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U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Two White Flint North
11545 Rockville Pike
Mail Stop T8A23
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 the Geologic Society of America Annual Meeting to be held November 9–18, 2000, in Reno, NV. The title of the abstract is:

> "Fingering Flow through A Superheated Fracture: Hele-Shaw Cell Experiment and Model Comparisons" by D.L. Hughson, J. Prikryl, and F. T. Dodge

This abstract presents results of work conducted by CNWRA as part of the Thermal Effects on Flow Key Technical Issue. This abstract provides a summary of recent work done to assess the validity of assumptions used by DOE in performance assessment modeling of the proposed nuclear waste repository at Yucca Mountain, Nevada. Presentation of this work in a forum such as the GSA meeting provides a valuable opportunity to exchange insights and to obtain feedback from the scientific community. This abstract is a product of the CNWRA and does not necessarily reflect the view(s) or regulatory position of the NRC.

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

Sincerely,

Budhi Sagar
Technical Director

/ph
Enclosures
cc: J. Linehan, T. Essig, W. Patrick, E. Whitt, K. Stablein, CNWRA Directors, B. Meehan, J. Pohle, CNWRA Element Mgrs, J. Greeves, D. Brooks, T. Nagy (SwRI Contracts), J. Holonich, H. Arlt, P. Maldonado, W. Reamer

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Fingering Flow through a Superheated Fracture: Hele-Shaw Cell Experiment and Model Comparisons

D.L. Hughson, J.Prikryl, and F.T. Dodge, Center for Nuclear Waste Regulatory Analyses, San Antonio, TX

Radioactive waste emplaced in the proposed repository at Yucca Mountain, NV,may produce sufficient heat to raise near-field temperatures above boiling and dry out the Topopah Spring welded tuff in the vicinity of the emplacement drifts. Focusing of condensate drainage into fingers of preferential flow through subvertical fractures will result in liquid flow into the superheated region a distance of order $l = \left(\rho_l Q h / k_m \beta \right)^{\frac{1}{2}}$ where ρ_l is liquid density, Q is volumetric flow rate in the finger, h is enthalpy of phase change, k_m is thermal conductivity of the surrounding rock, and β is temperature gradient in the rock (Phillips, 1996). We demonstrate this phenomenon by creating a temperature gradient, below boiling at the top to above boiling at the bottom of a vertical Hele-Shaw cell and applying a constant liquid water discharge from a pipe at the top center. The distance of flow into the above boiling region stabilizes temporally with the square of the finger width to a distance proportional to l, taking k_m as the independent fitting parameter. Analytical and numerical models show that the fitted k_m can be related to the geometry of the cooled region around the flowing finger. Rivulets of condensate drainage through superheated rock may adversely affect repository performance if l is greater than the thickness of dryout above the repository. This work is supported by the NRC, but it is an independent product of the Center for Nuclear Waste Regulatory Analyses and does not necessarily reflect the regulatory position of the Nuclear Regulatory Commission.

Reference:

Phillips, O.M., Infiltration of a liquid finger down a fracture into superheated rock, Water Resources Research 32(6): 1,665–1,670, 1996.