



U.S. Department of Energy
Office of Civilian Radioactive Waste Management

CRWM Program
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Total System Model (TSM)

Presented to:
Nuclear Waste Technical Review Board

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TOTAL SYSTEM MODEL - PURPOSE

- **TSM is a systems model used for integrated analyses of the waste management system from discharge of wastes at the waste generator sites to emplacement of waste packages in the repository at Yucca Mountain.**
- **TSM is flexible and can simulate different scenarios, thereby providing an effective tool to analyze “what-if” alternatives and to optimize system performance.**
- **TSM provides insights that aid decision-making. TSM does not provide design solutions.**



TOTAL SYSTEM MODEL - DESCRIPTION

- **PC-based commercial software with a graphical user interface.**
- **Real-time, object-oriented simulation wherein discrete items progress step-by-step through the processes dictated by the process flow logic that has been built into the model.**
- **Event-driven model whereby the completion of one step or the availability of the next step triggers a response.**
- **TSM simulation is based on 8-hour time intervals.**
- **TSM incorporates the capabilities and waste management needs of each waste generator site.**
- **TSM uses rail and highway routes described in the Yucca Mountain Final Environmental Impact Statement.**



TOTAL SYSTEM MODEL – DESCRIPTION (cont'd.)

- **The current version of TSM is consistent with the License Application.**
- **Repository surface facilities are modeled using process times determined by others from throughput analyses for the separate processing facilities.**



TOTAL SYSTEM MODEL ANALYSES COMPLETED

- **2005**
 - **Impact of a Canister-Based System on the Civilian Radioactive Waste Management System (CRWMS)**
- **2006**
 - **Evaluation of Alternative Geologic Repository Operating Area Configurations to Support the Revised Critical Decision-1 Conceptual Design Study**
- **2007**
 - **Thermal Management Strategy Scoping Studies**
- **Annually (Since 2005)**
 - **Input to Total System Life Cycle Cost (TSLCC) estimates.**



TSM INSIGHTS – IMPACT OF A CANISTER-BASED SYSTEM ON THE CRWMS

- **A canister-based approach has faster processing times and higher throughputs than a bare fuel handling system.**
- **The canister-based approach can meet the target waste acceptance rate, stay within the 21,000 Metric Tons of Heavy Metal (MTHM) aging pad capacity, meet the subsurface line load criterion (1.45 kW/meter at that time), and be completed within the 50-year operating timeline.**
- **The Transportation, Aging and Disposal (TAD) canister-based approach can accommodate nearly 90% of the commercial spent nuclear fuel (CSNF).**



TSM INSIGHTS – THERMAL MANAGEMENT SCOPING STUDIES

- **The key thermal constraints on the receipt of CSNF are the minimum 5-year out-of-reactor requirement in the Standard Contract (10 CFR 961) and the thermal limit on the transportation casks (assumed to be 22 kW, consistent with current cask designs).**
- **OCRWM can accept CSNF up to the assumed thermal limit of the transportation casks (22 kW) and can emplace CSNF waste packages up to 18 kW/waste package and 2.0 kW/meter line load without exceeding the aging pad design capacity (21,000 MTHM), the aging pad design capacity (21,000 MTHM), the post-closure thermal limits (mid-pillar temperature of 96°C, rock wall temperature of 200°C, and waste package surface temperature of 350°C), and the 50-year operating lifetime.**



TSM INSIGHTS – THERMAL MANAGEMENT SCOPING STUDIES (cont'd.)

- The thermal emplacement strategy affects the amount of the CSNF aging capacity required
 - Emplacement to just meet the postclosure thermal limits (96°C midpillar temperature) resulted in a maximum aging requirement of only 10,400 MTHM
- TSM results from the thermal management scoping studies supported the LA
 - *Total System Model Analysis for Repository Postclosure Thermal Envelope Study, Phase 1, 000-00R-G000-00600-000-001*
 - *Total System Model Analysis for Repository Postclosure Thermal Envelope Study, Phase 2, 000-00R-G000-01000-000-000*
- A Baseline Change Proposal (YMP-2008-022) raised thermal constraints to current LA values (18 kW/WP, 2.0 kW/m line load) was approved in March 2008



TOTAL SYSTEM MODEL – CURRENT STATUS

- **Program priority in FY09 is support of the License Application.**
- **TSM is in a maintenance mode.**
- **All TSM documentation is current for analyses performed to date.**
- **On-going TSM analyses are limited to support for the annual TSLCC evaluation.**

