD) Study – 2005**

An Integrated Solution to Waste Disposal

- **OCRWM continues to develop an integrated solution to accept, transport and dispose of spent nuclear fuel**
- **As with any large undertaking, this Program has resource, institutional interface, and existing technological constraints**
- **Total System Model (TSM) is one tool to analyze the linkages, interactions, and synergies between Program functions (waste acceptance, transportation, and the repository)**
  - **Baseline performance**
  - **Alternative analysis**
  - **System solutions**
  - **Program and policy impacts**

Systems Integration Tools
Total System Model Overview

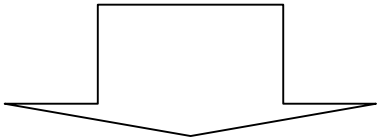


Systems Integration Tools
Total System Model Overview
(Continued)

Requirements/Inputs
SNF Characteristic Data
DOE HLW, SNF Data
DPC/TAD/TSC
Dry Storage Parameters
Utility Capabilities
Storage Status
Closure Times
Proposed shipments
Utility trading
Origin Unit Costs
Agreements/Commitments

Requirements/Inputs
Transport routes
Cask Capabilities
Cask Availabilities
Transit times
Unit costs
Fleet Management
Truck/rail options
Barge/Heavy Haul

Requirements/Inputs
Waste Acceptance Criteria
Thermal management
Lag Storage needs
Facility Design Baseline
Repository Unit Costs
Waste Handling Needs
Aging Pad Size



Integrated Waste Acceptance, Transportation, and Repository Systems Analysis

Systems Integration Tools
Total System Model Overview
(Continued)

Integrated Waste Acceptance, Transportation, and Repository Systems Analysis

SYSTEM ANALYSIS RESULTS

Truck/rail selection

Shipping Schedule

Cask Parameters (type, number, when)

Transportation Origin, Route, Time

Transportation Resources

Dose

Life Cycle Cost

Total Project Cost

Funding Requirements

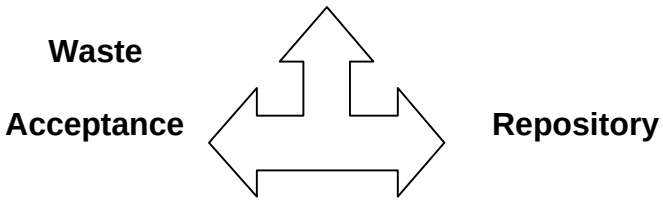
Aging Requirements/Schedule

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
(Continued)

Waste Acceptance Module

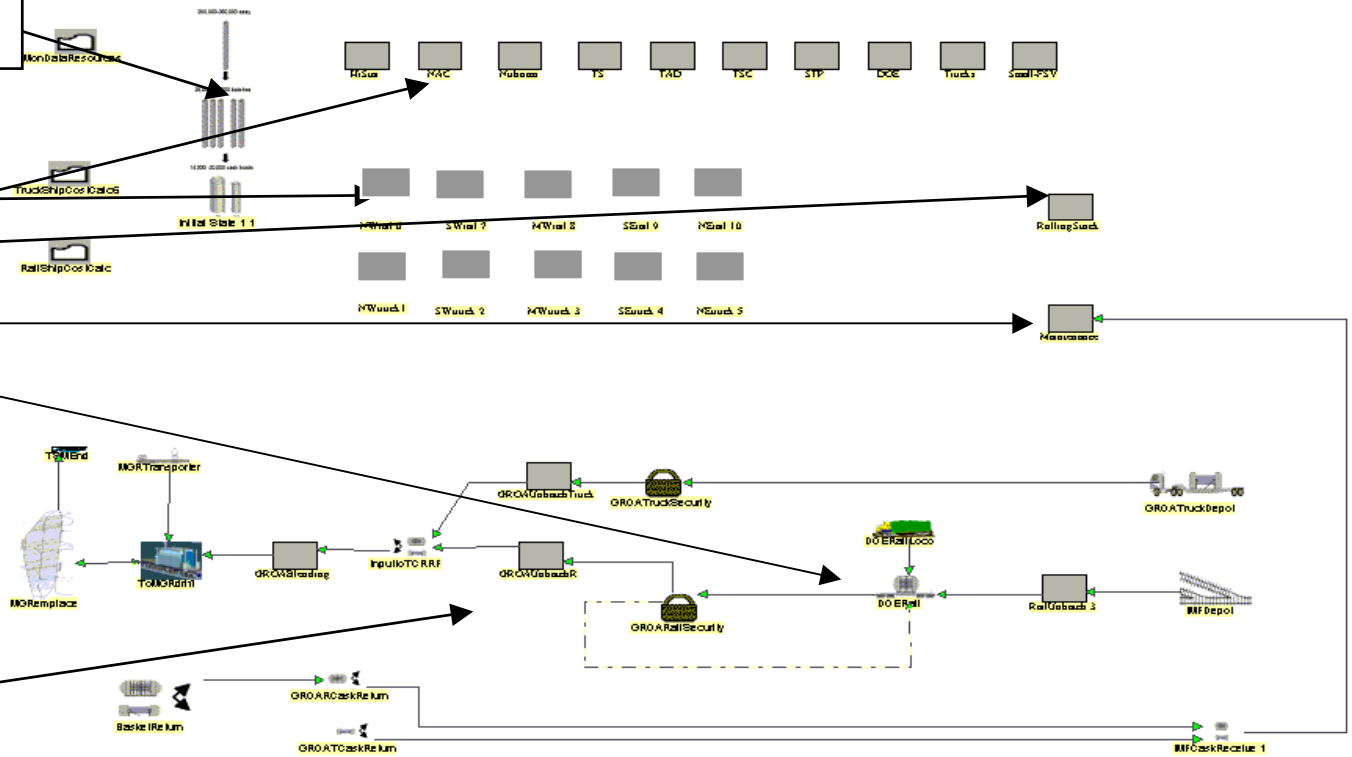
- Initial State (IS) calculation

Transportation Module

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

Repository Module

- Geologic Repository Operations Area (GROA) facility functions
- Transportation link into the GROA
- WP fuel loading and emplacement
- Fuel aging and return



Phase 1 TAD System Study - 2005

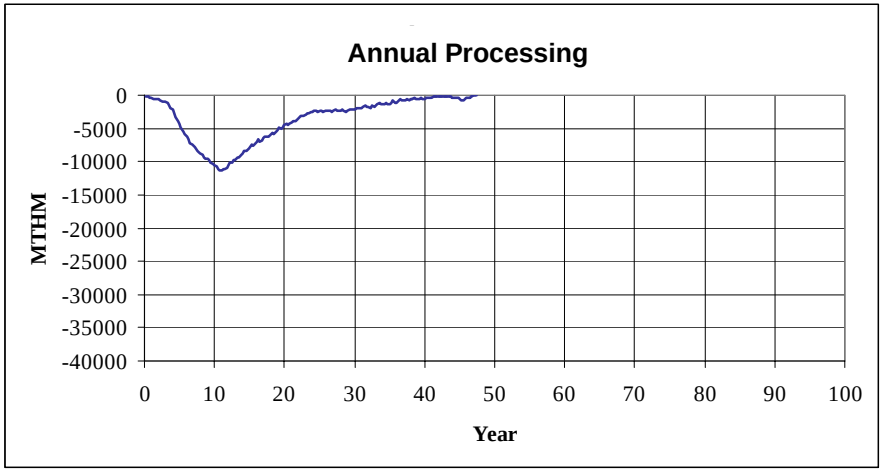
- **Phase 1 study began on March 21, 2005:**
- **"…system study to evaluate the feasibility of an alternative method for receiving, transporting, aging and disposal of commercial spent nuclear fuel using single canisters loaded a single time."**
- **List of 70 combinations of parameters covering key system elements developed**
- **Initially, 40 alternative scenarios selected to analyze impacts of transport, aging, and disposal (TAD) systems**

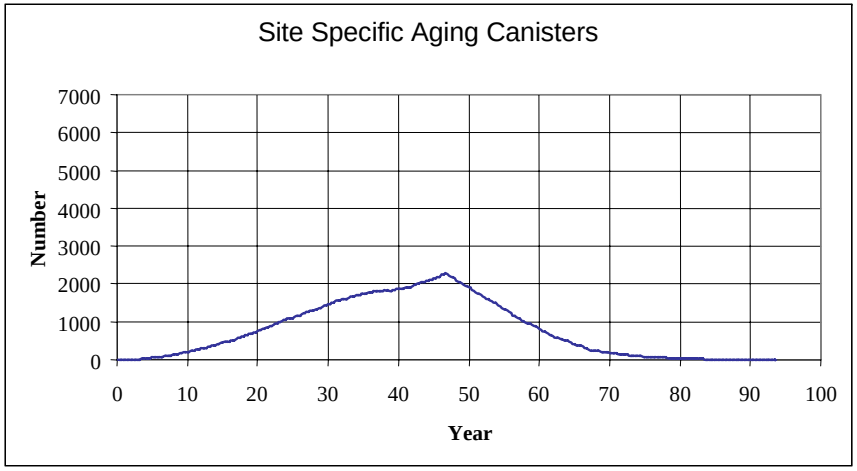
Key Elements in TAD System Study

CRWMS Element	Changes to Key Parameters
-1 CSNF Acceptance	YFF10/YFF5
-2 Utility DPC Options	Unload to DPCs or Pool after shutdown Unload DPCs to pool to fill transportation casks
-3 CSNF Site Pickup Strategy	CSNF Transport Cask TAD's, Truck, TSC's, DPC's, bare rail
-4 Site Capabilities	Base, FIDS Update, All TAD
-5 Transportation Cask Size Parameters	Large TAD 32/68,' Medium TAD 21/44, Small TAD 12/24, Bare Casks: 32/68, 20/42, 8/20
-6 TAD Heat content parameter	7.5 KW, 11.8 KW, 18 KW "strict"-"not strict"
-7 GROA Operation	Always Process/Process Bypass To Aging
-8 WP Heat	7.5 KW, 11.8 KW, 18 KW
-9 WP/MSC/SSC Sizes	Base/Large

Typical Results: Baseline Scenario 0A

- **Bare fuel, mostly rail, shutdown sites dump to pool, YFF10, 11.8 kW WP**

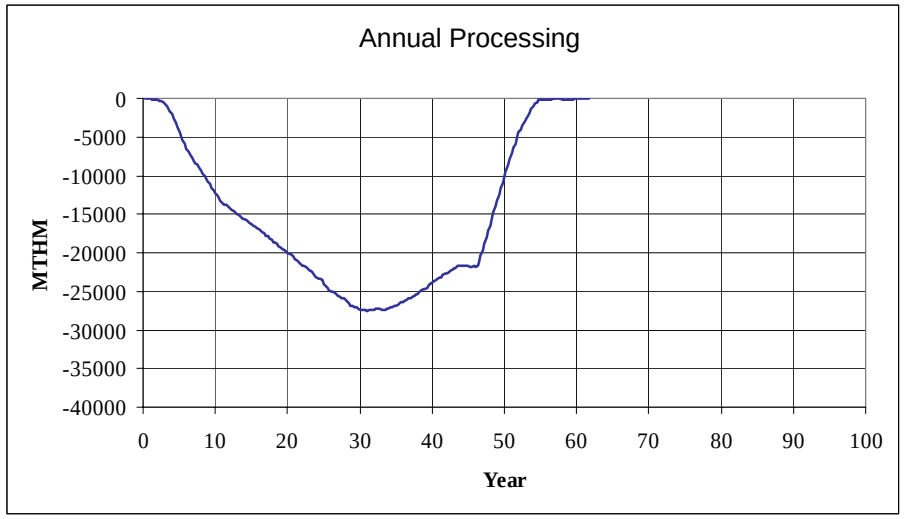


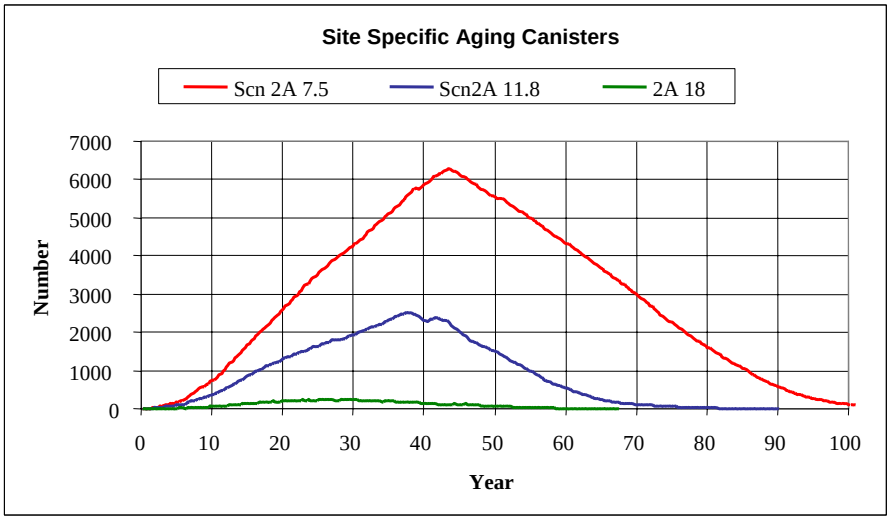


Typical Results: Scenario 2A

Key Element: Revised site capability data

- **Bare fuel mostly rail, shutdown sites dump to pool, YFF5, WPs: 7.5, 11.8, and 18 kW**





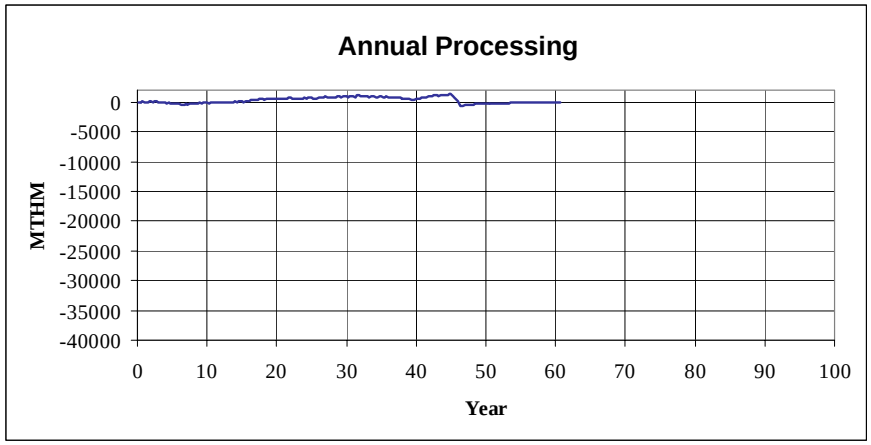
New site data requires using smaller casks and increases the number casks shipments. This results in a a deeper valley curve compared to Case 0A.

This shows the 2A with varying WP heat limits of 7.5, 11.8, and 18 KW.

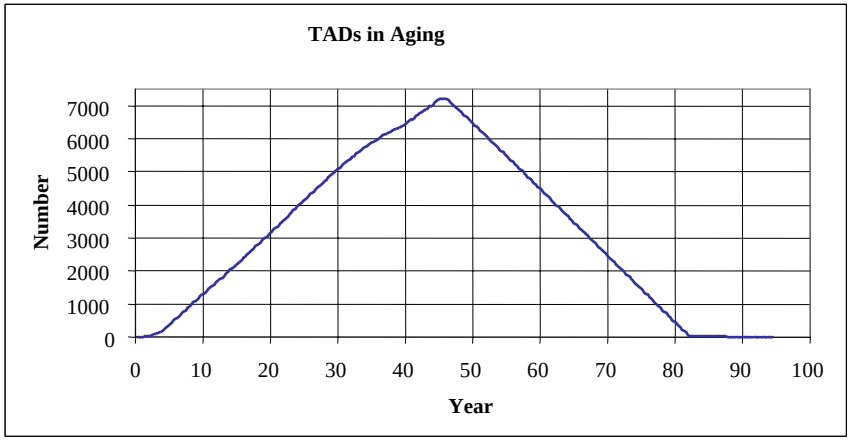
Typical Results: Scenario 25A

Key Element: Mostly rail - TADs (Medium [21P/44B] & Small [12P/24B] TADs, LWT for some sites)

- **Shutdown sites dump to pool, YFF5, 11.8 kW WP, new waste site capability**



Lack of a valley curve indicates that the GROA can keep up with the CRD acceptance rate.

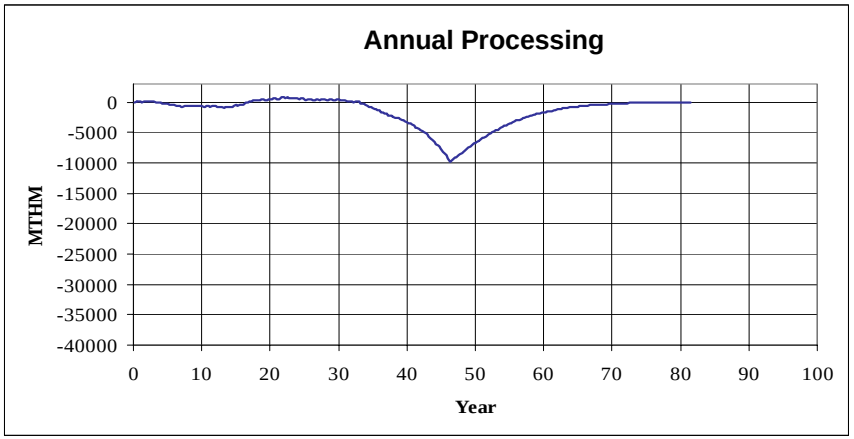


Scenario 25A aging includes TADs that are too hot and TADs that "bypass" processing. "Bypass" occurs when the TAD receipt rate exceeds the TAD line WP closure capability.

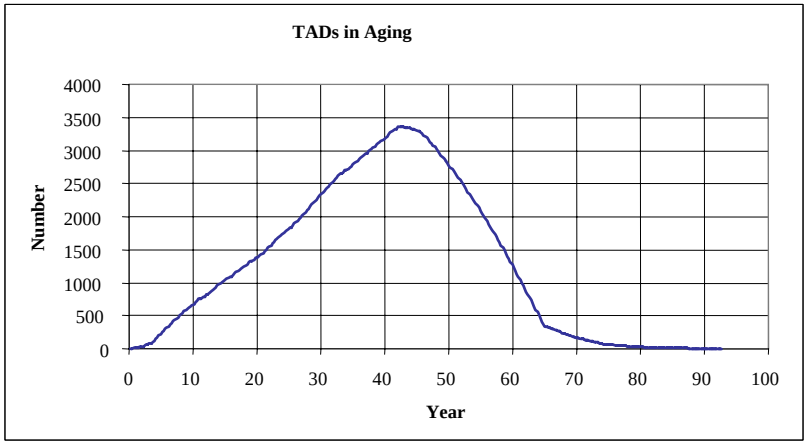
Typical Results: Scenario 27A

Key Element: 18 kW WP, Use Large (32P/68B) & Small TADS & LWT for some sites

- **Mostly rail, new origin site capability, shutdown sites dump to pool, YFF5**



There is a valley curve because there is not enough CSNF at the sites that is cool enough to fill every slot in a **large** TAD.



Considering thermal effects only, one would expect a large WP to put more in aging for 27A vs. 26A because the allowable heat per assembly is lower for the larger WP. However, there is less in aging because there is less bypass-there are fewer TADs to be processed.

Phase 1 TAD Study Key Observations

- **Primarily canister-based system using TADs can be a viable alternative to the primarily bare CSNF approach.**
  - **The CSNF processing rates are met**
  - **The 21,000 MTHM GROA aging capacity limit is achievable**
  - **Emplacement can be completed within 50 years of start of receipt**