September 15, 2000

April Gil, Lead
Regulatory Interactions & Policy Development Team
US Department of Energy
Yucca Mountain Site Characterization Office
P.O. Box 30307
Mail Stop 523
North Las Vegas, NV 89036-0307

SUBJECT: NRC STAFF COMMENTS ON "DRAFT ALCOVE 8 - NICHE 3 CROSS-OVER TEST PLAN"

Dear Ms. Gil:

At the August 16-17, 2000 meeting on unsaturated zone issues, held in Berkeley, CA, staff from your office agreed to provide the subject test plan (enclosure 1) for our review. The U.S. Nuclear Regulatory Commission staff has completed its review and we generally agree with the proposed test plan. However, we have some specific comments that we believe could improve the test usefulness and results (enclosure 2). We identified items that should be clarified in the test plan and documentation of testing. We also provided several recommendations that could improve results. For example, slots should be cut along the niche walls to intercept water that has been diverted just beyond the walls of niche 3. This approach would yield more reliable estimates of water diversion around underground openings. Even though some testing has begun at Alcove 8 - Niche 3, we understand that our recommendations can still be incorporated in the tests.

If you have any questions, please contact me at (301) 415-6615 or by email at nmc@nrc.gov.

Sincerely,
/ra/

Neil Coleman, Program Element Manager
High-Level Waste Branch
Division of Waste Management
Office of Nuclear Material Safety
And Safeguards

Enclosure 1: Draft Alcove 8 - Niche 3 Cross-Over Test Plan
Enclosure 2: NRC staff comments on "Alcove 8 - Niche 3 Cross-Over Test Plan"

cc: See attached list

Letter to Gil from Coleman dated: 9/15/2000

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Enclosure 2

NRC Staff Comments on "Draft Alcove 8 - Niche 3 Cross-Over Test Plan"
September 13, 2000

1. Potential for Diversion of Water Around Niche 3

The seepage fraction will be an important output of this test, including estimates of seepage threshold. The amount of applied water minus seepage and evaporation will be used to estimate diversion around the drift. From a mass balance point of view, uncertainties in the estimates of evaporation and fluid migration into the matrix, combined with the indirect estimates of water moving around the niche, will lead to uncertain estimates of water diversion. Neutron probe and GPR tomography only give indirect information on water movement that may miss actively flowing fractures or smear out the movement. Diverted water can be more directly measured, for example, by cutting slots along the walls of niche 3. These slots would be about 1 m deep and angled upward from the niche walls. Their purpose is to trap and collect water that has been diverted just beyond the walls. We recommend this approach to obtain more reliable estimates of water diversion around underground openings. Also, it is not clear what is meant by "wetting front sensors." Are they just electrical sensors indicating presence or absence of significant water? This should be clarified in the documentation of test results.

2. Evaporation Issue

Even with the bulkheads in place, evaporation caused by ventilation of the main drift will keep the relative humidity below the ambient value (~99.9%). This is caused by the need to open the bulkheads to do work and air bypassing the bulkhead through the fracture network. We have two comments:

a) There appears to be free air space between the collection apparatus and the niche ceiling allowing free air movement that could reduce observed seepage. While there are practical limitations to eliminate this problem, placing evaporation pans in the niche would show how much evaporation occurs. It is not stated where the evaporation pan(s) will be located. At least one should be placed inside the niche near the bulkhead, where some evaporation could occur.

b). The design of the evaporation pans was not discussed. Our impression from the Unsaturated Zone Technical Exchange (August 2000) was that half-full beakers were put on top of a weighing scale to measure the rate of evaporation from the beakers. Care should be taken to ensure the measured evaporation properly mimics evaporation from an exposed-rock ceiling. For example, we suggest using a wide, nearly full pan with the water level maintained by a reservoir. The reservoir would then be situated on a scale to measure water loss.

3. Fracture Pathway Tortuosity

Given the results of other field tests in fractured rocks (chalk deposits in Israel and multi-scale tests in basalts in Idaho), this large scale test may also exhibit flow in tortuous paths not readily predicted. The design (figure 5 of test plan) appears to show that the infiltration gallery in Alcove 8 overlies the Niche 3 bulkhead and that double rows of collection funnels are aligned on both sides of the bulkhead. If this is a control test to show the effect of ventilation, the results could be affected by the tortuous pathways of the water. Alcove 1 seepage results (A. Flint, SME conference February 2000) exhibited a strong heterogeneity across the alcove ceiling. For example, most flow may occur on one side or the other of the bulkhead along preferred

pathways. In fact, we do not understand why seepage collectors are being placed outside the bulkhead in a ventilated area. This seems an unnecessary complication of the test. These points need to be discussed in the test documentation.

4. Tension Infiltrometry

Since the initial high flux is designed to wet the system to reduce matrix sorption, we suggest performing infiltration tests in Alcove 8 under multiple tension boundary conditions instead of the specified flux condition. This could be done before the specified flux application by using a tension infiltrometer apparatus.

5. Test Objectives/Procedures

The Test Plan does not explain the differing objectives of the two infiltration tests (i.e. the Small Plot Experiment and the Large Plot Experiment). Figure 5 in the Test Plan mentions a "Fault Test." Is this the same as the Small Plot Experiment? Also, it is not clear whether the test procedures outlined on page 7 of the Test Plan pertain to the Large Plot Experiment, the Small Plot Experiment, or both. Finally, the Test Plan does not specify whether drainage of the rock mass will be monitored after the infiltration experiments. Models of flow and transport used to interpret the tests can be better constrained if the model can be calibrated to match drainage data in addition to wetting and steady-flow regimes. These various points should be clarified in the test documentation.

6. Seepage Collection

Figure 5 shows the seepage collection system design for the "fault test." Reiterating a concern raised in item 3, it is not clear why seepage collection is being done on the ventilated side of the bulkhead, and is limited to small areas on either side of the bulkhead. Will the collection area be expanded for the Large Plot Experiment? Also, a possibility exists that the entire amount of infiltration applied in Alcove 8 could flow along a preferential pathway that does not intersect Niche 3. What contingency plans exist to collect data in such an event? Provide clarification in the test documentation.

7. Faults and Fractures

In documentation for this test series, provide scale drawings to show the locations of mapped faults and fractures in the alcove and niche, and relative positions of the bulkheads and test boreholes and apparatus. Concentrations of lithophysae, vapor-phase partings, and depositional contact surfaces should also be identified. Fracture characteristics should be compared to the range of characteristics elsewhere at the site as described by Buesch, et al., and Sweetkind, et al.

This test provides an opportunity to study how fracture length and apparent aperture relate to seepage. To the extent practicable, DOE should document how seepage patterns relate to observed or inferred fracture characteristics.

8. Boreholes

Figure 3 of the test plan identifies 5 blast monitoring boreholes. Are these a part of the Alcove 8

hydrologic test? Their role if any should be noted in the test documentation.