PHASE I REVIEW: DOE STUDY PLAN FOR CLIMATIC INTERPRETATIONS OF TERRESTRIAL PALEOECOLOGY (STUDY PLAN 8.3.1.5.1.3, Revision 0)

by

Donald L. Chery, Jr.

Hydrologic Transport Section
Hydrology & Systems Performance Branch
Division of High-Level Waste Management, NMSS
U.S. Nuclear Regulatory Commission

April 27, 1992

Introduction

This DOE study plan summarizes and extends the discussion of SCP Study 8.3.1.5.1.3, "Climatic implications of terrestrial paleoecology." This study has three activities: (1) Analysis of pack rat middens; (2) Analysis of pollen samples; and (3) Determination of vegetation-climate relationships.

The results of this study and other studies under Investigation 8.3.1.5.1 ("Studies to provide the information required on nature and rates of change in climate conditions to predict future climates") will be used to relate past regional climatic changes with global climate variations, to validate numerical models of climate, to establish the relationships between past climatic changes and hydrologic responses, and to predict future climatic fluctuations. Results will be used to derive a model of climatic change to predict changes in the hydrologic regime which could alter the long-term waste isolation capability of the Yucca Mountain site. The three activities of this study were outlined in the DOE (1988) Site Characterization Plan (pages 8.3.1.5-54 to -59).

This NRC Phase I review of the DOE study plan was done with respect to (A) DOE/NRC agreement 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 I, 12/6/90).

Evaluation of Study Plans Relative to the Agreement and to the Responsible DOE Contractors QA Program (Study Plan Review Plan 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 on the level of detail for site characterization plans (SCP) and study plans, May 7-8, 1986).

Staff Review: This study has two field study and data collection activities; the analysis of pack rat middens and the analysis of pollen samples. The third activity is data intrepretation and synthesis activity called "determination of vegetation-climate relationships." The study plan is clearly and dirctly written with appropriately developed sections on the overall purpose and objectives, specific rationale for the planned activities, description of tests and analysis, application of results, and schedules. Attachment A is an itemized checklist of the study plan content as compared to the agreement on content resulting from the NRC/DOE level of detail meeting. "Yes" or "not applicable" responses were the case for all items of the checklist except for the QA questions. The QA issues are being covered by a QA grading package being prepared separately from the study plans, as explained by notes in the check list.

There are a couple of editorial items. Page iii, item 2.2 of the table of contents the last word before the page number should be "tests." Page 1-3, the 5th bullet from the top at the end of the paragraph it should be 10CFR60.122(b)(7)(v). The corrections are highlighted.

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

Staff Review: Of the 14 cited references, five are available in the DHLWM SCP reference file, seven are in referenced journals or publications that can be obtained through the NRC library services, and two are reports "in preparation or in press." The two "in press" reports can be supplied by DOE or should be available through the library services once they are published.

The two publications are:

Colman, S. M., and Pierce, K. L., in press, Summary of Quaternary dating methods, in Morrison, R. B., Quaternary nonglacial geology of the conterminous United States: Geological Society of America, Decade North

American Geology, V. K-2.

Edwards, T. W. D., and Fritz, P., in preparation, Stable isotope paleoclimate records for southern Ontario: results from marl and wood.

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 a discussion with William Belke, Quality Assurance Section, there are currently no open quality assurance items that affect the quality of the study plan.

There are no open items in the U.S. Geological Survey quality assurance program plan for Nevada Waste Storage Investigations, NNWSI-USGS-QAPP-01, Rev 5 (1989).

For each analysis, the level of QA was not indicated, no rationales provided for analyses not classified as QA level one, and the applicable specific QA requirements or levels of QA which apply to the analyses were not referenced. However, a determination of the quality status for the activities of this study will be made separately, according to AP-6.17Q, "Determination of the Importance of Items and Activities", which implements NUREG-1318, "Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements". The results of that determination will be reported in the Q-List, Quality Activities List and Non-Selection Record, which will be controlled documents. Furthermore, QA grading packages for the activities of this study plan will be prepared separately, according to AP-5.28Q, "Quality Assurance Grading". The resultant Quality Assurance Grading Report will be issued as a controlled document.

Identification of Objections (Study Plan Review Plan Objectives 2 through 4 and 6)

Criterion 1 Potential adverse effects on repository performance:

Staff Review: No adverse effects of the field sampling is expected on repository performance. Collection of packrat middens and sediment deposit samples will have no conceivable effect on the overall system performance. Further, most if not nearly all of the sampling will be outside the 5-km controlled area.

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

Staff Review: None. Collection of packrat middens and sediment deposit samples will have no conceivable effect on other site characterization activities. Further, most if not nearly all of the sampling will be outside the 5-km controlled area and some distance from most of the site characterization 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: None anticipated. Collection of packrat middens and sediment deposit samples should have no effect on the scheduling of other site characterization activities.

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

Staff Review: Based on a meeting with William Belke, Quality Assurance Section, there are currently no quality assurance inadequacies that have to be resolved before the work begins.

Closure of NRC Open Items (Study Plan Review Plan Objectives 8 and 11)

Staff Review: Not applicable - in its transmittal letter DOE did not propose to close any open items with this study.

Need for Detailed Technical Review

A DOE study plan is a candidate for a NRC detailed technical review if it meets any of the 5 criteria (described below) from step 6 of part 4.2 of the Review Plan. Each criterion is discussed below:

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

Staff Review: Studies and analyses performed under this study plan will apply to a number of key site-related issues. Relationships to the issues are briefly summarized below:

Performance Issue 1.1 (total system performance) relates to calculating the complementary cumulative distribution function (CCDF) for estimating post-closure radionuclide releases for a 10,000-year period. For this period, DOE also asserts that the information needed to satisfy Issue 1.1 will be sufficient to address Issues 1.8, 1.9a, 1.10, 1.11, and 1.12. These additional issues are:

> Issue 1.8, the potentially adverse condition - "potential for changes in hydrologic conditions resulting from reasonably foreseeable climatic changes" [10CFR 60.122(c)(6)], and the favorable condition for climate - "a climatic regime in which the average annual historic precipitation is a small percentage of the annual potential evapotranspiration" [10CFR 60.122(b)(7)(v)].
>
> Issue 1.9, DOE's postclosure guidelines (qualifying and disqualifying conditions) and with two performance evaluations that are required to predict radionuclide releases 100,000 years after repository closure and in particular qualifying conditions for geohydrology and climate [10CFR 960.4-2-1] and [10CFR 960.4-2-4].
>
> Issue 1.10, information on post emplacement near-field waste package environment.
>
> Issue 1.11, characterization and configuration of the repository engineered barriers.
>
> Issue 1.12, seal characterization.

Issue 1.8 relates to favorable and potentially adverse conditions (siting criteria under 10 CFR 60.122) that are associated with climatology. These include favorable conditions 7 (groundwater travel time substantially exceeds 1000 yr.) and 8(v) (A climatic regime in which the average annual historic precipitation is a small percentage of the average annual potential evapotranspiration) and the following potentially adverse conditions (PAC):

PAC 1: Potential for flooding of the underground facility,....

PAC 2: Potential for human activity to adversely affect the groundwater flow system,....

PAC 5: Potential for changes in hydrologic conditions that would affect the migration of radionuclides to the accessible environment,... (i. e., changes in hydraulic gradient, natural recharge, etc.).

PAC 6: Potential for changes in hydrologic conditions from reasonably foreseeable climatic changes.

PAC 16: Evidence of extreme erosion during the Quaternary Period.

PAC 20: Rock or groundwater conditions that would require complex engineering measures in the design and construction of the underground facility or in the sealing of boreholes and shafts.

PAC 22: potential for the water table to rise and saturate a repository located in the unsaturated zone

PAC 23: Potential for existing or future perched water bodies that may saturate portions of the underground facility or provide a faster flow path from an underground facility located in the unsaturated zone to the accessible environment.

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

Staff Review: Work under this study plan can be associated with SCA comments that address conceptual hydrogeologic models, scenario development, and aspects of groundwater travel time. These SCA comments are briefly described below:

SCA Comment 1 - This comment relates to the issue resolution strategy for Yucca Mt. It identified inconsistencies in scenario development and screening, and stated the need for a hypothesis testing table for total repository system performance.

SCA Comment 10- The technical basis for initial assessments of the significance of individual features, events and processes of the hydrogeologic system to performance measures or design and performance parameters is not discussed. ...

SCA Comment 94- Identification of all assumptions about features, events and processes related to the hydrologic system incorporated into the initial modeling strategy for the performance analysis of groundwater travel time is not complete. ...

SCA Comment 95- This comment recommended that DOE revise its approach to scenario analysis so that the approach will be both systematic and complete.

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

Staff Review: The climate information will be an important component in developing the input for the groundwater flow modeling of the Yucca Mountain site and the region encompassing the site. Although mathematical and numerical modeling have always played an important role in licensing, there are no previous examples where performance projections over thousands of years have had to be made as part of an NRC license application. These projections include long-range effects of climate change on aquifer resources and the groundwater flow systems.

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 disruption of the natural baseline.

Staff Review: The field work described in this study plan cannot conceivably disrupt the natural baseline.

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

Staff Review: The staff has not identified any other licensing concerns.

The study plan pertains to 3 of the 5 criteria, and thus by these criteria, the DOE study plan qualifies as a candidate for a NRC detailed technical review. However, the technical staff does not find a compelling need for such a review at this time.

REFERENCES

U. S. Dept. of Energy, 1988. Site Characterization Plan, Yucca Mountain Site, Nevada Research and Development Area, Nevada: DOE/RW-0199, Office of Civilian Radioactive Waste Management, December, 1988.

U. S. Nuclear Regulatory Commission, 1989. NRC Staff Site Characterization Analysis of the Department of Energy's Site Characterization Plan, Yucca Mountain Site, Nevada, August 1989.

ATTACHMENT A

ITEMIZED CHECKLIST OF STUDY PLAN CONTENT

for

PHASE I REVIEW: DOE STUDY PLAN FOR CLIMATIC INTERPRETATIONS OF TERRESTRIAL PALEOECOLOGY
(STUDY PLAN 8.3.1.5.1.3, Revision 0)

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_____ No_____ N/A__X__

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_____ N/A__X__

Simulation of repository conditions is not necessary to conduct the tests described in this study plan.

In describing the constraints for the study, does the study plan consider the required accuracy and precision?
Yes__X__ No_____ N/A_____

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_____

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_____ No_____ N/A__X__

Interference is not an issue with the activities of this study.

In describing the constraints for the study, does the study plan consider interference between tests and exploratory shaft
Yes_____ No_____ N/A__X__

Interference with the exploratory shaft is not an issue with the activities of this study.

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_____

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 procedures?

Yes_____ No__X__ N/A_____

Not all of the technical procedures have been developed, since it is proposed that some analyses may be made to "to elucidate certain paleoclimatic signals." It is not expected that this should be any issue, should the additional analyses be done.

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

Yes_____ No__X__ N/A_____

QA grading packages for the activities of this study plan will be prepared separately, according to AP-5.28Q, "Quality Assurance Grading". The resultant Quality Assurance Grading Report will be issued as a controlled document.

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

Yes_____ No__X_ N/A_____

Determination of the quality status for the activities of this study will be made separately, according to AP-6.17Q, "Determination of the Importance of Items and Activities", which implements NUREG-1318, "Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements". The results of that determination will be contained in the Q-List, Quality Activities List and non-Selection Record, which will be controlled documents.

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

Yes__X__ No_____ N/A_____

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

Yes__X___ No_____ N/A_____

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 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_____ No__X__ N/A_____

Not necessary for the type of planned field sampling.

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__X__ No_____ 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__X__ No_____ N/A_____

For each type of analysis does the study plan reference the technical procedures document that will be followed during analysis?
Yes__X__ No_____ N/A_____

For each type of analysis does the study plan indicate the levels of QA applied?
Yes_____ No__X___ N/A_____

QA grading packages for the activities of this study plan will be prepared separately, according to AP-5.28Q, "Quality Assurance Grading". The resultant Quality Assurance Grading Report will be issued as a controlled document.

For each type of analysis does the study plan identify data input requirements?
Yes__X__ No_____ N/A_____

For each type of analysis does the study plan describe the expected output and accuracy?
Yes__X__ No_____ 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__X__ No_____ N/A_____

IV. APPLICATION OF RESULTS

Does the study plan briefly discuss where results from 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_____

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: reference section 8.5 in SCP?
Yes__X__ No_____ N/A_____