PHASE I REVIEW: DOE PLAN FOR CHARACTERIZATION OF THE YUCCA MOUNTAIN UNSATURATED-ZONE PERCOLATION: SURFACE-BASED STUDIES (STUDY PLAN 8.3.1.2.2.6, Revision 0)

by

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Introduction

The stated purpose of the DOE "Study Plan 8.3.1.2.2.6, for Characterization of the Yucca Mountain Unsaturated-Zone Percolation Surface-Based Studies" is the measurement of the physical properties of the media and the hydrologic processes under which liquid and vapor flow occur in the unsaturated zone. This study plan consists of several related studies: (1) matrix hydrologic-properties testing; (2) matrix-property sampling of surface-based boreholes; (3) a Solitario Canyon horizontal-borehole study; and (4) the site vertical-borehole activity, which also includes a geophysical logging and vertical seismic profiling program.

The objectives of the Matrix hydrologic-properties testing activity are to characterize the flux-related, matrix hydrologic properties of geohydrologic units using core derived data and using statistical and geostatistical methods to estimate flux-related, matrix hydrologic properties for large volumes of rock. This activity describes a number of laboratory tests that will be used to examine core samples and the geostatistical approaches to selecting core samples for testing from surface based testing and the exploratory studies facility. The Matrix hydrologic properties testing activity consists of two main aspects; a matrix-property sampling program that will determine core sample intervals and a laboratory testing program that will be used to determine matrix hydrologic properties from core samples. The laboratory testing program will not only analyze core from the surface based testing program, but will also analyze core from the exploratory studies facility.

Main objectives of the site vertical borehole activity are to define the hydrologic potential field within the unsaturated zone and to determine the in situ bulk-permeability and bulk hydraulic properties of the unsaturated media. In this activity one 300 meter horizontal and 19 vertical holes are planned to be drilled from the surface into the water table. Of the 19 vertical boreholes, 8 will be located within the Conceptual Drift Boundary. It should also be noted, in the future, additional boreholes may be proposed by the DOE as data from boreholes and the exploratory studies facility are developed and compared.

After the boreholes are drilled, packer nitrogen-injection tests will be run in 15 boreholes to determine gas-phase permeabilities of the rock. Cross-hole pneumatic tests will be run in two sets of boreholes. Permeabilities to air will be measured using packer-injection tests in single and cross-hole configurations, with gas-tracer diffusion tests undertaken at 2 borehole sites. The determination of in situ potentials beneath the site will be accomplished by installing instruments within each borehole and monitoring these for a period of three to five years. During this long term monitoring period, access tubes will permit the vacuum sampling of in situ pore gases and water vapor for chemical and isotopic analysis. Finally, water permeabilities will be measured using packer-injection tests in single and cross-hole configurations.

This activity also incorporates geophysical borehole surveys and a vertical seismic profiling study. Two boreholes will be drilled and instrumented exclusively for the vertical seismic profiling study, which will provide subsurface geophysical data to reach interpretations of the structure and stratigraphy across the central section of Yucca Mountain.

The objectives of the Solitario Canyon horizontal-borehole study are to: (1) examine, on a local and limited scale, the extent of fractures, brecciation, and gouge development associated with the Solitario Canyon fault zone; (2) evaluate locally the geohydrologic significance of fault-related features on water movement within the Solitario Canyon fault zone; and (3) evaluate whether additional information is needed to adequately characterize hydrologic boundaries along the Solitario Canyon fault zone.

The results of this study plan will be used in the resolution of performance and design issues concerned with liquid and gas flow within the unsaturated zone. The principle applications will be in assessments of ground-water and gas travel times (Issues 1.1 and 1.6), and design analyses related to the underground-repository facilities (Issue 4.4). Issues concerned with repository seals (Issue 1.12), will also use the hydrochemical information resulting from this study.

A Phase I review of the study plan was done with respect to (A) DOE/NRC agreement on the content of study plans: (B) identification of objections; (C) closure of NRC open Items; and (D) the need for a Detailed Review (See Review plan for NRC staff review of DOE study plans, revision I, 12/6/90).

<u>Evaluation of Study Plans Relative to the Agreement and to the Responsible DOE Contractors QA Program (Objectives 1 and 5)</u>

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

Attached (Attachment A) is an itemized checklist of the study plan content as compared to the agreement on content resulting from the NRC/DOE level of detail meeting. In general, the content of the study plan is reasonably consistent with the agreement. However, the details of field and laboratory tests are contained in the technical procedures which were not provided as part of the study plan. Many of these technical procedures have not as yet been written. Out of 119 technical procedures identified in the report, 58% or 69 procedures have yet to be developed.

It should also be noted that for each type of test the study plan did not indicate the level of QA and provide the rationale for any tests that are not QA level one. Further the study plan did not reference the applicable specific QA requirements applied to the test or the levels of QA applied to each type of analysis. The reason for this is that a determination of the quality status for the activities of this study will be made separately, according to AP-6.17Q, "Determination of the Importance of Items and Activities", which implements NUREG-1318, "Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements ." The results of that determination will be contained in the Q-List, Quality Activities List and non-Selection Record, which will be controlled documents. Furthermore, QA grading packages for the activities of this study plan will be prepared separately, according to AP-5.28Q, "Quality Assurance Grading". The resultant Quality Assurance Grading Report will be issued as a controlled document.

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

Staff Review

All references have not been provided. However, the study plan lists 114 references and of these only 13 are considered not readily obtainable by the U.S. NRC library. Attachment B is a copy of the list of references from the study plan with all references marked either SCP (referenced in the Site Characterization Plan), 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, have been resolved.

Staff Review :

Based on a meeting with Kenneth Hooks, Section Leader, Quality Assurance Section, there are currently no open quality assurance items that would call into question the quality of the study plan.

Identification of Objections (objectives 2 through 6)

Staff Review

In the study plan it is stated that five of the investigative methods described in this study plan have been identified by the DOE as having the potential to either adversely impact long-term repository performance, and/or the potential to create interference that could compromise the data and testing objectives of another testing method. These five methods include:

1. drilling and coring;
2. in situ pneumatic testing;
3. stemming, in situ instrumentation and monitoring;
4. vertical seismic profiling; and
5. water injection testing.

In reviewing this study plan, the NRC agrees that some test interferences will occur and that there may be some impacts on repository performance. However, the NRC staff did not identify an "objection" level concern. The staff did not identify any 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).

Criterion 1 Potential adverse effects on repository performance:

Staff Review

Adverse effects on repository performance could arise from the construction of 19 vertical boreholes, 8 of which will be located within the Conceptual Drift Boundary. These boreholes might allow more water to flow from the surface to the repository or become faster paths for radionuclide transport from the repository to the water table.

Presently, no method is available for reliable, noninvasive measurement of in situ pneumatic, thermal, and moisture potentials. The work outlined in this study plan is entirely dependent upon gaining direct physical access to the geologic units beneath Yucca Mountain. Therefore boreholes are required to accomplish the objectives of this study.

All boreholes will be constructed to meet the relevant requirements of 10 CFR 60.15. These are:

1. Methods of drilling, borehole testing, and instrumentation shall limit adverse effects on long-term repository performance to the extent practical (10 CFR 60.15(c)(1)).

2. The number of boreholes, particularly those within the repository block or immediate vicinity, should be limited to the extent practical consistent with obtaining information needed for site characterization (10 CFR 60.15(c)(2)).

3. Boreholes in the repository block should be located where shafts are planned for the repository, or where large unexcavated pillars are planned, (10CFR 60.15(c)(3)).

Furthermore the study plan reports that, the planned boreholes within the Conceptual Drift Boundary can be accommodated in the published conceptual repository design (Sandia National Laboratory, 1987), using a minimum standoff distance of two opening diameters between boreholes and mined openings to control the minimum size pillar in the repository layout. In addition, a standoff distance of at least 30 m (100 ft) will be maintained between boreholes and emplaced waste. The DOE concludes that this strategy will reduce the useable area of the repository by only a small amount.

The borehole siting strategy described in the study plan was guided by consideration of multiple, working hypotheses on water flow in unsaturated-fractured rock at Yucca Mountain and recognition of the need to support performance assessment evaluations. Vertical borehole drill sites were chosen to satisfy requirements to: (1) investigate specific geohydrologic features; (2) cover Yucca Mountain areally; (3) minimize disturbance to the main body of the proposed repository within the Conceptual Perimeter Drift Boundary; (4) locate in areas suitable for construction of relatively large drilling pads with a minimum of disturbance to the natural terrain; and (5) locate in areas sufficiently distant from boreholes previously drilled with water or foam-based drilling fluid. It should also be noted, in the future, additional boreholes may be proposed by the DOE as data from boreholes and the exploratory studies facility are developed and compared. According to the study plan the number of planned unsaturated-zone boreholes cannot be reduced, without significantly impacting the characterization of important features of the unsaturated zone.

Borehole sealing is the primary method to mitigate negative impacts from the vertical boreholes on repository performance. At the time of repository closure it is planned that each unsaturated-zone borehole located within the Conceptual Perimeter Drift Boundary, and possibly every borehole in the site area will be plugged and sealed. The study plan presents two alternatives addressing the need to seal the unsaturated-zone boreholes: (1) show that the stemmed configuration constitutes a viable seal, or (2) demonstrate that stemmed boreholes can eventually be drilled out for sealing.

Present plans for the Yucca Mountain sealing program call for (1) preliminary testing and laboratory work during site characterization; (2) development of a preliminary sealing concept for the repository license application; (3) confirmation testing during repository construction and operation; and (4) development of a final sealing concept for the license amendment to close the repository. The study plan states that current plans comply with regulatory requirements, but explicit sealing requirements are not currently available to guide borehole construction and completion during site characterization.

Potential problems with drilling out unsaturated-zone boreholes for sealing are:

1. The drilling process must remove cable, metal assemblies, and other materials in addition to the stemming material.

2. The drill must follow the stemmed hole, even in the softest formation and in the presence of "junk".

3. The operation may have to be performed "dry" to prevent large losses of drilling fluid.

The study plan concludes that drilling out unsaturated-zone boreholes stemmed with a single strand of hollow rigid tubing, is probably feasible. Plastic materials and the fiberglass pipe could be easily crushed and carried up hole by air circulation. A large bundle of electrical cable would be more problematic, but could probably be drilled out if the cable were selected for ease of disruption. Metallic transducer assemblies could create problems unless they are of minimal size and constructed of light gauge, millable materials.

The DOE feels some of the uncertainties of drilling out boreholes prior to sealing may be reduced by: (1) adherence to tight verticality specifications during drilling; (2) accurate borehole deviation surveys prior to stemming; and (3) precise centering of the central stemming tube in the borehole for later use as a pilot/centering hole to drill out the borehole prior to sealing. The feasibility of effectively sealing and plugging the horizontal borehole in Solitarion Canyon may be less certain than for the vertical boreholes. However, should there be problems in sealing that borehole, it is located well outside the Conceptual Perimeter Drift Boundary, where it can have little effect on repository performance.

It does not appear to the staff the the conduct of the activities described in this study plan will have significant adverse impacts on repository performance. This decision was influenced by the following considerations: (1) the information from this study plan is important to site characterization; (2) there does not appear to be a noninvasive method of collecting the data; (3) DOE has committed to sealing each unsaturated-zone borehole within the Conceptual Perimeter Drift Boundary; and (4) the study plan has outlined a process to develop acceptable borehole sealing requirements and approaches. In regards to the fourth point, the NRC staff expects 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 for the period of permanent closure". It should also be noted that in the future, additional boreholes may be proposed by the DOE as data from boreholes and the exploratory studies facility are developed and compared. However, conclusions concerning this study plan, should not be construed to mean that the NRC has reached these same conclusions with respect to additional or other boreholes not identified in this study plan (i.e., Revision 0).

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

Staff Review

The study plan describes the expected magnitude of interference effects and precautions taken to lessen them. Test interferences will occur because many kinds of testing activities are planned for each individual borehole and drilling disturbs the in situ hydrologic conditions of core samples.

To mitigate drilling impacts on other studies, the boreholes will be drilled with air to preserve in situ conditions to the extent practical. Drilling with air may have some disadvantages with respect to drying the core and rock surrounding the borehole. However, modeling by Bodvarsson and others, 1987, and experimental studies in tuffs in "G" Tunnel at the Nevada test site have shown that drilling with air disturbs the in situ hydrologic conditions in unsaturated rock much less than wet drilling. It is projected that for cluster boreholes, drying of the rock due to drilling may be greater than for isolated boreholes. The present testing strategy assumes that most drying effects are restricted to the rock matrix in the vicinity of the fractures, so that matrix hydrologic properties are not significantly disturbed by drilling and testing. To evaluate the magnitude of drilling and testing drying effects; moisture potentials measured in samples from the first cluster borehole to be drilled in a cluster will be compared with that from later boreholes.

Another effect of drilling is the contamination of the gaseous phase by meteoric air and moisture, which could perturb planned carbon-isotope, oxygen-isotope, and tritium studies based on gas sampling in the unsaturated zone. To mitigate this problem a chemical tracer such as sulfur hexaflouride (SF6) will be metered into the drilling air to estimate the amount of contamination in future gas samples from drilling.

In situ pneumatic testing will involve the injection of relatively dry gas through borehole test intervals isolated by paired packers. This testing activity is expected to cause some drying of the rock in the immediate vicinity of the borehole test intervals. The drying of the rock matrix adjacent to the borehole and along fractures could effect borehole long-term monitoring moisture-potential data. Much of the air used in pneumatic testing is expected to flow into fractures because of low matrix permeabilities. Probable magnitudes of the drying effects were numerically modeled, with no discernible change in saturation occurring at radial distances from 0.08 to 0.4 meters (depending on modeled water saturations). The study plan indicates that the effects of pneumatic testing on the long-term monitoring instrument stations will be mitigated by the length of the instrument stations. The length of each instrument station will be three times the length of the standard air injection interval. It is felt that the near field effects of drying will tend to be masked by the much larger in situ instrument stations, since in situ monitoring instruments are expected to provide an average value of moisture potential integrated over the entire volume of the instrument station cavity. The study plan expects that the disturbance effects of air injection will be relatively short lived within the planned three to five year in situ monitoring period.

Drying effects from in situ pneumatic testing may be greater at cluster borehole sites. Borehole spacing at cluster sites is designed primarily to support cross hole pneumatic testing. The study plan anticipates that the magnitude of the drying effects can be evaluated by comparing in situ measurements of moisture potential with similar measurements on core samples; and by comparing differences between moisture data from nearby boreholes.

Following in situ monitoring, a series of water injection tests are planned for each of the boreholes. Water will be introduced into the unsaturated-zone borehole instrument station cavities. The study plan considers the total amount of water needed to conduct an individual test to be relatively small with respect to the volume of rock that will be affected. The zone of influence is not expected to exceed a radius of 1 to 2 meters for complete saturation of the nearby rock. Implementation of these tests, will preclude continuation of the in situ monitoring program. The final decision to proceed with water injection tests will be contingent upon completion of the other data collection activities. A decision to begin water injection tests will be predicated on an analysis of the prospective utility of the injection tests, the potential impacts on waste isolation, and the benefits to be derived from continuation of in situ monitoring beyond the original three to five years that is currently planned.

The magnitude of test interference effects described in the study plan are deemed acceptable to the NRC staff. Many of the interference effects are unavoidable, but some of the effects may be eliminated by drilling more boreholes and conducting fewer kinds of tests in each hole. However, it is probably not justified to take these approaches, because: (1) the predicted magnitude of interference effects attributable to study plan activities looks acceptable; (2) the study plan methods to mitigate and evaluate interference effects appear well thought out; (3) there is a value to collecting many different kinds of data from the same location; and (4) there may be potential adverse impacts on repository performance from more boreholes.

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

It is important to note that this study plan references many prototype tests. Testing procedures have been chosen that investigators expect will work as planned. However, the investigators recognize that there is a degree of risk associated with many of the tests which have not been previously tried. Therefore, tests to evaluate the feasibility of proposed testing methods are planned. Critical prototype testing identified in this study plan will be completed successfully before site-characterization testing is started. Equipment selection and development is a major objective of the prototype testing. As such, specifications for equipment to be used during site characterization cannot be completely defined until this testing is done. The construction and borehole testing program is estimated to last approximately three years, with in situ monitoring followed by water injection testing lasting for a period of three to five years. The relatively long period (6 to 8 years) needed to complete these activities, plus the need to conduct many prototype tests, means there is very little time in the present schedule for delay. However, such delays would not impact the DOE's ability to obtain information for licensing over a longer time period.

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

Staff Review

Based on a meeting with Kenneth Hooks, Section Leader, Quality Assurance Section, there are currently no quality assurance inadequacies that have to be resolved before the work begins.

Closure of NRC Open Items (Objectives 8 and 11)

Staff Review

Not applicable - In its transmittal letter DOE did not propose to close any open items with this study.

Need for Detailed Technical Review

A study plan is a candidate for a detailed technical review if it meets any of the following 5 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 on all 5 criteria. It is important to note that this study plan references many prototype tests. Critical prototype testing identified in this study plan must be completed successfully before site-characterization testing is started. Characterization of the site will not be conducted by methods described in this study plan if prototype testing demonstrates that the methods and/or equipment cannot be applied successfully to Yucca Mountain.

Having identified the need for a detailed technical review, we note that much prototype testings still needs to be conducted, that the study plan will not use the methods described if the prototype tests are not successful, and of 119 technical procedures 69 or 58% remain to be developed. Therefore it is recommended that a detailed technical review not be performed at this time.

Each criterion is discussed below:

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

Staff Review

This study plan is related to one or more key site related issues. The results of this study will be used in the resolution of performance and design issues concerned with fluid flow (both liquid and gas) within the unsaturated zone beneath Yucca Mountain. The principal applications will be in assessments of ground water and gas travel times (Issues 1.1 and 1.6), and design analyses related to the underground-repository facilities (Issues 4.4). Issues concerned with repository seals (Issue 1.12), will also use the hydrochemical information resulting from this study. Information from this study plan will also be used to resolve Issue 2.2 (worker radiological safety under normal operating conditions) and Issue 2.7 (Characteristics and configurations of the repository).

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

Staff Review

To determine if the study plan pertains to some NRC open items a search was conducted of the NRC July 31, 1991, review of DOE Responses To NRC Point Papers On Site Characterization Plan/Consultation Draft December 1988. This search simply identified those open items which specifically referenced this study plan or one of it's testing activities by name. The search identified one open item.

(1) SCA COMMENT 15 which contains concerns relative to the Solitario Canyon Horizontal Borehole Studies. This study plan was referenced as one of two study plans that would have to be reviewed by the NRC staff before progress could be made towards closure of this comment.

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

Staff Review

This study plan references many prototype tests. Testing procedures have been chosen that the investigators expect will work as planned. The investigators recognize, however, that there is a degree of risk associated with many of the tests which have not been previously tried. Therefore, tests to evaluate the feasibility of the proposed testing methods have been planned. Prototype testing will serve several purposes, including the development of reasonable and adequate quality-assurance procedures and an assessment of data-acquisition and storage needs of individual tests. Prototype tests will be needed to: (1) determine the most suitable methods and develop new methods to conduct matrix hydrologic properties tests; (2) design and evaluate borehole drilling and sealing technology and performance; (3) design and evaluate the capabilities and limitations of instruments to be used over the extended monitoring phase in the site vertical boreholes; and (4) test and design air and water injection test apparatus.

Prototype-test plans applicable to activities in this study plan are described in detail in project prototype-testing documents. Critical prototype testing identified in this study plan must be completed successfully before site-characterization testing is started. Characterization of the site will not be conducted by methods described in this study plan if prototype testing demonstrates that the methods and/or equipment cannot be applied successfully to Yucca Mountain.

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 studies described in this study plan are important to the evaluation of site performance. These tests will preclude continuation of the in situ monitoring program. Therefore, the site vertical-borehole and the Solitario Canyon horizontal-borehole studies probably cannot be repeated at the exact same location, because at the end of in situ monitoring, a series of water injection tests are planned. It should also be noted that given the long time period required to conduct the tests in this study plan (6 to 8 years) any need for the duplication of these tests could extend the DOE's projected schedule.

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 systematic, iterative approach to identifying the information and analyses needed to support a license application has previously been recommended in other NRC documents (e.g., Comment 1 in NRC's Site Characterization Analysis of DOE's SCP), and is hereby recommended once again for the DOE's consideration as its site characterization program proceeds.

REFERENCES

Bodvarsson, A, and others, 1987, Preliminary calculations of the effects of air and liquid water-drilling on moisture conditions in unsaturated rocks: Earth Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California.

Nuclear Regulatory Commission, 1991, Review of DOE Responses To NRC Point Papers On Site Characterization Plan/Consultation Draft December 1988

Sandia National Laboratories, 1987, Site characterization plan - conceptual repository design report: SAND84-2641, 6 volumes.

ATTACHMENT A
ITEMIZED CHECKLIST OF STUDY PLAN CONTENT
CHARACTERIZATION OF THE YUCCA MOUNTAIN UNSATURATED-ZONE PERCOLATION SURFACE-BASED STUDIES

I. PURPOSE AND OBJECTIVE

Is the information to be obtained in the study described?
Yes_X_ No___ N/A___

Is the rationale for information to be obtained provided?
Yes_X_ No___ N/A___

II. RATIONALE FOR STUDY/INVESTIGATION

Does the study plan provide the rationale for tests and analysis, indicating alternatives considered and options, advantages, and limitations?
Yes_X_ No___ N/A___

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

Does the study plan describe the constraints for the study?
Yes_X_ No___ N/A___

In describing the constraints for the study, does the study plan consider potential site impacts?
Yes_X_ No___ N/A___

In describing the constraints for the study, does the study plan consider the need to simulate repository conditions?
Yes___ No___ N/A_X_

Duplication of repository conditions are not necessary to conduct the tests described in this study plan.

In describing the constraints for the study, does the study plan consider the required accuracy and precision?
Yes_X_ No___ N/A___

In describing the constraints for the study, does the study plan consider the limits of analytical methods?
Yes_X_ No___ N/A___

In describing the constraints for the study, does the study plan consider the capability of analytical methods?
Yes_X_ No___ N/A___

In describing the constraints for the study, does the study plan consider time required vs. time available?
Yes_X_ No_____ N/A_____

In describing the constraints for the study, does the study plan consider the scale of phenomena and parameters?
Yes_X_ No_____ N/A_____

In describing the constraints for the study, does the study plan consider interference among tests?
Yes_X_ No_____ N/A_____

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

III. DESCRIPTION OF TESTS AND ANALYSIS

For each type of test does the study plan describe the general approach that will be used?
Yes_X_ No_____ N/A_____

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

For each type of test does the study plan indicate the number of tests and locations?
Yes_X_ No_____ N/A_____

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

Yes_____ No_X_ N/A_____

Not all of the technical procedures have been developed. Out of 119 technical procedures identified in the report, 58 % or 69 procedures have yet to be developed.

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

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

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

Yes____ No_X_ N/A____

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

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

Yes_X__ No____ N/A____

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

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

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

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

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

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

IV. APPLICATION OF RESULTS

Does the study plan briefly discuss where results from study will be used for support of other studies?
Yes__X__ No_____ N/A_____

Does the study plan refer to specific performance assessment analyses?
Yes__X__ No_____ N/A_____

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

Does the study plan describe where information from the study will be used in planning other characterization activities?
Yes__X__ No_____ N/A_____

V. SCHEDULES AND MILESTONES

Does the study plan provide durations of and interrelationships among principal activities associated with this study?
Yes__X__ No_____ N/A_____

Does the study plan list key milestones including decision points associated with study activities?
Yes_X__ No_____ N/A_____

Does the study plan describe the timing of the study relative to other studies and other program activities?
Yes_X__ No_____ N/A_____

Does the study plan provide dates for activities for the study plans: reference section 8.5 in SCP?
Yes_X__ No_____ N/A_____

ATTACHMENT B

6 REFERENCES

NAA Agarwal, R. G., 1979, Real gas pseudotime - a new function for pressure buildup analysis of MHF gas wells: Paper SPE 8279 presented at the 1979 SPE Annual Technical Conference and Exhibition, Las Vegas, Nevada, September 23-26.

AA Al-Hussainy, R., Raney, Jr., H. J., and Crawford, P. B., The flow of real gases through porous media: J. Petroleum Technology, May 1966, p. 624-636.

AA American Petroleum Institute, Recommend Procedure RP-27, 1220 L Street N.W., Washington, D.C.

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