

ENCLOSURE A

PHASE I REVIEW: CHARACTERIZATION OF THE VERTICAL AND  
LATERAL DISTRIBUTION OF STRATIGRAPHIC  
UNITS WITHIN THE SITE AREA  
(DOE STUDY PLAN 8.3.1.4.2.1, REV. 0)

by

Harold E. Lefevre

Geology-Geophysics Section  
Geology and Engineering Branch  
Division of High-Level Waste Management, NMSS  
U.S. Nuclear Regulatory Commission

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Introduction

The purpose of DOE's study plan "Characterization of the Vertical and Lateral Distribution of Stratigraphic Units Within the Site Area" is to (1) determine the geometry of rock units present within the Yucca Mountain area, (2) establish the spatial variability of pertinent rock parameters within individual stratigraphic units and (3) to determine the spatial variations in primary and secondary rock parameters within individual subunits (e.g., volcanoclastic facies, degree of compaction and welding, lithophysae development, devitrification, diagenetic alteration). The integrated geological, geophysical, and petrophysical activities proposed in this study will establish a comprehensive database on the three-dimensional distribution of lithostratigraphic subunits, providing a basis for rock correlation throughout the area.

The study plan consists of five activities to be conducted in the Yucca Mountain site area: (1) surface and subsurface stratigraphic studies of the host rock and surrounding units, (2) surface-based geophysical studies, (3) borehole geophysical surveys, (4) petrophysical properties testing, and (5) magnetic properties and stratigraphic correlations.

The study plan was reviewed with respect to (A) DOE/NRC agreements on the content of study plans, (B) Identification of objections, (C) Closure of NRC open items, and (D) The need for a detailed review (See review plan for NRC staff Review of DOE Study Plans, Revision 1, dated December 6, 1990).

EVALUATION OF STUDY PLANS RELATIVE TO THE AGREEMENT AND TO THE RESPONSIBLE DOE CONTRACTOR'S QA PROGRAM (OBJECTIVES 1 AND 5)

Criterion 1 - The content of the study plan under review is reasonably consistent, as appropriate for the activities, tests and analyses described, with the Agreement (NRC-DOE meeting of May 7-8, 1986 on the level of detail for site characterization plans [SCP] and for study plans)

Staff Review: With few exceptions, the content of the study plan is reasonably consistent with the NRC/DOE agreements on the content of study plans. Enclosure B is an itemized checklist of the study plan content versus the Agreement on content resulting from the above level of detail meeting.

Criterion 2 - All study plan references have been provided when the study plan was issued.

Staff Review: All references have not been provided. The study plan lists 14 references, two of which are SCP references and 12 others appear to be available either as textbooks, professional journals or as government reports. An additional three listed References are not cited in the study plan text and three documents are cited in the study plan text but have not been included in the References. Enclosure C is a copy of the References from the study plan with all references marked either SCP (referenced in the SCP), AA (assumed to be available), RNP (referenced in the study plan text with no citation provided in the References), or IR (identified in the References and not cited in the study plan text). With respect to the three documents used in the study plan text, but not included in the References section (see Enclosure D), we suggest DOE be requested to (1) provide the NRC with a copy of each of the references or (2) provide the full description of the subject references as they would appear in the References section of the study plan. The staff would then make its determination of the availability of the documents. With respect to the three documents cited in the References but not included within the study plan text (see Enclosure D), we suggest DOE clarify the need for these references.

Criterion 3 - Open items relative to the QA program [of the DOE contractor responsible for the study plan] that could call into question the quality of the study plan have been resolved.

Staff Review: There are no open QA items that would call into question the quality of the study plan. The U.S. Geological Survey is the DOE contractor responsible for this study plan.

IDENTIFICATION OF OBJECTIONS (OBJECTIVES 2 THROUGH 6)

Criterion 1 - Potential adverse effects on repository performance.

Staff Review: DOE (study plan Section 2.4.4, Activity 8.3.1.4.2.1.4, Petrophysical properties testing, p. 2-17) indicates that drilling and coring operations, included as a test under another activity "may have some potential impact on the site area." The nature of the impact of the test potentially affecting the site has not been identified in the study plan. However, DOE, while discussing the drilling-related potential impacts in the SCP (pp. 8.4.3-38 through 8.4.3-43) indicates that no permanent adverse changes to the performance of the overall system are expected because the boreholes (both shallow and deep) will be sealed.

Although DOE indicates on page 2-17 that these drilling and coring operations are being conducted independently of this study, it does not identify the independent activity. However, the staff assumes (based on statements included in study plan Section 2.1.1.2, Activity 8.3.1.4.2.1.1, Borehole drilling and coring, p. 2-3), that the borehole drilling and coring operations are to be conducted under Activity 8.3.1.4.1.1, Integrated drilling program (SCP, p. 8.3.1.4-24). This activity has not yet been submitted by DOE for staff review.

The remainder of the activities to be conducted under this study are, in the staff's opinion, unlikely to have a potential adverse effect on repository performance. This is because the remaining tests are either (1) non-destructive or surface-based or (2) will be utilizing samples acquired through the drilling and coring operations previously identified as posing a potential impact (that is expected to be remedied through borehole sealing) on the site area.

Since extensive drilling and coring operations have been, and are continuing to be conducted at, and near, the controlled area, it is unclear whether the "potential impact on the site area" applies to the existing drillholes, the proposed drillholes, to the boreholes currently being drilled, or to all the drillholes. It is the staff's impression that the potential impact will apply to all completed boreholes. It is also assumed by the staff that the DOE remedy regarding the potential impact of all holes will be through sealing of all penetrations (boreholes, shafts and ramps).

**Recommendation:** Although DOE has indicated that drilling and coring operations "may have some potential impact on the site area" DOE also indicates that, because of sealing, no permanent adverse changes to the performance of the overall system are expected. Although the staff has no objection to this DOE position, borehole sealing will be addressed further in the detailed technical review of this study plan.

**Criterion 2** - Potential significant and irreversible/unmitigable effects on characterization that would physically preclude obtaining information necessary for licensing.

**Staff Review:** No effects of this type have been identified by the staff. However, DOE (see Objection Criterion 1, above) has indicated a potential impact on the site resulting from drilling and coring operations. This matter is addressed separately under the auspices of Objection Criterion 1. As in our assessment of Objection Criterion 1 we find no objection relative to this matter.

No interference is expected between the tests (other than drilling and coring, as identified by DOE) and other characterization activities, nor is it expected that these tests will affect other activities. DOE does indicate (section 2.4.4, p. 2-17) that, "with regard to possible interference with tests in other studies utilizing cores, the size of the samples required for petrophysical properties testing is small and should not pose problems as to the total volume of available core material unless the core recovery is very poor." The staff agrees with this assessment.

**Criterion 3** - Potential significant disruption to characterization schedules or sequencing of studies that would substantially reduce the ability of DOE to obtain information necessary for licensing.

**Staff Review:** The conduct of this study should have no impact on either characterization schedules or on the sequencing of studies. As a practical matter, however, the staff makes the following observation from a generic standpoint. According to DOE's program schedule as stated in the Fifth Progress Report on Site Characterization (p. 1-2), all site characterization activities are to be completed by the end of the year 2001. Based upon the following discussion it appears unlikely that this date can be met. The schedule for this study (see Figure 5-1) indicates that the currently scheduled date for the study final report is eight years (say mid-2000). This is assumed by the staff to indicate that all the study activities (there are five) have, or are about to be, commenced. The study gives no indication of the relative status of any of these

activities. The study, other than by occasional reference, gives no indication of the status of activities upon which it is dependent. Critical activities, upon which this study is dependent, such as 8.3.1.4.1.1 (Development of an integrated drilling program) have yet to be submitted to the NRC for review consideration. In summary, DOE has not presented sufficient information to the staff that would demonstrate that the integration of study plans has been conducted in a manner that would permit the proper sequencing of studies.

Criterion 4 - Inadequacies in the QA program which must be resolved before work begins.

Staff Review: There are no inadequacies in the QA program which must be resolved before the work begins.

CLOSURE OF NRC OPEN ITEMS (OBJECTIVES 8 AND 11)

Staff Review: Not applicable since the DOE, in its study plan transmittal letter to the NRC, did not propose to close any open items.

NEED FOR DETAILED TECHNICAL REVIEW

A study plan is a candidate for detailed technical review if it meets any of the following criteria from step 6 of part 4.2 of the Review Plan. In summary, this plan is a candidate for detailed technical review based on evaluation against criteria 1, 2 and 5.

Criterion 1 - The study plan may be related to one or more key site-related issues.

Staff Review: The purpose of this study is to acquire a very clear understanding of the vertical and lateral distribution of stratigraphic units essential for the development of a three-dimensional geologic model which will supply the framework for most other site characterization and performance assessment studies, as well as design criteria for the engineered barriers.

Specifically, the information collected under this study plan will provide key information for the following:

Performance Issues

- Issue 1.1 (total system performance)
- Issue 1.4 (post closure waste package containment)
- Issue 1.5 (engineered barrier system)
- Issue 1.6 (ground water travel time)

Design Issues

- Issue 1.10 (waste package characteristics)
- Issue 1.11 (configuration of the underground facility)
- Issue 1.12 (shaft and borehole seal characteristics)
- Issue 2.7 (repository design criteria)
- Issue 4.4 (preclosure design - technical feasibility)

Characterization Programs

- Geohydrology, geochemistry, thermal-mechanical, tectonics, human interference, repository, seals, waste package, performance assessment

Criterion 2 - The study plan pertains to some NRC open items.

Staff Review: To determine if the study plan pertains to some NRC open items, a search was conducted of the NRC (July 31, 1991) review of DOE Responses to NRC Point Papers On Site Characterization Plan/Consultation Draft, December, 1988. This search was intended to identify those open items which specifically referenced this study plan or one of its testing activities by name. The search identified a number of open items (comments) referencing either the study directly or in an indirect manner through reference to the program (8.3.1.4 - Overview of the rock characteristics program) under which the study is conducted.

We consider the above open items sufficiently related to the study plan to meet the intent of criterion 2.

Criterion 3 - The study plan describes unique, state-of-the-art tests or analysis methods that, up to this date, have not had a supportive scientific history of providing data usable in licensing.

Staff Review: From the geochemical and geophysical perspectives the study plan describes only standard tests and analysis methods having a supportive scientific history of providing data usable in licensing.

Criterion 4 - The study plan describes a study critical to the evaluation of site performance that cannot be repeated for a number of years due to its disturbance of the natural baseline.

**Staff Review:** The data acquired through this study is both from the surface and the subsurface. The geophysical data - acquired from the surface as well as the subsurface - should not disturb the natural baseline of the repository. Likewise, the testing of samples (core and cuttings) acquired from the subsurface through drilling operations would not disturb the natural baseline.

**Criterion 5** - The staff has some other critical relationship to potential licensing concerns.

**Staff Review:** A potential licensing concern (not an objection) has been identified as a direct result of the review of this study plan. The concern centers on the DOE statement that an activity (drilling and coring) being conducted under another study has the potential for impacting the site. This concern, which was identified under Identification of Objections, Criterion 1 (Potential adverse effects on repository performance) is repeated below.

"DOE (study plan Section 2.4.4, Activity 8.3.1.4.2.1.4, Petrophysical properties testing, p. 2-17) indicates that drilling and coring operations, included as a test under another activity "may have some potential impact on the site area." The nature of the impact of the test potentially affecting the site has not been identified in the study plan. However, DOE, while discussing the drilling-related potential impacts in the SCP (pp. 8.4.3-38 through 8.4.3-43) indicates that no permanent adverse changes to the performance of the overall system are expected because the boreholes (both shallow and deep) will be sealed."

"Although DOE indicates on page 2-17 that these drilling and coring operations are being conducted independently of this study, it does not identify the independent activity. However, the staff assumes (based on statements included in study plan Section 2.1.1.2, Activity 8.3.1.4.2.1.1, Borehole drilling and coring, p. 2-3), that the borehole drilling and coring operations are to be conducted under Activity 8.3.1.4.1.1, Integrated drilling program (SCP, p. 8.3.1.4-24). This activity has not yet been submitted by DOE for staff review.

With the exception of the borehole sealing issue as described above, the staff has no additional newly-identified licensing concerns regarding this study plan.