Million-Year Estimates of Net Infiltration at Yucca Mountain, Nevada

S. Stothoff[1]
[1]Center for Nuclear Waste Regulatory Analyses (CNWRA), Southwest Research Institute

The performance period for the potential high-level radioactive waste repository at Yucca Mountain, Nevada, may extend to one million years. Assessments of repository performance may use a stylized steady-state representation for deep percolation fluxes after 10,000 years, while considering the uncertainty in the steady-state value. A procedure for estimating million-year-average deep percolation integrates time sequences of areal-average net infiltration estimates over potential future time-varying climate sequences. Two estimates of million-year-average deep percolation were developed from two independent estimates of future climate sequences, both based on correlating climate (in the form of mean annual precipitation and temperature) during past glacial cycles to the orbital characteristics of the Earth and projecting the orbital characteristics into the future. Correlations based on core data, glacier extent, lake stands, treeline variation, and vegetation species composition provide bases for relating climate to the extent of continental glaciation. Despite the independent assumptions and data sources, both approaches to estimating climate yield similar estimates of million-year-average future precipitation and temperature. A numerical model for net infiltration, which compares well with regional and site estimates for net infiltration, provides the link between climate and areal-average deep percolation. Analyses using the net infiltration model suggest that million-year-average net infiltration is expected to be approximately 3 times greater than at present using both sets of climate estimates. The analysis found that the mean and variance of estimated future million-year-average areal-average net infiltration is reduced by less than 10 percent and less than 20 percent, respectively, from the case using uncertain time-varying climate to the case with steady and certain climate, regardless of the climate sequence used. The results imply that most of the uncertainty in estimating future net infiltration can be attributed to the uncertainty in estimating net infiltration for individual climate states. Small systematic increases in expected long-term-average net infiltration arise from uncertainty in the climate sequences that may occur over glacial cycles and from climatic variability over glacial cycles.

This paper is an independent product of the CNWRA and does not necessarily reflect the view or regulatory position of the NRC.