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Publication Date
2002-07-17

Effects of Rock Mechanical Degradation on Seepage into Drifts

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Abstract

Seepage into drifts in unsaturated tuff is an important issue for the long-term performance of the potential nuclear waste repository at Yucca Mountain, Nevada. Drifts in which waste packages will potentially be emplaced are subject to degradation in the form of rockfall from the drift ceiling, induced by stress relief, seismic, or thermal effects. The objective of this study is to calculate seepage rates for various drift-degradation scenarios and for different values of percolation flux for the Topopah Spring middle nonlithophysal (Tptpmn) and the Topopah Spring lower lithophysal (Tptpll) units. Seepage calculations are conducted by (1) defining a heterogeneous permeability model on the drift scale that is consistent with field data, (2) selecting calibrated parameters associated with the Tptpmn and Tptpll units, and (3) simulating seepage on detailed degraded-drift profiles, which were obtained from a separate rock-mechanics engineering analysis. The simulation results indicate (1) that the seepage threshold (i.e., the percolation flux at which seepage first occurs) is not significantly changed by drift degradation and (2) the degradation-induced increase in seepage above the threshold is influenced more by the shape of the cavity created by rockfall than the rockfall volume.

Keywords: unsaturated flow, drift degradation, seepage, heterogeneity, Yucca Mountain, Nevada