

PHASE I REVIEW: ANALYSIS OF THE PALEOENVIRONMENTAL
HISTORY OF THE YUCCA MOUNTAIN REGION
(DOE STUDY PLAN B.3.1.5.1.4, 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 the DOE's "Study Plan for Analysis of the Paleoenvironmental History of the Yucca Mountain Region" is to provide information that will be used to establish a stratigraphic succession of surficial deposits that reflects the climatic conditions and surficial processes that were prevalent in the Yucca Mountain region throughout the Quaternary. Basic data on the distribution, thickness, physical and chemical properties, conditions of deposition, and ages of soils and surficial deposits will be obtained by detailed geologic mapping, stratigraphic and soil profile studies, systematic sampling programs, and a variety of physical, chemical, mineralogical, and isotopic analyses.

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 C is an itemized checklist of the study plan content versus the Agreement on

content resulting from the above level of detail meeting. The study plan consists of three activities to be conducted in the Yucca Mountain vicinity: (1) modeling of soil properties in the region, (2) mapping of surficial deposits in the area, and (3) determination of the eolian history of the region.

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 48 references, six of which are SCP references and 39 others appear to be available either as textbooks or as government reports. Three others could be difficult to obtain as they are documents not likely to be in a technical library readily accessible to the NRC. Attachment D is a copy of the list of references from the study plan with all references marked either SCP (referenced in the SCP), AA (assumed to be available), or NAA (not assumed to be available). DOE should provide copies of all references marked NAA to the NRC. If needed for future reviews or technical exchanges and if the NRC is unable to acquire a copy of the reference(s) through its own resources those references marked AA may be requested of the DOE.

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: Based on an October 15, 1991, conversation with K. Hooks (QA), there are currently 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: Adverse effects are not expected. The activities described in this study are limited to on and off-site shallow, surface-based field activities such as trenching, acquisition of dust, soil and other materials and off-site activities such as laboratory testing, and computer modeling.

Lithologic information acquired through previously-drilled shallow boreholes (about 15-30 meters deep) will be used to supplement the data acquired under 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. No interference is expected between these tests and other characterization activities, nor is it expected that these tests will affect any other activities.

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: Disruption of the schedules is not expected. The schedule for this study (see Figure 5-1) indicates that the study, with the exception of Activity 3, is independent of other studies and can therefore proceed as indicated. In the single indicated case (Activity 3) where there is dependence upon other studies, the schedule for the final activity report permits a slip of up to one year in order to "feed" the Quaternary Climate study. This indicates some welcome flexibility in the overall schedule.

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

Staff Review: Based on an October 15, 1991, conversation with K. Hooks (QA), 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 3.

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

Staff Review: This study will examine surficial deposits to determine climatic conditions and surficial processes throughout the Quaternary. The record of the past climatic changes provides input for predicting the possible range of future climate conditions in the Yucca Mountain region. The data will assist in evaluating the effects of future climates on surface water, unsaturated zone, and saturated zone hydrology, which is essential to address the objective of limiting radionuclide releases to the accessible environment. Dating surficial deposits will assist in constraining the ages and recurrence intervals of Quaternary fault movements.

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

Performance Issues

- Issue 1.1 (total system performance)
- Issue 1.8 (NRC siting criteria [includes four potentially adverse conditions and two favorable conditions])
- Issue 1.9 (higher level postclosure findings [qualifying conditions for climate and geohydrology])

Design Issues

- Issue 1.11 (configuration of the underground facility)

Characterization Programs

- Geohydrology, geochemistry, erosion and preclosure hydrology

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

Staff Review: Based upon the program interrelationships presented in the study plan (see Figures 1-2 and 1-3) fifteen of NRC's open items* are included within subject matter to be addressed in this study plan. A breakdown of the open items by topic include: geohydrology (10), geochemistry (3) and erosion (2). The resolution of many other open items (including those comments dealing with age-dating of faults) will also be influenced heavily by data obtained under the auspices of this study plan.

* As reflected in the NRC's July 31, 1991, letter to the DOE, wherein the Commission forwarded its evaluation of the DOE's December 14, 1990 responses to NRC's SCA.

In addition, this study will be using some of the same dating techniques that are to be used in the study on Quaternary Regional Hydrology of the Yucca Mountain Region (8.3.1.5.2.1). These dating techniques were the subject of Comment 3 which was generated in the detailed technical review of that study plan.

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

Staff Review: This study will use state-of-the-art tests that do not have a supportive scientific history of providing data usable in licensing. In fact, some of the dating techniques proposed for use in this study have not been included in other study plans because of the uncertainties associated with those techniques.

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: Since the study relies upon data acquired from the surface and near-surface (a few meters in depth), this study should not disturb the natural baseline of the repository. In addition, because the study is surficial in nature, the locations of tests could be adjusted (if considered necessary to do so) such that no interference between tests is encountered.

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

Staff Review: The staff has no licensing concerns regarding this study plan other than those listed above.

ENCLOSURE C

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I. PURPOSE AND OBJECTIVE

Is the information to be obtained in the study described?

Yes__X__ No_____ N/A_____

Is the rationale for information to be obtained provided?

Yes__X__ No_____ N/A_____

II. RATIONALE FOR STUDY/INVESTIGATION

Does the study plan provide the rationale for tests and analysis, indicating alternatives considered and options, advantages, and limitations?

Yes__X__ No_____ N/A_____

Does the study plan provide the rationale for the number, location, duration and timing of tests, considering uncertainty, and identify obvious alternatives?

Yes__X__ No_____ N/A_____

Does the study plan describe the constraints for the study?

Yes__X__ No_____ N/A_____

In describing the constraints for the study, does the study plan consider potential site impacts?

Yes__X__ No_____ N/A_____

In describing the constraints for the study, does the study plan consider the need to simulate repository conditions?

Yes_____ No__X__ N/A_____

Staff Comment: Although the study plan is silent on this matter, the staff reviewer assumes that because only shallow (several tens of meters in depth at most) field testing will be conducted that has no effect on the repository itself that no simulation of repository conditions is required.

In describing the constraints for the study, does the study plan consider the required accuracy and precision?

Yes__X__ No_____ N/A_____

Staff comments on the remaining Study/Investigation

Rationale topics: Although the response to the following topics is in the affirmative there is nothing of substance for the staff to review were this study plan to be considered as a candidate for a detailed review. As far as the reviewer can determine, positive, acceptable words and phrases were inserted in the study plan, with no basis for such statements given in the plan itself.

In describing the constraints for the study, does the study plan consider the limits of analytical methods?

Yes__X__ No_____ N/A_____

In describing the constraints for the study, does the study plan consider the capability of analytical methods?

Yes__X__ No_____ N/A_____

In describing the constraints for the study, does the study plan consider time required vs. time available?

Yes__X__ No_____ N/A_____

Staff Note: The above affirmative is to be caveated in that "timing" is mentioned in the study plan, but no details underlying the basis for such a statement have been provided.

In describing the constraints for the study, does the study plan consider the scale of phenomena and parameters?

Yes__X__ No_____ N/A_____

In describing the constraints for the study, does the study plan consider interference among tests

Yes__X__ No_____ N/A_____

In describing the constraints for the study, does the study plan consider interference between tests and exploratory shaft

Yes__X__ No_____ N/A_____

III. DESCRIPTION OF TESTS AND ANALYSIS

For each type of test does the study plan describe the general approach that will be used?

Yes__X__ No_____ N/A_____

For each type of test does the study plan describe the key parameters that will be measured in the test and experimental conditions under which the test will be conducted?

Yes__X__ No_____ N/A_____

For each type of test does the study plan indicate the number of tests and locations?

Yes__X__ No_____ N/A_____

Staff Comment: In the case of some tests, the number of specific locations for the particular test type is given but the number of samples for testing can not be stated definitively. This is dependent upon the presence (or absence) of appropriate samples at that particular location.

For each type of test does the study plan summarize the test methods if non-standard procedure, summarize steps of the test, how it will be modified, and reference technical procedure?

Yes__X__ No_____ N/A_____

Staff Comment: This study will use state-of-the-art tests that do not have a supportive scientific history of providing data usable in licensing. In fact, some of the dating techniques proposed for use in this study have to been included in other study plans because of the uncertainties associated with those techniques.

For each type of test does the study plan indicate the level of QA and provide the rationale for any tests not QA level?

Yes__X__ No_____ N/A_____

For each type of test does the study plan reference the applicable specific QA requirements applied to test?

Yes__X__ No_____ N/A_____

For each type of test does the study plan specify the tolerance, accuracy, and precision required in the test?

Yes__X__ No__X__ N/A_____

Staff Comment: In some cases (see Section 3.1.3.4, p. 3-5) these parameters have been specified. In other cases (see Section 3.1.1.4, p. 3-2) the statement "no explicit requirements for tolerance, accuracy, or precision have been specified for this test" is made.

Specific Comment: Since no explanation is given, the meaning of the statement is not obvious to the reviewer. It is unclear whether (1) no requirements are necessary or (2) requirements are necessary but have yet to be determined. The intent of the statement is to be clarified by the DOE since it appears many times in this study plan.

For each type of test does the study plan indicate the range of expected results and the basis for those results?

Yes__X__ No__X__ N/A_____

Staff Comment: In the case of standard tests (of which there are many indicated in this study Plan), both the range and the bases for the expected results have been stated. On the other hand, because of the absence of testing experience on other matters, statements regarding the range of expected results cannot be made (see Section 3.1.6.5, p. 3-9).

For each type of test does the study plan list the equipment requirements, briefly describing special equipment?

Yes__X__ No_____ N/A_____

For each type of test does the study plan describe the techniques to be used for data reduction and analysis?

Yes__X__ No_____ N/A_____

For each type of test does the study plan describe the representativeness of the test, indicating limitations and uncertainties that apply to use of results?

Yes__X__ No_____ N/A_____

For each type of test does the study plan provide illustrations of test locations?

Yes__X__ No__X__ N/A_____

Staff Comment: In the case of field tests this is done (see Figures 2-1, 3-1 and 3-2. In other cases, (e.g., where laboratory tests are conducted) no physical diagram of the laboratory facility is shown (or appropriate).

For each type of test does the study plan discuss the relationship of the test to set performance goals and confidence levels?

Yes__X__ No_____ N/A_____

For each type of analysis does the study plan state the purpose of analysis, indicate conditions to be evaluated and describe any uncertainty analysis?

Yes_____ No__X*_ N/A_____

For each type of analysis does the study plan describe the methods of analysis, including analytical expressions and numerical models to be used?

Yes_____ No__X*_ N/A_____

For each type of analysis does the study plan reference the technical procedures document that will be followed during analysis?

Yes_____ No__X*_ N/A_____

For each type of analysis does the study plan indicate the levels of QA applied?

Yes_____ No__X*_ N/A_____

For each type of analysis does the study plan identify data input requirements?

Yes_____ No__X*_ N/A_____

For each type of analysis does the study plan describe the expected output and accuracy?

Yes_____ No__X*_ N/A_____

For each type of analysis does the study plan describe the representativeness of the analytical approach, indicating limitations and uncertainties that apply to results?

Yes_____ No__X*_ N/A_____

- * The above seven topics deal with analyses. Since the study plan does not address this matter, the staff has indicated that the study plan does not comply with the conditions of the Agreement. However, considering the nature of the tests (both standard and those unproven at the Yucca Mountain Site) and the fact that it is assumed that the analyses will be described within the referenced procedures the staff's evaluation of the

analyses can be appropriately deferred and can be considered along with other matters contained within the procedures.

IV. APPLICATION OF RESULTS

Does the study plan briefly discuss where results from the study will be used for support of other studies?

Yes__X__ No_____ N/A_____

Does the study plan refer to specific performance assessment analyses?

Yes__X__ No_____ N/A_____

Does the study plan describe where information from the study will be used in construction equipment and engineering system design and development?

Yes__X__ No_____ N/A_____

Staff Comment: The description within the study plan is an implied one in that Figure 1-3 (Logic Diagram Showing relation of Paleoclimate-Paleohydrology Synthesis Study to Performance and Design Issues and Other Characterization Programs) indicates a linkage between the study and DOE Design Issue 1.11 (Configuration of the Underground Facility). Using this assumption the staff has concluded that the response to the above query is affirmative.

Does the study plan describe where information from the study will be used in planning other characterization activities?

Yes__X__ No_____ N/A_____

V. SCHEDULES AND MILESTONES

Does the study plan provide durations of and interrelationships among principal activities associated with this study?

Yes__X__ No_____ N/A_____

Does the study plan list key milestones including decision points associated with study activities?

Yes__X__ No_____ N/A_____

Does the study plan describe the timing of the study relative to other studies and other program activities?

Yes__X__ No_____ N/A_____

Does the study plan provide dates for activities for the study plans.

Yes No N/A

Staff Comment: Although the study plan suggests no actual dates, the timing and interrelationships of events (studies, activities and investigations) are expressed (see Figure 5-1) in terms relative to resumption of (site characterization) work. This approach is acceptable to the staff.

Does the study plan reference section 8.5 in the SCP?

Yes No N/A

Staff Comment: Although there is no reference to Section 8.5 of the SCP, there is a note (see Figure 5-1) indicating that milestone levels have been determined according to an administrative procedure. The staff assumes that the above administrative procedure supercedes the referenced SCP section.

AA = ASSUMED AVAILABLE

/AA = ASSUMED TO BE NOT AVAILABLE

SCP = REFERENCED IN THE SCP

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