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Contract No. NRC-02-93-005
Account No. 20-5702-723

Nuclear Regulatory Commission
ATTN: T. J. McCartin
Two White Flint North (7F-6)
Washington, DC 20555

Subject: Transmittal of Report on Near-Field Flow Analysis: Intermediate Milestone 5702-723-450

Dear Mr. McCartin:

The subject report was transmitted to you on October 28, 1994. A few editorial and formatting problems were discovered soon after the original transmittal. At that time, we informed you of these problems and indicated that a revised corrected copy will be provided to you. Such a corrected copy is attached with this letter for your review and approval. This report fulfills IM 5702-723-450.

If you have any questions, please call me on 210/522-3805 or Peter C. Lichtner on 522-6084.

Very truly yours,

for Robert G. Baca, Manager
Performance Assessment &
Hydrologic Transport

BS/bsc

cc: J. Linehan, S. Fortuna, [redacted], B. Meehan, M. Knapp, J. Austin, J. Holonich, M. Bell, S. Wastler, W. Belke, D. Brooks, K. McConnell, C. Interrante, B. Jagannath, S. Bahadur, N. Costanzi, W. Ott, J. Randall, N. Eisenberg, R. Wescott, R. Codell, W. Patrick, CNWRA Directors, CNWRA Element Directors, R. Manteufel, P. Lichtner, R. Green, C. Freitas, M. Seth, H. Nguyen, S. Rowe

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ABSTRACT

A fundamental problem in understanding the redistribution of moisture in a high-level nuclear waste repository emplaced in an unsaturated porous host rock is transport of liquid water and water vapor in the near field of the repository. To investigate the assumptions and approximations used in various two-phase flow models of a high-level waste repository, a detailed study was conducted using a repository-scale model. Calculations are presented using CTOUGH, a modified version of the VTOUGH code, for one- and two-dimensional simulations with a cylindrically symmetric repository. The model calculations are based on a disk-shaped heat source providing an average representation of the heat-generating high-level radioactive waste. Both a single homogeneous medium and layer media are considered. The effects of different repository loadings, vapor pressure lowering, and enhanced vapor diffusion on repository dry-out are investigated, as well as formation of heat pipes in the high thermal loading case. Relative humidity is found to be a more sensitive measure of moisture content compared to saturation. It is concluded that the formulation of enhanced vapor diffusion given by Pruess and Tsang (1993, 1994) extrapolated from soil data may grossly overestimate vapor diffusion rates in tuffaceous rock.

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