WILLIAMS & ASSOCIATES, INC.

P.O. Box 48, Viola, Idaho 83872 (208) 883-0153 (208) 875-0147

Hydrogeology • Mineral Resources • Waste Management • Geological Engineering • Mine Hydrology

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WM Project 10,11,16
Docket No.
PDR ✓
LPDR ✓ (B,N,S)

Distribution:
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Mr. Jeff Pohle
Division of Waste Management
Mail Stop 623-SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: NTS

Dear Jeff:

This letter constitutes a "letter report" as required by Subtask 1.1. A list of documents obtained by Williams and Associates, Inc. for NNWSI is enclosed. Recommendations for the addition, deletion, and/or modification of issues identified in Exhibit 1 are as follows:

Issue 1.1.1.2 What are the distributions of measured and interpolated hydrogeologic parameters?

We feel that the wording describing this issue should be changed as follows: Flow paths and flow rates are partly a function of the hydraulic properties of an aquifer. The measured and interpolated hydraulic properties reflect the known distribution of heterogeneities in the ground water system. Consequently, these properties will determine to a large extent what the predicted flow paths and travel times will be. Measured values are generally more reliable than values obtained indirectly but it is impossible to measure hydrogeologic parameters everywhere, therefore interpolated values or values obtained indirectly from models also must be used in some calculations. A three-dimensional description of the hydraulic head is necessary to establish hydraulic gradients used in travel time calculations. Hydraulic heads will be used as initial conditions in any quantitative modeling process.

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Issue 1.1.2.2 What are the recharge and discharge locations, mechanisms, and amounts for the Yucca Mountain ground water system?

We recommend that the discussion of this issue be modified. The last sentence in the discussion of this issue states that, "the analysis of ground water flux helps to define the expectable repository impacts because the flux determines the travel time to the accessible environment." This statement is incorrect. The term flux is defined as the volume rate of flow per unit cross sectional area. This is equal to the specific discharge or Darcy velocity where flux is equal to $Q/A = -K(dh/dl)$. Flux is not the same as seepage velocity which takes into account effective porosity. Seepage velocity is equal to $Q/n_eA = -K/n_e\ dh/dl$, where Q is equal to discharge, A is equal to the cross sectional area, K is equal to the hydraulic conductivity, dh/dl is equal to the hydraulic gradient, and n_e is equal to the effective porosity. For unsaturated flow, effective porosity and hydraulic conductivity are functions of moisture content.

Issue 1.1.2.6.1 What are the hydrogeologic processes and important hydrogeologic parameters in the saturated zone?

We recommend that the fourth sentence in the discussion of this issue be changed as follows: For example, in the unsaturated zone hydraulic conductivity is a function of moisture content.

Issue 1.1.2.6.2 What is the three-dimensional distribution of both measured and interpolated hydrogeologic parameters in the saturated zone?

We recommend that the next to the last sentence in the discussion of this issue be changed as follows: In addition, the three-dimensional distribution of hydraulic head is important not only in establishing hydraulic gradients necessary for travel time calculations but in establishing the characteristics of vertical or horizontal flow.

Issue 1.1.3 What mathematical model(s) are used to predict ground water flow?

We recommend that the discussion of this issue be changed as follows: Mathematical models serve two purposes: First, they quantify conceptual models of ground water flow and they verify compatibility of conceptual models with field measurements. Second, they can be used to help predict the future migration rate of radionuclides.....

In addition to the aforementioned modifications to the existing issues, we recommend that the following concepts be added to the existing issues or rewritten to form new issues.

1) The high tensions (or capillary pressures) in-situ and relatively high saturations which have been measured in the field are substantiated by the testing of the lab cores by Battelle Northwest. This substantiation and the observation itself are important in the development of a defensible conceptual model for the movement of water through the unsaturated tuffs at Yucca Mountain.

2) The movement of water in fractures is dependent on site characteristics. Therefore, we believe that infiltration into fractures should be investigated by a rainfall simulation on Yucca Mountain. Several different surface characteristics, such as exposed fractures and slight soil mantle should be investigated. The movement of water through the fractures should be monitored. Although the current investigations that use fractured rock infiltrometers provide useful information. We believe several questions about the behavior of the fractured rock at Yucca Mountain remain unanswered. Also in the current investigations, the actual depths that water infiltrated into the fractures has not been measured.

3) Ultimately, the mathematical models of heat, vapor, and water flow, due to a heat source should be verified. Several models have shown that flow in response to a heat source behaves much as would be expected. However, we believe that these models should be verified by physical experiments.

4) The selection of appropriate, defensible, conceptual models is necessary to ascertain representative values of hydraulic properties of an aquifer. The use of inappropriate conceptual models may produce significant errors in the estimation of aquifer hydraulic properties. Use of these values may result in significant errors in travel time calculations.

Sincerely,

James L. Osiensky

JLO:sl

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1.0 The quantity of waste radionuclides released from a repository at Yucca Mountain must be small enough and transport time to the accessible environment long enough to meet the radiation release limits specified by the EPA and NRC.

1.1 What degree and period of radionuclide containment will be provided by a waste package system designed for use in the tuffs of Yucca Mountain.

1.1.1 Character of potential waste emplacement horizon(s) to be used and effect on waste package design.

A reasonable knowledge of the local .....

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Table--Hydrologic data needed to address key issue of water travel time in the unsaturated zone.

Table--Summary of data for observation wells in hydrologic network.

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