

Optimization of Deep Borehole Systems for HLW Disposal

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ABSTRACT

The objective of the research proposed here is to provide a comprehensive evaluation of the deep borehole option for disposal of high level nuclear reactor waste. For purposes of this work a deep borehole repository consists of a grid of individual oil-well type holes drilled 4 or 5 km deep into granitic bedrock, where the ambient chemistry is reducing in nature, and the host rock has exceptionally low permeability – both of which give high assurance of confinement.

This project builds upon a long history of prior work carried out by the collaborating university and national laboratory partner. It is conceptualized in part as a response to the recent report to the Secretary of Energy by the Blue Ribbon Commission on America’s Nuclear Future, which identified deep boreholes as an alternative to shallower mined repositories well worth evaluation. As they note: “...the subcommittee has also identified deep boreholes as a potentially promising technology for geologic disposal that could increase the flexibility of the national system for nuclear waste management, and therefore merits research, development and demonstration.”

The proposed work is naturally structured as a sequence of series/parallel linked models starting with ingress of water through natural and engineered barriers to contact with aged HLW, progressive release therefrom, followed by transport to and through a caprock barrier, and then penetration of overburden into the biosphere, where hypothetical future inhabitants are exposed to radionuclide-bearing well water. We will collect/adapt/improve/develop/exercise the requisite modules as required, followed by their linkage into an overall performance predictor program. Documentation will thus accumulate in stage-wise fashion, culminating in a probabilistic assessment of the degree to which waste sequestration can be achieved as a function of the dominant site and borehole design parameters such as host and caprock/plug permeability. Estimates of waste disposal costs in terms of dollars per kilogram of initial heavy metal irradiated in light water reactors will also be made.