

MIN/PET/KS

MAR 13 1991

- 1 -

Mr. Dwight E. Shelor, Acting Associate Director
for Systems and Compliance
Office of Civilian Radioactive Waste Management
U. S. Department of Energy, RW 30
Washington, D.C. 20585

Dear Mr. Shelor:

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION (NRC) STAFF REVIEW OF STUDY
PLAN FOR MINERALOGY, PETROLOGY, AND CHEMISTRY OF TRANSPORT PATHWAYS

In a letter to the U.S. Department of Energy (DOE) dated August 20, 1990, NRC informed DOE that the NRC had found the Study Plan for Mineralogy, Petrology, and Chemistry of Transport Pathways (Study Plan 8.3.1.3.2.1) acceptable for further review, and in addition, that the NRC staff's Start-Work Review of that study plan had identified no objections with the activities proposed. NRC also indicated that it had decided to proceed with a Detailed Technical Review of that study plan. The purpose of this letter is to transmit the results of the NRC staff's Detailed Technical Review.

With respect to the material in the subject study plan, the staff has identified one comment and five questions (Enclosure 1). The comment documents the staff's concern that the study plan may not provide for adequate information to be collected on rock outside the repository horizon. The questions are related to several topics treated in the study plan for which the staff needs clarification with respect to either the meaning of certain terms or the processes by which certain methods of characterization or analysis were selected.

The Detailed Technical Review comment and questions on this study plan will be tracked by the NRC staff as open items similar to Site Characterization Analysis (SCA) objections, comments, and questions. NRC recommends timely resolution of these concerns and is prepared to interact with DOE upon DOE's request to work toward resolution.

In its review, the staff observed that work planned under the activity Role of Fractures and Faults as Past Transport Pathways and Evidence for Paleo-Water Table(s) partially addresses an open item from the staff's Detailed Technical Review of the Study Plan for Characterization of the Yucca Mountain Quaternary Regional Hydrology (Study Plan 8.3.1.5.2.1). That open item (Comment 1 on that study plan) states that evidence to be considered for establishing paleowater table elevations appears to be restricted to near-surface calcite-silica veins. In the subject study plan, plans are presented for sampling and analysis of a greater variety of fault and fracture-lining minerals to greater depths to provide evidence for establishing paleowater table elevations. The staff considers these plans to be appropriate for that purpose and are sufficient to partially address the aforementioned Comment 2, but noted that characterization of the rock matrix at depth may also provide similarly useful

9103140386 910313
PDR WASTE
WM-11 PDR

102.8
WM-11
NH16

evidence. Plans to characterize the rock matrix for this purpose may be forthcoming in the Study Plan on History of Mineralogic and Geochemical Alteration of Yucca Mountain (Study Plan 8.3.1.3.2.2). The staff will determine whether the comment is resolved after that study plan has been received and reviewed.

If you have any questions concerning this letter or the enclosure, please contact King Stablein (FTS 492-0446) of my staff.

Sincerely,

ORIGINAL SIGNED BY



for

John J. Linehan, Acting Director
Repository Licensing and Quality Assurance Project Directorate
Division of High-Level Waste Management
Office of Nuclear Material Safety and Safeguards

Enclosure: As Stated

- cc: R. Loux, State of Nevada
- C. Gertz, DOE/NV
- S. Bradhurst, Nye County, NV
- M. Baughman, Lincoln County, NV
- D. Bechtel, Clark County, NV
- D. Weigel, GAO
- P. Niedzielski-Eichner, Nye County, NV

DISTRIBUTION

CNWRA	NMSS R/F	HLPD R/F	LSS
LPDR	ACNW	PDR	Central File
BJYoungblood, HLWM	JBunting, HLEN	JLinehan, HLPD	RBallard, HLGP
On-Site Reps	JBradbury, HLGP	DBrooks, HLGP	KStablein, HLGP

*See previous concurrence

OFC :HLPD*	:HLGP*	:HLGP*	:HLGP*	:HLWM	:
NAME:KStablein	:JBradbury	:DBrooks	:RBallard	:JLinehan	:
Date:03/04/91	:03/04/91	:03/05/91	:03/05/91	:03/13/91	:

Study Plan 8.3.1.3.2.1 Mineralogy, Petrology, and Chemistry of Transport Pathways

Comment 1

Although the study plan calls for gathering data on "textural relationships of minerals along potential groundwater pathways," which are important to establish stratigraphic location of core samples and to determine the accessibility of potentially sorbing phases to radionuclides, only the candidate host rock will be analyzed petrographically. Thus, it appears that inadequate information will be collected on rock outside the repository horizon.

Basis

The analytical techniques proposed for determining Quantitative Mineralogy of the Host Rock and Along Transport Pathways will be XRD and XRF (p.14).

In addition to XRD and XRF, the candidate host rock will also be analyzed petrographically (p.17).

Chemical variability in the host rock and along transport pathways will be determined by XRF, NAA, AA, and electron microprobe analysis (p.19).

Although "petrographic thin sections will be prepared for all of the mineralogic samples" (p. 11), except for the work to be done on the fractures and faults (p. 23), petrographic analysis is not proposed for rocks outside of the Topopah Spring unit.

Textural information can be used to establish stratigraphic location of core samples and to determine the accessibility of potentially sorbing phases to radionuclides.

Recommendation

Include petrographic analysis for determining textural relationships of minerals along the transport pathways between the Topopah Spring Member and the accessible environment.

FULL TEXT ASCII SCAN

Activity 8.3.1.3.2.1.1 Quantitative Mineralogy of the Host Rock and Along
Transport Pathways

Question 1

Given that the accuracy of data from this study needed for transport modeling has yet to be determined, how were the methods of characterization selected?

Basis

"The purpose of this Study is to characterize the mineralogy, petrology, and chemistry along potential groundwater flow paths leading from the repository to the accessible environment. Data gathered in this Study will provide information about the types, abundances, distributions, compositions, and textural relationships of minerals along potential groundwater pathways. This information will be used in conjunction with data from sorption experiments (SCP Investigation 8.3.1.3.4) to evaluate radionuclide retardation by sorption processes along flow paths to the accessible environment" (p.1).

"The accuracy of input required for transport modeling has not been determined yet, therefore the accuracy of results needed in this activity cannot be defined" (p.15).

If it is determined in the future that greater accuracy is required for transport modeling than proposed in this study plan, work carried out according to this plan may be inadequate.

Recommendation

Explain how the methods of characterization were selected and do contingent plans exist if the requirements for accuracy for transport modeling are not met.

Activity 8.3.1.3.2.1.2 Internal Stratigraphy for the Candidate Host Rock

Question 2

Could the effect of characterizing thin sections of core primarily cut in a vertical orientation significantly bias the estimations of types, abundances, distributions, compositions, and textural relationships of minerals along potential groundwater pathways such that calculated radionuclide retardation would be overestimated?

Basis

The Procedure for Determination of Volume Constituents in Thin Sections of Rocks (TWS-ESS-DP-102, R2) describes that only "under exceptional circumstances" will horizontal thin sections be cut where sample site is critical.

"The unsaturated zone beneath the Yucca Crest consists of a layered sequence of tuffs deposited from volcanic eruptions ..." (Hoxie, 1989).

Due to contrasts in hydraulic conductivity between horizontal layers, lateral components of flow may be significant. "In aquifer-aquitard systems with permeability contrasts of 2 orders of magnitude or more, flowlines tend to become almost horizontal in the aquifers and almost vertical in the aquitards" (p.173 Freeze and Cherry, 1979). At Yucca Mountain, for example, Tiva Canyon welded tuff has a saturated hydraulic conductivity of $10E-11$ m/s, whereas the underlying Paintbrush nonwelded unit has a saturated hydraulic conductivity of $10E-7$ m/s (Hoxie, 1989).

Recommendation

Provide evidence to show that studying thin sections primarily cut in a vertical orientation will not bias estimations of types, abundances, distributions, compositions, and textural relationships of minerals along flow paths to be used in transport modeling.

References

Freeze, R. A. and J. A. Cherry, 1979, Groundwater, Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Hoxie, D. T., 1989, A conceptual model for the unsaturated-zone hydrologic system, Yucca Mountain, Nevada, in Radioactive Waste Management and the Nuclear Fuel Cycle, 1989, Vol. 13(1-4), pp. 63-75.

Study Plan 8.3.1.3.2.1 Mineralogy, Petrology, and Chemistry of Transport Pathways

Question 3

How do the parameters characterizing rocks and minerals determined in this study correlate with parameters important to sorption to be collected in Study Plan 8.3.1.3.4.1: Batch Sorption Studies?

Basis

"The purpose of this Study is to characterize the mineralogy, petrology, and chemistry along potential groundwater flow paths leading from the repository to the accessible environment. Data gathered in this Study will provide information about the types, abundances, distributions, compositions, and textural relationships of minerals along potential groundwater pathways. This information will be used in conjunction with data from sorption experiments (SCP Investigation 8.3.1.3.4) to evaluate radionuclide retardation by sorption processes along flow paths to the accessible environment" (p.1).

Work planned in Activity 8.3.1.3.4.1.1, Batch sorption measurements as a function of solid phase composition, will determine correlations of sorption coefficients with mineralogy (p.8.3.1.3-70). The solid parameters, which may be important to sorption, such as surface area, site density, cation exchange capacity, etc. will be determined on pure mineral separates in the Sorption Studies.

Recommendation

Explain how the information from this study will be used in the sorption studies.

Activity 8.3.1.3.2.1.1 Quantitative Mineralogy of the Host Rock and Along
Transport Pathways

Question 4

What is the method for determining changes in lithology?

Basis

"Analyses will be performed on samples from core and from the exploratory shaft samples whenever changes in lithology are apparent so that complete mineralogical data are available for all lithologies" (p.14).

It is not evident that the method for determining changes in lithology is described in any of the listed detailed procedures.

Recommendation

Provide a description of the method for determining changes in lithology.

Study Plan 8.3.1.3.2.1 Mineralogy, Petrology, and Chemistry of Transport Pathways

Question 5

What is the difference between software verification and validation and model verification and validation?

Basis

"The software used to support licensing will be verified and validated according to the LANL Software QA plan" (p.13).

The term "model validation" is defined by Brooks and Coplan (1987) as the method taken to assure that a model is a correct representation of the process or system for which it is intended. Consensus on how to achieve assurance does not yet exist.

The term "software validation" is unfamiliar to the NRC technical reviewers, and its meaning is unclear in the study plan.

Recommendation

Discuss the difference between software verification and validation used in this study plan and model verification and validation.

Reference

Brooks, P. and S. Coplan, 1987, The role of verification and validation in licensing repositories for disposal of high-level waste, Proceedings of GEOVAL 1987, vol. 1, p. 41.