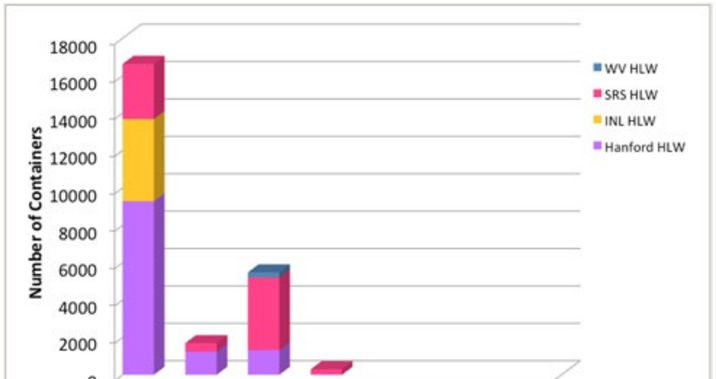
Field Scale Experiment and Simulations of Heat Generating Nuclear Waste in Salt - 19286

Background

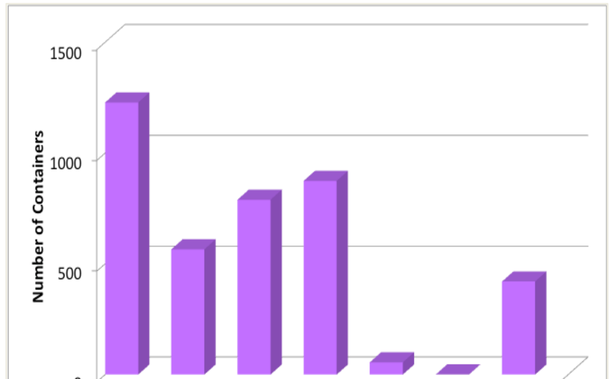
Can we make a safety case for storing DOE managed high-level nuclear waste (HLW) and Spent Nuclear Fuel (SNF) in bedded salt?

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

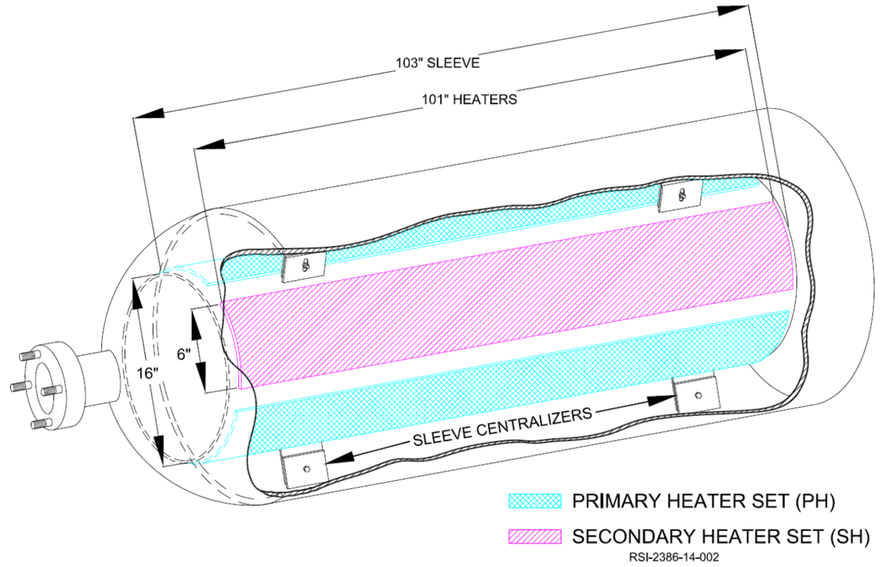
High-Level Waste



DOE Spent Nuclear Fuel



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

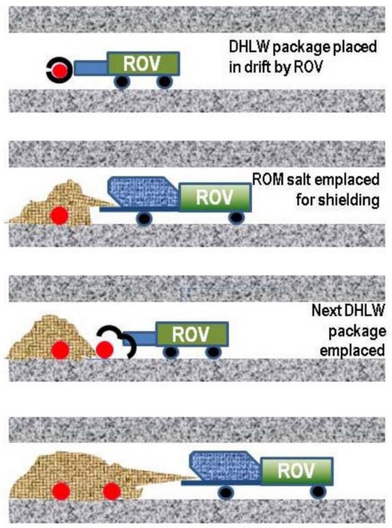


3 m canister

0.6 m diameter

In-drift disposal concept for salt repository

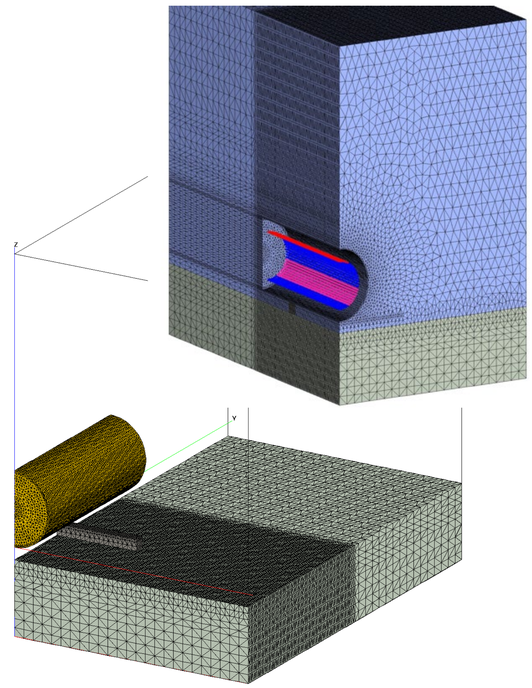
Simple lower cost method. Backfill is readily available in salt formations



Hardin et al., FCRD-UFD-2012-000219

DOE/CBFO-12-3485

Above Ground Canister Testing including canister simulations (Oct 2014 - May 2015)



LA-UR-19-21737

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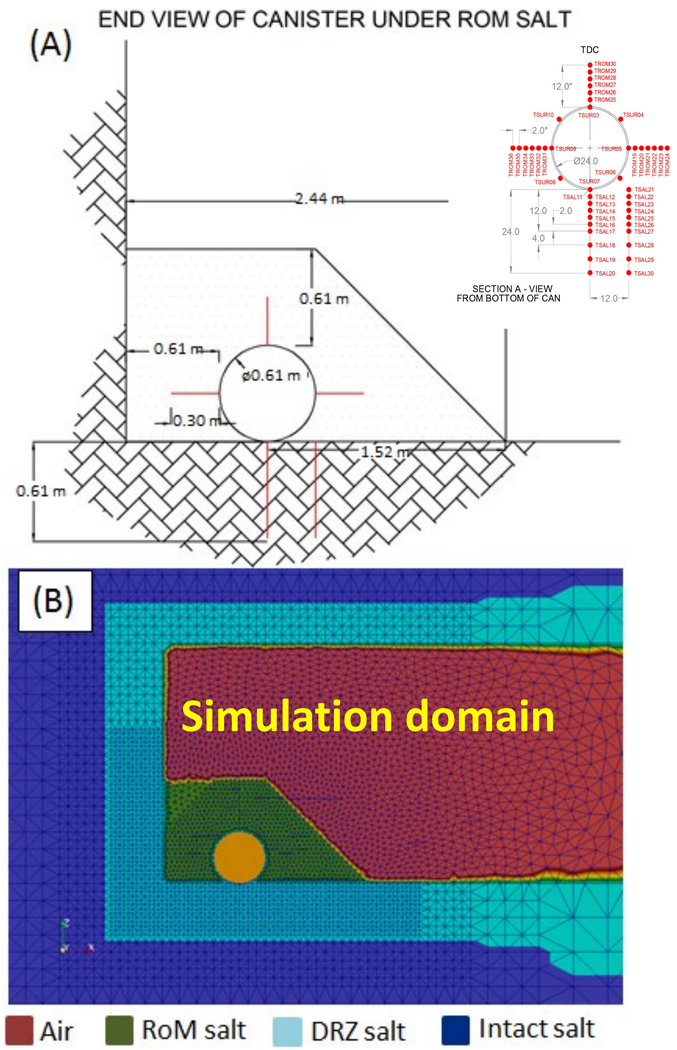
Canister buried under run-of-mine salt (ROM Salt) in WIPP

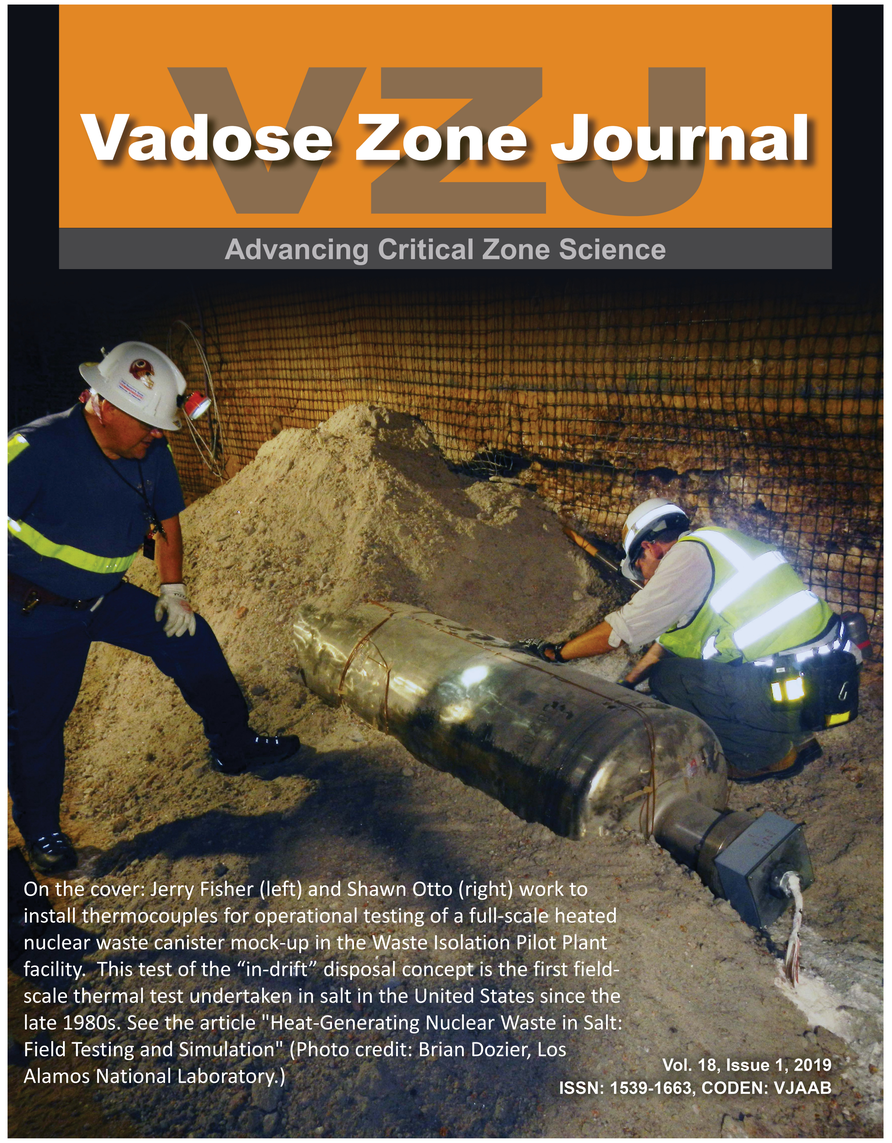
Experiment details

34 thermocouples

2 humidity sensors in the pile.

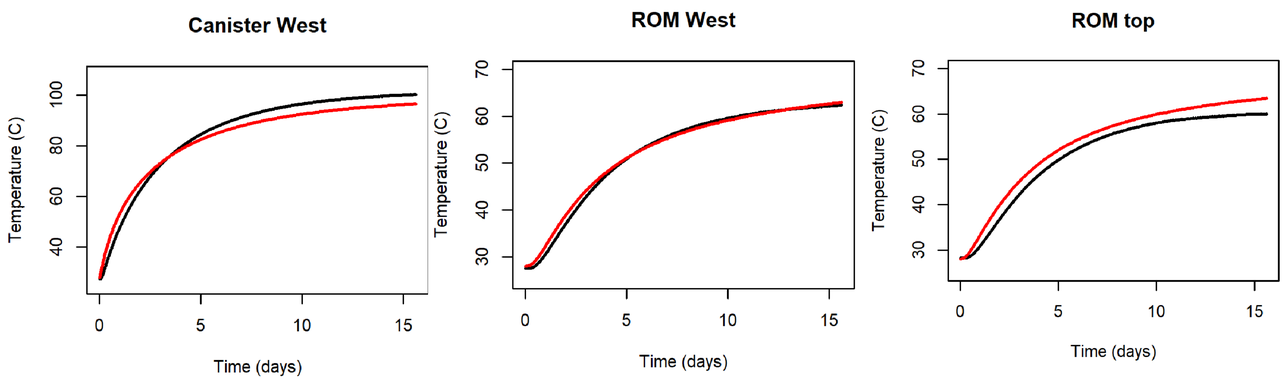
Mine air temperature and humidity.





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.

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