Field Scale Experiment and Simulations of Heat Generating Nuclear Waste in Salt - 19286

Background
Can we make a safety case for storing DOE managed high-level nuclear waste (HLW) and Spent Nuclear Fuel (SNF) in bedded salt?

- US Department of Energy (DOE)
- Generic repository research
- Collaboration with DOE Office of Environmental Management

High-Level Waste

DOE Spent Nuclear Fuel

In-drift disposal concept for salt repository

Simple lower cost method.

Backfill is readily available in salt formations

Full size waste canister mock-up tested before underground deployment in the Waste Isolation Pilot Plant (WIPP)

3 m canister
0.6 m diameter
Canister buried under run-of-mine salt (ROM Salt) in WIPP

Experiment details
- 34 thermocouples
- 2 humidity sensors in the pile.
- Mine air temperature and humidity.

Simulation details (fehm.lanl.gov)
- Mass and energy conservation
- Relative permeability for unsaturated flow
- Thermal effects on solubility
- Water vapor pressure lowering (capillary and solute)
- Porosity and temperature effects thermal conductivity
- Vapor and non-condensable gas diffusion
- Permeability changes with porosity
- Porosity changes from precipitation/dissolution
- Mine air relative humidity boundary condition

Temperature in the ROM salt pile: Field data versus simulation

Conclusions
- A field-scale experiment and numerical simulations confirm salt backfill behavior.
- Simulations closely match temperature around and under the piled salt backfill.
- Limited dissolution–precipitation reactions around the canister.
- Alteration of backfill is unlikely if the drift is allowed to dry before emplacement.