August 11, 2000

Asadul H. Chowdhury, Manager
Mining, Geotechnical, and Facility Engineering
Center for Nuclear Waste Regulatory Analyses
6220 Culebra Road P.O. Drawer 28510
San Antonio Texas 78228-5166

SUBJECT: RDTME KTI INTERMEDIATE MILESTONE NO. 20-01402.671.050: THERMAL-MECHANICAL EFFECTS ON REPOSITORY DESIGN/PERFORMANCE: DISCONTINUUM MODEL

Dear Dr. Chowdhury:

I have reviewed the Center for Nuclear Regulatory Analyses (CNWRA) report entitled: "Drift Stability and Ground Support Performance Under Thermal and Dynamic Load in Fractured Rock mass at Yucca Mountain Nevada." I concur with the change of title, which better reflects the contents of the report. I also concur with the decision to present the product in the form of a report rather than a conference/journal paper. The subject report documents the results of numerical modeling of rock mass behavior to study drift stability under thermal load, taking into account rock support provided by steel sets and reinforcing rock bolts. The report also documents conclusions on ground support performance subject to vibratory ground motion.

The fact that the effects of ventilation are not factored into the analyses presented in the subject report accounts for the overestimated temperatures and thermally induced stresses. To make the results applicable to pre-closure conditions, the next phase of this modeling exercise should account for the effects of ventilation on thermally induced stresses and drift stability. There are two conclusions in the report that stand out: (1) thermally induced stresses and deformation are greater in higher quality rock mass than in a lower quality rock mass; and (2) the existing experience on ground support design gained from the Exploratory Studies Facility and conventional underground mining and tunneling industry may not be applicable to ground support design under thermal load (particularly at high thermal loads and for higher quality rock mass).

The first conclusion is contrary to the common understanding that a lower quality rock mass would experience greater deformation than a higher quality rock mass under the same loading conditions. I have raised this point before when previous studies by the CNWRA came to the same conclusions. Based on my discussions with Dr. Simon Hsiung and Dr. Rui Chen of your staff, it is clear they understand my concerns, and they have assured me that the results are not an artifact of modeling assumptions or limitations. I would strongly recommend that some analytical verifications be done using simple closed form solutions to convince ourselves that, indeed, the results are not artifacts of numerical modeling. For example, thermal stresses due to a point/line heat source can be superimposed on the readily available solutions for stress distributions around a hole in an elastic plate. The results can be used to verify trends observed in the numerical studies.

The second conclusion begs the question, “What should the U.S. Department of Energy (DOE) be doing, if neither the ESF experience nor the conventional mining and tunneling experience can be relied upon?” How should the findings of this report be used in reviewing the DOE designs of heated drifts (with respect to reinforcement and roof support of different quality rocks)?

I look forward to further discussions on this study with the author of the report and the other team members. If there are any additional comments on the subject report from other KTI teams, they will be communicated to you through informal discussions or e-mails. If you have any questions on the contents of this letter, please contact me at (301) 415-6695 or via e-mail (msn1@nrc.gov). No written response to this letter is required and the subject report is considered to fulfill the CNWRA’s contractual obligations for this Intermediate Milestone.

Sincerely,

/ra/

Mysore Nataraja
Program Element Manager
Repository Design Thermal-Mechanical
Effect KTI
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

cc: J. Linehan, PMDA
B. Meehan, ADM/DCPM/CMB2

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Sincerely,

Mysore Nataraja
Program Element Manager
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cc: J. Linehan, PMDA
B. Meehan, ADM/DCPM/CMB2

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