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MEMORANDUM FOR: Joseph Holonich, Director
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management

FROM: Sher Bahadur, Acting Chief
Hydrology and Systems Performance Branch
Division of High-Level Waste Management

SUBJECT: PHASE I REVIEW OF STUDY PLAN 8.3.1.3.7.1
"RETARDATION SENSITIVITY ANALYSIS," REVISION 0
[PPSAS 411421, TACS L60272]

As requested, we have completed the Phase I review of the Study Plan 8.3.1.3.7.1 Revision 0 for Retardation Sensitivity Analysis (See enclosure). This review was conducted using the Review Plan for NRC Staff Review of DOE Study Plans Revision 1 (Dec. 6, 1990). No objection-level concerns have been identified.

This study plan describes the methods that will be used to analyze the effects of geochemical and coupled processes, as well as particulate transport on radionuclide transport from the proposed repository at Yucca Mountain to the accessible environment. A conceptual model of the Yucca Mountain site will be developed based on available geochemical, hydrologic, and other site characterization data, and on the analyses done under this study. Computational models simulating processes in the conceptual model will be constructed. The computational models will be used to perform integrated transport calculations to estimate radionuclide migration rates from the repository to the accessible environment and to determine the sensitivity of such transport calculations to retardation processes and parameters included in the codes. The results of the sensitivity analyses will be used to guide site characterization activities, focusing efforts on the characterization of processes that most strongly affect radionuclide migration. The study is subdivided into three activities:

- o Sensitivity analysis using a geochemical transport model of Yucca Mountain and integrated geochemical transport calculations (SCP Section 8.3.1.3.7.1.2)
- o Analysis of physical/chemical processes affecting transport (SCP Section 8.3.1.3.7.1.1)
- o Transport models and related support (SCP Section 8.3.1.3.7.1.3)

The work under the first activity will involve the construction of a computational model of the geochemical transport system at Yucca Mountain that represents the conceptual model of the effects of site geochemistry on radionuclide transport. The conceptual model of site geochemistry will consist of the integration of site mineralogy and petrology, ambient water

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chemistry, models for radionuclide sorption and solubility, and other geochemical processes affecting transport to the accessible environment. The conceptual model will continuously be updated as new information is gathered in the characterization of the site.

The initial modeling efforts will utilize the coupled flow and transport code TRACRN. Calculations will supply sensitivity analyses of the effects of retardation on transport, address the effects of spatial distribution of hydrologic parameters, geochemical parameters, and mineral assemblages on retardation of radionuclides, and help ensure geochemical characterization activities are efficiently applied to repository performance assessment.

The work under the second activity will focus on modeling alternative processes that could affect radionuclide transport. These alternative processes include (1) transport of radionuclides in the form of colloids; (2) effects of geochemical processes on transport; (3) effects of physical processes on transport, in particular, the effects of fracture flow in the unsaturated zone and of dispersion and diffusive behavior on transport; and (4) effects of coupled processes, in particular, the effects of regional stress and heat on transport and geochemistry.

The work under the third activity will be to provide documentation, verification, validation and software support for the transport codes to be applied to the retardation sensitivity analyses. Most of the codes to be used in this study are modified versions of existing computer codes.

The DOE has not proposed to close any open items with this study plan. However, this study plan describes activities that could pertain to Questions 1 and 3 generated in the Detailed Review of the Study Plan 8.3.1.3.2.1 on Mineralogy, Petrology, Geochemistry along Flowpaths. Question 1 concerns how the methods of characterization were selected, given that the accuracy of the data needed has yet to be determined. The work in the retardation sensitivity analysis study is intended to provide information on the needed accuracy of site parameters. Question 3 concerns how the parameters collected in the Mineralogy/Petrology Study will correlate with those in the Batch Sorption Study. Again the work in the retardation sensitivity analysis study plan which uses data from both of these other studies may provide information to address this question.

We continue to be concerned about the lack of explicit discussion of an overall program of iterative performance assessment or a discussion of the timing of this study relative to such a program. This type of program leads to the identification of information and analyses needed to support a license application.

Based on criteria 1, 2 and 5 of the Review Plan for NRC Staff

Review of DOE Study Plans Revision 1 (Dec. 6, 1990), the study plan is a candidate for detailed technical review. However, we do not believe that a detailed technical review is needed at this time. Based on the Phase 1 review, we have an adequate understanding of the activities described and doubt if any comments or questions would be generated by conducting a detailed review. Instead, the work performed in this study should be tracked as it addresses the issues pertaining to criteria 1, 2 and 5 of the Review Plan. One method for evaluating the work in the Retardation Sensitivity Analysis Study is for the NRC staff to exercise the main flow and transport code to be used in this study. Possibly, this work could be done in IPA Phase 3. Finally, while 32 references have fallen into the "not assumed available" category, we do not feel all those need to be obtained from the DOE at the present time. Instead, only those marked with an asterisk should be requested now. The review was conducted by John Bradbury of the Hydrologic Transport Section.

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Sher Bahadur, Acting Chief
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Enclosure: As stated

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