U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: TOTAL SYSTEM PERFORMANCE ASSESSMENT (TSPA) II: ENHANCEMENTS TO TSPA-1991

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Major TSPA II Objectives

• Evaluate effects of alternative
  - Thermal regimes
  - Emplacement modes
  - Waste-package designs

• Incorporate new site information

• Evaluate effects of alternative performance measures

• Conduct sensitivity/uncertainty analyses
TSPA II Source Term

- Will couple hydrologic, thermal, and chemical effects
- Will include alternative emplacement and thermal-loading strategies
- Will use inventory based on current waste-stream estimates
- Inventory chosen for both release and dose effects
Repository Areas Modeled for Alternative Emplacements and Thermal Loads

57 kW/Ac Thermal Loading

Area = ~820 acres

114 kW/Ac Thermal Loading

Area = ~480 acres

114 kW/Ac Thermal Loading

Area = ~410 acres

(SCP Layout)

Ghost Dance Fault

(In-drift Layout)
Inventory Based on Current Waste-Stream Estimates

- **Spent fuel**
  - 25-year decay
  - 40 GWd/MTU (PWR), ~58% of total
  - 30 GWd/MTU (BWR), ~32% of total

- **Glassified high-level waste** ~10% of total
Source Term Module
(Developed in Cooperation with LLNL)

- Coupled thermal and hydrological processes
  - Boiling front, dryout, reflux

- Multiple barriers
  - Waste-package degradation processes
    -- Pitting corrosion
    -- General corrosion
  - Waste-form degradation
    -- High-temperature oxidation
    -- Aqueous alteration
    -- Congruent leaching
Dryout and Reflux from Thermal Effects
Failure Distribution for all Waste Packages
(as simulated by YMIM)

TIME SINCE EMLACED (years)

Wet-Generalized
Wet-Localized
Dry
Juvenile

CUMULATIVE FAILURE

0

0 1000 10000

~10,000
Thermal Effects Incorporated in the Weeps Model

Thermal Input Data

1
Containers outside of Boiling Isotherm

2
Volume encompassed by Boiling Isotherm

3
Temperature of Container Wall

Weep DCTSNLD8 125 NWTRB/7-13/14-93
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East-West Transect Used to Generate Column 2

Second Simulation

Tenth Simulation

Elevation

West

East

DCTSNLHD11.125.NWTRB/7-13/14-93
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Dose Calculation Module

Repository Block

Containment Plume

5 Kilometers

Water Well
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Sensitivity Analyses

- Sensitivity studies performed on TSPA-91 aqueous release models

- Sensitivities highly dependent on conceptual model used
  - Composite porosity most sensitive to
    -- Percolation flux
    -- Gaseous transport time
    -- Container lifetime
    -- Fuel matrix alteration rate
  - Weeps Model most sensitive to
    -- Fracture aperture
    -- Fracture connectivity
    -- Infiltration (flux and number of episodes)
Sensitivity of Aqueous Releases to Percolation Flux (Composite-Porosity Model)
Summary of SNL TSPA-II

Improvements on First Iteration

- Coupled thermal/hydrologic processes
- More sophisticated source term
- Saturated zone model constructed using more site information
- Dose module
- Sensitivity studies