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May 10, 1988

Mr. Ronald L. Ballard, Chief
Technical Review Branch
Division of High-Level Waste Management
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Ballard:

Attached is a brief description of the GEO2 code that has been developed at the Pacific Northwest Laboratory.

This code evolved from the GEOTHER/VT4 effort which was originally developed for the BWIP application. The GEO2 code is a different version designed specifically for applications to the Tuff repository at Yucca Mountain.

Currently, one of the favored design concepts at the Tuff site is to pack the waste containers closely to keep the near-field groundwater in a vapor phase as long as possible. A computer tool with the two-phase capability would be needed to study the "steaming" and rewetting behavior in the near field.

The GEO2 code could give NRC such a tool to provide an independent evaluation of the designs as proposed by DOE's OCRWM. In addition to the basic features such as noncondensable gases, capillary pressures, and two-phase modeling, the GEO2 code does have unique features that are not available from the codes used by DOE's other contractors working on the Tuff project (see attachment for more details).

If you are interested in the code, or in PNL's technical support in this area, please give me a call at (509-375-2455) or Shaw Bian at (509-375-3764).

Sincerely,

C. W. Stewart, Manager
Fluid and Thermal Science Section

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Attachment

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GEO2 UPDATE

Status of the GEO2 Code
May 1988

The GEO2 code has been written with the specific purpose of providing support for the analysis of the hydrothermal conditions in an unsaturated rock formation such as the Tuff Nuclear Repository. It evolved from the GEOTHER/VT4 code, which was developed at PNL for application to the Basalt Waste Isolation Project.

The GEO2 code simulates the heat and mass transport in a multi-component system (water, non-condensible gases, rock and solid) with phase changes and external heat sources. The governing equations are the mixture (steam-gas-liquid) mass conservation equation, mixture energy conservation equation, gas mass equation and rock/solid heat conduction equation. The independent variables solved by the code are the node total pressure, node gas partial pressure, water saturation and rock/solid temperature. The rock/solid heat conduction equation is used not only to calculate the heat transfer inside the rock and between the rock and fluid, but also used to calculate temperature distributions within a non-porous medium such as a waste container.

Currently a simplified version of the Brooks-Corey capillary pressure model[a] is incorporated in the code. Since the code is modularized, it is a simple procedure to incorporate other models to the code to fit the particular needs of a user.

The four governing equations stated above are solved using the "finite-volume" approach. It allows the flexibility of arbitrary geometry modeling by requiring the system be divided into polygons with the number of surfaces for each polygon being variable. This feature is useful in a case where the object of interest is best simulated with one coordinate system while its surroundings are best modeled with another coordinate system, such as cylindrical containers in a rectangular lattice.

If the code can be of any use in your area, please contact Shaw Bian at (509) 375-3764.

(a) LA-9667-MS, Los Alamos National Laboratory.