HLWYM HEmails

From: John Stamatkos
Sent: Thursday, May 18, 2006 5:27 PM
To: Debashis Basu
Subject: FW: Review of EPRI report
Attachments: ReviewOfEPRIReport.wpd

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-----Original Message-----
From: Pavan Shukla [mailto:pshukla@cnwra.swri.edu]
Sent: Thursday, May 18, 2006 11:05 AM
To: John Stamatakos
Subject: Review of EPRI report

John,

Please find the attached file on review of EPRI report.

Sincerely
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Hearing Identifier: HLW_YuccaMountain_Hold_EX
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Subject: FW: Review of EPRI report
Sent Date: 5/18/2006 5:26:42 PM
Received Date: 5/18/2006 5:26:47 PM
From: John Stamatkos

Created By: jstam@cnwra.swri.edu

Recipients:
"Debashis Basu" <dbasu@cnwra.swri.edu>
Tracking Status: None

Post Office: cnwra.swri.edu

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ReviewOfEPRIReport.wpd	1738201	

Options
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Review of the EPRI Report

by
Pavan Shukla and Debashis Basu

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1. Cooling of Magma Flowing in a Drift:

In EPRI report, DOE's model on magma temperature has been cited and used to draw conclusions on thermal evolution of magma in the repository drift. The model for magma temperature consists one dimensional solution of time dependent heat conduction equation (2nd order) in the Cartesian coordinate system (x,y,z). The physical system represented by the governing equation represent a slab of thickness 2a. The slab is considered to be of finite thickness in x direction, and infinitely long in y and z direction. The origin of the coordinate system is located in the middle of the slab. The temperature at the external surface of the slab is assumed to be fixed. The solution of the governing equation is written in terms of error function integral equation. The presented thermal model predicts that magma temperature will reach 900 °C after 1 to 9 days from the initial temperature of 1150 °C. A graph showing the temperature evolution of magma in the repository drift (from EPRI report) is attached below.

The DOE's model does not account for spent fuel decay heat and its effect on waste package and magma temperature. Under intrusive eruption, the waste packages are expected to be surrounded by the magma, and the heat generated by the spent fuel is expected to raise the temperature of the waste packages and magma. Eventually, the interface region of waste packages and magma will reach a thermal equilibrium, and heat generated by spent fuel will be transferred to the magma. Therefore, the decay heat will raise the magma temperature, as opposed to drop in magma temperature as predicted by the DOE's model.

To model the waste package-magma system in the repository drift, CNWRA suggests to use cylindrical coordinate system (r,θ,z). The coordinate system accounts for change is area for heat transfer with radius in the circular geometry which is absent in the Cartesian coordinate system. Furthermore, the temperature at the drift wall and magma interface can not be fixed, instead, a fixed temperature can be assumed only at certain distance away from the drift walls. A composite thermal model of waste packages, magma, and repository drift walls can be developed in the cylindrical coordinate system. The thermal model should explicitly account for decay heat of waste packages, latent heat of magma solidification, and magma-drift wall interface temperature to predict the temperature evolution of magma in the repository drift.

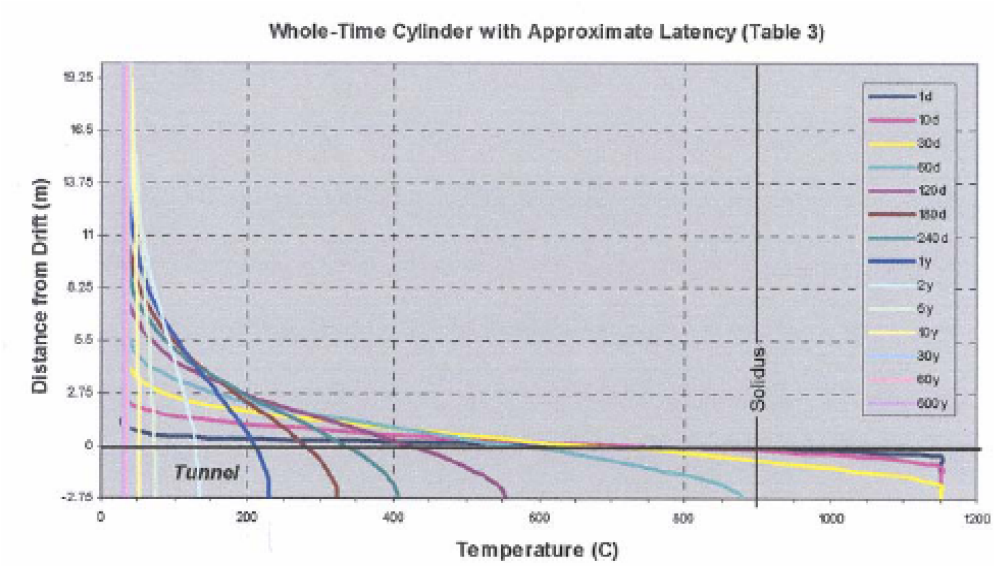

Figure 3-2
Results from OCRWM (2003a) Heat Flow Calculations Assuming a Cylindrical Drift Geometry Surround by Porous Tuff Wall Rock. The Plot shows the Whole-Time Temperature Profiles for Various Cooling Times on the Scale of Days to Years (Taken from Figure 16 of OCRWM, 2003a)

2. Flow of Magma in the Repository Drift: In the EPRI report, the initial temperature of the magma is assumed to be 1010 °C for flow predictions, where as the initial maximum temperature is assumed to be 1150 °C for the thermal analysis of the magma. The lower initial temperature of the magma will result in higher viscosity and, therefore, more viscous flow and less penetration in the repository drift. As a result, the magma will come in contact with only few waste packages located near the dike.

Furthermore, it is not clear which computer code was used to model the magma flow in the repository drift, however, DOE has used TOUGHREACT (LBLN 2002) to simulate the flow. EPRI report further states that lower viscosity magma are not possible in the Yucca mountain region. This conclusion is based on previous basaltic events in that region.