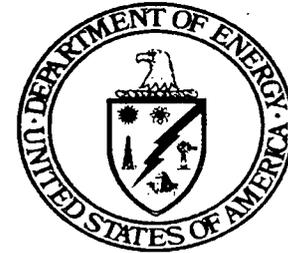


Disposal of vitrified high-level waste and immobilized weapons-grade plutonium



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

Presented to:
Nuclear Waste Technical Review Board

Presented by:
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YUCCA
MOUNTAIN
PROJECT



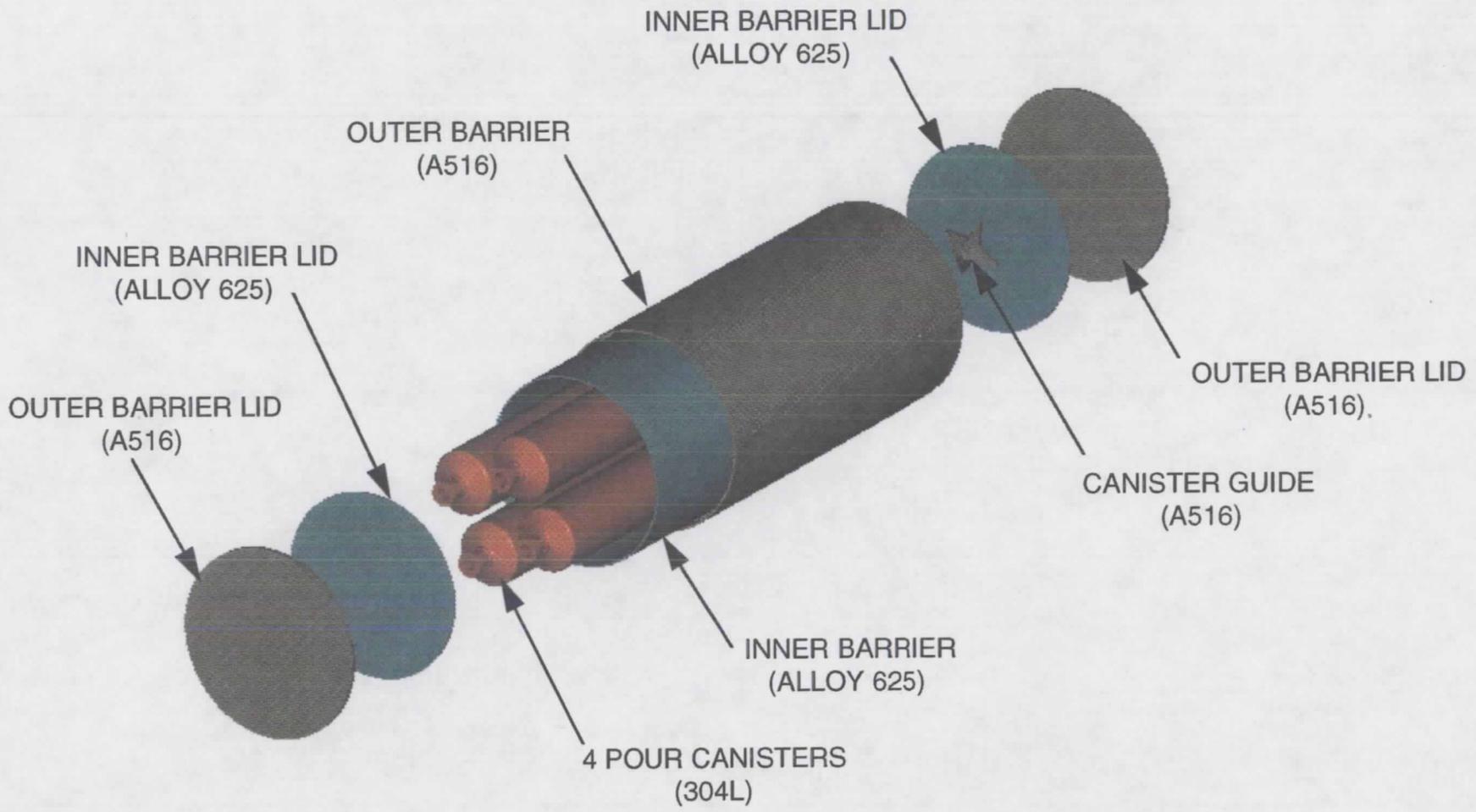
December 17, 1997

Overview

- Waste package design
- Performance assessment
- Criticality analyses

Waste package design

- **Vitrified high-level waste**
 - 4 or 5 HLW canisters per waste package
 - Containment barriers
 - 10 cm carbon steel
 - 2 cm Alloy 625 (evaluating C-22 as replacement)
- **Immobilized Pu**
 - 1 or 2 Pu containing canisters per waste package with vitrified HLW canisters in remaining capacity
 - Quantity of Pu containing canisters per waste package will be reviewed for VA based on new formulation/configuration



**4-DEFENSE HIGH LEVEL WASTE
DISPOSAL CONTAINER**

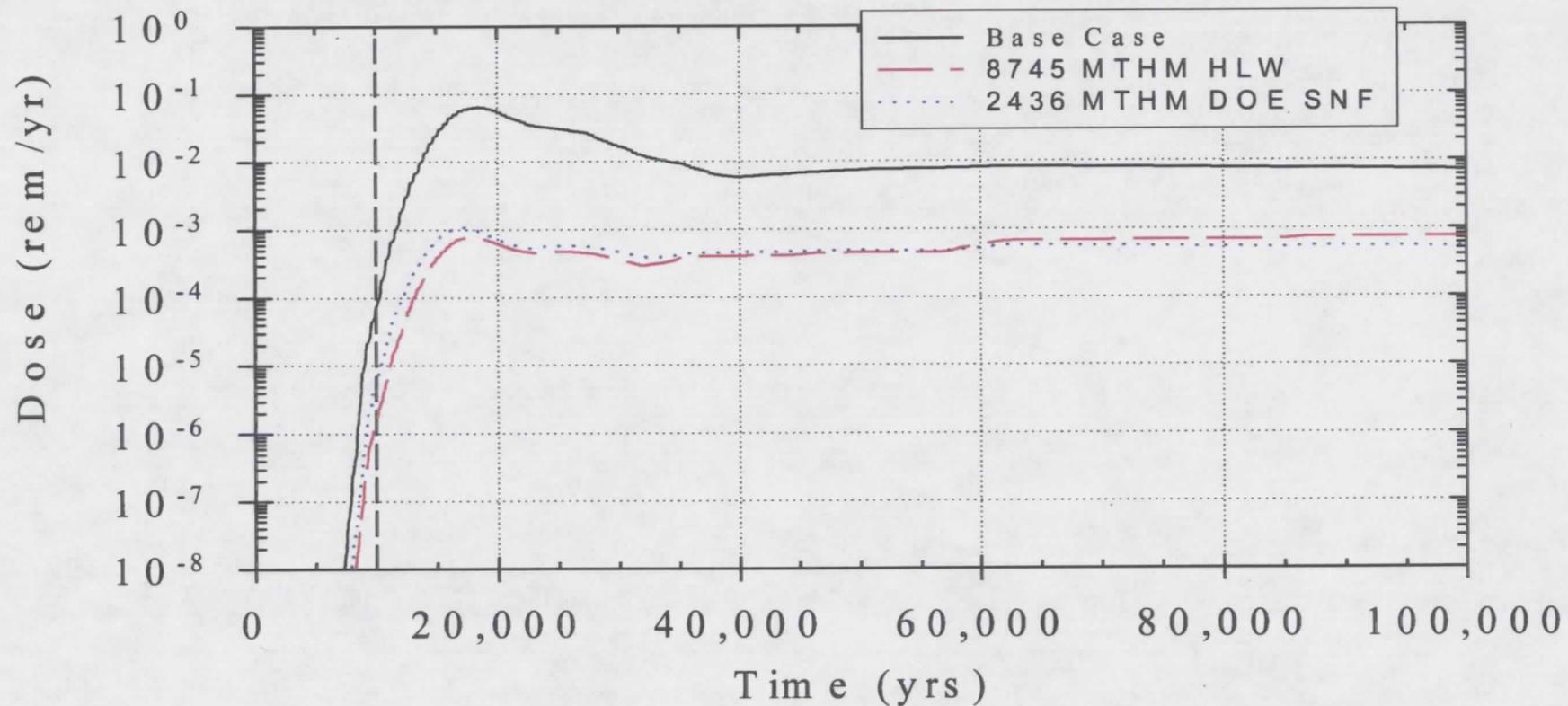
Performance assessment

- Sensitivity analysis for DOE SNF bases for vitrified HLW (DWPF HLW)
- TSPA-1995 bases for immobilized Pu
 - Update using the TSPA-VA bases planned for FY98
- Colloidal transport of Pu not considered
 - Planned for TSPA-VA

Findings: Dose at the accessible environment

- Vitrified HLW does not significantly impact the dose at the accessible environment (~2 orders of magnitude less than commercial SNF)
- Dose releases from equal quantities of DWPF HLW and immobilized Pu waste form are similar

Comparison of HLW vs. TSPA-1995 base case



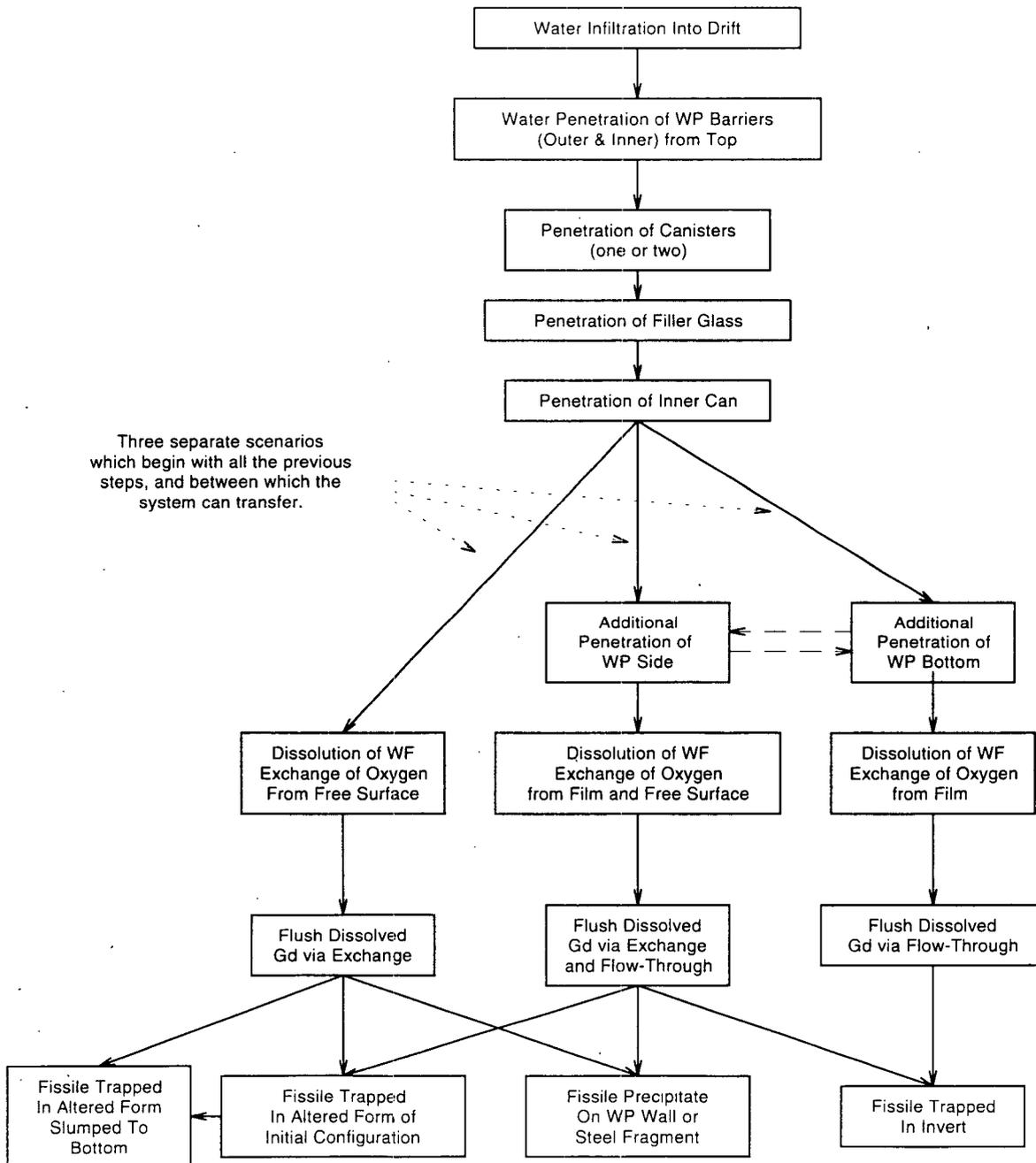
Immobilized Pu criticality analyses

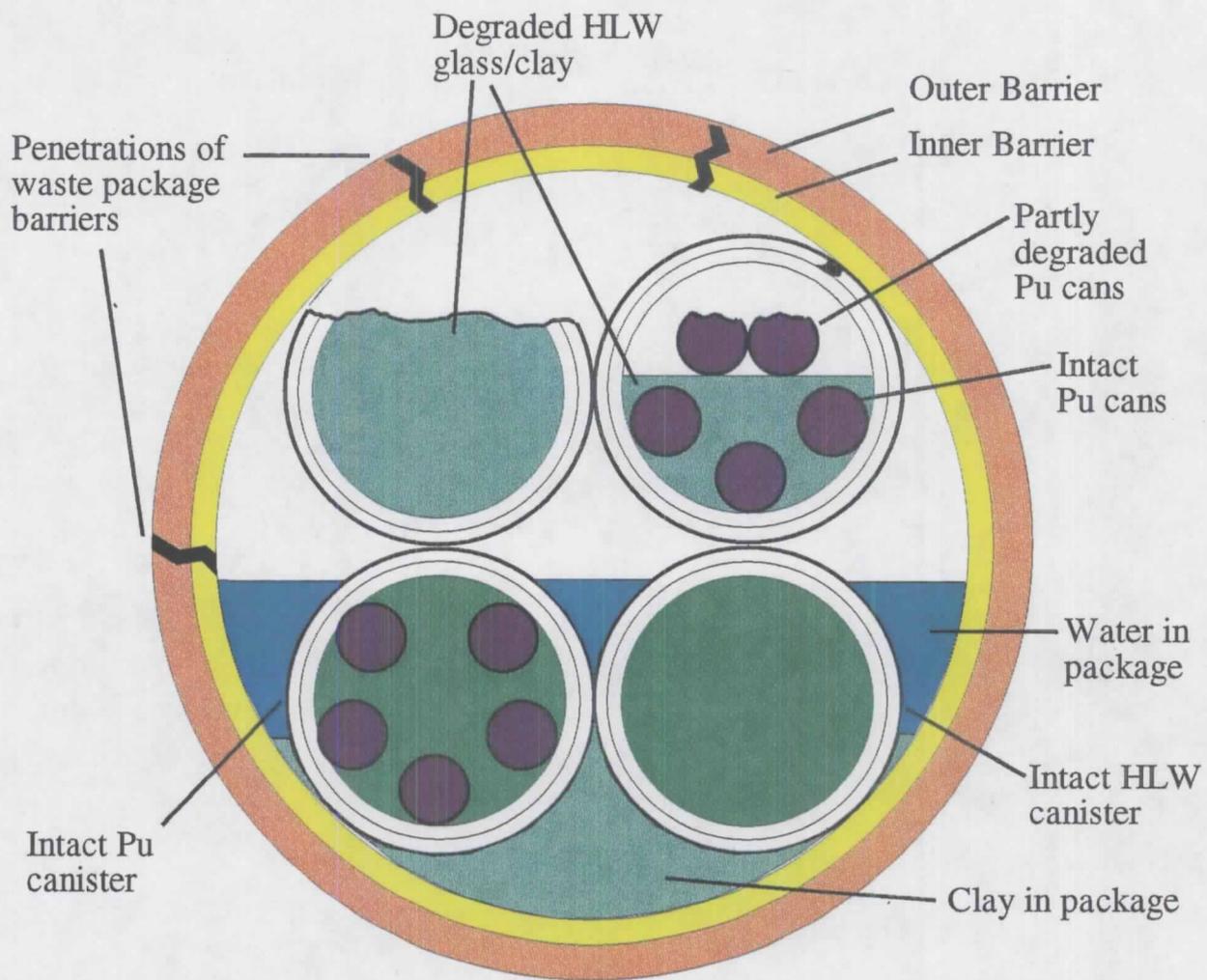
- 93% ^{239}Pu assumed
- Pu immobilized in glass evaluated for intact, degraded internal & external configurations
- Pu immobilized in ceramic evaluated for intact & internal degraded configurations (old formulation)

Comparison of old vs. new ceramic formulations

Parameter	Old	New
Pu/can	2.56 kg	1.02 kg
Can/canister	20	28
Pu/canister	51.2 kg	28.7 kg
Absorbers	Gd, some Hf	Gd, Hf
Other mat'ls	Zr, Ca, Ti	Ti, ²³⁸ U, Ca

SCENARIO GENERATION STEP 1





Partly Degraded Codisposal Waste Package for 2 HLW Glass Canisters and 2 Immobilized Plutonium Canisters

Findings (old formulation)

- Internal criticality can be prevented with a mass limit of 50 kg ^{239}Pu per waste package
- Hf provides additional defense-in-depth
- External configurations
 - Reaction with invert and host rock in near field
 - ~5 kg of fissile material
 - ~15 m³ within the footprint of the waste package
 - below critical limit

Findings (old formulation)

(continued)

- **External configurations** (continued)
 - Far field
 - Zeolites are abundant in Yucca Mountain
 - Maximum U adsorption: 0.17% by weight in zeolite
 - insufficient to accumulate critical mass
 - Reducing environments
 - No more than trace quantities of reducing conditions at Yucca Mountain
 - Low probability of precipitation of U by reduction mechanism

Findings (old formulation)

(continued)

- **External configurations** (continued)
 - **Consequences (scoping analysis)**
 - Hypothetical case
 - 6 kg ^{239}Pu in 1 m³ block (conservative)
 - 500 Watts power for 4,000 years
 - 14% increase in radioactivity

Current Status

- Analysis of intact & internal degraded configurations using new ceramic formulation planned for FY98
- Analysis of external configurations, evaluations of probabilities & consequences planned for FY99

Summary

- Impact to total system performance is small for both vitrified HLW and immobilized Pu
- Internal configurations of immobilized Pu can be maintained at subcritical levels
- Disposal of immobilized Pu appears workable