Direct Disposal of Commercial SNF in Dual-Purpose Canisters: Session Introduction

Ernest Hardin,
Sandia National Laboratories

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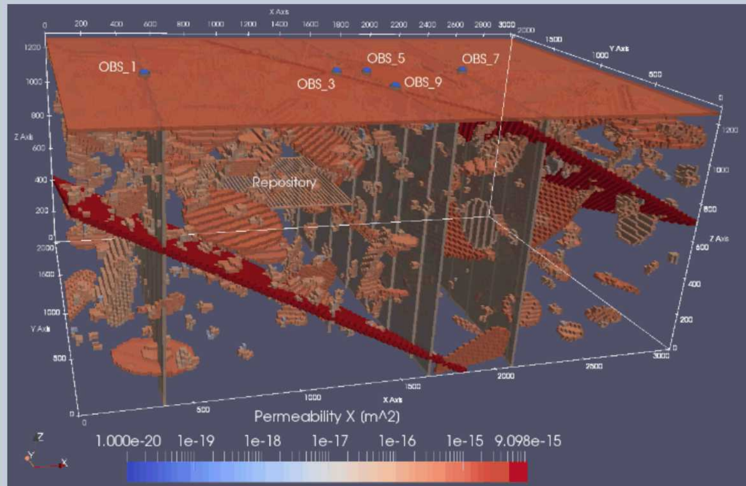

SFWD

Spent Fuel & Waste Disposition

Annual Working Group Meeting
UNLV-SEB – *Las Vegas, Nevada*
May 21-23, 2019

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Direct Disposal of Commercial SNF in DPCs: Drivers

- Avoid repackaging (109,000 MTU or ~8,000 DPCs) → \$20B saved
- Avoid collective worker dose associated with repackaging (up to 250 mrem per canister or 2,000 rem overall)
- Treat existing (already loaded) DPCs for postclosure criticality control → ≥ \$300k per canister, or ≥ \$1B to \$3B overall (e.g., injectable fillers)
- Modify future (not yet loaded) DPCs for postclosure criticality control → roughly \$300k per canister, or \$1.5B overall (e.g., disposal control rods/blades)

DPC Disposition Strategy

N ≈ 10,000 U.S. DPCs (total):

Low consequence? → **Yes** → **IMPLEMENT FOR ALL N (one repository)** [A]

No (low probability FOR ALL N)

- [A] Include or exclude FEPs
- [B] Includes a repository in salt
- [C] Possible post-load mods. include:
  - Injectable fillers
  - Cut open DPC for solid filler or disposal control features (e.g., rods/blades) and reseal
- [D] Possible pre-load mods. include:
  - Solid fillers
  - Disposal control features (rods/blades, absorber plates)

For each DPC of *existing* design, unmodified, already loaded:

X: Reactivity margin [B] **gets $k_{eff} \ll 1$ OR**

Y: Modification [C] **gets $k_{eff} \ll 1$ OR**

(N-X-Y): Repackage

For each future DPC of *modified* design:

Z: Modified DPC design [D] **gets $k_{eff} \ll 1$ OR**

(N-X-Y-Z): Repackage

Consequence Screening – Performance Assessment Considerations

- Fractional release source term models (conservatively) assume fuel degradation
- Criticality depends on intact configuration of fuel, so fractional release may be non-conservative
- Regulatory criteria for FEP inclusion/exclusion:

  "…Specific features, events, and processes must be evaluated in detail if the magnitude and time of the resulting radiological exposures to the reasonably maximally exposed individual, or radionuclide releases to the accessible environment, for 10,000 years after disposal, would be significantly changed by their omission." § 63.114(a)(5)

- Nuclear criticality has the potential for credible impacts on the radionuclide source term → Comparisons should start with a non-bounding, non-conservative PA model

DPC Investigations – Multi-Year Goals

- Fillers R&D: Select candidate filler material(s) for bench-scale tests
- Engineering feasibility: Develop DPC modification options and repository subsystem descriptions for DPC handling/disposal
- Safety analysis/consequence screening: Repository-scale generic simulations with and without criticality events (bounding approach)
- Criticality modeling: Coupling of neutron transport and thermal hydraulics, and modeling of basket/fuel degradation
- Independent, external, multi-disciplinary peer review

Key Accomplishments (May 2019)

- Fillers
  - Fillers requirements review (July, 2018)
  - $AlPO_4$ (berlinite) cement investigation (next report September, 2019)
  - Simulation and filling experiments for fillers (status reports February, March and September, 2019)
- Engineering
  - ROM option identification and costing study (April, 2019)
  - M2 strategy/options report (June, 2019)
- Criticality consequence
  - Postclosure criticality evaluations, independent peer review (April, 2018)
  - Scoping report (January, 2019)
  - Preliminary consequence analysis (December, 2019)
  - Coupled analysis (status reports April and September, 2019)
  - Basket/fuel degradation modeling underway (September, 2019)

DPC Session Agenda

Introduction and Key Accomplishments (10 min) – Hardin

Neutronics-TH coupling status (15 min) – Scaglione/Davidson

Fillers R&D status (20 min) – Banerjee/Rigali

Consequence screening status (15 min) – Price/Gross

Basket/fuel degradation modeling status (20 min) – Damjanac/Furtney

Cladding degradation overview (20 min) – Hanson

R&D priorities (15 min) – Price facilitates

The DPC criticality modeling team is invited to convene here at 1715 for a short meeting on reactivity simulation for fillers.