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PHASE I REVIEW: DOE STUDY PLAN FOR CHARACTERIZATION OF THE SITE
SATURATED-ZONE GROUNDWATER FLOW SYSTEM
(STUDY PLAN 8.3.1.2.3.1, Revision 0)

by

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Introduction

The purpose of the "Study Plan for Characterization of the Site Saturated-Zone Groundwater Flow System" study is to obtain data to support models of saturated-zone groundwater flow. The hydrogeologic data include estimates of hydraulic gradients, boundary conditions imposed by structures, and bulk hydraulic properties. The data will be used in Study 8.3.1.2.3.3 (Saturated-zone hydrologic system synthesis and modeling) to describe flow paths, fluxes, velocities, and travel times within the saturated zone. This study focuses on studies within the site area, as compared to Study 8.3.1.2.1.3, which will characterize the regional groundwater flow system.

This study is designed to collect and evaluate the data needed to assess the performance of the Yucca Mt. Site with respect to federal regulations 10 CFR 60, 10 CFR 960, and 40 CFR 191. The study plan contains six activities: (1) Solitario Canyon fault study; (2) site potentiometric-level evaluation; (3) analysis of single- and multiple-well hydraulic stress tests; (4) multiple-well interference testing; (5) testing of C-well complex with conservative tracers; and (6) well testing with conservative tracers throughout the site.

Two additional activities are part of the saturated zone groundwater characterization. These are: (1) testing of the C-hole complex with reactive tracers; and (2) well testing with reactive tracers throughout the site. The first of these activities was documented in a separate study plan by Los Alamos National Laboratory that was previously submitted to and reviewed (Phase I) by NRC (Attachment D).

The following Phase I review of the study plan was done with respect to evaluating (A) DOE/NRC agreements on the content of study plans and DOE's QA program, (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 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 on the level of detail for site characterization plans (SCP) and study plans, May 7-8, 1986)

Staff Review: In general, the content of the study plan is reasonably consistent with the NRC/DOE agreements on the content of study plans. Attached (Attachment A) is an itemized checklist of the study plan content versus the agreement on content resulting from the level of detail meeting. However, many technical procedures remain to be developed. Seventeen technical procedures under this study plan are identified as either "IBD" (to be determined) or "Needed". Key work activities for which procedures are needed include drilling and coring of wells, equipment calibration, and methods for conducting cross-hole hydraulic tests, large-scale pumping tests, and tracer tests. Also, a number of procedures have both numbers and dates, but do not appear on the list of currently active procedures. The status of these procedures is unclear. Examples include USGS-HP-02 and USGS-HP-23.

It was noted that the connection between this study and synthesis and modeling activities (Study Plan 8.3.1.2.3.3) is described as an iterative process whereby modeling may lead to additional data collection and refinement of a conceptual model. Although the study plan describes general relationships between this and other studies, there is no explicit discussion of an overall program of iterative performance assessment, or discussion of the timing of this study relative to such a program. This kind of assessment is a systematic, iterative approach to identifying the information and analyses needed to support a license application. Such an approach was recommended in NRC's SCA Comment #1.

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 63 references in addition to the DOE Site Characterization Plan (SCP). Of these, only 7 were listed as references for Chapter 3, Hydrology, of the SCP. Of the remainder, most appear to be available as journal articles, government reports, textbooks, etc. However, some references, such as theses and copies of foreign conference proceedings, may be difficult to obtain. Attachment B 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. References marked AA may be requested later if needed for future reviews or technical exchanges.

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.

Staff Review: Based on a meeting with J. Conway (QA), there are currently no open QA items that would call into question the quality of the 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 plan will not alter the site in a way that could significantly affect repository performance. Field activities will be limited to data collection in boreholes and wells. This work includes drilling and coring of wells, borehole logging, hydrogeologic monitoring and pumping tests, tracer tests, and groundwater sampling. Disturbed areas of ground surface will be too small in areal extent to significantly change infiltration rates. Further, many of the field sites are located where they would not significantly affect the ground surface above the proposed repository. For example, the C-hole complex, proposed as a site of extensive testing, is about two km from the proposed repository block.

This study requires the use of boreholes that are deep enough to penetrate the water table (Figure 3.2-4 in Study Plan). These boreholes physically alter rock properties, and some of the existing water-table holes penetrate the proposed repository block. These include USW holes WT-2, G-4, and H-5. However, the NRC staff has assumed (for the purpose of this review) that proper sealing of boreholes will eventually be performed, consistent with 10 CFR 60.134, which states "Seals for shafts and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives..."

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

Staff Review: No irreversible interferences are expected between these and other characterization activities. However, if tests are not properly scheduled in sequence and time, there may be enough interference between tests that the quality of the data could be questioned. The potential for interference is high given the large number of tests planned for the C-hole site, involving investigators from both the USGS and LANL. Careful planning and coordination will be required. For example, transient effects caused by pumping during aquifer tests and during groundwater sampling will alter local groundwater levels. However, these levels can recover to ambient values given sufficient time. It

will be necessary to establish baseline groundwater levels prior to starting aquifer testing and sampling.

The introduction of suites of chemical tracers during conservative and reactive tracer testing will alter local hydrochemistry. Most of the conservative tracers will probably be recovered during the testing process, but a fraction of each tracer will be lost to the formation. Larger amounts of reactive tracers will be lost to the formation. Accordingly, the DOE will clearly need to establish background hydrochemistry prior to starting any tracer tests at a given test locale, and will also need to assess the affects of initial tracer tests on later ones.

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 schedules is possible, both within this study and within other investigations. However this would not have an irreparable adverse effect on the site characterization program (see Attachment C/Draft Comment). Many tests are planned at the C-hole site. Proper sequencing and timing are required to avoid significant interferences between tests. Testing schedules could be disrupted if tests become delayed due to equipment or personnel problems, or if unexpectedly long periods of time are needed for the aquifer to return to ambient conditions. Researchers from both the USGS and LANL will be working on the C-hole test program. Therefore, testing schedules will need to be carefully coordinated between these groups.

An approximate timeline is shown starting on page 5.1-2 of the study plan. The DOE plans to develop durations, and start and finish dates for the activities. The related LANL study plan on reactive tracer testing also contains a general timeline, and states that the start of LANL's field experiments depends on when the USGS conducts its hydraulic and conservative tracer tests. LANL predicts that its field experiments will take 12-20 weeks.

The schedule for this study is dependent on the drilling schedules for the water-table holes. It is not dependent on other investigations. However, at least seven major investigations directly depend on data from the site saturated zone study. The dependent investigations are listed below:

- 8.3.1.2.3 Description of the saturated-zone hydrologic system at the site
- 8.3.1.2.1 Studies to provide a description of the regional hydrologic system
- 8.3.1.3.1 Studies to provide the information on water chemistry within the potential emplacement horizon and along potential flow paths

- 8.3.1.3.7 Studies to provide the information required on radionuclide retardation by all processes along flow paths to the accessible environment
- 8.3.1.4.2 Geologic framework of the Yucca Mountain site
- 8.3.1.4.3 Development of three-dimensional models of rock characteristics at the repository site, and
- 8.3.1.8.3 Studies to provide information required on changes in unsaturated- and saturated-zone hydrology due to tectonic events

Thus, there appears to be potential for significant disruption to characterization schedules or sequencing of studies.

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

Staff Review: Based on a meeting with J. Conway (QA), there currently are no QA inadequacies that have to be resolved before the work begins.

Closure of NRC Open Items (Objectives 8 and 11)

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

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 study plan is a candidate for a detailed technical review based primarily on criteria 1, 2, and 4. A detailed technical review is recommended. Each criterion is discussed below:

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

Staff Review: The information collected under this study plan will provide key information for the performance determination of pre-emplacement, ground-water travel time (Issue 1.6) and the predictions of radionuclide releases to the accessible environment (Issue 1.1). Results of this study will also help resolve the issues concerned with limiting individual doses in the accessible environment, protection of special sources of groundwater (Issue 1.3), and design requirements for shaft, engineered barriers, and borehole seals (Issues 1.11, 1.12, and 4.4).

This study also provides input to NRC siting criteria (Issue 1.8) and higher level findings (Issue 1.9) through its contributions to Issues 1.1 and 1.6.

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

Staff Review: Work under this study plan is directly related to those SCA comments that address site saturated-zone testing and potentiometric-level evaluation. The related SCA comments are briefly described below:

SCA Comment 19 - This comment stated that planned saturated zone activities are not adequate to characterize hydrologic boundaries, flow directions and magnitudes, and flow paths. Additional activities were recommended, including the construction of additional multiple-well complexes. The NRC staff considers that planning should begin immediately by DOE to ensure that sufficient numbers of aquifer tests will be performed at appropriate scales to adequately support performance assessment calculations. This planning is important if DOE reasonably expects that a high level of confidence will be needed in the solute-transport characteristics of the saturated-zone barrier.

SCA Comment 20 - This comment stated that the potentiometric surface in the controlled area is not adequately defined by existing well locations, and will not be adequately defined by proposed additional well sites. Areas where additional wells and data were needed were identified. These include an area north of the perimeter drift where a large hydraulic gradient exists, and the area south of wells G-3 and WT-1. The DOE has agreed that additional drilling and testing are needed in the northern area to characterize the zone of large hydraulic gradient. However, for the southern area, the DOE has chosen to defer identifying additional activities until data needs are defined. The NRC staff still considers that additional wells should be constructed in the controlled area south of wells G-3 and WT-1 and east of WT-10 to adequately characterize the potentiometric surface in that area.

The above NRC comments remain "open" as technical issues, and progress towards closure may result from a detailed review of this study plan.

Finally, it should be noted that this study is indirectly related to SCA comments 1, 6, 9, and 95, each of which relates to scenario development and hypothesis testing. These SCA comments are briefly described below:

SCA Comment 1 - This comment concerns 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 Comments 6 and 9 - These comments address inconsistencies in the hypothesis testing tables in the SCP. These tables present alternative conceptual models related to the Yucca Mt. site.

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

It is not expected that work under this study will resolve these comments due to the indirect relationship of the study to the generalized comments.

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: The testing to be performed under this study does not generally consist of state-of-the-art methods. The procedures listed in the study plan are currently classified as "standard." However, the NRC staff recognizes that there may be a need for some types of prototype hydrologic tests, particularly in the areas of measuring small hydraulic gradients and in obtaining field estimates of effective porosity in fractured, saturated tuffs. The DOE intends to use the C-hole site as a location to evaluate different types of tests for use elsewhere at the site. Accordingly, the C-hole testing will assume a "prototype" role, even though the tests described in the USGS study plan are described as "standard" methods.

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 study involves withdrawal and injection tests and tracer tests. Therefore, while testing at other locations could be initiated, this work has the potential to locally disrupt baseline conditions of groundwater levels and hydrochemistry. In particular, large-scale multi-well pumping tests can potentially alter groundwater levels over large areas for many months. Given the large number of tests planned at multi-well sites like the C-hole cluster, it is essential that the DOE first obtain baseline information and then proceed with tests in a schedule that minimizes interferences between test methods. Potential interferences with other test locations also need to be considered. As soon as practicable, a timeline that shows all proposed work activities under the site saturated zone investigations should be submitted to the NRC. This timeline should include durations and start and finishing dates for all activities under this study plan along with those under the previously submitted LANL study plan for reactive tracer testing (8.3.1.2.3.1.7).

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

Staff Review: Although the study plan describes general relationships between this and other studies, there is no explicit discussion of an overall program of iterative performance assessment, or discussion of the timing of this study relative to such a program. This kind of assessment is a systematic, iterative approach to identifying the information and analyses needed to support a license application. Such an approach was recommended in NRC's SCA Comment #1.

ATTACHMENT A

Phase I Review of Study Plan 8.3.1.2.3.1.1-6
Characterization of the Site Saturated-Zone Ground-Water Flow System

Hydrologic Transport Section
June 1991

I. Purpose and Objective

Describe the information to be obtained in the study.

Yes No N/A

Provide the rationale for information to be obtained.

Yes No N/A

II. Rationale for Study/Investigation

Provide rationale for tests and analysis, indicating alternatives considered and options, advantages, and limitations

Yes No N/A

Provide the rationale for the number, location, duration and timing of tests, considering uncertainty, and identify obvious alternatives.

Yes No N/A

There are six activities included in this study. Rationales for the location and number of tests, and to some extent test duration, are provided separately for each activity. However, it is stated in Section 5.1 that "Specific durations, and start and finish dates for the activities are being developed as part of ongoing planning efforts" and that "the testing of the saturated zone flow-system as described in this study plan will be dependent on the drilling schedules of the water-table holes". Other than the dependency on the drilling schedules, the rationale for the timing of tests is not clear. For example, the potential for pressure interferences between concurrent pumping tests is not considered in the general discussion of test interference. Thus, it is not clear whether such potential interference is, or will be, considered during development of test timing.

Describe the constraints for the study, considering:
-Potential site impacts

Yes No N/A

-Need to simulate repository conditions

Yes No N/A

The study objectives relate to characterization of the site saturated zone primarily in the context of "baseline" water levels and other hydrologic parameters. Testing does not involve simulation of the post-waste-emplacement environment of a planned underground facility in the unsaturated zone. Thus, the reviewer considers this criterion not applicable.

-Required accuracy and precision

Yes_____ No_X_ N/A_____

It is stated on page 2.2-1 that "The accuracy and precision of the information required for performance assessment has not been specified. Consequently, the accuracy and precision required from the results of this study cannot be specified".

-Limits of analytical methods

Yes_X_ No_____ N/A_____

-Capability of analytical methods

Yes_X_ No_____ N/A_____

-Time required vs. time available

Yes_X_ No_____ N/A_____

-Scale of phenomena and parameters

Yes_X_ No_____ N/A_____

-Interference among tests

Yes_X_ No_____ N/A_____

There is only limited discussion of interference among tests in the study plan. Discussion is generally limited to control of water discharged to the land surface during pumping tests and control of tracer use to avoid contamination (p. 2.2-2).

It is stated in Section 5.1 (Schedules) that "the development of the schedule for the present study has taken into account how the study will be affected by contributions of data or interferences from other studies, and also how the present study will contribute to, or interfere with, other studies". With respect to tests to be done under this study plan, it is stated in Section 5.1 that "Specific durations, and start and finish dates for the activities are being developed as part of ongoing planning efforts" and that "the testing of the saturated zone flow-system as described in this study plan will be dependent on the drilling schedules of the water-table holes". Pumping tests are, by nature, interference tests because observed changes in pressure induced by pumping at various distance scales are the data sought by the test. Thus, given the planning uncertainties in the sequencing, duration and pumping rates of both single

and multiple well tests, activities that must be accomplished during active site water table monitoring, there is a potential for pressure interference between concurrent, intra-study activities that would have to be accounted for. Controlling the sequence and location of tests can minimize unwanted pressure interferences. The study plan does not discuss details of the potential for, or control of, this type of potential intra-study test interferences.

-Interference between tests and ES

Yes_____ No_X_ N/A_____

The potential for interference between tests and the ES is not explicitly discussed. However, it is clear from the discussion of potential impacts of activities on the site (p. 2.2-1) that it is very unlikely there will be any impacts from well construction or saturated zone pumping tests on the ES or unsaturated zone testing in the ES.

III. Description of Tests and Analyses

For Each Type of Test

-Describe general approach that will be used.

Yes_X_ No_____ N/A_____

-Describe key parameters that will be measured in test and experimental conditions under which the test will be conducted.

Yes_X_ No_____ N/A_____

-Indicate number of tests and locations.

Yes_X_ No_____ N/A_____

-Summarize test methods; if non-standard procedure, summarize steps of test, how it will be modified, and reference technical procedure.

Yes_X_ No_____ N/A_____

Numerous procedures are not identified with an effective date ("TBD"). The plan indicates that "Procedures that are not identified with an effective date will be completed and available 30 days (for standard procedures) or 60 days (for non-standard procedures) before associated testing is started" (p. 3.4-11).

-Indicate level of QA and provide rationale for any tests not QA level.

Yes_X_ No_____ N/A_____

-Reference the applicable specific QA requirements applied to test.

Yes No N/A

-Specify tolerance, accuracy, and precision required in test.

Yes No N/A

It is stated in the plan that "Methods were selected on a basis of their precision and accuracy, duration, and interference with other tests and analyses. The accuracy and precision of the saturated zone tests are difficult to quantify prior to implementation of the test method. However, when the results of tests or analyses are reported, the accuracy and/or precision of the results will be described. The degree of accuracy and/or precision of each method within activities is a qualitative, relative judgement based on current knowledge and familiarity with, and understanding of, the method as well as specific aspects of each individual test. The accuracy and precision of the information required for performance assessment has not been specified. Consequently, the accuracy and precision required from the results of this study cannot be specified" (p. 2.2-1).

-Indicate range of expected results and basis for those results.

Yes No N/A

-List equipment requirements, briefly describing special equipment.

Yes No N/A

Equipment requirements are not listed per se. Inferences as to some equipment requirements can be made from list of applicable technical procedures.

-Describe techniques to be used for data reduction and analysis.

Yes No N/A

-Describe representativeness of test, indicating limitations and uncertainties that apply to use of results.

Yes No N/A

-Provide illustrations of test locations.

Yes No N/A

-Discuss relationship of test to set performance goals and confidence levels.

Yes No N/A

For Each Type of Analysis

-State purpose of analysis, indicate conditions to be evaluated and describe any uncertainty analysis.

Yes No N/A

-Describe methods of analysis, including analytical expressions and numerical models to be used.

Yes No N/A

-Reference the technical procedures document that will be followed during analysis.

Yes No N/A

-Indicate levels of QA applied.

Yes No N/A

-Identify data input requirements.

Yes No N/A

-Describe expected output and accuracy.

Yes No N/A

While the expected output of the analyses is described, it is stated in the plan that "Methods were selected on a basis of their precision and accuracy, duration, and interference with other tests and analyses. The accuracy and precision of the saturated zone tests are difficult to quantify prior to implementation of the test method. However, when the results of tests or analyses are reported, the accuracy and/or precision of the results will be described. The degree of accuracy and/or precision of each method within activities is a qualitative, relative judgement based on current knowledge and familiarity with, and understanding of, the method as well as specific aspects of each individual test. The accuracy and precision of the information required for performance assessment has not been specified. Consequently, the accuracy and precision required from the results of this study cannot be specified" (p. 2.2-1).

-Describe representativeness of analytical approach, indicating limitations and uncertainties that apply to results.

Yes No N/A

IV. Application of Results

Briefly discuss where results from study will be used for support of other studies.

Yes No N/A

There is considerable discussion in Section 4.2. This discussion is primarily in the context of other field activities, hydrologic modeling and synthesis activities and, ultimately, performance analysis. While it is noted that "Within performance assessment, a decision will have to be

made as to whether the data and model are sufficient to adequately address performance assessment needs" and that "if performance assessment defines needs for additional data, then another phase of data collection may result", no explicit relationship to any ongoing, iterative performance assessment activities is mentioned.

Refer to specific performance assessment analyses.

Yes No N/A

There is considerable discussion in Section 1.3 (Regulatory rationale and justification) of how the results of this study will provide some hydrologic data needed for performance assessment calculations of ground-water travel time, predictions of radionuclide releases to the accessible environment and design analyses of the underground facility, repository seals, and waste packages. However, the discussion tends to focus on the performance assessment analyses as an end point in the licensing process rather than an ongoing, iterative program area.

Describe where information from study will be used in construction equipment and engineering system design and development.

Yes No N/A

Describe where information from study will be used in planning other characterization activities.

Yes No N/A

V. Schedules and Milestones

Provide durations of and interrelationships among principal activities associated with this study.

Yes No N/A

It is stated in Section 5.1 that "Specific durations, and start and finish dates for the activities are being developed as part of ongoing planning efforts". As for time interrelationships among principal activities associated with this study, it is also noted in Section 5.1 that "the testing of the saturated zone flow-system as described in this study plan will be dependent on the drilling schedules of the water-table holes". Relative time interrelationships are provided in Figures 5.1-1 and 5.1-2.

List key milestones including decision points associated with study activities.

Yes No N/A

Describe timing of study relative to other studies and other program activities.

Yes No N/A

It is stated in Section 5.1 (Schedules) that "the development of the schedule for the present study has taken into account how the study will be affected by contributions of data or interferences from other studies, and also how the present study will contribute to, or interfere with, other studies". However, there are no time relationships between this study and any other studies or activities described in the timeline or milestone charts. Further, there is no discussion of the relationship between any planned iterative performance assessment activities and the timing, milestones or schedules of this study.

Provide dates for activities for the study plans: reference section 8.5 in SCP.

Yes_____ No_X_ N/A_____

It is stated in Section 5.2 that "Specific dates for the milestones are not included in the tables, as project schedules have been revised from those originally stated in Section 8.5 of the SCP, and are subject to further change due to ongoing planning efforts".

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SCP 8.3.1.2.3	Investigation: Studies to provide a description of the saturated zone hydrologic system at the site
8.3.1.2.3.1.2	Activity: Site potentiometric-level evaluation
8.3.1.2.3.1.4	Activity: Multiple-well interference testing
8.3.1.2.3.1.5	Activity: Testing of the C-hole sites with conservative tracers
8.3.1.2.3.1.7	Activity: Testing of the C-hole sites with reactive tracers
Study Plan 8.3.1.2.3.1.1-6, Rev. 0	Characterization of the Site Saturated-Zone Groundwater Flow System (USGS)
Study Plan 8.3.1.2.3.1.7, Rev. 0	Testing of the C-Hole Sites with Reactive Tracers (LANL)

COMMENT

There is considerable potential for interferences among planned hydrologic tests at the C-hole site (UE-25c#1, #2, #3). If interferences should occur, the result could be significant disruption of characterization schedules.

BASIS

- ° Investigators from both the USGS and LANL will be performing a new program of hydrologic tests at this site. This work is documented in two separate study plans (DOE, 1989; DOE, 1990), even though all of the work falls under only one study as described in the SCP. Planned tests include cross-hole tests, a large-scale pumping test, and many types of tracer tests. In addition, it is possible that a fourth well may be added to the well cluster.

- The the C-hole site is to be used as a location to evaluate different types of tests for use elsewhere at the site. For example, methods for conservative and reactive tracer testing will be evaluated for use at wells throughout the site, and results of multiple-well tests will be compared to those of single-well tests. DOE will then decide whether single-well tests can be used elsewhere at the site to produce meaningful results. Accordingly, the C-hole testing will assume a "prototype" role, even though the tests described in the USGS study plan are described as "standard" methods. This "prototype" role elevates the importance of all activities at the C-hole site, and requires careful planning and coordination of the work. Given the fact that numerous investigators will be using the same site, the DOE needs to demonstrate that adequate planning and coordination is taking place between all investigators.
- The respective study plans generally discuss the need to avoid test interferences, but do not address how the work will be coordinated. The reactive tracer testing will be performed by LANL, while the hydrologic and conservative tracer testing will be done by the USGS. The USGS is also conducting the ongoing activity of measuring groundwater levels to obtain a potentiometric baseline for the Yucca Mt. site.
- The schedules for the USGS and LANL study plan work are attached. The USGS schedule shows that many tests are planned for the third and fourth fiscal years. These include cross-hole, pumping, drift-pumpback, and convergent tests. The LANL schedule suggests that the reactive tracer testing (and other LANL field tests) will begin when the USGS testing ends, toward the middle of the sixth fiscal year. Under the USGS schedule, the field testing at the C-hole site would end in the fifth fiscal year. Although the schedules show a planned separation in schedules between the USGS and LANL field tests, there is considerable need for mutual planning and coordination. For example, the USGS report on interpretation of multiple-well tracer tests at the C-hole site is scheduled for completion at the same time that the LANL field tests would begin. However, preliminary USGS interpretations will undoubtedly be needed earlier to finalize plans for the LANL work. Finally, given the general sequencing of studies, any delays in the USGS program will result in corresponding delays in the later LANL work.
- There is considerable potential for interferences if the work is not adequately timed and sequenced. For example, potentiometric baseline should be firmly established before hydraulic testing begins, particularly the large-scale hydraulic test. The proposed large-scale hydraulic test will, by its nature, induce groundwater drawdowns on a scale dependent on both test and aquifer conditions. The area influenced by the test may be quite large, and time will be needed to allow a return to quasi-baseline conditions. Tests run too soon after the large-scale test could be

adversely affected. It may be advantageous to run a large-scale test near the end of the initial hydraulic testing. Hydrochemical background needs to be established before tracer testing begins, and to assess how previous drilling at the site may have altered the groundwater chemistry. Potential effects of early tracer tests on later tracer tests should also be assessed. The tracer tests will also require interpreted results from the initial hydraulic testing to properly interpret their results. Planning should also include the installation of equipment needed to support the various types of tests.

- ° At least seven major investigations directly depend on data from the site saturated zone study. The dependent investigations are listed below:
 - 8.3.1.2.3 Description of the saturated-zone hydrologic system at the site.
 - 8.3.1.2.1 Studies to provide a description of the regional hydrologic system.
 - 8.3.1.3.1 Studies to provide the information on water chemistry within the potential emplacement horizon and along potential flow paths.
 - 8.3.1.3.7 Studies to provide the information required on radionuclide retardation by all processes along flow paths to the accessible environment.
 - 8.3.1.4.2 Geologic framework of the Yucca Mountain site.
 - 8.3.1.4.3 Development of three-dimensional models of rock characteristics at the repository site, and
 - 8.3.1.8.3 Studies to provide information required on changes in unsaturated- and saturated-zone hydrology due to tectonic events.

RECOMMENDATIONS

The DOE should prepare a timeline that shows all proposed work activities under the site saturated zone investigations and any other work planned in the vicinity of the C-hole site. This timeline should include durations and start and finishing dates for all activities. If it is not yet possible to include actual start dates, then a detailed timeline should be prepared that clearly shows the relative starting times and durations for all related tests, including the LANL program of testing.

Investigators from both the USGS and LANL should be involved throughout the hydraulic and tracer testing program at the C-hole site. Planning for the tracer tests will be strongly dependent on the results of hydraulic testing. The DOE/USGS/LANL will also need to assess the potential impacts of initial tracer tests on later tracer tests, given the multitude of tests planned at the C-hole site.

The DOE should submit relevant reports that show in detail how the USGS and LANL investigators are planning and coordinating their proposed studies at the C-hole site. This should include documents prepared by planning groups, including any memoranda of understanding that were produced, and a schedule of future meetings.

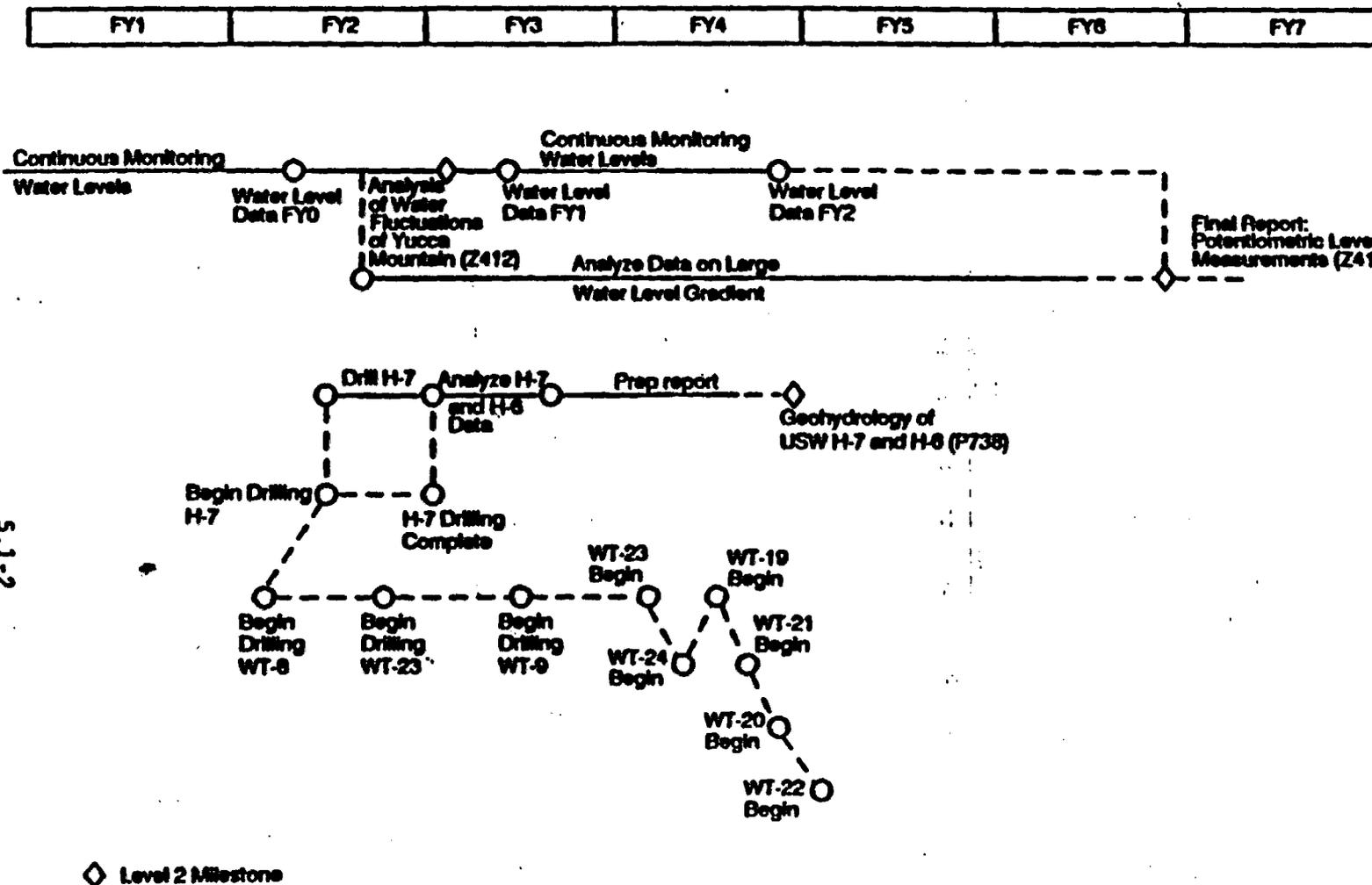
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S.1-2

MAY 18, 1990

Figure 5.1-1. Summary network for Solitario Canyon and potentiometric-level activities show drilling schedule.

FY1	FY2	FY3	FY4	FY5	FY6	FY7
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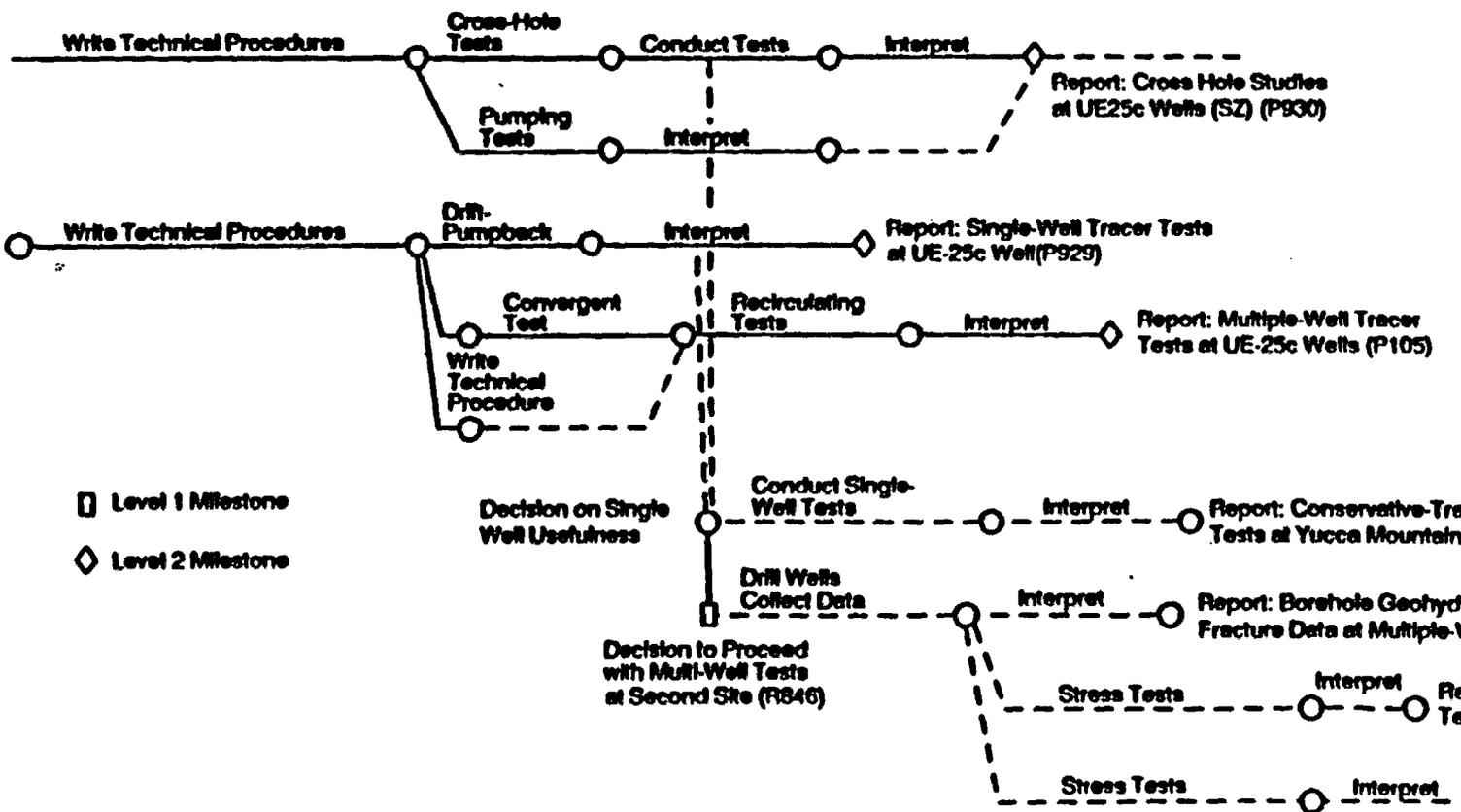
◇ Report: Barometric & Earth-Tide Analysis--UE25c-1,2,3 (T170)

—◇ Report: Analysis of Hydraulic Stress Tests at UE25c Wells (SZ) (P891)

—◇ Report: Analysis of Intraborehole-Flow Tests UE25c Wells (S347)

Fracture Analysis —◇ Report: Hydrogeology of UE-25c Wells (P828)

5.1-3



May 18, 1990

Figure 5.1-2. Summary network for hydraulic and conservative tracer tests.

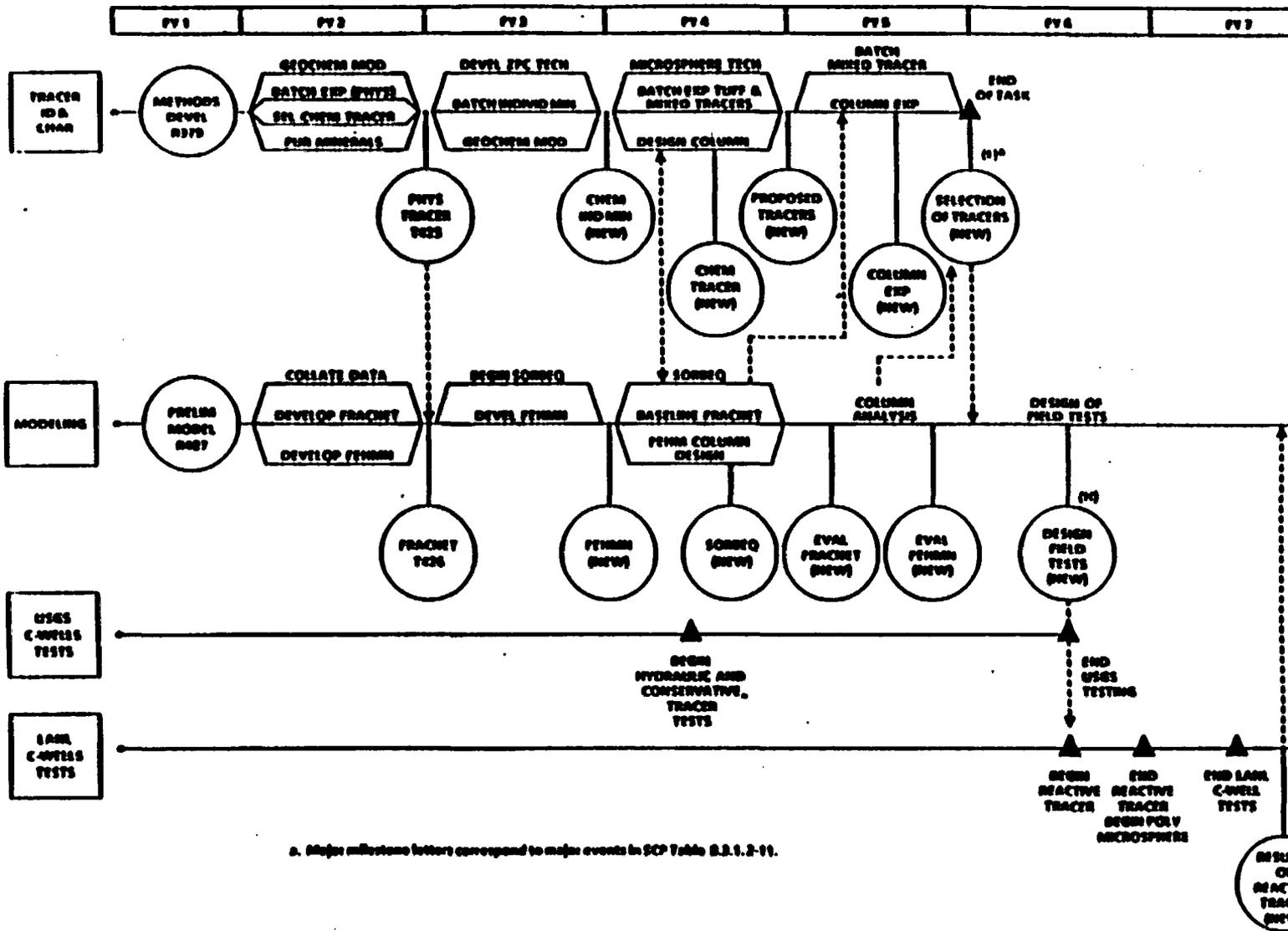


Figure 8. Schedule and Milestones for the Testing of the C-Hole Sites with Reactive Tracers Ac

Document Name:
91/08/05/NMC

Requestor's ID:
JENSEN

Author's Name:
Coleman

Document Comments:
Objection - C-hole test program

Document Name:
91/08/05/NMC

Requestor's ID:
ABRUSCAT

Author's Name:
Coleman

Document Comments:
Objection - C-hole test program

90/05/17/DUP

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MAY 22 1990

MEMORANDUM FOR: N. King Stablein, Senior Project Manager
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management

FROM: Neil Coleman, Hydrogeologist
Hydrologic Transport Section
Geosciences & Systems Performance Branch

SUBJECT: ACCEPTANCE AND START-WORK REVIEW OF STUDY PLAN FOR
CHARACTERIZATION OF THE SITE SATURATED-ZONE GROUNDWATER
FLOW SYSTEM (L64335 411432)

In response to your note dated May 8th, I have performed a Phase I review of the subject study plan, consisting of a combined acceptance and start-work review. Preliminary results of the review were presented in the Yucca Mt. team meeting on May 16th.

On first examining the study plan, I was concerned that activity-level work has been documented as a separate study plan. As shown in the SCP (8.3.1.2.3.1), the study to characterize the site saturated-zone groundwater system consists of eight activities (Attachment 1). Only one of these activities, reactive tracer testing at the C-hole sites (8.3.1.2.3.1.7), is included in the submitted study plan. Consequently, this review deals only with that one activity, which I shall refer to as activity 7. It is unclear why a separate study plan has been generated for activity level work. I suggest that the DOE merge this "study plan" with documentation for the other seven activities to produce an overall study plan for the site saturated-zone study.

Acceptance Review

I have completed this review and find the activity to be acceptable in terms of content and level of detail. A checklist that documents this review is attached (Attachment 2). I have also reviewed the list of 100 references and found 22 that may not be readily available to the NRC staff. These references should be requested from the DOE (Attachment 3).

Start-Work Review

I have completed this review and have several concerns. As described above, although the subject document is called a study plan, it contains only one of eight activities under the site saturated-zone study. There are three general "sub-activities" under the reactive tracer testing activity. These are: (1) tracer identification and characterization; (2) field experiments; and (3) modeling analyses. Detailed procedures for the field testing sub-activity do not yet exist. These will be adapted from the procedures to be written by the USGS for Activity 5 (conservative tracer testing at the C-hole sites). However,

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JY 17

I cannot recommend start-work approval for sub-activities that have no documented procedures.

Further, the work is closely related to two other activities, involving work in hydraulic testing and conservative tracer testing at the C-hole sites. Those activities are not yet available for review, and I cannot evaluate the potential for interference between related tests.

Based on this review, I recommend that the DOE be notified to start work on a limited number of the sub-activities described in activity 7. Specifically, start-work approval should be granted only for those sub-activities in this "study plan" that have written technical procedures. No start-work approval should be given for the sub-activities titled "Field Experiments" in activity 7 of the study plan.

The recommendation of a partial start-work should stipulate that the USGS and LANL closely coordinate their related activities in tracer and hydraulic testing. The NRC can monitor progress in that regard through technical interactions with the DOE. In particular, development of procedures for the tracer identification and characterization tasks for the reactive and conservative tracer studies should be closely coordinated.

Recommendations Regarding Detailed Review

I recommend that a limited start-work approval be granted and that a detailed review of the reactive tracer testing be performed. However, I suggest that a detailed review not be performed until plans for the other activities of this study are submitted. At a minimum, we would need documentation for the following activities: (1) multiple-well interference testing at the C-hole sites (8.3.1.2.3.1.4), and (2) C-hole conservative tracer testing (8.3.1.2.3.1.5). These activities are closely related to the reactive tracer testing. Concurrent detailed reviews are needed to properly evaluate potential interferences.

ORIGINAL SIGNED BY

Neil Coleman, Hydrogeologist
Hydrologic Transport Section
Geosciences and Systems Performance
Branch

Attachments: As Stated

Study 8.3.1.2.3.1

**"Characterization of the site saturated-zone
groundwater flow system"**

Activities:

- 1. Solitario Canyon fault study (boreholes
WT-8,9 and H-6,7)**
- 2. Site potentiometric level evaluation**
- 3. Analysis of single- and multiple-well
hydraulic stress tests**
- 4. Multiple-well interference testing at the
C-hole complex**
- 5. Testing at the C-hole sites with conservative
tracers**
- 6. Well testing with conservative tracers
throughout the site**
- ** 7. Testing at the C-hole sites with reactive
tracers**
- 8. Well testing with reactive tracers throughout
the site**

Acceptance Review of Content of Study Plan 8.3.1.2.3.1.7
Study Plan for Testing of the C-Hole Sites with Reactive Tracers

Neil M. Coleman, Hydrologic Transport Section
May, 1990

I. Purpose and Objective

- ° Describe the information to be obtained in the study.
Yes No N/A
- ° Provide the rationale for information to be obtained.
Yes No N/A

II. Rationale for Study/Investigation

- ° Provide rationale for tests and analyses, indicating alternatives considered and options, advantages, and limitations.
Yes No N/A
- ° Provide the rationale for the number, location, duration, and timing of tests, considering uncertainties, and identify obvious alternatives.
Yes No N/A

The start of the field testing described in this study plan is linked to the beginning of hydraulic testing at the C-hole sites. The hydraulic testing is considered an independent activity within the overall study.

Describe the constraints for the study, considering:

- ° Potential site impacts
Yes No N/A
- ° Need to simulate repository conditions
Yes No N/A
- ° Required accuracy and precision
Yes No N/A
- ° Limits of analytical methods
Yes No N/A

- Capability of analytical methods
Yes No N/A
- Time required vs. time available
Yes No N/A
- Scale of phenomena and parameters
Yes No N/A
- Interference among tests
Yes No N/A
- Interference between tests and ES
Yes No N/A

The C-holes are located more than 3 km downgradient from the proposed exploratory shaft (ES) location. No interference is expected between the C-hole testing and work at the ES.

III. Description of Tests and Analyses

For Each Type of Test

- Describe general approach that will be used.
Yes No N/A
- Describe key parameters that will be measured in test and experimental conditions under which test will be conducted.
Yes No N/A
- Indicate number of tests and locations.
Yes No N/A

The location of testing is given. Although the total number of tests is not provided, the various types of tests are described. Some tests may be repeated.

- Summarize test methods, if non-standard procedure, summarize steps of test, how it will be modified, and reference technical procedure.

Yes No N/A

Although not all tests are described, brief summaries are given for six of the non-standard tests. As stated on page 58 of the study plan, procedures have not been written for the field testing portion of this activity. Procedures will be adapted from those to be prepared by the USGS under the conservative tracer testing activity.

- Indicate level of QA and provide rationale for any tests not QA level.

Yes No N/A

- Reference the applicable specific QA requirements applied to test.

Yes No N/A

- Specify tolerance, accuracy, and precision required in test.

Yes No N/A

- Indicate range of expected results and basis for those results.

Yes No N/A

- List equipment requirements, briefly describing special equipment.

Yes No N/A

- Describe techniques to be used for data reduction and analysis.

Yes No N/A

- Discuss representativeness of test, indicating limitations and uncertainties that apply to use of results.

Yes No N/A

- Provide illustrations of test locations.

Yes No N/A

- Discuss relationship of test to set performance goals and confidence levels.

Yes No N/A

Resolution of performance issue 1.6 is discussed, but confidence levels are not.

For Each Type of Analysis

- State purpose of analysis, indicate conditions to be evaluated and describe any uncertainty analysis.

Yes No N/A

- Describe methods of analysis, including analytical expressions and numerical models to be used.

Yes No N/A

- Reference the technical procedures document that will be followed during analysis.

Yes No N/A

All of the detailed technical procedures listed in the study plan are nonstandard. Procedure numbers and dates are given for the tracer identification and characterization task. Proposed procedures for the field experiments task will be developed by the USGS under the conservative tracer testing activity. Procedures for this study will be adapted from those under the USGS activity.

- Indicate levels of QA applied.

Yes No N/A

- Identify data input requirements.

Yes No N/A

- Describe expected output and accuracy.

Yes No N/A

- Describe representativeness of analytical approach, indicating limitations and uncertainties that apply to results.

Yes No N/A

IV. Application of Results

- ° Briefly discuss where results from study will be used for support of other studies.

Yes No N/A

- ° Refer to specific performance assessment analyses.

Yes No N/A

- ° Describe where information from study will be used in construction equipment and engineering system design and development.

Yes No N/A

This activity is not directly relevant to engineering system design.

- ° Describe where information from study will be used in planning other characterization activities.

Yes No N/A

V. Schedule and Milestones

- ° Provide durations of and inter-relationships among principal activities associated with this study.

Yes No N/A

- ° List key milestones including decision points associated with study activities.

Yes No N/A

- ° Describe timing of study relative to other studies and other program activities.

Yes No N/A

- ° Provide dates for activities for the study plans; reference section 8.5 in SCP.

Yes No N/A

Dates for activities are not provided because the field testing portion of the reactive tracer testing will be concurrent with C-hole hydraulic testing. Specific dates for the hydraulic testing have not been established. Although SCP Section 8.5 was not referenced, Table 8.3.1.2-11 of the SCP (page 8.3.1.2-449) was referenced (Section 8.5 is a summary of the schedule information given in Section 8.3).

References to be provided by the DOE

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REVIEW PLAN FOR
NRC STAFF REVIEW OF DOE
STUDY PLANS
Revision 1

December 6, 1990

DIVISION OF HIGH-LEVEL WASTE MANAGEMENT
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

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1.0 INTRODUCTION

The Department of Energy (DOE) is responsible under the Nuclear Waste Policy Act of 1982 (NWPAA) for carrying out a comprehensive national program that has as its goal the eventual construction of geologic repositories for the permanent disposal of high-level nuclear waste. The program has advanced to the site characterization stage, during which DOE is to conduct activities intended to collect the information necessary to determine if the site is suitable and to support a license application for a geologic repository.

The DOE has developed a Site Characterization Plan (SCP) for the Yucca Mountain, Nevada proposed geological repository site which describes in broad detail how DOE intends to obtain the needed information. Programs, such as the geology program, and investigations, which consist of one study or a set of related studies, are presented in the SCP, in accord with agreements reached in the May 7-8, 1986 NRC-DOE Level of Detail for Site Characterization Plans and Study Plans Meeting (hereafter Level of Detail Meeting); however, the finer level of detail about DOE's plans, and in particular, how the investigations are to be carried out, is to be presented in study plans that are being issued subsequent to issuance of the SCP.

A study has specific objectives that, if achieved, contribute to meeting the broad objectives of the investigation with respect to obtaining an adequate understanding of the site. Studies are comprised of one or more activities, each of which is intended to provide certain data or knowledge necessary to satisfy the objectives of the study. Each activity is a combination of tests and analyses which deal with a single or several related objectives within a given area. A test consists of a combination of procedures (detailed stepwise processes specifying how a test will be conducted) that produces information about some parameter through one or more experiments. An analysis consists of an assessment of test results through calculations, modeling, or technical judgment. Details for studies, activities, tests, and analyses will be presented in the aforementioned study plans; individual test procedures will be identified in both the SCP and study plans.

During the Level of Detail Meeting, agreement (hereafter the Agreement) was reached and documented in the meeting summary (Enclosure 4, Attachment B to that summary) on the content of study plans. Appendix A to this Review Plan consists of a table comparing the level of detail required in study plans with that required in the SCP descriptions of investigations.

As indicated above, the study plans (in this review plan, the term study plan includes its supporting references and procedures) document how DOE plans to implement the site characterization program DOE has designed to resolve the issues related to regulatory requirements that DOE identified in the SCP. The NRC staff's independent evaluation of DOE's program to resolve these issues will give guidance to DOE that is intended to result in DOE submitting a

complete and high quality License Application. This in turn will help assure that the NRC staff will be able to make a decision regarding construction authorization within the three-year statutory licensing time period.

NRC concerns, i.e., objections, comments, or questions (as these terms are defined in Appendix B to this Review Plan) that the staff presents in its written review of any study plan or procedure will be entered in the Open Item Tracking System (OITS) that is being used to track the progress toward resolution of NRC open items. These include the objections, comments, and questions presented by the staff in the Site Characterization Analysis (SCA) of the SCP, as well as other NRC open items from NRC-DOE interactions and NRC reviews of DOE documents. The new open items identified during the review of a given study plan have the same significance and are to be tracked just as the SCA open items and other NRC open items. Furthermore, the staff review of a particular study plan may result in closure of some SCA or other NRC open items if DOE has proposed certain items be closed based upon the material in the study plan.

This Review Plan for NRC Staff Review of DOE Study Plans provides guidance for the NRC staff designed to assure the quality and consistency of reviews of any study plan submitted by DOE and thereby fulfills the internal quality assurance function for review of major DOE HLW documents mandated in the Division of High-Level Waste Management Internal Quality Assurance (IQA) Plan. This plan also serves as documentation for later reference during the licensing process of the way in which the NRC staff reviewed study plans.

This review plan replaces the Draft Review Plan for NRC Staff Review of DOE Study Plans and Procedures issued in December 1987. Numerous significant changes have been incorporated into the new review plan. The most significant change involves streamlining of the review process in two respects. Whereas the 1987 review plan contained a three-phase review process (Acceptance Review; Start-Work Review; Detailed Technical Review) of study plans, the new review plan contains a two-phase review process (Phase I Review; Detailed Technical Review), wherein the Phase I Review represents a combination and modification of elements of the original Acceptance and Start-Work Reviews. In addition, whereas the 1987 review plan delineated a separate Procedure Review, the new review plan has absorbed the review of procedures into the Detailed Technical Review.

Concomitant with the streamlining of the review process, the format of the review plan has been simplified. The Review Guides which appeared in the old review plan have been eliminated in favor of an approach that more directly conveys the substance of the reviews.

Other important changes reflected in the new study plan include an increased emphasis during the reviews on evaluation of the study plans for potential progress toward resolution of SCA or other NRC open items. Also, the IQA

responsibilities of NRC staff and management involved in the reviews have been more clearly defined. In addition, a section has been added to the review plan to cover staff interactions with the Advisory Committee on Nuclear Waste (ACNW) regarding staff reviews of study plans.

2.0 PURPOSE, OBJECTIVES, AND SCOPE

2.1 Purpose

The general purpose of the NRC review of the study plans is to continue the NRC staff's efforts since passage of the NWPA toward early identification and resolution of potential licensing issues during the pre-licensing part of DOE's HLW program. During these reviews, the NRC staff intends to identify any significant concerns with DOE's plans to gather the information that DOE indicated in the SCP is needed to resolve licensing issues or to gain an adequate understanding of the site.

2.2. Objectives

To accomplish the purpose of the NRC staff review of the study plans, the following specific objectives must be achieved:

1. Determine whether the content of the study plan is substantively consistent, as appropriate for the activities, tests, and analyses described, with the Agreement.
2. Evaluate whether the objectives of the study plan are consistent with those proposed in the investigation plan presented in the SCP and whether the objectives of the study plan are technically defensible in the context of the overall site characterization program.
3. Assess whether the activities, tests, and analyses presented in the study plan could have significant unmitigable adverse effects on the waste isolation capabilities of the site.
4. Evaluate, to the extent possible based upon the SCP and available study plans, whether the activities, tests, and analyses presented in the study plan could significantly interfere with or be interfered with by other site characterization testing and/or construction of the exploratory shaft facility (ESF) such that the ability to obtain information needed for licensing is precluded.
5. Determine whether the study plan was developed under an acceptable QA program and whether it references a QA program that is in place and accepted by NRC to provide assurance that the activities, tests, and analyses comprising the study plan can produce data of demonstrably high quality usable for licensing.

6. Evaluate whether the proposed use (if any) of radioactive materials in testing is necessary to obtain the information that the study is designed to obtain.
7. For any study plan selected for detailed technical review (see sections 3.0 and 4.2 for selection criteria), evaluate the extent to which the activities, tests, and analyses presented in the study plan will enable DOE to obtain the information for licensing that the study is designed to obtain and that it should obtain.
8. If DOE has proposed that one or more NRC open items be closed on the basis of the material in the study plan, determine whether those items can be closed.
9. For any study plan selected for detailed technical review, evaluate whether progress toward resolution of any SCA or other NRC open items can be identified on the basis of the contents of the study plan.
10. Document review results in a review package for transmittal to DOE. For any study plan selected for detailed technical review, document results of that review in a separate review package.
11. Enter new concerns and progress toward resolution of existing concerns into the OITS.

2.3 Scope

In accord with this Review Plan, the review of a study plan should consider whether it meets the requirements for content of study plans in the Agreement and whether it can result in obtaining the information to fulfill its objectives. It should be considered as well in terms of its relationship to appropriate parts of the SCP and SCP progress reports (e.g., the investigation that the study is implementing; relevant portions of the performance allocation process). In addition, a study plan is to be examined relative to other available study plans which are designed to acquire complementary information or which propose testing that could interfere with or be interfered with by the testing in the particular study plan under review. A study plan is also to be examined for potential progress toward resolution of NRC open items, especially if DOE has proposed closure of one or more NRC open items on the basis of the material in the study plan.

3.0 GENERAL APPROACH

The NRC staff will perform a Phase I Review of all study plans issued by DOE. The Phase I Review is to confirm that a particular study plan contains the material specified in the Agreement on the content of study plans. The NRC staff will also review relevant QA documents, such as QA audit and surveillance reports, to assure that there are no QA open items that could significantly

affect the quality of the study plan or the work to be conducted under the study plan. In addition, the Phase I Review is to identify objections (as defined in Section 4.1.2 and Appendix B) with respect to the study, and to evaluate whether any open items that DOE has proposed for closure on the basis of the study plan may be closed. Results of the Phase I Review are to be transmitted to DOE ordinarily within two months of NRC receipt of the study plan.

A second review phase, which will be undergone by only selected study plans, is a Detailed Technical Review to evaluate in detail the adequacy of a given study to provide the information for licensing that it should provide and that it is designed to provide. Study plans that are related to key site-specific issues or NRC open items or that feature unique, state-of-the-art test or analysis methods are typical candidates for this second phase of review. Results of the Detailed Technical Review are to be transmitted to DOE ordinarily within four months of NRC receipt of the study plan and any procedures requested by NRC.

4.0 PHASE I REVIEW

4.1 Specific Approach

4.1.1 Evaluation of Study Plans Relative to the Agreement and to the Responsible DOE Contractor's QA Program (Reference Section 2.2, Objectives 1 and 5)

In the Level of Detail Meeting, agreement was reached on the content requirements for descriptions in study plans (Enclosure 4, Attachment B of the Meeting Summary; Appendix A of this Review Plan). One aspect of the Phase I Review (and the first part of the review to be done) is to determine if the content of the study plan under review is reasonably consistent, as appropriate for the activities, tests, and analyses described, with the Agreement. This will be more than a simple check of the table of contents to note whether items have been addressed; it will also be to determine if the material provided is substantive enough for NRC staff resources to be productively used in continuing the Phase I Review of the document. This implies that all key supporting study plan references not already provided by DOE or not readily available in the open literature need to be provided to NRC at the time the study plan is issued.

This first part of the Phase I Review also involves a check to confirm that there are no 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. If such open items are found to exist, there will be no basis for NRC staff resources to be committed to continuing the Phase I Review of the study plan until those QA-related open items have been resolved.

4.1.2 Identification of Objections (Reference Section 2.2, Objectives 2-6)

Assuming that the Phase I Review continues, a second aspect of the review is the identification of any objections to the study plan. An objection is a concern with the DOE program as presented in the study plan related to either: (1) potential adverse effects on repository performance; (2) potential significant and irreversible/unmitigable effects on characterization that would physically preclude obtaining information necessary for licensing; (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; or (4) inadequacies in the QA program which must be resolved before work begins. Objections are reserved primarily for concerns with activities, tests, and analyses which, if started, could cause significant and irreparable adverse effects on the site, the site characterization program, or the eventual usability of the data for licensing (programmatic fatal flaws). Due to the irreparable nature of objections, NRC would recommend that DOE not start work until the objections are satisfactorily resolved. If objections are identified by the staff, they are to be transmitted in writing to DOE in the letter containing the results of the Phase I Review.

4.1.3 Closure of NRC Open Items (Reference Section 2.2, Objectives 8 and 11)

If DOE has proposed in its letter transmitting the study plan that one or more NRC open items be closed based upon material in the study plan and its supporting references, a third aspect of the Phase I Review is the NRC staff's determination whether it agrees with DOE that those open items are closed. The NRC staff is to review the material presented to support resolution and needs to indicate (a) agreement on complete or partial closure (certified by signature of the appropriate Section Leader and Branch Chief) and, if necessary, an explanation of why the material provided for closure is inadequate; or (b) disagreement on closure and an explanation of why the material provided for closure is inadequate. The results of the NRC staff evaluations will be recorded in OITS and included in the letter to DOE containing the results of the Phase I Review.

4.2 Activities/Products

The Phase I Review is to consist of the following steps:

1. The Project Manager (PM) transmits the study plan to the QA Section Leader and to the Section Leader whose Section is to be responsible for providing the technical lead for the review.
2. The QA Section Leader and the appropriate technical Section Leader appoint the QA reviewer and the technical lead (henceforth "lead") respectively. The activities of the lead throughout the review are to be coordinated with the lead's Section Leader. The PM confirms

that the lead, the QA reviewer, their Section Leaders, and any other staff members involved in the review have read and understand this Review Plan.

3. The PM, lead, and the lead's Section Leader briefly scan the study plan to determine whether there are obvious major concerns that need to be called to the attention of DHLWM management. In addition, they ascertain, based upon the amount, substance, and complexity of the material provided, whether it will be necessary to seek assistance from other Sections in DHLWM, other parts of the NRC (e.g., Office of Research), or from the Center for Nuclear Waste Regulatory Analyses (CNWRA), and recommend to DHLWM management a schedule for completion of the review. The PM arranges through appropriate channels for whatever outside assistance is deemed necessary. Further assistance may be sought by the PM at any time during the review if a need for it is identified.
4. The lead and the QA reviewer review the study plan relative to the Agreement and to the responsible DOE contractor's QA program under which the study plan was developed (see Section 4.1.1 of this Review Plan). If significant deficiencies are not found, the review continues (Proceed to Step 5). If significant deficiencies are found, such that in the judgment of the reviewers, their Section Leaders, and the PM further review of the study plan cannot productively be done, the PM documents the deficiencies and this conclusion in a letter he prepares for the Project Director to transmit to DOE.
5. The lead, the QA reviewer, and any other technical reviewers review the study plan to determine whether there are any objections with respect to it. The QA reviewer particularly checks relevant QA audit and surveillance reports to ascertain whether there are any open items related to the QA program of the responsible DOE contractor that could call into question the quality of the activities, tests, and analyses to be conducted under the study plan. The reviewers may at this stage also identify procedures that need to be reviewed. The PM requests these procedures from DOE.
6. The lead and any other technical reviewers review the study plan as a candidate for detailed technical review. If the study plan (1) may be related to one or more key site-related issues, (2) pertains to some NRC open items, (3) describes unique, state-of-the-art test or analysis methods that therefore do not have a supportive scientific history of providing data usable in licensing, (4) describes a study critical to evaluation of site performance that cannot be repeated for a number of years due to its disruption of the natural baseline,

or (5) has some other critical relationship to potential licensing concerns, the study plan is a viable candidate for detailed technical review.

7. The lead briefs the PM and appropriate Section Leaders on the results of the Phase I Review and makes a recommendation about whether a Detailed Technical Review of the study plan should be conducted. The PM and appropriate Section Leaders consider the recommendation of the lead and, with appropriate recognition of the budgetary and resource limitations on the number of Detailed Technical Reviews that can be supported, recommend to DHLWM management whether a Detailed Technical Review is warranted.
8. If DOE has proposed that one or more NRC open items should be considered closed based upon the material in the study plan and its supporting references, the lead and other technical reviewers as appropriate review the material related to those open items and determine whether the NRC staff agrees that they are closed.
9. The lead prepares a package containing the results of the Phase I Review, including (1) objections, as defined in Section 4.1.2 and Appendix B, and written in the format of the SCA open items, (2) a recommendation concerning the need to conduct a Detailed Technical Review of the study plan and the rationale for that recommendation, and (3) if applicable, whether the NRC staff agrees with DOE's proposed closure of NRC open items based on the study plan and its references. The lead incorporates the comments of all reviewers and resolves any significant comments raised during the Section Leader/PM briefing. He transmits this package to his Section Leader for review.
10. The Section Leader reviews the package, coordinates any changes needed with the technical lead, and transmits the package to his Branch Chief for review.
11. The Branch Chief reviews the package and transmits it to the Project Director, with a copy sent to the PM.
12. The PM determines whether the DHLWM Director and Deputy Director want to be briefed on the results of the Phase I Review. The lead briefs them if they so desire.
13. The PM prepares a letter from the Project Director to DOE containing the results of the Phase I Review and informing DOE whether a Detailed Technical Review of the study plan will be conducted. The letter may also request any procedures needed for review if those have not already been requested by the PM.

14. The Project Director issues the cover letter and review package to DOE with copies to the State and affected units of local government and Indian Tribes.
15. PM arranges to have objections placed in the OITS and to have the closure of any open items based on the Phase I Review recorded there. Agreement that an open item is partially or totally closed is certified by signatures of the appropriate Section Leader and Branch Chief.

5.0 DETAILED TECHNICAL REVIEW

5.1 Specific Approach

5.1.1 Evaluation of Study Plan Relative to Obtaining Data Needed for Licensing (Reference Section 2.2, Objective 7)

A primary objective of the Detailed Technical Review is to evaluate in detail whether the activities, tests, and analyses comprising that study plan are adequate to provide the data for licensing that the study plan should provide and that it was designed to provide. If the staff perceives that execution of the activities, tests, or analyses as presented would not achieve their intended purpose, or that that intended purpose is not consonant with the information needed for licensing, comments or questions (as defined in Appendix B) documenting such concerns will be transmitted in the letter to DOE containing the results of the Detailed Technical Review.

5.1.2 Evaluation of Progress toward Resolution of NRC Open Items (Reference Section 2.2, Objective 9)

The study plans provide a greater level of detail about implementation of DOE's site characterization plan than was contained in the SCP, and as such, may contain information relevant to certain open items being tracked in OITS. If, in its transmittal letter, DOE has proposed closure of any open items based upon material in the study plan, the staff evaluated the status of those open items in the Phase I Review (Section 4.1.3). However, even if DOE did not make such proposals, a second objective of the Detailed Technical Review is for the NRC staff to examine the study plan in the context of progress toward resolution of open items. Such progress may form the basis for interactions with DOE leading to ultimate resolution of the open items and therefore needs to be recorded in OITS and documented in the letter to DOE containing the results of the Detailed Technical Review.

5.2 Activities/Products

The Detailed Technical Review is to consist of the following steps:

1. PM, lead, and the lead's Section Leader scope the review and determine whether assistance is needed from other disciplines in DHLWM, other parts of the NRC (e.g., Office of Research) or the Center for Nuclear Waste Regulatory Analyses (CNWRA), and recommend to DHLWM management a schedule for completion of the review. The PM arranges through appropriate channels for whatever outside assistance is deemed necessary.
2. Reviewers conduct review of activities, tests, and analyses for adequacy to obtain the licensing information sought and that should be sought. As part of this activity, they may identify procedures (in addition to those obtained from DOE during the Phase I Review) they wish to have furnished by DOE. The PM requests the needed procedures from DOE.
3. Reviewers examine the study plan for progress (other than that already identified in the Phase I Review) toward resolution of NRC open items.
4. Procedures selected for detailed review are evaluated for their technical acceptability to obtain data usable in licensing.
5. Lead, in coordination with his Section Leader, prepares draft comments and questions (both terms as defined in Appendix B), incorporating those of all reviewers.
6. Lead briefs PM and appropriate Section Leaders on comments and questions resulting from the Detailed Technical Review.
7. Lead prepares revised draft of comments and questions, resolving any significant comments raised during the Section Leader/PM briefing. He transmits the package to his Section Leader for review.
8. The Section Leader reviews the package, coordinates any needed changes with the lead, and transmits the package to his Branch Chief for review.
9. The Branch Chief reviews the package and transmits it to the Project Director, with a copy sent to the PM.
10. The PM determines whether the DHLWM Director and Deputy Director want to be briefed on the results of the Detailed Technical Review. If they so desire, the lead briefs them.

11. PM prepares a letter from the Project Director to DOE containing the results of the Detailed Technical Review.
12. Project Director issues the cover letter and review package to DOE with copies sent to the State and affected units of local government and Indian Tribes.
13. PM updates the OITS by arranging for entry of the new open items resulting from the Detailed Technical Review and for recording of progress toward resolution of the existing open items based on the Detailed Technical Review.

6.0 INTERNAL QUALITY ASSURANCE (IQA) REQUIREMENTS/RESPONSIBILITIES/RECORDS FOR STUDY PLAN REVIEWS (PHASE I AND DETAILED TECHNICAL REVIEWS)

6.1 IQA Requirements

In accord with the IQA plan for DHLWM, IQA requirements for Phase I and Detailed Technical Reviews of study plans are as follows:

1. Before the technical reviewers begin their review, ensure through a required reading of this Review Plan and subsequent group question-and-answer sessions that they have familiarized themselves with this Review Plan.
2. Conduct the reviews and develop the review packages consistent with this Review Plan.
3. Conduct IQA reviews of the review packages using the following review criteria:
 - a. Technically defensible;
 - b. Accurately represents information in the study plan, supporting references, and procedures;
 - c. Consistent with appropriate sections of this Review Plan;
 - d. Consistent with the description of open items (objections, comments, questions) given in Appendix B;
 - e. Technically consistent within a discipline and across disciplines;
 - f. Consistent with 10 CFR Part 60;

- g. Written in a clear, concise, complete, and specific manner with clear and adequate support given for concerns, responses addressing DOE's proposed resolution of concerns, and observations regarding progress toward resolution of other open items;
 - h. Written in an objective and factual tone;
 - i. Written in a grammatically correct manner and with editorial consistency throughout;
 - j. Products transmitted by the Branch Chiefs to the Project Director reflect internal resolution of significant comments;
 - k. Entries into OITS accurately reflect the results of the study plan reviews with respect to new NRC concerns and to closure or progress toward resolution of existing NRC concerns.
4. Document that the requirements above have been satisfactorily completed. The signature of the Section Leader on the review package submitted to the Branch Chief, the signature of the Branch Chief on the review package submitted to the Project Director, and the signatures of appropriate Section Leaders and Branch Chiefs certifying the total or partial closure of NRC open items constitute the documentation that the requirements above have been met.

6.2 Responsibilities

Within the DHLWM, the lead and the other technical reviewers, Section Leaders, Branch Chiefs, and the PM are jointly responsible for assuring that the IQA criteria in section 6.1 are met. In particular, the technical reviewers are responsible for following this Review Plan, conducting the Phase I and Detailed Technical Reviews in their technical areas, and providing input to the lead, who has the responsibility for incorporating the products of the technical reviewers and preparing internal comments for briefings and a review package for transmittal to his Section Leader. The lead is also responsible for keeping his Section Leader informed of and involved in the conduct of the review.

The Section Leaders are responsible for assuring that: (1) their staff follow this Review Plan; and (2) their staff's products are of technically high quality. The lead's Section Leader is specifically responsible for the IQA review of the lead's review package. Appropriate Section Leaders are also responsible for certifying the total or partial closure of open items.

The Branch Chiefs are responsible for assuring that all significant internal comments are resolved in the final products transmitted to the Project Director. The lead's Branch Chief is specifically responsible for the IQA

review of the review package which is transmitted to him by the lead's Section Leader. Appropriate Branch Chiefs are also responsible for certifying the total or partial closure of open items.

The PM is responsible for overall project management of the review, and especially for: (1) assuring that the technical reviewers have familiarized themselves with this Review Plan prior to starting their study plan reviews; (2) coordinating (as necessary) the efforts of the technical reviewers in the different disciplines; (3) verifying that necessary concurrences and certifications have been obtained for review packages and totally or partially closed open items; (4) preparing letters from the Project Director to DOE that preserve the technical quality of the packages transmitted by the Branch Chiefs and that are written in an objective and factual tone; (5) arranging for entry into the OITS of information relative to new and existing NRC concerns that accurately reflects the results of the study plan reviews; and (6) compiling the IQA record of the study plan reviews.

6.3 Records

The IQA record contains those documents judged necessary to document the study plan reviews. All other documents not identified as part of the IQA record are unnecessary to retain for IQA purposes. The following documents comprise the IQA record:

1. This Review Plan;
2. Signed review package(s) transmitted by the Branch Chief to the Project Director;
3. Review package(s) transmitted by the Project Director to DOE.
4. Certifications by signatures of the appropriate Section Leader(s) and Branch Chief(s) of total or partial closures of NRC open items as a result of the review of the study plan.

Examples of documents that are not part of the IQA record and therefore need not be retained for IQA purposes include:

1. Early technical reviewer drafts leading to the review package(s) submitted by the technical lead to his Section Leader;
2. Various drafts between the documents designated above for retention;
3. Mark-ups of drafts;
4. Personal notes.

The DHLWM IQA coordinator is available during study plan reviews to provide assistance in determining whether there is an IQA rationale for retaining particular documents.

7.0 OPEN ITEM IDENTIFICATION, TRACKING, AND RESOLUTION

7.1 Identification of NRC Open Items

The SCA contains objections, comments, and questions as defined on p. 186 of the SCP Review Plan (modified here as Appendix B). These are staff concerns for which the staff has made recommendations for resolution to DOE and are considered to be open items which need to be resolved by DOE and tracked in terms of progress toward resolution by NRC staff via OITS. In this Review Plan it has been indicated that open items may be generated as the result of the Phase I Review or of the Detailed Technical Review. These are to be entered as new open items in OITS and treated in the same way as SCA and other NRC open items.

SCA open items are clearly related to the DOE program organization in Chapter 8 of the SCP and are tied to those portions of DOE's Issues Hierarchy which correlate with Part 60. The open items resulting from study plan reviews should be similarly related.

7.2 Tracking Progress Toward Resolution of NRC Open Items

Earlier sections of this Review Plan have emphasized the need for the staff (in the Phase I Review) to evaluate whether the information provided in the study plan is sufficient to close out any open items proposed for closure by DOE on the basis of the study plan, and (in the Detailed Technical Review) to investigate whether the contents of the study plan mark progress toward resolution of any other NRC open items. All progress toward resolution is to be documented in OITS.

8.0 ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW) INTERACTIONS

Interactions with the ACNW regarding NRC staff reviews of study plans are to be conducted in accordance with the October 1990 Memorandum of Understanding (MOU) between the ACNW and the NRC Executive Director for Operations (EDO). Upon NRC's receipt of a study plan, the PM is to transmit a copy to the Office of Nuclear Material Safety and Safeguards (NMSS) staff contact for ACNW, who will in turn transmit it to his ACNW counterpart. If the ACNW wishes to interact with the NRC staff regarding the staff's review of the study plan, the ACNW contact will so inform the NMSS staff contact. A briefing will then be scheduled for an appropriate time.

9.0 STATE, TRIBAL, AND LOCAL GOVERNMENT INTERACTIONS

Study plans are provided by DOE to the State of Nevada and affected units of local government and Indian Tribes at the same time that they are provided to NRC. Those parties have the opportunity to communicate their concerns with respect to a particular study plan to the PM at any time during the NRC review process. They may also inquire at any time about the status of the NRC review process. When NRC's review results are sent to DOE, they are also sent to all affected parties.

APPENDIX A

COMPARISON OF LEVEL OF DETAIL
REQUIRED IN DOE STUDY PLANS VERSUS THAT
REQUIRED IN SCP DESCRIPTIONS OF INVESTIGATIONS

Appendix A consists of a table comparing the level of detail required in DOE study plans with that required in the SCP descriptions of investigations. This table is considered by NRC and DOE to accurately summarize the agreements relative to content of study plans made at the May 7-8, 1986 NRC-DOE Level of Detail for Site Characterization Plans and Study Plans Meeting.

Comparison of DOE Content Requirements for Descriptions of Study Plans and Investigations

	Study Plans	Investigations
I. Purpose and Objectives	<ul style="list-style-type: none"> • Describe the information to be obtained in the study • Provide the rationale for information to be obtained 	<ul style="list-style-type: none"> • Describe the information to be obtained in the investigation • Provide the rationale for the information to be obtained
II. Rationale for Study/Investigation	<ul style="list-style-type: none"> • Provide the rationale for tests and analyses, indicating alternatives considered and options, advantages and limitations • Provide the rationale for number, location, duration, and timing of tests, considering uncertainties, and identify obvious alternatives • Describe the constraints for the study, considering: <ul style="list-style-type: none"> - potential site impacts - need to simulate repository conditions - required accuracy and precision - limits of analytical methods - capability of analytical methods - time required vs. time available - scale of phenomena and parameters - interference among tests - interference between tests and exploratory shaft 	<ul style="list-style-type: none"> • Provide the rationale for investigations, identifying relevant issues • Describe the constraints for the investigation affecting selection of studies, including interferences among studies and between studies and the exploratory shaft • Discuss the strategy for resolving issues
III. Description of Tests and Analyses/Studies	<p>For each type of test:</p> <ul style="list-style-type: none"> • Describe general approach that will be used in test • Describe key parameters that will be measured in test and experimental conditions under which test will be conducted 	<p>For each study:</p> <ul style="list-style-type: none"> • State objectives of study • Indicate if the study is to provide information for development of conceptual models • Indicate if study is being performed to guide characterization activities • List tests, test methods, data/parameters, locations, numbers, technical procedures and duration of tests • Reference study plans

**Comparison of DOE Content Requirements for Descriptions of Study Plans and Investigations
(Continued)**

	Studies	Investigations
III. Description of Tests and Analyses/Studies (continued)	<ul style="list-style-type: none"> • Indicate number of tests and locations • Summarize test methods; if non-standard procedure, summarize steps of test, how it will be modified, and reference technical procedure • Indicate level of QA and provide rationale for any tests not QA Level 1 • Reference the applicable specific QA requirements applied to test. • Specify tolerance, accuracy, and precision required in test • Indicate range of expected results and basis for these results • List equipment requirements, describing briefly special equipment • Describe techniques to be used for data reduction and analysis • Discuss representativeness of test, indicating limitations and uncertainties that apply to use of results • Provide illustrations of test locations • Discuss relationship of test to test performance goals and confidence levels <p>For each type of analysis:</p> <ul style="list-style-type: none"> • State purpose of analysis, indicate conditions to be evaluated and describe any uncertainty analysis 	<p>For each analysis:</p> <ul style="list-style-type: none"> • List method of analysis and information that will result from analysis

**Comparison of DOE Content Requirements for Descriptions of Study Plans and Investigations
(Continued)**

	Studies	Investigations
III. Description of Tests and Analyses/Studies (continued)	<ul style="list-style-type: none"> • Describe methods of analysis, including analytical expressions and numerical models to be used • Reference the technical procedures document that will be followed during analysis • Indicate levels of QA applied • Identify data input requirements • Describe expected output and accuracy • Describe representativeness of analytical approach, indicating limitations and uncertainties that apply to results 	
IV. Application of Results	<ul style="list-style-type: none"> • Briefly discuss where results from study will be used for support of other studies • Refer to specific performance assessment analyses • Describe where information from study will be used in construction equipment and engineering system, design and development • Describe where information from study will be used in planning other characterization activities 	<ul style="list-style-type: none"> • Briefly discuss where results from investigation will be used for support of other investigations • Refer to specific performance assessment studies • Indicate where information from studies will be used in construction equipment and engineering system, design and development • Describe where information from studies will be used in planning other characterization activities
V. Schedule and Milestones	<ul style="list-style-type: none"> • Provide durations of and inter-relationships among principal activities associated with conducting the study • List key milestones including decision points associated with study activities • Describe timing of study relative to other studies and other program activities • Provide dates for activities for the study plans; reference Sec. 8.8 in SCP 	<ul style="list-style-type: none"> • Show interrelationships and sequencing of (groups of) tests and analyses; use PERT chart to illustrate • List major milestones which will result from studies • Present schedule for studies supporting the investigation, providing beginning and end dates

APPENDIX B

DEFINITION OF OPEN ITEMS
IDENTIFIED IN NRC STAFF REVIEW
OF DOE STUDY PLANS

Objection: a concern with the DOE program as presented in the study plan related to either: (1) potential adverse effects on repository performance; (2) potential significant and irreversible/unmitigable effects on characterization that would physically preclude obtaining information necessary for licensing; (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; or (4) inadequacies in the QA program which must be resolved before work begins. Objections are reserved primarily for concerns with activities, tests, and analyses which, if started, could cause significant and irreparable adverse effects on the site, the site characterization program, or the eventual usability of the data for licensing (programmatic fatal flaws). Due to the irreparable nature of objections, NRC would recommend that DOE not start work until the objections are satisfactorily resolved.

Comment: a concern with the DOE program as presented in the study plan that would result in a significant adverse effect on licensing if not resolved, but would not cause irreparable damage if site characterization started before resolution. The DOE program could be modified in the future, with some risk to not having the necessary information for licensing; the adverse effects would be primarily related to the program schedule. Therefore, for these concerns, DOE could start work at its own risk before resolving such concerns with NRC. NRC would recommend timely resolution of comments. If resolution is not achieved in a timely manner, comments might evolve into the third category of objections described above (i.e., potential significant disruption of schedules).

Question: a major concern with the presentation of the DOE program in the study plan, such as missing information that should be in the study plan, level of detail, contradictions, and ambiguities that preclude understanding a part of DOE's program, thereby preventing the staff from being able to comment. NRC would recommend timely DOE response to such questions. If a question is related to a potential objection, satisfactory resolution should be accomplished before work begins. If the question is not related to an objection, then DOE could choose to proceed with work at its own risk, and resolve the question in future reports. Questions should be reserved for major items; minor inconsistencies, etc., should not be included.

DOCUMENT NAME: DB CONTROL EXCHANGE LETTER

DOCUMENT PREPARATION CHECKLIST
DIVISION OF HIGH-LEVEL WASTE MANAGEMENT

This checklist is to be submitted with each document sent for typing or for distribution

1. Is this document a final draft? Yes No
2. If it is a final draft, does it have the concurrence of a Branch Chief or higher? Yes No
3. Is this a ticketed item? If Yes, ticket number No
4. DISTRIBUTION:

(Names on the standard distribution lists need not be listed; they will be included automatically.) [Attach labels for other than standard distribution]

ANY OTHERS?

FDR	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	<u>MNataraja</u>	_____
LPDR	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	_____	_____
CNWRRA	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	_____	_____
LSS	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	_____	_____
ACNW	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	_____	_____
Proprietary	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	_____	_____
PreDecisional	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	_____	_____

5. CC's Usual 10

6. CONCURRENCES:
Please list the names of all individuals who should be on concurrence:

KStablein, MNataraja, RBallard, JHolomah, JLucian,

7. Date Originated: 10/15/91 Date Due or Needed 10/16/91
8. Task Assigned to: _____ Date Completed and sent to 4-G-17 11/5/91

REQUIRED ONLY FOR LSS DOCUMENTS

9. Date DID'ed to INRC02/IRMTLSS [NOTE: send only if LSS box is marked Yes above] _____

10. TLSS: Returned by _____ Date _____
Approved by _____ Date _____

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