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U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Office of Nuclear Material Safety and Safeguards
Program Management, Policy Development, and Staff
Office of the Director
Mail Stop 8D–37
Washington, DC 20555

Subject: Programmatic Review of Abstract

Dear Mrs. DeMarco:

The enclosed abstract is being submitted for programmatic review. This abstract will be submitted for presentation at GeoProc to be held October 13–15, 2003, in Stockholm, Sweden. The title of the abstract is:

> "Numerical Simulation of Thermohydrological Processes Observed at the Drift-Scale Heater Test at Yucca Mountain, Nevada" by R. Green and S. Painter

This abstract summarizes results of numerical analyses performed on the Drift-Scale Heater Test at Yucca Mountain as part of the DECOVALEX III model validation project. The analysis results identify which model parameter values and conceptual model assumptions and properties will be important in thermohydrological simulations of the proposed repository. The GeoProc Conference will have several sessions dedicated to the final findings of the DECOVALEX III project.

Please advise me of the results of your programmatic review. Your cooperation in this matter is appreciated.

Sincerely,

Budhi Sagar
Technical Director

/ph
Enclosures: Abstract
NRC Form 390A

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Numerical Simulation of Thermohydrological Processes Observed at the Drift-Scale Heater Test at Yucca Mountain, Nevada by Ronald T. Green and Scott L. Painter, Center for Nuclear Waste Regulatory Analyses, San Antonio, TX.

Results from the four-year long heating phase of the Drift-Scale Heater Test at the Exploratory Studies Facility at Yucca Mountain, Nevada provide a basis to evaluate conceptual and numerical models used to simulate thermohydrological coupled processes expected to occur at the proposed repository. A three-dimensional numerical model was built to perform the analyses. All model simulations were predicated on a dual (fracture and matrix) continuum conceptualization. The ambient system was first modeled to insure that the model adequately represented the physical setting. The four-year heating phase of the test was then modeled to evaluate thermohydrological coupled processes by applying thermal sources to represent the test canister and wing heaters. The canister thermal load was applied directly to the drift wall, thereby removing mechanisms associated with heat and mass transfer in the drift from the model. Two sets of sensitivity analyses were performed; a first set to evaluate factors that affect the pre-heating phase ambient matrix saturation and a second set to evaluate factors that affect heat and mass transfer during the heating phase. The multiphase code MULTIFLO was used in all simulations.

Factors evaluated in the analyses included infiltration rate {3.0 and 0.06 mm/yr [0.01 and 0.002 ft/yr]}, block size {0.41 to 20.0 m [1.3 to 65 ft]}, intrinsic fracture permeability, canister heat load (basecase and reduced by 20 percent), open and closed boundary at the drift wall, imposition of an active fracture model, and comparison of two versus three dimensionality. A low infiltration rate of 0.06 mm/yr [0.002 ft/yr] was found to simulate an ambient saturation consistent with the 0.92 observed ambient matrix saturation. An infiltration rate of 3.0 mm/yr [0.01 ft/yr] resulted in an ambient matrix saturation of 0.99. Saturation was reduced to 0.97 when an active fracture model was incorporated into the model. Changes to intrinsic fracture permeability (fracture permeability divided by fracture porosity) were found to have a profound effect on the formation of a heat pipe during the heating phase. Better agreement with observed temperatures was achieved by assigning a recently revised value of 0.01 to the fracture porosity. The earlier reported fracture porosity value of 0.0001 resulted in excessive heat pipe formation. The thermal load and the boundary conditions at the drift wall were varied to evaluate the potential effect of heat and mass loss through the heater drift bulkhead. A 20% reduction in the canister heat load to account for conduction and radiation heat loss through the bulkhead and a constant pressure boundary condition at the drift wall provided better agreement between observed and model temperatures. Inclusion of the active fracture model to account for a reduction in the number of fractures that were hydraulically active also provided better agreement between model results and observed temperatures. Temperature results from a two-dimensional model that were compared with similar results from the three-dimensional model indicated that the two-dimensional model results were within 10 °C [19 °F] of temperatures obtained from the three-dimensional model during the four-year heating phase.