

Performance Assessment of a Generic Repository in Bedded Salt for DOE-Managed Nuclear Waste

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A mined repository in salt is one of the concepts under consideration for disposal of DOE-managed defense-related spent nuclear fuel (SNF) and high level waste (HLW). Bedded salt is a favorable medium for disposal of nuclear waste due to its low permeability, high thermal conductivity, and ability to self-heal. Sandia's Generic Disposal System Analysis framework is used to assess the ability of a generic repository in bedded salt to isolate radionuclides from the biosphere. The performance assessment considers multiple waste types of varying thermal load and radionuclide inventory, the engineered barrier system comprising the waste packages, backfill, and emplacement drifts, and the natural barrier system formed by a bedded salt deposit and the overlying sedimentary sequence (including an aquifer). The model simulates disposal of nearly the entire inventory of DOE-managed, defense-related SNF (excluding Naval SNF) and HLW in a half-symmetry domain containing approximately 6 million grid cells. Grid refinement captures the detail of 25,200 individual waste packages in 180 disposal panels, associated access halls, and 4 shafts connecting the land surface to the repository. Equations describing coupled heat and fluid flow and reactive transport are solved numerically with PFLOTRAN, a massively parallel flow and transport code. Simulated processes include heat conduction and convection, waste package failure, waste form dissolution, radioactive decay and ingrowth, sorption, solubility limits, advection, dispersion, and diffusion. Simulations are run to 1 million years, and radionuclide concentrations are observed within an aquifer at a point approximately 4 kilometers downgradient of the repository. The software package DAKOTA is used to sample likely ranges of input parameters including waste form dissolution rates and properties of engineered and natural materials in order to quantify uncertainty in predicted concentrations and sensitivity to input parameters.

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