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March 8, 1988

009/1.6/WWL.002
RS-NMS-85-009
Communication No. 244

U.S. Nuclear Regulatory Commission
Division of High-Level Waste Management
Technical Review Branch
MS 623-SS
Washington, DC 20555

Attention: Mr. Jeff Pohle, Project Officer
Technical Assistance in Hydrogeology - Project B (RS-NMS-85-009)

Re: Subtask 1.6 CDSCP comment folow-up

Dear Mr. Pohle:

Attached please find a letter to NWC from Mr. Tom Sniff, the Water, Waste and Land Project Engineer who is responsible for most of the day-to-day technical assistance provided by WWL. The letter addresses one of the principal points raised in the NWC-WWL point papers prepared for the Consultation Draft Site Characterization Plan (NWC Communication No. 240): is it reasonable to expect that the proposed approach to site characterization of the hydrologic system can be accomplished in the time-frame suggested by the DOE. WWL has gone back to Parviz Montazer's Ph.D. dissertation, "Permeability of Unsaturated, Fractured Metamorphic Rocks Near an Underground Opening" in order to understand better the approach and the likely consequences of the approach proposed by DOE. The basic conclusion of the WWL review is that the DOE approach is dependent on the development and application of a significant body of testing (and test-analysis) procedures that do not now exist as accepted methods, and that this implies that a there is a major R&D effort, to be followed by a major effort at the development of technical consensus, ahead of DOE. We remain concerned that the practical, logistical aspects of this program have not been adequately addressed by DOE, either explicitly or through the development of contingency plans.

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The WWL report has received a managerial and technical review by M. Logsdon (NWC), and the report was prepared under WWL's QA procedures, consistent with the NWC QA manual. If you have any questions about this transmittal letter or about the WWL letter to NWC, please contact me immediately.

Respectfully submitted,
NUCLEAR WASTE CONSULTANTS, INC.

Mark J. Logsdon

Mark J. Logsdon, Project Manager

Att: Letter from T. Sniff (WWL) to M. Logsdon (NWC)

cc: US NRC - Director, NMSS (ATTN PSB)
HLWM(ATTN Division Director)
Edna Knox, Contract Administrator
HLTR (ATTN Branch Chief)
D. Chery, HLTR
W. Ford, HLTR

Water, Waste & Land, Inc.
CONSULTING ENGINEERS & SCIENTISTS

February 19, 1988 WWL #4001

Mr. Mark Logsdon
Nuclear Waste Consultants, Inc.
155 South Madison Street, Suite 302
Denver, Colorado 80209

Dear Mark:

After our discussion regarding the amount of prototype testing which has been planned as part of characterization of Yucca Mountain as outlined in the CDSCP, I thought it would be appropriate to summarize some of the conclusions from a document in our data base. Parviz Montazer's Ph.D. Thesis, entitled "Permeability of Unsaturated, Fractured Metamorphic Rocks Near an Underground Opening," describes his research on procedures and equipment to measure and analyze rock-mass permeability of unsaturated, fractured hard-rock masses.

The approach taken by Montazer is essentially the same as that proposed by the DOE, i.e., multichamber, packer injection testing equipment primarily using air or nitrogen. Montazer's thesis was submitted in 1982 and I have not yet determined if additional relevant research has been conducted at the Colorado School of Mines.

Some of the conclusions presented by Montazer were:

1. The fracture characterization technique used for this study is believed to be applicable to radioactive waste repository site characterization.

2. Apertures measured in boreholes are not the same as the equivalent parallel plate apertures and are much exaggerated.

3. Although <u>in situ</u> permeabilities smaller than 10^{-14} cm^2 were not encountered in his investigation, the instruments are capable of detecting permeabilities of 10^{-17} cm^2 by the steady state injection of gases.

4. For porous material, the steady radial flow equations can be used reliably to estimate the permeabilities on the order of 10^{-13} cm^2. When such materials are dry or have low water content, nitrogen seems to be a suitable testing fluid.

5. Water and carbon dioxide underestimate the permeability.

6. Tests with nitrogen would require wide ranges of pressures to delineate the Klinkenberg effect.

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7. Pressure-permeability relationships from systematic injection testing of the longitudinal boreholes are non-linear and are due to a combination of effects of unsaturated nature of rock and gas slip phenomena.

Montazer recommended the following investigations be performed, either at the Colorado School of Mine's site or at other underground sites:

1. Intact fracture samples should be obtained for study of the stress-permeability relationships as well as unsaturated flow investigations.

2. A three-dimensional finite element stress-flow model should be set up for a large scale room or breakout.

3. A large-scale permeability test is suggested for the entire room.

The current estimate of the Topopah Spring welded unit's hydraulic conductivity is about 0.7 mm/yr which would indicate an intrinsic permeability of approximately 10^{-14} cm^2. Based on the conclusions and recommendations presented by Montazer, it would appear that the many prototype tests proposed by the DOE in the CDSCP are a direct continuation of his basic research. I believe that this reinforces the opinion presented by WWL/NWC as to the DOE not being able to characterize the Yucca Mountain site in the required time frame with the necessary detail.

Sincerely,

WATER, WASTE & LAND, INC.

Tom L. Sniff

Tom L. Sniff
Project Engineer

TLS:dml