See file Pocket 2 for enclosure

SUMMARY OF NRC/DOE MEETING
ON THE
SITE CHARACTERIZATION PLANS SECTION 8.3

DATE AND LOCATION OF MEETING:

October 29-30, 1985
Room 1E-245
Forrestal Building
Washington, D.C.

LIST OF ATTENDEES:

See Attachment 1

BACKGROUND:

The purpose of the meeting was for DOE to present their current position on the contents, requirements, and level of detail to be provided in the test plans, analyses, and studies of Section 8.3 of the SCP. DOE's presentation consisted of a discussion of their guidance on "Content Requirements for Descriptions of Studies in Chapter 8 of the SCP" (Attachment 2) and an example of the application of this outline to a specific test(s) by each of the three projects (Attachments 3 to 7). Because the NRC, States, and Tribes did not have an opportunity to review the examples prior to the meeting it was agreed that the meeting participants would not be in a position to provide any significant feedback to DOE during the meeting. Rather, questions would focus on clarification and amplification of the points discussed by DOE.

In response to DOE's request for NRC feedback and ultimate agreement on the level of detail for test plans needed in Section 8.3 of the SCP, the NRC staff agreed that, while DOE must ultimately make the decision on what level of detail is appropriate in Section 8.3 vs the referenced test procedures, the NRC would review and comment on the outline and examples provided by DOE.

Encl. to Summary of NRC/DOE mtg 10/29-30/85 109 WM-1

OBSERVATIONS/AGREEMENTS/OPEN ITEMS

1. NRC REVIEW OF CONTENT REQUIREMENTS AND EXAMPLES OF STUDIES

NRC provided preliminary observations during the meeting on both the Content Requirements and examples and agreed to provide the DOE with written comments within four weeks. NRC agreed that its review will focus on 1) the appropriate level of detail in section 8.3, and 2) the application of perfomance goals and confidence levels in the examples DOE provided. DOE would like feedback on whether presenting study level plans in the SCP is the appropriate level of detail or if a lower level is desirable. DOE stated that the three examples given are considered to be at a study level and that, with certain exceptions, this is DOE's preferred level.

NRC observed that examples presented by the three projects were inconsistent with each other and with the "Content Requirements" presented by DOE/HQ. These inconsistencies will also be a topic that NRC will focus on in their review.

2. DEFINITION AND CONSISTENT USE OF TERMS

NRC expressed the need to have a consistent set of terms defined and used by all three DOE projects in Chapter 8. Among important terms needing definition are program, investigation, study, test, experiment, methodology, and procedure. While DOE/HQ discussed the intended definitions for these terms, during the meeting the examples provided by the Projects (see Attachments 3 to 7) used different terms. Therefore, to facilitate NRC's review of the examples, DOE is developing a list of consistent terms and definitions and agrees to give NRC written definitions for the above terms by November 8, 1985. NRC agreed to provide comments on the level of detail to DOE within 4 weeks, contingent on receipt of the definitions.

3. HIERACHIAL LEVEL AT WHICH STUDY LEVEL DESCRIPTIONS WILL BE PROVIDED IN THE SCP

Study level plans will be presented at various levels in the hierachy of Chapter 8. DOE plans to use a consistent format in the SCP in describing activities at the study level of the hierarchy. (A study represents a group of related tests, and in some cases, analyses.) However, the format used to descibe the levels of the hierarchy above the study level may vary within the topical areas in Section 8.3. Therefore, the number of levels in the hierarchy will vary depending on the topic addressed.

4. DESCRIPTION OF THE QA INFORMATION FOR STUDIES AND TESTS

NRC expressed the concern that the substitution of the "content" document for Table 2 in section 8.3 of the annotated outline will eliminate certain QA information which the staff feels is necesssary in the test plan. In particular, Item 5 of Table 2, which states that DOE will describe the QA program for planned tests and experiments, will be replaced by only a statement of the quality level (I, II, III) for each test. Section 8.6 (Quality Assurance Program) as presented in the annotated outline deals with the general QA program. Depending on the level of detail provided regarding individual test plans, Section 8.6 may provide the information laid out in Item 5 of Table 2. Based on the information given in the meeting, the NRC cannot determine if adequate information will be provided.

DOE intends that the entire QA program be contained in Section 8.6. Therefore, DOE believes that additional discussion in 8.3 would be redundant and unnecessarily repititious. DOE believes that the Section 8.3 discussion of QA should be confined to an identification of QA levels and a reference to the appropriate section of 8.6.

The NRC in its review of the SCP and its references (such as test procedures) will look for proper incorporation of the administrative QA procedures into the technical procedures. Many areas of QA are generic to all procedures and need not be described on a case-by-case basis. QA administrative procedures could simply be referenced. Others, however, such as the inspection requirements for a test procedure and the need for a peer review of a procedure are unique for each test and need to be addressed on a case by case basis.

DOE and NRC agree that this topic will be added to the agenda of the NRC/DOE meeting on QA scheduled for December 4-5, 1985.

5. CHANGES TO SCP ANNOTATED OUTLINE AND SCP CONTENT

DOE indicated that their outline "Content Requirements for Description of Studies in Chapter 8 of the SCP" which replaces Table 2 "Suggested Format for Description of Planned Tests and Experiments", of the annotated outline, was only meant to provide a greater level of detail than was provided in the annotated outline for the SCP. However, the NRC staff noted upon a cursory review that the outline omitted quality assurance information to be applied to data collection and analysis and uncertainties of test methods, analysis and data which were contained in Table 2, as well as the text of 8.3 of the annotated outline. DOE indicated that any omission of discussions of uncertainties was inadvertant and that the subject would be added to their outline. Regarding quality assurance (see Item # 4) it was agreed that this should be a topic in the NRC/DOE meeting on QA scheduled in December.

DOE intends that the "Content Requirements for Descriptions of Studies in Chapter 8 of the SCP" be consistent with the content requirements of Section 8.3 of the Annotated Outline for Site Characterization Plans. DOE intends to include discussions of limitations and uncertainties.

The DOE stated that a large percentage of test procedures (on the order of 80%) would not have been developed or adapted to the needs of the site characterization program at the time of issuance of the SCP. DOE also stated that the SCP would not contain detailed technical procedures but would forward reference them instead. The NRC expressed concern about the timeliness of availability of test procedures for NRC staff review. The DOE stated that procedures for future testing will be available so that they can be reviewed sufficiently before the tests are to be performed. DOE stated that if any tests were to be conducted immediatedly after the issuance of the SCP, the procedures for those tests would be available for review sufficiently in advance of testing.

For non-standard procedures which remain to be developed, DOE needs to provide sufficient time to develop the procedure or to provide contingencies for alternative testing through the performance allocation process.

6. USE OF PERFORMANCE ALLOCATION

NRC observed that the "content requirements (attachment 2) only specified that performance goals and confidence levels be identified and discussed in the justification (purpose and objectives) for the information need and not in the rationale for a selected study or test. DOE and NRC reconfirmed the earlier agreement (no. 5) made in the September 26-27, 1985 meeting on Subsystem Performance Allocation that "the rationale for every test or suite of tests will be provided in the SCP and that the rationale, where the tests relate to resolution of performance issues, will include the relationship of the test to the set performance goals and confidence levels."

7. INCORPORATION OF ESTP, SBTP AND PAP INTO THE SCP

DOE intends that the SCPs be the primary program document for presenting plans for the site characterization program. Every test to be conducted during site characterization must be described in the Site Characterization Plan to at least the Study level of detail according to the format in Attachment 2. DOE/HQ does not intend that individual project-specific support documents such as ESTPs, SBTPs, PAPs, which may contain supplemental materials, be used as the vehicles for presenting portions of the plans for the site characterization program. By including all plans for site characterization activities in the SCP, the DOE believes that it can more effectively address performance allocation for the total site characterization program and provide a better integration of the entire site characterization testing program.

8. INTEGRATION OF PLANS

NRC asked if separate tests, plans, and studies would be integrated into broader level plans. DOE descibed the heirarchial approach to plans which they are developing and which were illustrated most clearly in Attachments 4 and 5. This approach would identify upper level studies/investigations which integrate lower level studies, tests, and analyses. Integration will also be achieved by describing relationships of studies and tests to issues and information needs as well as other studies in the descriptions of studies (section I, IV, and V of "Content Requirement" attachment 2).

9. IDENTIFICATION OF DECISION POINTS

NRC observed that while the "Content Requirements" (attachment 2 did not specify in Section V the need to identify decision points at the study and test level, some of the examples did identify that decision points would be identified. NRC asked DOE to refer to NRC's Site Technical Position no. 1.1 on BWIP Hydrologic Testing Strategy for an example of how decision points have been identified and agreed to by NRC and BWIP to guide the course of an evolving testing program.

10. RELEASE OF DRAFT TEST PLANS

In accord with the need for early ongoing consultation in the development of test plans, NRC asked if DOE would release copies of draft test plans which have already been written. DOE did not agree to the release of these plans and considered a premature release to be inappropriate since the existing test plan drafts have not yet incorporated the process of performance allocation. Such application will result in significant changes to existing test plans. NRC disagreed with DOE's position since the technical aspects of the test plan, the basic data needs and types and methods of testing, would not be expected to change significantly. DOE did state that a complete draft of a fully integrated SCP would be made available for information purposes about three months before the release of the SCP. Individual Chapters or Sections of the SCP will not be released due to the need for overall document integration.

NRC pointed out that while early release of the SCP itself is not necessary, there needs to be early review of the test plans and strategies during development, if NRC is to provide guidance to DOE in a timely manner. NRC's ability to review the SCP within the current schedule is based on such early consultation and identification and resolution of concerns.

Although DOE feels that premature release of draft Chapters or Sections of the SCP would be inappropriate for the reasons given above, DOE agrees that the NRC/DOE interactions are extermely important during the development of the SCP. DOE suggests that future meetings could focus on selected technical topics contained within those Chapters or Sections, rather than on a Chapter or Section in its entirety.

11. STATE/TRIBAL CONSULTATION

Representatives from the States of Lousiana, Mississippi, and Utah, and from the Yakima and Nez Perce Indians attended the meeting. They provided comments and questions throughout the meeting. At the conclusion of the meeting, DOE invited observations for the record. None were offered.

12. Future Meetings

The NRC and DOE agreed that two future meetings, one on the contents of the Quality Assurance discussions to be presented in Sections 8.3 and 8.6 of the SCP (see item 4), and one on project-specific issue hierarchies and associated information needs, should be held as soon as possible.

Robert J Johnson 10/31/85	Donald H. Alexander 10/31/85
for John J. Linehan Division of Waste Management Office of Nuclear Material Safety and Sageguards U.S. Nuclear Regulatory Commission	Donald H. Alexander Division of Geosciences and Technology Office of Geologic Respoitories U.S. Department of Energy

NRC/DOE Meeting on SCP Section 8.3

October 29-30, 1985

[redacted]

Name	Organization
Donald Alexander	DOE-HQ
Carol Hanlon	DOE HQ
Glen F Kircher	Battelle/ONWI
CYRUS KLINGSBERG	DOE/HQ
Vic Montenyohl	WESTON
Jan Perthu	State of Utah
Leslie A. Casey	DOE-SRPO
Andrew P. Cook	DOE-SRPO
Al Stevens	NNWSI/SNL
Owen E Swanson	Battelle/ONWI
RW Klingensmith	BATTELLE/ONWI:SRP
JOHN HUTCHINS	CERT
Michelle Henry	NEZ PERCE TRIBE, ID
FRANK NEWMAN	AEROSPACE CORP
Michael Blackford	NRC/WMGT
DINESH GUPTA	NRC/WMEG
Atef Elzeftawy	NRC
M.S. Nataraja	NRC/WMEG
Ralph Stein	DOE/HQ
R L. Fish	RHO/BWIP
GEORGES V. ABI-GHANEM	EWA/YAKIMA
JOSEPH J. KRUPAR	DOE/RL/BWIO
Jeff Nelson	Weston
CANDACE BIDDISON	NNWSI/SAIC
JOHN KOVACS	DOE-BWIP
Jay Rhoderick	DOE-HQ
JEROME R PEARRING	NRC/WMEG
Kenneth W. Stephens	Aerospace Corp
Lil Pallinger	State of LA
Joe Palmer	LA. Geological Survey

[redacted]

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Name	Organization	
H. N. Kalia	Battelle / ONWI	6
R. John Byrne	Golder	2
J. Wittman	Utah	(8
Jan Perttu	"	
Stan Echols	DOE/OGC	
JOHN LINEHAN	NRC	301

NRC/DOE Meeting on SCP Section 8.3

October 29-30, 1985

Name	Organization
Kelly A. Haggard	Miss. Nuclear Waste Program
Don R. Christy	MS Nuclear Waste Program
T. C. Johnson	US NRC
John S. Trapp	US NRC
Jim Kennedy	USNRC
S. M. Coplan	USNRC/DWM
RS Wegeng	Rockwell Hanford Operations
Tom Baillieul	U.S. DOE - SRPO

NRC/DOE Meeting on SCP Section 8.3
October 29-30, 1985

Name	Organization
John Buckley	NRC/WMEG
David Brooks	NRC/WMGT
John T. Greeves	NRC/WMEG
King Stablein	NRC/WMRP
Robert C. Johnson	NRC/WMRP

CONTENT REQUIREMENTS FOR DESCRIPTIONS OF STUDIES IN CHAPTER 8 OF THE SCP

The following outline describes the information that will be provided in the SCP with regard to the plans for studies given in Section 8.3.1 through 8.3.4. A study may involve a single test or a set of tests and analyses, as appropriate. The tests include those measurements of physical parameters, or observations of physical phenomena, that are performed in the field or in the laboratory. Test activities include preparation of procedures, test set-up, conduct of the test, data acquisition and data reduction. The analyses referred to include those calculations or other evaluations needed to establish site characteristics and support design activities. Those analyses to address performance issues are not described in Section 8.3.1 through 8.3.4, but are described in Section 8.3.5.

The items listed in the outline will be addressed for studies, tests, and analyses to the extent that each item applies. Not all items will be applicable in all studies. Furthermore, judgment will be used in deciding at what specific location in Chapter 8 each of the items can best be addressed.

I. Purpose and Objectives

- Describe the information that will be obtained in this study. Briefly discuss how this information will be used to resolve issues.

- Provide the rationale and justification for the information to be obtained by the study. It can be justified by 1) a performance goal and a confidence level in that goal (developed via the performance allocation process and results that will be described elsewhere in the SCP), 2) a design goal and a confidence level in that goal (design goals beyond those related to performance issues) and/or 3) a direct federal, state, and other regulatory requirements for specific studies. Where relevant performance or design goals actually apply at a higher level than the study (e.g., where the goals apply to a group of studies), describe the relationship between this study and that higher level goal.

II. Rationale for Selected Study

- Describe the constraints (limits) that exist for the study, and explain how these constraints affect selection of test methods and analytical approaches. Factors to be considered include:

  - Potential impacts on the site from testing

  - Whether the study needs to simulate repository conditions

  - Required accuracy and precision of parameters to be measured with test instrumentation

  - Limits of analytical methods that will use the information from the tests

- Capability of analytical methods to support the study
- Time required versus times available to complete the study
- The scale of phenomena and parameters that need to be studied

- Provide the rationale and justification for the selected tests and analyses. Indicate the alternative test and analysis methods from which they were selected, including options for type of test, instrumentation, data collection and recording and alternative analytic approaches. Describe the advantages and limitations of the various options.

III. Description of Tests and Analyses

For each type of test:

- Describe the general approach that will be used in the test. Describe the key parameters that will be measured in the test and the experimental conditions under which the test will be conducted. Indicate the number of tests and their locations (spatial location on the site; and where the test is actually performed, such as the exploratory shaft, ground surface, laboratory).

- Summarize the methods to be used for the test. Reference any standard procedures (e.g., ASTM, API) to be used. If any of the procedures to be used are not standard, summarize the steps of the test, and reference the technical procedures document that will be followed during the test. If procedures are not yet available, indicate when they will be available. Indicate the level of quality assurance that will be applied to the test.

- Specify the tolerance, accuracy, and precision required in the test, where appropriate.

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

- List the equipment required to conduct the test and describe briefly any such equipment that is special.

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

- Discuss the representativeness of the test and indicate any limitations that will apply to the use of the results.

For each type of analysis:

- State the purpose of the analysis, indicating the testing or design activity being supported. Indicate what conditions or environments will be evaluated and any sensitivity or uncertainty analyses that will be performed.

- Describe the methods of analysis, including any analytical expressions and numerical models that will be employed.

- Identify the data requirements of the analysis.

- Describe the expected output of the analysis.

- Describe the representativeness of the analytical approach to repository conditions, and indicate any limitations that will apply to the results.

IV. Application of Results

- Briefly discuss where the results from the study will be used for the support of other areas of study, for use in performance assessment, and for use in design.

- For the support of other areas of study, refer to other investigations which use the information produced in the study described above.

- For performance assessment uses, refer to specific performance assessment analyses (described in Section 8.3.5) which will use the information produced from the studies described above, and refer to any use of the results for model validation.

- For design uses, refer to, or describe, where the information from the study described above will be used in engineering system design and development, construction equipment design and development.

V. Schedule and Milestones

- Provide the durations of and interrelationships among the principal activities associated with conducting the study (e.g., preparation of test procedures, test set-ups, testing, data analyses, preparation of reports), and indicate the key milestones associated with the study activities.

- Describe the timing of this study relative to other studies and other program activities, for those studies that will affect or be affected by the schedule for completion of the subject study.

  (Dates for activities or milestones for the study should not be provided. Only durations and interrelationships will be provided here; schedules will be provided in Section 8.5).

Attachment 3

DOE/NRC Meeting on

Strategy for Presentation of Planned Tests,
Analyses, and Studies, SCP Section 8.3

Tuesday, October 29, 1985
Forrestal Building
Washington, D.C.
Room 1E-245

AGENDA

DOE/NRC MEETING

Tuesday, October 29, 1985

STRATEGY FOR PRESENTATION OF PLANNED TESTS, ANALYSES, AND STUDIES, SCP SECTION 8.3

Washington, D.C.
Room 1E-245, Forrestal Building

9:00 a.m. DOE Introduction

9:15 a.m. NRC Remarks

9:30 a.m. DOE PRESENTATION ON STRATEGY FOR 8.3

- Headquarters' presentation
- Project Offices' presentation

11:30 a.m. NRC QUESTIONS

12:00 noon LUNCH

1:00 p.m. DISCUSSION OF STRATEGY FOR 8.3

- NRC Comments on Approach
- DOE Clarification

4:00 p.m. DEVELOPMENT OF SUMMARY RECORD OF MEETING

To be resumed Wednesday, October 30, 1985 at 9:00 a.m. in Room 5E-069, Forrestal, if necessary.

FOR ILLUSTRATIVE PURPOSES ONLY

BWIP

8.3.4.3.2.2.2 Uniform Corrosion Tests

Purpose and Objective. The uniform corrosion tests are planned for the purpose of characterizing the uniform corrosion behavior of candidate waste package container materials under conditions closely simulating the anticipated waste package environment. Preferential modes of corrosion (e.g., pitting, crevice, intergranular) will also be characterized if they are observed in these tests to help develop an understanding of the active corrosion processes as well as to account for their contribution to overall specimen weight loss in establishing the uniform corrosion behavior. The data needs that this testing helps satisfy are all related to "corrosion behavior of container materials" (SRT 2.1.1.4.1.1.1, SRT 2.1.1.5.2.1.1.1, SRT 2.1.1.5.3.1.1.1, SRT 2.1.2.1.2.1, SRT 2.1.3.1.1.1.1 and SRT 2.1.3.1.1.3.2.1).

The specific objective of the uniform corrosion tests is to generate uniform corrosion rate data over the range of conditions anticipated at the waste package container external surface in an NWRB. The data thus generated must provide the basis for the development of uniform corrosion predictive codes and accompanying statistical analyses to be used in waste package performance and design reliability analyses.

The data obtained from these tests will assist in addressing the performance allocation to the waste container, i.e., 1,000 year containment with a 90% reliability. The performance goal for uniform corrosion for alloy "x" shall not exceed a rate of ______/year for repository conditions with a confidence of ______.

Approach.

A. Constraints - The uniform corrosion tests are constrained primarily by time. The tests must be conducted in a time frame of "a few years" due to the limitations imposed by the need to develop a high-level nuclear waste repository as rapidly as possible. However, the container is required to have a design life on the order of "hundreds of years". As a result of this constraint, an understanding of the active corrosion processes will have to be developed in order to support corrosion predictive code development and extrapolate the short-term (10 yr) data to the time period required for radionuclide containment (300 to 1,000 yr).

B. Options - The two most significant options for uniform corrosion tests to establish the uniform corrosion behavior of container materials are the "immersion weight-loss" and "electrochemical polarization resistance" techniques. The BWIP has chosen the immersion specimen weight-loss approach using multiple specimens as the primary means of uniform corrosion measurement. Electrochemical polarization resistance measurements are made on a working electrode specimen (in the aqueous environment of interest) by imposing an electrochemical potential pulse (relative to a reference electrode in the same environment) of ±20mV from its freely corroding potential, and measuring the corresponding current response between the specimen and an auxiliary electrode. The nature of the current response can be related to the freely corroding current exchange density (thus the corrosion rate) for the specimen through parameters established from previously generated polarization scans on the same material.

Although very low, instantaneous corrosion rates can be determined using polarization resistance techniques, the disadvantages far outweigh the advantages for use as the primary option for investigating uniform corrosion behavior. High temperature and high pressure operation of reference, auxiliary and working electrodes over extended periods of time is expensive. The technique requires many times the number of autoclaves (one measurement system per autoclave) to obtain the statistically significant quantity of data required. Because of shifts in calibrations throughout a long-term test, the specimen weight loss that occurred during the test would need to be determined and used to "calibrate" the polarization resistance measurements taken throughout the test. Contributions to the measured specimen current response from any preferential corrosion would also have to be accounted for in the same way. Thus no assurance would be available that a meaningful rate was known until at the very end of the longest required time period test (unless many additional autoclaves and associated electrochemical cells were used). For all of these reasons, the uniform corrosion tests will be conducted by simple immersion weight loss techniques using pressure vessels and autoclaves as described below.

Description of Test. The uniform corrosion testing will be conducted in air/steam (with and without the reference packing material in contact with the specimens) and groundwater-saturated packing environments. Corrosion will be measured using pre- and post-test examination techniques (primarily weight-loss) on multiple specimens immersed in the simulated environments for various exposure periods. Exposure periods of up to 10 yr or more will be used to test container materials under conditions as close as possible to the anticipated waste package environment. Groundwater chemistry and oxygen concentrations will be allowed to equilibrate during these tests, to levels naturally governed by the basalt-bentonite system under test.

The vapor/hydrologic regime within the actual waste package is likely to be quite stagnant regardless of the situation in the repository host rock, because of the low permeability and other conditions imposed by the waste package bentonite/basalt packing material. Therefore, incorporation of the packing material in the test chambers, vessels and autoclaves is essential to the simulation of the waste package environment.

The uniform corrosion tests will be conducted in the temperature range of 50°C to 300°C and at gamma dose rates up to 3×10^5 Rad/hr. A ^{60}Co radiation facility is used to help assess the effects of a gamma field. The reference packing material is a mixture of 75 wt% crushed basalt and 25 wt% bentonite. Groundwater chemistry effects, including oxygen concentration, will be studies. Both static and flowing groundwater (groundwater flow rate controlled by diffusion through the packing) conditions will be investigated. Container material composition (i.e., for carbon steel: carbon, manganese and silicon) and microstructure (weldments, heat treatment, etc.) will be studied to establish needed controls, if any, to impose on the materials processing and container fabrication. The parameters that must be controlled, the required tolerances on applicable key parameters and a brief listing of the data produced by uniform corrosion tests are presented in Table 8.3.4.3.2.B.

Table 8.3.4.3.2.B. Summary of Data Produced, Control Parameters and Required Tolerances for Uniform Corrosion Tests.

Data Produced	Range of Parameters	Required Tolerances
o Uniform Corrosion Rate o Intergranular Corrosion Rate (If Applicable)	Temperature (50^{o} - $300^{o}C$)	T $\pm$ $5^{o}C$
o Pit Depth and Density Distribution (If Pitting Occurs) o Pit Growth Rate (If Pitting Occurs)	Groundwater Chemistry (Cl^-, F^-, SO_4, CO_3, O_2, etc)	GW Chem. $\pm$ 10% of concentration
	Flow Rate (Diffusion Controlled)	
	Material Microstructure: Wrought, Cast, Weldments, Heat Treatment	
	Material Composition: Carbon, Manganese, Silicon, etc.	Major Element Comp. $\pm$ 0.05% of total weight
	Radiation Dose Rate (Up to 3×10^5 Rad/Hr)	Rad $\pm$ 0.2 orders of magnitude
	Microbes	

Air/steam chambers will be used to simulate operational period (preclosure) environments. The air/steam chamber allows exposure of container material specimens (both with and without packing material contact with the specimens) to air/steam environments at temperatures ranging from 150°C to 300°C. The air/steam reference flow velocity is quite low (0.013 cm/s). The groundwater source tank is the humidifier. The humidifier feeds the chambers and is held at 50°C to simulate the host rock ambient temperature.

Sealed static pressure vessels (125 ml) are used to help simulate the anticipated post-closure, groundwater-inundated waste package environment. The static pressure vessels are assembled in an argon glove box. The vessels are fabricated from Grade 4 titanium. The groundwater oxygen concentration is reduced to __0.05 mg/L by sparging with argon prior to mixing the groundwater with the dry packing mixture (1.6 groundwater to packing material ratio by weight). The groundwater-saturated packing mixture is added to the vessel to fill approximately two-thirds of the vessel volume. As many as five replicate specimens are then placed into the packing in the vertical orientation with care taken to avoid contact with each other and the vessel wall. The vessels are sealed while still in the argon glove box to maintain the inert gas cover. Capabilities exist to use other cover gases (e.g., methane or nitrogen) to investigate the effects they might have on corrosion behavior. The vessels are heated in either an oven or with heating coil jackets to the desired test temperature.

Refreshed autoclaves (1 liter and 1 gallon) are used to simulate as closely as possible, the potential, "low-flow," saturated packing waste package environment. The refreshed autoclave tests are conducted by placing the specimens in packets (with 0.2 m sintered metal filters at each end) filled with groundwater-saturated packing material in the same manner described above for the static pressure vessels (using an argon glove box) or by direct placement of the specimens in the autoclave if a "no packing material" environment needs to be simulated. A reservoir contains the groundwater made up to a specified composition and sparged with either an inert gas or air. A positive displacement pump delivers water to the autoclave at a very low flow rate (net 5 mL/h max). The water flows through a bed of crushed basalt placed at the bottom of the autoclave prior to contact with the container material specimens in the specimen packets.

When the desired test duration has been achieved, in any of the test vehicles (air/steam chambers, pressure vessels or autoclaves), the specimens will be removed, visually examined and photographed if appropriate to provide a preliminary assessment of corrosion mode (e.g., uniform, pitting, intergranular). Sufficient sets of test specimens (four or five specimens per set) will be included initially in each type of test vehicle to provide at least five test durations (e.g., 1, 4, 10, 18, and 28 months). Specimen sets will be replaced as they are extracted. Selected specimens, generally triplicates or quadruplicates, will be stripped of their corrosion product films by immersion in a formaldehyde-inhibited hydrochloric acid cleaning agent. The specimens will be weighed, and the weight loss converted to metal penetration depth. The penetration depth is divided by time of exposure to report a "uniform corrosion rate". If preferential corrosion has occurred, it will be quantified using metallographic techniques and accounted for in reporting the uniform corrosion behavior. Selected companion specimens will also be prepared for X-ray diffraction, electron microprobe and scanning electron microscopy (SEM) examination to characterize their corrosion product films as a means of understanding the active corrosion processes. Such an understanding is essential to the eventual development of predictive codes that will be used for interpolating and extrapolating the container materials corrosion behavior.

In preparation for conducting long-term tests under anticipated conditions, statistically designed Plackett-Burman (Plackett and Burman, 1946, pp. 305-325) test matrices will be developed and used to investigate the effects of temperature, gamma dose rate, groundwater chemistry, oxygen concentration, microbes and material variables (chemistry and microstructure). These parameters will be varied over their reasonably anticipated range in an NWRB to determine the "most severe" combinations of conditions for uniform corrosion. These "most severe" conditions will be used to conduct long-term uniform corrosion tests.

Corrosion product layers developed on container materials in air/steam or high temperature groundwater environments may be protective in nature and subsequently result in lower corrosion rates at lower temperatures and other environments compared with uncorroded container material under the same conditions. To most realistically characterize and predict container material uniform corrosion behavior, sequential temperature/environment tests will be planned and performed to provide a data base for understanding the corrosion behavior of container materials with corrosion product films developed previously in a different environment and/or at a higher temperature.

Application of Results. The uniform corrosion test data will be used to help select and verify selection of container materials and to develop waste package container uniform and preferential corrosion predictive codes in the Performance Analysis and Reliability Analysis Work Requirements (see section 8.3.4.5.1). The Performance Analysis codes will be deterministic and the Reliability Analysis codes will be probabilistic in nature. The corrosion predictive codes that are developed in the Performance Analysis Work Requirement (deterministic codes) will be used in the waste package design process to establish corrosion allowances for the container thickness, with appropriate design safety factors, using a container design life requirement as the primary criterion. The container design will be analyzed using the Performance and Reliability Analysis corrosion codes as part of the overall waste package design analysis activity. Table 8.3.4.3.2.C summarizes the data produced and application of the data produced within the Container Materials Corrosion Test Work Requirement.

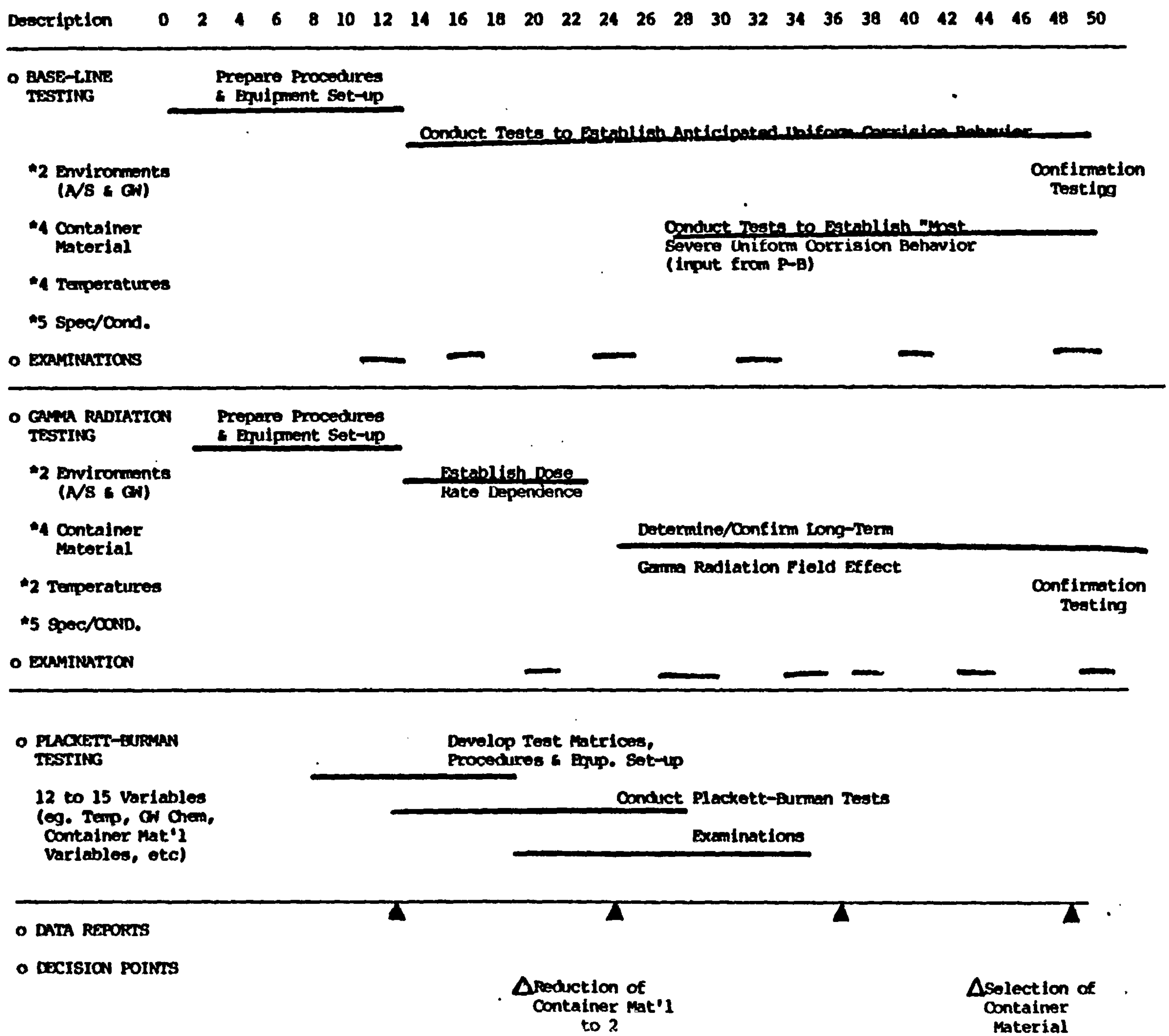
Schedule. Uniform corrosion testing is currently underway and will continue through preparation of the DEIS, License Application and the repository construction phase as appropriate. Raw data will be collected and documented in Data Aquisition Packages on an annual basis. Figure 8.3.4.3.2.D describes the major test variables and test durations to be investigated. Periodically (to be scheduled by FY), topical reports will be prepared which reduce the data and publish results. These results, in turn, will feed the following work requirements: Establish Design Requirements (B-24), Develop Waste Package Design (B-25), and Analyze Performance of Waste Package (B-28). These work requirements will iterate as the design progresses through Advanced Conceptual and License Application design phases.

TABLE 8.3.4.3.2.C. Container Materials Uniform Corrosion Testing Data and Application of Data

Work Requirement Identification	Test Identification	Data Produced	Application of Results
Container Materials Corrosion Testing	Uniform Corrosion Tests	o Uniform Corrosion Rate o Intergranular Corrosion Rate (If Applicable) o Pit Depth and Density Distribution (If Pitting Occurs)	(1) Provide basis for helping select a container material. (2) Corrosion allowances (container wall thickness) will be established in container design on the basis of corrosion behavior and requried container lifetime. (3) Corrosion data and mechanisms will be used with strength and ductility data to develop predictive codes for use in performance and reliability analyses.

(For Illustration Only)

FIGURE 8.3.4.3.2.D CONTAINER MATERIALS UNIFORM CORROSION TESTING



10/24/85

An Example of a Subsection of

SCP Section 8.3.1.

NNWSI

Including an Issue, and an Information Need Under that Issue to Show Level of Detail in the Investigations Discussion and the Test Descriptions within the Investigations

FOR ILLUSTRATIVE PURPOSES ONLY

8.3.1.3.2 Issue 4.2: What are the characteristics of the host rock and surrounding units that must be known to determine if construction, operation, and closure of a repository are feasible?

Four information needs have been identified which must be satisfied in order to resolve this Issue. The data required by these information needs are the stratigraphy of the site, the structural features present, the thermal and mechanical properties of each of the stratigraphic units and their spatial distribution within each unit, and the spatial distribution of ambient stress and thermal conditions.

Stratigraphic information (Information Need 4.2.1) is required in order to define the spatial extent of the proposed repository host rock unit, both in terms of areal extent and in terms of the thickness of the unit. In addition, stratigraphic units which occur between the repository horizon and the surface must be identified and their properties understood in order to design and construct a means of access to the repository horizon. Finally, the stratigraphic distribution of units surrounding the host rock unit must be known on a scale such that the spatial extent of the effects of a repository on the thermal, mechanical, geochemical, and hydrologic environment can be defined.

The locations and characteristics of structural features (Information Need 4.2.2) are important to the resolution of this Issue for several reasons. Such features affect the design process through effects on opening orientation, size, and shape. Fracture frequency and/or the presence of faults affects both the mining process itself as well as the support necessary to maintain stable openings for the life of a repository.

Thermal and mechanical properties and their spatial distribution (Information Need 4.2.3) play a crucial role in the determination of the response of the repository horizon and surrounding units to the presence of a repository and the resulting thermal and mechanical loads. The resulting estimates of temperatures and stresses as a function of time and position affect the design process through the need to maintain a safe and acceptable worker environment for the operational life of a repository, and the need to maintain the isolation capability of the site after closure.

The spatial distribution of ambient stress and thermal conditions (Information Need 4.2.4) must be known so that the stresses acting on opening support systems and the preexisting temperatures are known. Both of these pieces of data serve as initial conditions in calculations of the rockmass response to the presence of a repository. In addition, a knowledge of the ambient stress conditions aids in the interpretation of the stability of major structural features.

The resolution and accuracy with which these data are required are dictated both by design data needs as expressed in Chapters 6 and 7 and by performance assessment data needs as expressed in Section 8.3.5. These data needs result from the regulatory and functional requirements imposed upon the total repository system and its subsystems. Performance goals have been assigned to each of the subsystems and subsystem components which indicate the anticipated role of each subsystem and component in meeting the total system performance.

Taken together, the design and performance data needs are weighted by the goal of performance allocation to arrive at a required resolution and accuracy for each data need. At the parameter level these requirements impact the scope and details of the testing and analysis work as indicated in the description of investigations and tests below.

8.3.1.3.2.1 Information Need 4.2.1: Stratigraphy necessary to locate the underground facility.

(supplied by USGS)

8.3.1.3.2.2 Information Need 4.2.2: Locations and characteristics of structural features.

(supplied by USGS)

8.3.1.3.2.3 Information Need 4.2.3: Spatial distribution of thermal and mechanical properties.

<u>Why the Need Exits</u>

Thermal and mechanical properties of the proposed repository host rock and surrounding units that may be impacted by the presence of a repository are needed to satisfy parts of federal regulations 10CFR60 and 10CFR960. A knowledge of these properties is necessary to address the preclosure system guideline on ease and cost of siting, construction, operation, and closure, and the safety of repository workers (10CFR960.5-1(3)). In particular, these rock characteristics must be known to evaluate potential safety hazards associated with the characteristics and to evaluate for extensive maintenance implementation of costly engineering measures during repository construction and operation (10CFR960.5-2-9).

Rockmass mechanical and thermal properties must also be known to address the design criteria for the repositry in 10CFR60.133. Mechanical properties are important for determining the stability of openings and for evaluating the option of waste retrieval. Particular attention must be focused on the effects of thermally induced changes to rock mechanical properties, since artificial thermal loading is the primary difference between a repository and a conventional mine. The thermomechanical properties of the host rock must be known in order to evaluate the effects of the thermal load on rock stability during the period prior to and following final closure.

Technical Basis for Addressing the Information Need

Parameters to be investigated

Thermal properties:	thermal conductivity, heat capacity, thermal expansion coefficient
Mechanical properties:	tensile strength, compressive strength, elastic moduli, fracture properties, density, porosity

This suggests two categories of investigations: (1) Thermal properties investigations, and (2) Mechanical properties investigations. Within each category both laboratory and field (in situ) testing will be conducted.

Logic

Thermal properties (thermal conductivity and heat capacity) must be characterized so that the temperature field created by the presence of heat-producing waste can be calculated. Thermal conductivity, heat capacity, and density are used in the heat conduction equation to calculate the temperature field induced by the presence of heat-producing waste. Combination of the temperature field, the thermal expansion coefficient, and elastic moduli allows the calculation of thermal stresses in the rockmass. Knowledge of the mechanical properties and of the size and shape of the underground openings allows the calculation of mechanical stresses induced by the presence of the openings. Superposition of the thermal and mechanical stresses onto the preexisting in situ stresses (IN 1.3.4 and IN 4.2.4) and comparison of these total stresses to the strength of the rockmass allows calculation of factors of safety and estimation of opening stability.

Mechanical properties (compressive strength, tensile strength, elastic moduli, and fracture properties) are necessary for the determination of opening stability, whether the opening be a drift, shaft, or waste emplacement hole. Estimation of the future values of these properties, even during the operational life of the repository prior to closure, requires an evaluation of the changes in the properties, if any, induced by changes in the temperatures and stresses in the rock with time.

Although not strictly thermal or mechanical properties, the spatial distribution of both density and porosity is useful to the resolution of this information need. Density is used in the calculation of vertical in situ stress, in the calculation of temperature fields induced by the presence of waste, and in calculation of radionuclide retardation. Porosity is used both directly and indirectly. The direct uses include the calculation of groundwater velocities and travel times, the calculation of heat capacity, and estimation of radionuclide retardation of diffusion. In addition, calculational models have been developed that relate compressive strength, Young's modulus, and thermal conductivity to porosity, so that these properties can be estimated indirectly through a knowledge of the value of porosity. In the Investigation Descriptions that follow, density and porosity will be included under mechanical properties.

Properties discussed so far are not constrained to be values of the rock matrix (intact rock). Most of the properties, in fact, should be evaluated for both the intact rock and for the rockmass. This latter evaluation requires in situ measurements as well as extrapolation from intact rock values through the use of empirical relationships.

Not only do all of these properties need to be determined, both for intact rock and for the rockmass, but the variation of the properties with location beneath the mountain must be estimated so that stability of mine openings (drifts, shafts, and waste emplacement boreholes), as well as containment and isolation, can be assured throughout the repository area. This spatial variability applies for both the vertical and horizontal directions.

When these parameters of thermal and mechanical properties are sufficiently determined for the host rock and surrounding units, estimates can be made of the response of the rock to the presence of a repository. These estimates affect the design process through the need to maintain a safe and acceptable working environment for the operational life of the repository, and the need to maintain the isolation capability of the site after closure. The level of sufficiency of data will be determined iteratively through performance assessment modeling, and when that level is reached the Information Need is satisfied.

Basis for required accuracy of parameters measured

For post-closure performance purposes, the natural barrier (site) subsystem has been assigned a performance goal of ___ percent in meeting the performance requirement on isolation of radioactive materials from the accessible environment. The waste package and other engineered barriers are in a reserve or redundant status with a combined performance goal of ____ percent. Preliminary performance assessment indicates that the thermally induced stress field resulting from the emplacement of heat-producing waste, when superimposed on the prior-existing ambient stress field, must not result in rockmass displacements, or other "failure," sufficient to increase the water flux in the unsaturated zone and through the repository horizon by more than one order of magnitude (see Issue 1.12, Section 8.3.5.2.1.1).

For the reserve or redundant waste package performance, this same total stress field shall not cause emplacement hole instabilities sufficient to reduce the waste package lifetime below the goal of ___ years (Issues 1.9 and 1.13, Sections 8.3.4. . and 8.3.5.2.1.2, respectively).

For preclosure performance purposes, the site subsystem has been assigned a performance goal of ___ percent in meeting the functional requirement for underground opening stability. That is, the goal is to have stable openings during the construction, operational, and retrieval life of the repository. A reserve or redundant role is assigned to the repository subsystem in the form of support systems (e.g., roof bolts.)

There are three components of the accuracy with which the spatial distribution of thermal and mechanical properties must be determined to meet the performance goals:

1. measurement accuracy for individual tests.
2. spatial distribution of samples to be tested.
3. interpolation of data between sample locations.

An uncertainty of less than 5 percent is typical for the laboratory measurement of density, porosity, and the thermal properties listed above (reference Chapter 2). Further, experience indicates there is no significant difference between laboratory and in situ measurements of these properties, which means that these properties do not depend on scale or sample size. Uncertainties in the measurement of mechanical properties show more scatter between samples of like size, and a pronounced sample size dependency (reference Chapter 2). As a consequence, sample size effects for mechanical properties must be characterized where access is available in the Exploratory Shaft Facility for large samples which will yield rockmass properties. Then results from core samples taken from outlying boreholes can be "corrected" to the rockmass equivalent values.

The spatial distribution of wellbores from which to select samples has been determined using existing core and wellbore data from the site (see Chapters 1 and 2), requirements for design (see Chapter 6), and professional judgement. A detailed description of the locations of the test borings is included under Information Need 1.3.1 above. The distribution is not uniform, but rather depends on known structural features, and the distance between adjacent wellbores does not exceed _ km in general. Selection of sample frequency from the wellbores for individual test suites is discussed under appropriate test descriptions below.

Planned Investigations (Tests, Analyses, and Studies)

Issue 4.2 requires information about the characteristics of the host rock and surrounding units that must be known to determine if construction, operation, and closure of a repository are feasible. This required information is essentially identical to the present characteristics of the site that must be known to determine compatibility with containment and isolation under Issue 1.3. Consequently, the spatial distribution of thermal and mechanical properties required under both Issue 1.3 and 4.2 are identical. As a result, the rationale for the data required and the description of tests and procedures to be used in acquiring the necessary data are the same. The discussion below, then, is repetitive from the discussion under Information Need 1.3.3 (Section 8.3.1.3.3).

The testing activities required for the thermal properties and mechanical properties investigations and the parameters addressed, are listed in table 8.3.1.3.2-1. Both categories of investigations require a combination of laboratory and field (in situ) tests. In general, the laboratory testing permits the convenient examination of a sufficient number of samples to establish a statistical basis for accuracy and confidence in the results, both for samples at a given location and for the spatial distribution of sample locations. The in situ tests permit examination of the effects of sample size to a scale not achievable in the laboratory.

For those work activities where test procedures and standards exist and are well known, the test descriptions below will be very brief. The reader is invited to consult the referenced published procedures for detailed information. For those work activities where test procedures are either nonstandard or unpublished, a detailed test description will be given here.

TABLE 8.3.1.3.2-1: SUMMARY OF INVESTIGATIONS AND PARAMETERS

Investigation	Test/Analysis	Parameters Addressed
4.2.3.1 Thermal Properties		
	Heat Capacity Tests	Heat Capacity
	Thermal Conductivity Tests	Thermal Conductivity
	Thermal Expansion Tests	Thermal Expansion Coefficient
	Canister-Scale Heater Tests	Thermal Conductivity Thermal Expansion Coefficient
	Small-Scale Heater Test	Thermal Conductivity Thermal Expansion Coefficient
	Heated Block Test	Thermal Conductivity Thermal Expansion Coefficient
4.2.3.2 Mechanical Properties		
	Compression Tests of various sized samples	Compressive Strength
	Tensile Strength Tests	Tensile Strength
	Tests for Anisotropy	Compressive Strength
	Fracture Properties Tests	Fracture Properties
	Parametric Sensitivity Tests	All Parameters
	Spatial Variability Tests	All Parameters
	Compression Tests of Lithophysae-rich Tuff	Compressive Strength
	Shaft Convergence Tests	Elastic Moduli
	Plate-Loading Tests	Elastic Moduli
	Slot Strength Tests	Compressive Strength
	Heated Block Test	Elastic Moduli Fracture Properties

Investigation 1: Thermal properties

Purpose and Objectives

The thermal properties to be determined are the thermal conductivity, heat capacity, and thermal expansion coefficient, and their variation and distribution within the Topopah Spring Member, the host rock, and in surrounding units (Table 8.3.1.3.2-1). The need for this information is discussed in detail above under "Technical Basis for Addressing the Information Need". This need includes meeting the performance goals set for preclosure performance of the site and repository and the goals set for the postclosure performance of the natural barriers (site). Thermal properties data will be compared with the pre-established performance goal that there is a ___ percent level of confidence in meeting the functional requirement for underground opening stability.

Strategy

The tests and analyses necessary to define the spatial distribution of thermal properties are summarized in Table 8.3.1.3.2-1. These tests consist of laboratory analyses of samples taken from the exploratory shaft breakout rooms and lateral core from the shaft, and in situ experiments performed in the exploratory shaft facility (ESF). The laboratory tests are heat capacity tests, thermal conductivity tests, and thermal expansion tests. The in situ experiments are a canister-scale heater test, a small-scale heater test, and a heated block test.

Since the laboratory tests are all performed on the same suite of samples, the tests will of necessity be done in series. The tests in the ESF will be conducted in the upper and lower demonstration breakout rooms (DBR), and will be run concurrently and independently of each other.

The laboratory tests that were chosen for this investigation use standard, well-known procedures, and were designed to provide precise data within the ranges of expected results. The choice of in situ tests in the ESF was made on the basis of experience in the G-Tunnel facility, where these and other in situ experiments were performed on tuff similar to the host rock in the Topopah Spring Member (Zimmerman, 1973). The three tests described here have been shown to provide the range of values expected in the host rock tuff.

One of the constraints on in situ thermal testing is that the measurements are to be focused on the rock mass surrounding the waste-package system. It is assumed that the waste-package system will have an outer metallic boundary, which could be a borehole liner or overpack. It is further assumed that there will be a small air gap with no packing materials between the outer metallic boundary and the inside surface of the emplacement hole; thus, there will be primarily radiant heat transfer between these surfaces. As designs evolve, it is expected that some of these conditions will change, and it is intended that impacts of these decisions will be factored into this investigation so that it will continue to be relevant to NNWSI needs.

Description of Tests and Analyses

1. Heat capacity tests: samples of tuff units expected to be within the zone of elevated temperature around a repository will be tested in the laboratory using ASTM procedure HC-R-123 (Heat Capacity Test Procedures for Rocks) to determine heat capacity as a function of temperature and mineralogy. Samples of the welded Topopah Spring Member (both lithophysae-rich and lithophysae-poor), the vitrophyre of the Topopah Spring Member, a nonwelded vitric ashflow of the Topopah Spring Member, and zeolitic ashflows of the Tuffaceous Beds of Calico Hills are included in the sample suite.

   Tests on twenty samples taken from these units in the Exploratory Shaft Facility are expected to confirm the existing data (see Chapter 2) which show that heat capacity (per unit dry mass) has a vertical variation of less than 10 percent within any tuff unit. Lateral variations across the site within any tuff unit will be checked with one sample from each of the tuff units from four coreholes at the extremities of the central block. Results are expected to confirm that the lateral variation of this property is of the same order as vertical variation within a given tuff unit.

   These tests are also expected to confirm existing data which show that the heat capacity per unit of dry rockmass varies less than 15 percent between all tuff units in the formulation at the site. Thus, while calculated estimates of temperature profiles around emplaced waste containers is linearly dependent upon the value for heat capacity, the effect of vertical and lateral variations in this parameter are expected to be less than the apparent variations which are judged to be small.

2. Thermal conductivity tests: these laboratory tests will be conducted on the same suite of 20 samples used for the heat capacity tests described above. This practice is acceptable under the ASTU procedures TC-R-456 (Thermal Conductivity Test Procedures for Rocks), which produce individual test sample uncertainties of less than 5 percent. Both vertical and lateral variations of this property within a given unit is expected to be less than 10% based on existing data. Variations between tuff units are expected to be as much as 50 percent, however. As a result, it is necessary to appropriately define unit interfaces for calculational purposes (see IN 4.2.1 above).

Thermal conductivity, because it is not defined on a per unit mass basis, is expected to show a correlation with porosity or bulk density, discussed below under mechanical properties investigations.

3. Thermal expansion tests: these laboratory tests will be conducted on the same suite of 20 samples used for the heat capacity and thermal conductivity tests described above, a practice acceptable under ASTM procedures TE-R-789 (Thermal Expansion Test Procedures for Rocks). Individual test sample uncertainties using these procedures are less than 10 percent. Variations in this parameter are expected to be

less than 10 percent, both laterally and vertically within any tuff unit, based on existing data. Variations between tuff units are expected to be as much as 50 percent.

4. Canister-scale heater: in situ values of thermal conductivity and thermal expansion coefficient will be obtained in the Lower Demonstration Breakout Room. (More detail needed here, test description to be pulled from ESTP).

5. Small-scale heater experiment: The Small-Scale Heater Experiment is to be performed in the upper DBR primarily for the purpose of establishing the validity of a thermal model for the high lithophysal-rich tuff. Three small-scale experiments, conducted in the G-Tunnel Underground Facility, have demonstrated that a thermal model emphasizing conduction in the rock mass and radiation across the air gap between the heater and the surrounding rock mass is sufficient to describe the thermal behavior of both welded and nonwelded tuffs. [Zimmerman (1983) reported on two experiments]. In each of these experiments, it was found that laboratory-based thermal properties could be used as input for models. No experiments like this have been performed in the lithophysal-rich tuffs found in Yucca Mountain and the purpose of this experiment is to determine whether laboratory properties are sufficient for input into a thermal model of such rock.

The objectives for the Small-Scale Heater Experiment in the upper demonstration breakout room (DBR) are:

(1) to evaluate the thermal behavior of welded tuff with high lithophysal-void contents in order to establish laboratory-field scaling relationships needed for repository designs and performance assessment calculations;

(2) to evaluate the thermomechanical expansion in a direction parallel to the heater to verify laboratory-field scaling assumptions used by repository designers; and

(3) to monitor the possible moisture migration patterns around the heater and assess possible gravity influences that might affect either waste-package or near-field performance assessment calculations (included as a continency).

The experiment is designed so that emplacement-hole temperatures representing 1 year of operation at the canister scale can be reached in approximately 1 month. Thus a 1-month operation period can be used to validate the thermal model and provide useful documentation of the hydrothermal phenomena associated with start-up of the heater.

Emplacement-hole temperature measurements taken as a function of time and position along the hole, provide the most useful information as to the thermal an hydrothermal performance of the rock. Measurements of the temperature as a function of time are compared with results from thermal model calculations for one part of the thermal model validation process. Temperatures near the heater midplane represent the highest rock temperatures and are the key quantities used. Thermocouples located on the bottom surface of the emplacement hole should monitor any water flow in the hole.

Temperature measurements in the rock mass outside the emplacement hole aid in the interpretation of the thermal conductivity of the rock and are used to confirm the model predictions. Rock-mass temperatures also can be used to define the movement of the vapor front out into the rock mass. Definition of the vapor front movement as a function of time is an important factor in the analysis of the thermal model.

A third data item is to monitor changes in in situ water contents. These data account for the dewatering of the tuff as the vapor front moves out into the rock and are detected using a neutron probe. These data are a useful reference for those who are performing thermal-hydrological calculations (see "Where the Information will be used").

Deformation measurements are used to determine the coefficient of thermal expansion in order to confirm that laboratory-scale data are valid at the upper level. The planned measurements are one-dimensional. It is expected that the thermal-expansion coefficient will be isotropic in the lightly fractured tuff in the region of testing. so one-dimensional testing should suffice. Follow-up laboratory testing will be used to confirm this assumption.

The Small-Scale Heater Experiment is formed by placing a heater in a cylindrically shaped emplacement hole and operating the heater at power levels that increase the temperature of the surrounding lithophysal-rich tuff to relatively high values. A relatively small volume of tuff, 0.3 m^3 (10 ft^3), is heated up, yet sufficient volume exits to make the desired measurements in a manner of weeks. Temperature measurements are taken along the surface of the heater, along the surrounding emplacement hole, and in three boreholes in the surrounding rock mass that are parallel to the heater. Thermocouples are located at specific measurement locations in the rock mass so that the thermal responses can be determined for purposes of evaluating the effectiveness of a thermal model for this material.

The dimensions used, power levels set, and testing period in this experiment are related to the Canister-Scale Heater Experiment (previously described) through scaling laws. This experiment is not precisely scaled to the canister scale, but it is representative. The key scaling quantity is maximum temperature at the boundary of the heater emplacement holes in both experiments. The dimensions of this experiment are such that the temperature reached in the smaller experiment in 8 days corresponds to a 3-month testing period at the canister scale. Also power levels of 1000 W in the smaller experiment scale to over 2600 W at the larger scale. Thus, the power levels selected and durations for testing for this experiment have been selected to closely represent the Canister-Scale Heater Experiment.

The emplacement hole will have sensors to detect the presence of water in liquid and vapor states. An additional hole will be drilled parallel to the heater hole so that a neutron probe can be used to monitor the changing moisture contents of the tuff around the heater.

Finally, two multiple-point borehole extensometer (MPBX) units will be installed in other boreholes that are parallel to the heater and within a radius of 0.25 m from the heater centerline. The MPBXs will have anchors located in the borehole so that the thermal expansion parallel to the emplacement hole can be measured. Figure 8.3.1.3.2.1 shows views of the heater and instrumentation layouts. The Small-Scale Heater Experiment is patterned after small-diameter heater experiments that were conducted in the G-Tunnel Underground Facility (Zimmerman, 1983). The experiment is to be located in the rib of the upper DBR. The heater emplacement hole will be located after the rib has been mapped for geological features.

Field preparations for the Small-Scale Heater Experiment consist of diamond drilling a horizontal hole 12.7 cm (5 in.) in diameter and 2.4 m (8 ft) long. The first 15 cm (6 in.) of the hole is drilled to a diameter of 20 cm (8 in.) to facilitate attachment of the heater pressure unit (HPU).

The heater unit consists of the heated section, the insulation section, and the terminal section. The heater contains two horseshoe-shaped heater elements. The insulation section serves to contain the heat in the heater section while gradually allowing the upper portions of the heater elements to dissipate heat. The terminal section is the location for all electrical lead connections.

The heater pressure unit serves to isolate the top of the heater hole from the surrounding environment. All electrical leads extend through the HPU and are sealed to prevent moisture loss. Pressure and relative humidity for the emplacement hole are measured in the HPU.

Eighteen thermocouples are located along the length of the heater unit. They are located in three lines spaced at 120° around the cylindrical surface. Five additional thermocouples are located inside the heater to monitor the element temperatures and transition temperatures in the insulated region. Twelve thermocouples are located along the emplacement-hole surface, above the heater and six below, all in a vertical plane. A total of 12 thermocouples are to be located in three EX-size diamond-drilled holes parallel to the heater hole as shown in Fig. 5.4-1.

The thermal portion of the experiment is to be evaluated by comparing the temperatures along the emplacement hole and in the rock mass with those predicted from a thermal conduction model. The predicted temperatures will be based on the utilization of laboratory-determined thermal properties and the heat fluxes planned for the experiment.

Table 8.3.1.3.2-X summarizes the instrumentation requirements.

TABLE 8.3.1.3.2-x INSTRUMENTATION REQUIREMENTS

Data Item	Test Method	Procedure	Parameter Measured	Expected Value
Emplacement-hole temperature	Thermocouple	SNL-TBD	Temperature	<350°C
	Relative humidity	SNL-TBD	Relative humidity	≤100%
	Pressure	SNL-TBD	Pressure	<7KPa
Rock-mass temperature	Thermocouple	SNL-TBD	Temperature	<250°C
In Situ water content	Neutron probe	SNL-TBD	% Saturation	<100%
Thermal-expansion measurements	Deformation measurements	SNL-TBD	Deformation	<1 mm

Instruments to be continuously monitored by the Integrated Data System (IDS) are the thermocouples, heater power monitors, relative humidity, HPU pressure, and MPBXs. All raw data will be logged into the IDS, and converted data will be stored in Winchester hard disks operated by an HP 9845-based system that is part of the IDS. Predetermined and precalibrated conversion factors will be prepared for necessary unit conversions and temperature compensations. These will be contained as part of the experiment preparations.

Data Analyses

Thermal Scale Effects

A steady-state heat flow model using axisymmetric geometry can be used to describe the temperature phenomena associated with this experiment.

The experiment is to be evaluated by comparing the measured temperatures with the predicted temperatures. Predicted temperatures will be based on th staged power thermal loadings discussed earlier. The thermal model will be based on the staged power thermal loadings discussed earlier. The thermal model will be considered to be valid if the maximum temperatures predicted are within 15% of those measured; 15% is a value deemed achievable based on G-Tunnel testing. If this goal is not achieved, then the thermal properties in the model will be varied until this condition is reached. While the properties are being varied, thermal profiles, both measured and predicted, will be compared and evaluated for diagnostic purposes. The goal will be to adjust the thermal properties using feedback from other measurement-prediction comparisons so that the resultant calculations will conform to observed phenomena. When the maximum temperature compliance has been achieved, an assessment will be made as to whether the differences are due to scaling factors, model limitations, or unexpected phenomena. Larger tuff samples will be extracted from the upper DBR region and subjected to laboratory thermal property measurements to confirm the hypothesis, if necessary.

Hydrothermal Phenomena

A mass accountability of hydrothermal phenomena have not proven to be quantifiable in previous small-diameter heater experiments, yet qualitative phenomena descriptions have helped establish the expected environment that the rock mass is expected to provide. Hydrological phenomena appear to be governed by the *in situ* geological and hydrological conditions. It is planned that any hydrothermal phenomena will be monitored so that data and observations will be available to those involved in the design of the waste package.

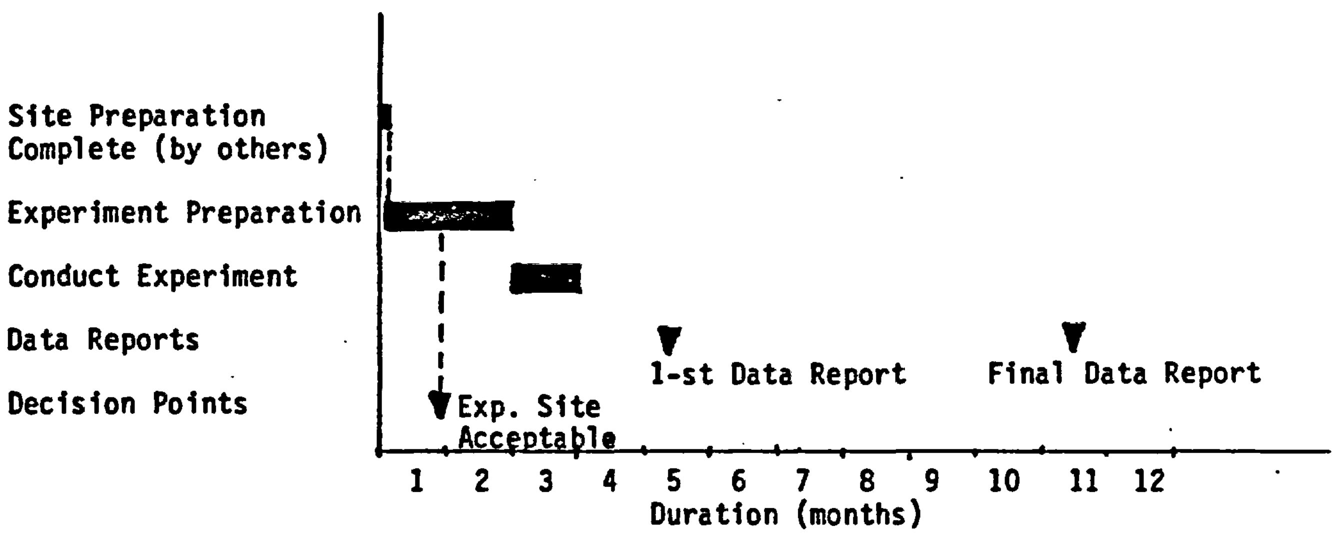
Thermomechanical Phenomena

The objective in this effort is to verify that laboratory-scale thermomechanical data are valid for this lithophysal-rich tuff. The heater experiment is to be modeled with a jointed rock continuum model. Anchor displacements will be predicted in the model and these will be compared with those measured. Laboratory properties will be used until field values from other measurements are available. G-Tunnel experience indicates that the only related property that may be sensitive to fractures is the modulus of deformation.

Unless there are unusual geologic features in the vicinity of the heater, it is expected that the model-measurement displacement comparisons will be within 20%, a value used as a target for the Canister-Scale Heater Experiment. Confidence is placed in this limit because of the expected paucity of fractures in the lithophysal-rich tuff. If this desired goal is not achieved, then model parameter modification procedures similar to those discussed with the thermal modeling will be pursued.

Schedule and Milestones

The duration of the small-scale heater test and the dependencies of the test on other activities is shown in the following graph.



6. Yucca Mountain heated block: in situ values of thermal conductivity, coefficient of thermal expansion, deformation modulus, and fracture properties will be obtained. (More detail is needed on test description to be pulled from ESTP).

Investigation 2: Mechanical Properties Investigations

Purpose and Objectives

The mechanical properties to be determined are the tensile strength, compressive strength, elastic moduli, and fracture properties of the host rock in the Topopah Spring Member, and of surrounding units (Table 8.3.1.3.2-1). The need for this information is discussed in detail above under "Technical Basis for Addressing the Information Need". This need includes meeting the performance goals set for preclosure performance of the site and repository and the goals set for the postclosure performance of the natural barriers (site).

Strategy

The tests and analyses necessary to define the spatial distribution of rock mechanical properties are summarized in Table 8.3.1.3.2-1. These tests consist of laboratory analyses of samples taken from the exploratory shaft and breakout rooms, and in situ experiments performed in the exploratory shaft facility. The laboratory tests consist of compression tests of various sample sizes, tensile strength tests, tests for anisotropy, fracture properties tests, parametric sensitivity tests, spatial variability tests, and compression tests of lithophysae-rich tuff. In situ tests include shaft convergence tests, plate-loading tests, slot strength tests, and a heated block test.

[sequencing of tests]

[justification of choice of tests]

[limits and constraints]

Description of Tests and Analyses

1. Compression tests of various sample sizes: a minimum of 26 samples of welded Topopah Spring Member of five different sizes will be tested in compression to determine the effect of sample size on compressive strength and Young's modulus. All samples will be taken from the ES facilities to permit acquisition of the necessary range of sample sizes from adjacent locations.

   [additional material to be added]

2. Tensile strength tests: a minimum of six samples of the welded Topopah Spring Member will be tested by the direct pull tensile test to determine tensile strength. Samples will be approximately 2 in. by 4 in. dog-boned cylinders. Test results will be compared to data from Brazil indirect tensile tests (Blacio et al., 1982).

[additional material to be added]

3. Tests for anisotropy: a minimum of four samples of the welded Topopah Spring Member will be tested at each of four orientations to the dominant rock fabric. Samples will be 2 in. by 4 in. cylinders, and will be tested in compression under ambient pressure and temperature, at a strain rate of 10E-5 s-1 with complete saturation. All samples will be taken from the same location in the ES facility.

[additional material to be added]

4. Fracture properties tests: approximately 165 tests will be performed on 90 samples of fractures (both natural and artificial) in the Topopah Spring Member to measure normal stiffness, shear stiffness, shear strength, and the coefficient of friction as a function of temperature, surface roughness, slip rate, the presence or absence of gauge, and the effective stress normal to the fracture plane. all samples will be taken from the ES Facility where samples of sufficient size can be retrieved.

[additional material to be added]

5. Parametric sensitivity tests: 60 samples of the welded Topopah Spring Member will be tested to determine the effects of variations in pressure, temperature, strain rate, saturation, and sample size on mechanical properties. Samples will be obtained from the Exploratory Shaft, and will be tested in compression.

[additional material to be added]

6. Spatial variability tests: four samples from each of the tuff units in the Exploratory Shaft, and a minimum of four outlying coreholes, will be tested to determine the density, porosity, elastic moduli, tensile strength, compressive strength, and fracture properties. Results will be used to assess vertical and horizontal property variability within the repository area.

[additional material to be added]

7. Compression tests of lithophysae-rich tuff: 20 samples of lithophysae-rich Topopah Spring Member will be obtained from the Exploratory Shaft and tested in compression. Two sample sizes will be tested. Results will be used to confirm and extend test results on samples from surface outcrops.

[additional material to be added]

8. Shaft convergence tests: in situ values of deformation modulus (correlative with Young's modulus for intact rock) will be determined in three locations in the Exploratory Shaft.

[description from ESTP]

9. Plate-loading tests: in situ value of deformation modulus will be obtained in both Demonstration Breakout Rooms.

[description from ESTP]

10. Slot strength tests: in situ values of rockmass strength will be obtained in both Demonstration Breakout Rooms.

[description from ESTP]

11. Heated block test: in situ values of thermal conductivity, coefficient of thermal expansion, deformation modulus, and fracture properties will be obtained.

[description from ESTP - may be moved under Thermal Properties Investigation 1 above]

Where the Information Will be Used

This Information Need is identical to Information Need 1.3.3 under postclosure characterization Issue 1.3, and the parameters and investigations are the same for each. The difference lies in the reason for, and application of, the data that is obtained for each. Use of this information to address postclosure issues has been described under Information Need 1.3.3 (section 8.3.1.2.3.3) and will not be repeated here. Use of this Information Need (i.e. 4.2.3) to support preclosure Issues and Information Needs is explained here.

In general, the thermal and mechanical properties determined for this Information Need will be used to help resolve repository design issues and preclosure performance assessment issues. The host rock mechanical properties are necessary for repository design to ensure non-radiological health and safety during construction and operation (Issue 4.6). The thermal and mechanical properties provide input to Information Needs 4.7.1 and 4.7.4, which address the issue of reasonable available technology (Issue 4.7). These data will also be required to determine if the repository system will be cost-effective (Issue 4.8).

Preclosure performance assessment Issues that require data from this Information Need include the Issue of waste retrieval (4.9) and assessment of meeting the higher-level findings of 10CFR960 (Issue 4.10). Thermal expansion data and other rock mechanical properties will be used to ascertain if the waste retrieval option can be maintained throughout the preclosure period of the repository. The mechanical properties of the host rock will be used to evaluate the higher-level finding for ease and cost of siting, construction, operation, and closure of the repository.

Schedules and Milestones

Investigation	Milestone Number	Milestone Level	Milestone Description	Delivery Date
Thermal Properties	N494	II	Thermal Expansion Report	5/31/86
	N602	II	Report on Small-Scale Heater Test	8/8/89
	M631	II	Report on Heated Block Test	2/1/90
	M691	II	Report on Canister Scale Heater Test	2/5/91
Mechanical Properties	N496	II	Fracture Properties Report	9/30/86
	M620	II	Shaft Convergence Report	5/27/88
	M065	II	Report on Lithophysae Testing	12/1/88
	M067	II	Report on Parametric Sensitivity Tests	4/1/89
	N600	II	Report on Slot Strength Test	10/5/89
	M697	II	Report on Plate-Loading Test	12/6/89
	M631	II	Report on Heated Block Test	2/1/90

FOR ILLUSTRATIVE PURPOSES ONLY
MINE-BY TEST

SRPO

I. PURPOSE AND OBJECTIVES

The primary issues addressed by the Mine-By Test are the design, construction (excavation and support) and maintenance of waste disposal rooms and access drifts, together with the pre-closure stability of such openings under ambient temperature conditions. The response variables that will be monitored during and following the excavation process are stress change and deformation. These data will be compared with the corresponding predictions of geomechanical model studies for validation of the models used to predict the room-scale, ambient temperature rock mass response. Room closure data will be compared with a pre-established performance goal which is that there is a percent level of confidence that the average rate of room closure is between millimeters/year and millimeters/year. Data will also be gathered on other response characteristics, such as bedding plane separation, which are more difficult to predict quantitatively. The presence and extent of mechanical damage caused by excavation will be determined by direct sampling, testing and observation.

The justification for the information to be obtained from the Mine-By test is contained in the following federal regulatory requirements:

10CFR960.5-2-9 Rock Characteristics [(a)(2), (b)(2), (c)(2), (c)(3), (d)]
10CFR60.122 Siting Criteria [(c)(20), (c)(21)]
10CFR60.133 Additional Design Criteria for the Underground Facility [(e), (f)]

II. RATIONALE FOR SELECTED STUDY

Although data from the Mine-By test will be used for geomechanical model validation purposes, there are aspects of behavior (e.g., impacts of bedding planes on room stability) which are less amenable to numerical analysis. A full-scale demonstration of the response of a simulated repository room is therefore required to adequately define expected behavior of the underground openings under ambient temperature conditions. The layout of the Mine-By test, consisting of a series of parallel rooms with room and pillar dimensions equivalent to those planned for the repository (see Figure) will therefore duplicate a sub-element of a repository waste disposal panel.

A significant constraint of the Mine-By test is the representativeness of the test room to the repository at large. This constraint will be partially overcome by developing an extensive database through monitoring the mechanical performance of the test facility excavations in general, and correlating performance with observed geological/geomechanical conditions. Because it will not generally be possible to pre-instrument the test facility excavations, however, much early-time data will be lost. The Mine-By test will, therefore, provide the opportunity for baselining the more extensive, but less complete, information obtained elsewhere throughout the test facility. This will be achieved by pre-instrumenting the Mine-By test room from the adjacent rooms (observation galleries) prior to excavation. A further constraint for the Deaf Smith County site is the inability to construct an observation gallery above the Mine-By test room, and this will limit the quality of the instrumentation coverage which can be installed in the roof area before the room is excavated.

Since full-scale demonstrations are required to fully define room stability/deformational response, as noted above, the only practical alternative to the Mine-By test is to rely on mechanical response monitoring of the other full-scale excavations in the test facility at large. This would result in a no baseline condition (i.e., total response evaluation from essentially the virgin state), and could complicate evaluation of the data. There is little advantage to eliminating the Mine-By test in this manner, as excavation schedules can be organized such that the requirement for pre-instrumentation will have minimal schedule or cost impacts on the ESF construction.

There are no potential impacts on the site from such testing which are different from those posed by the repository excavations in general.

III. TEST DESCRIPTION

The Mine-By test will consist of a single pre-instrumented simulated waste disposal room, with observation galleries located on either side which simulate adjacent rooms within a typical repository panel. The test will be located within the ESF as indicated in Figure . Only ambient temperature response will be evaluated and the effect of heat on the room performance will be studied by the Room Heater test.

The virgin in situ stress, which is a key parameter for interpreting the Mine-By test response, will be determined as outlined in Technical Procedure . Following excavation of the adjacent observation rooms, displacement (extensometer and inclinometer), temperature, and stress change monitoring instrumentation will be installed at three instrumentation stations along the length of the test room as indicated in Figure y. The relevant procedures for installing the above instrumentation are respectively, Technical Procedures , , , and . All exposed surfaces will be geologically mapped as described in Technical Procedure . Instrumentation holes will be cored and the core logged, according to Technical Procedure .

All instrumentation will be monitored for several weeks before start of excavation of the Mine-By test room. The room will be excavated using a road-header type mining machine, similar to that to be used for repository room construction, and using similar methods of room development and support. Instrumentation will be continuously monitored during excavation. Additional instruments of the type indicated above, together with room convergence monitoring points (Technical Procedure), will be installed within the Mine-By test room at each of the three instrumentation stations, as these stations are exposed. The layout of the additional instrumentation is also shown in Figure y. Detailed construction records will be kept, to include timing of excavation and support, advance rates, maintenance activities, etc. The instrumentation will be monitored for approximately six months prior to starting the heated phase of the test (see Room Heater test).

Because the time-dependent deformational response of salt is highly dependent on stress level and temperature, there should be a percent level of confidence that the virgin state of stress is measured to within ± percent, and that temperatures around the test room are monitored to within ± °C. Relative displacements within the rock mass should be measured to within ± mm and room closures to within ± mm, and stress change monitoring should be performed to within ± percent or ± MPa, to a level of confidence of percent.

Empirical creep laws for salt materials are sufficiently defined at this stage such that there is a percent level of confidence that observed room closure will be within a factor of ± percent of numerical model predictions for relatively ideal conditions. Although the effects of structure, such as weak bedding planes, can be incorporated, a discontinuum response (e.g., bedding plane separation, fracturing, etc.) can be less satisfactorily modeled. Departures from the two dimensional assumption of the models will also result in less satisfactory agreement between observations and predictions. Stability considerations (e.g., roof falls, etc.) are less amenable to numerical analysis and are more satisfactorily resolved by empirical analysis or demonstration.

Pretest calculations of the expected deformational and stress change responses for the Mine-By test have been performed using the finite element computer code IWONDER. The basis for these predictions is given in Reference . A typical prediction for room closure with time is given in Figure . The prediction is given as a percent confidence interval estimate, which reflects present understandings of the accuracy of such predictive analyses. All instrumentation will be automatically monitored (with the exception of inclinometers and some convergence points), converted to the appropriate engineering units via appropriate algorithms, and presented in tabular and graphical format for comparison with the predicted results.

Assurance of the quality of the Mine-By test results and evaluation will be provided by adherence to the requirements of Reference , "ONWI Quality Assurance Plan." This particular test has been assigned quality level I.

IV. APPLICATION OF RESULTS

The results of the Mine-By test will directly indicate the response of the rock mass to the excavation of a simulated repository room. This response will be compared with the predictions made by the geomechanical model on the basis of prior test results and the site specific geological characterization, allowing confirmation and/or refinement of the model for application under ambient temperature conditions. This model will then provide the basic framework within which further confirmation/validation testing will be undertaken for coupled thermal-mechanical modeling (e.g., Room Heater test, Room Backfill test). In addition, information will also be obtained on the excavation, support and stability of waste disposal rooms under ambient temperature conditions, and this will support the repository design effort. Finally, definition of the character and extent of the construction affected zone surrounding such underground excavations will provide input to groundwater flow and radionuclide transport performance assessment evaluations.

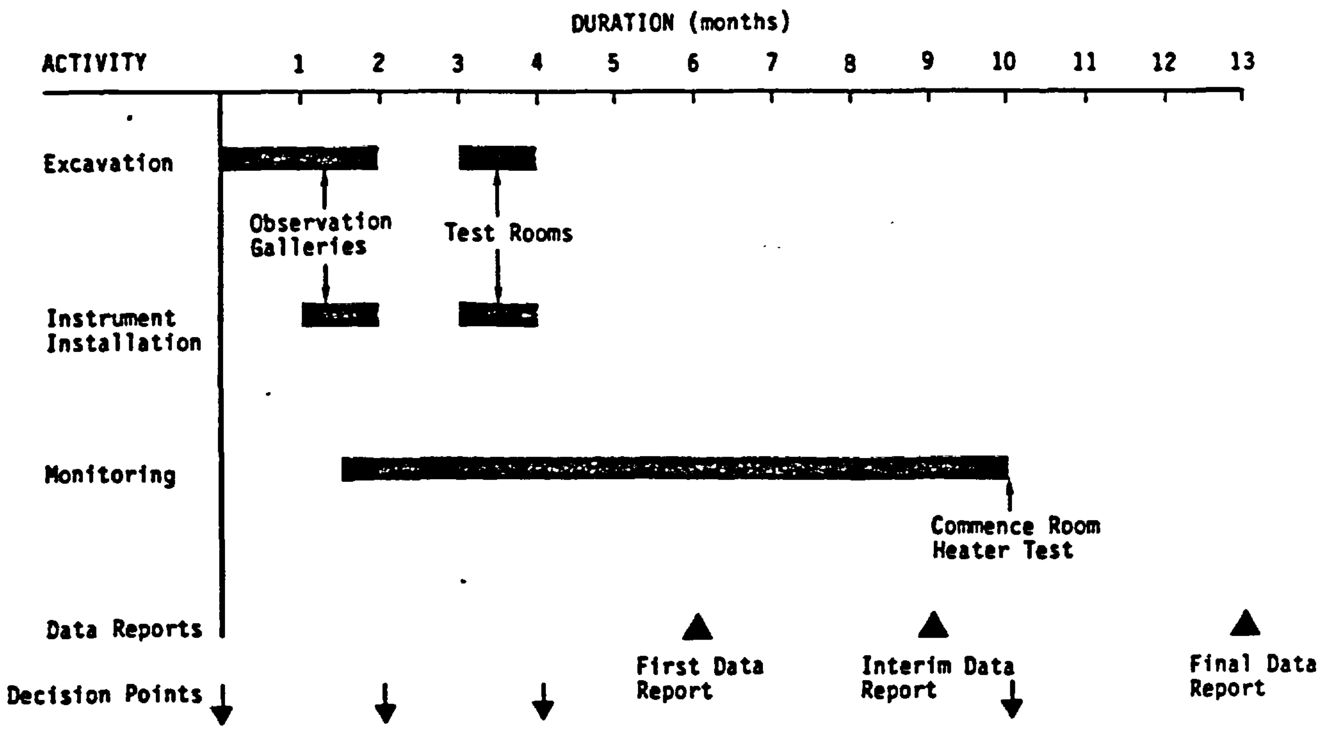
V. SCHEDULE AND MILESTONES

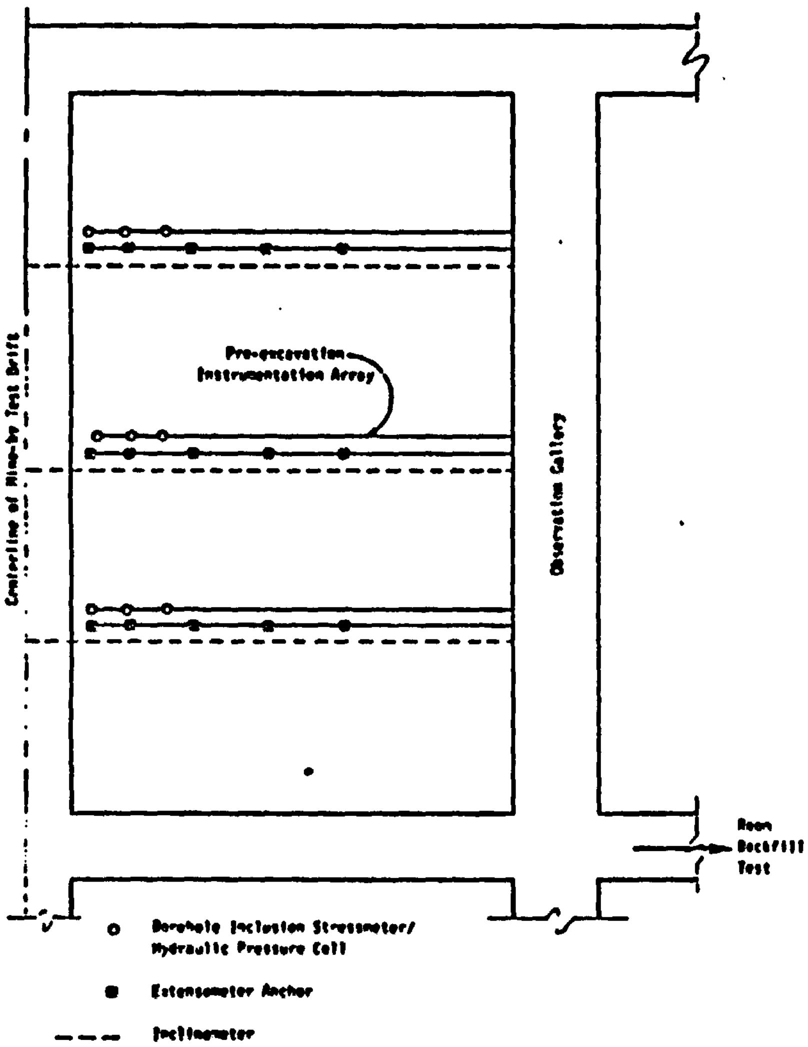
Planning requirements for performance of the Mine-By test include preparation of the Underground Test Management Plan, Mine-By Test Plan, Data Management Plan, Automatic Data Acquisition Plan, and supporting technical procedures as noted above. As noted in the schedule, all planning activity will be finished before completion of the exploratory shafts to the test horizon and the start of development of the at-depth excavations.

The total time required to conduct the Mine-By test is about 10 months. Two months will be required to excavate the observation galleries and to pre-instrument the Mine-By test area. The construction sequence for the observation galleries will be such that instrument installation can commence during their excavation. The instruments will then be monitored for about one month, during which time the remainder of the test facility will be excavated. Excavation of the Mine-By test room, which will be the final excavation activity within the ESF, and concurrent installation of additional instrumentation, will require approximately one month. Monitoring will then continue for a period of six months, during which time equipment and instrumentation for the heated phase of the test will be installed, prior to initiation of the Room Heater test.

Major decision points of the Mine-By test will be prior to the start of excavation of the observation galleries when existing exposures in the area will be evaluated to determine suitability of the test location, following completion of the observation galleries and again following completion of the test room itself when additional exposures are available for observation, and immediately prior to the start of the heated phase of the test to ensure that sufficient data have been obtained before heat is introduced.

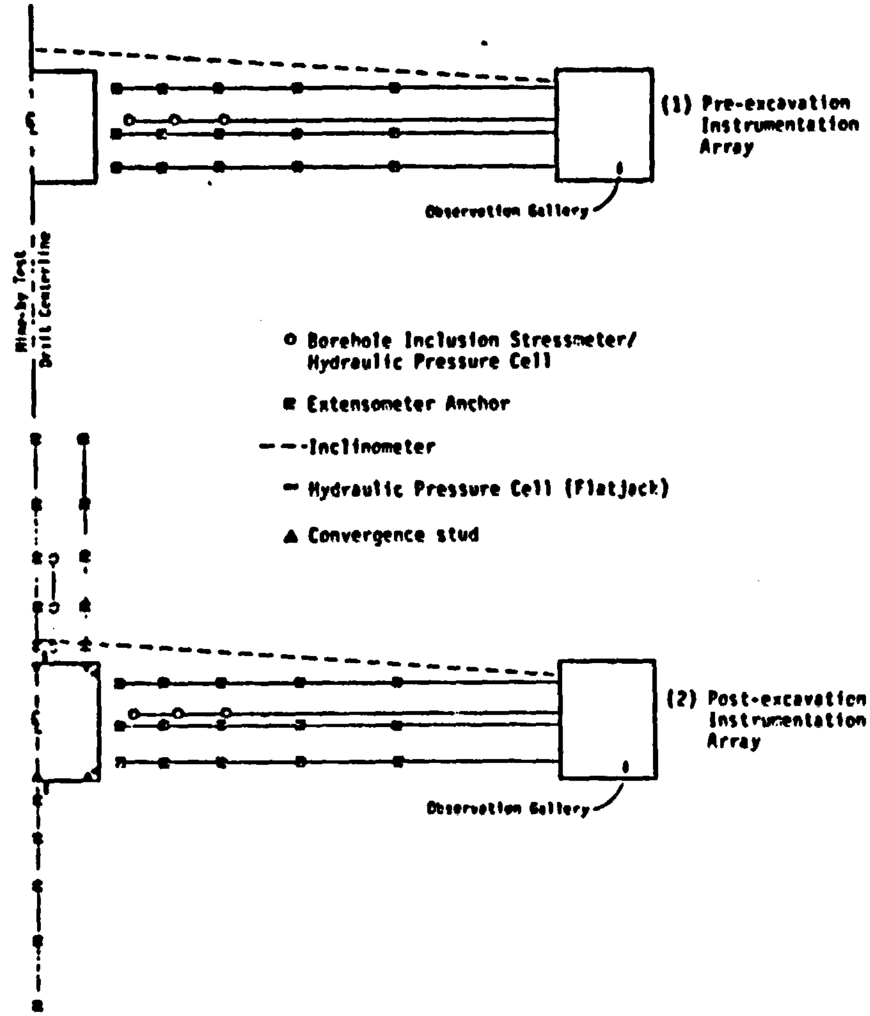
A first data report will be prepared two months following completion of the Mine-By test room excavation, with an interim report submitted three months later and a final data report submitted a further four months later. As shown in the schedule, the final data report will be completed several months before the cut-off date for LA submission.


DURATION (months)
ACTIVITY
1
2
3
4
5
6
7
8
9
10
11
12
13
Excavation
Observation Galleries
Test Rooms
Instrument Installation
Monitoring
Commence Room Heater Test
Data Reports
First Data Report
Interim Data Report
Final Data Report
Decision Points



NOTES: Actual construction will include two observation galleries arranged symmetrically around the indicated centerline.

Not to scale



NOTES: (1) Actual construction will include two observation galleries arranged symmetrically around the indicated centerline.

(2) Not to Scale.

FIGURE Y

Purpose of Meeting

To Agree on Appropriate Level of Detail to be Presented in SCP Chapter 8.3, Planned Tests, Analyses, and Studies

Attachment 4

Contents of Site Characterization Plan

Part A (Chapers 1-7) Description of Site, Waste Package and Repository Design	Part B (Chaper 8) Site Characterization Program
Ch. 1 Geology	8.1 Rationale for Site Characterization Program
Ch. 2 Geoengineering	8.2 Issues to be Resolved and Information to be Acquired During Site Characterization
Ch. 3 Hydrology	8.3 Planned Tests, Studies, and Analyses
Ch. 4 Geochemistry	8.4 Planned Site Preparation Activities
Ch. 5 Climatology and Meteorology	8.5 Milestones, Decision Points, and Schedule
Ch. 6 Conceptual Design of a Repository	8.6 Quality Assurance Program
Ch. 7 Waste Package	8.7 Decontamination and Decommissioning

8.1
Rationale for Planned Site Characterization Program

- Process for Identifying and Prioritizing Information Needs

- Process for Aggregating Common Information Needs and Identifying Required Tests

- Process for Utilizing Information
  - Meeting 112(a) Criteria
  - Assessing Site Suitability
  - Resolving Issues

8.2
Issues to be Resolved and Information Required During Site Characterization

- Issues to be Resolved
- Approach to Resolution
- Matrix Correlation of Issues with:
  - Mission Plan Issues
  - IOCFR 960
  - Information Needs
  - (Tests)
  - (Design Interfaces)

8.3
Planned Tests, Analyses, and Studies

- Describes Tests and Studies to Acquire Information
- Describes Methods Used to Analyze Information
- Relates Planned Tests/Studies to:
  - Issues to be Resolved
  - Information Required to Resolve Issues
  - Information Presented in Part A

Integration of Chapter 8 Sections

8.1 Rationale for Planned Site Characterization Program

8.2 Issues to be Resolved and Information Required During Site Characterization

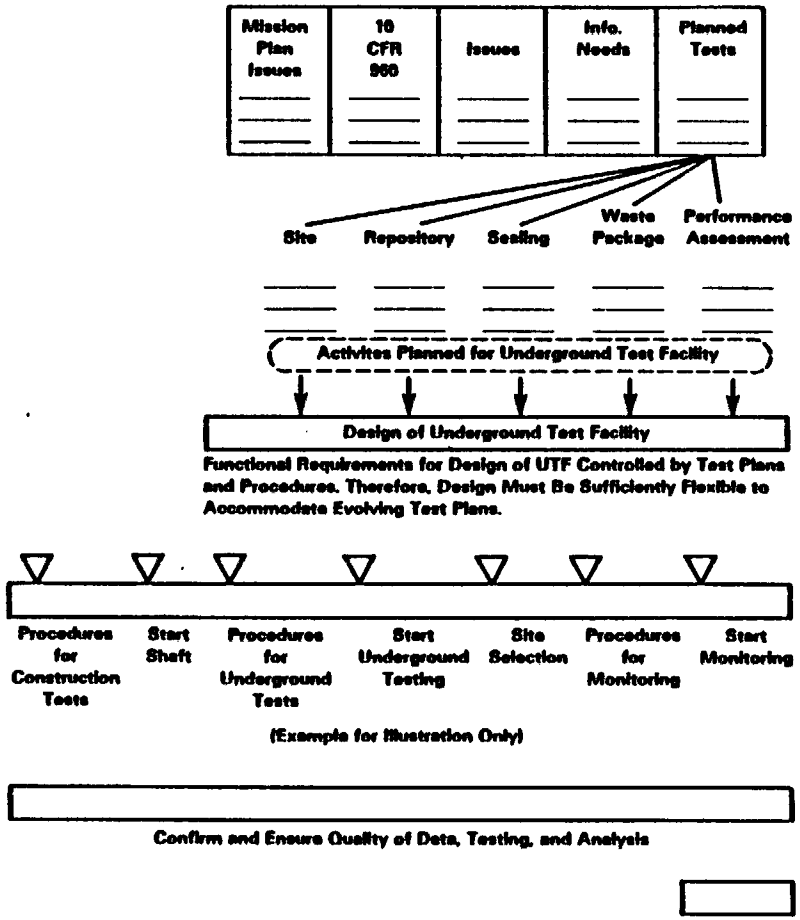
8.3 Planned Tests, Analyses and Studies

8.4 Planned Site Preparation Activities — 8.4.2 Underground Test Facility

8.5 Milestones, Decision Points and Schedules

8.6 Quality Assurance Program

8.7 Decontamination and Decommissioning



Hierarchy of 8.3
Planned Tests, Analyses, and Studies

8.3.1 Site Program
8.3.1.1 __________
____
____
8.3.1.1 ____ x Planned Studies
8.3.1.1 ____ x.x Planned Tests

8.3.2 Repository Program
8.3.2.1 __________
____
____
8.3.2.1 ____ x Planned Studies
8.3.2.1 ____ x.x Planned Tests

8.3.3 Seal System Program
8.3.3.1 __________
____
____
8.3.3.1 ____ x Planned Studies
8.3.3.1 ____ x.x Planned Tests

8.3.4 Waste Package Program
8.3.4.1 __________
____
____
8.3.4.1 ____ x Planned Studies
8.3.4.1 ____ x.x. Planned Tests

8.3.5 Performance Assessment Program Plan

Content Requirements for SCP Sections 8.3.1 Thru 8.3.4

Developed to:

- Provide General Guidance on Format, Content, and Level of Detail for Presentation of Plans

- Provide Flexibility for Projects to Present Specific Approach

Content Requirements for SCP Sections 8.3.1 Thru 8.3.4

I. Purpose and Objectives

II. Rationale for Selected Study

III. Description of Tests and Analyses

IV. Application of Results

V. Schedules and Milestones

I. Purpose and Objectives (of Test/Study)

1. Relation of Tests/Study to Issue(s)
2. Relation to Information Need
3. Contribution to Performance Allocation
   - Performance Goal
     - Confidence Level
   - Design Goal
     - Confidence Level

II. Rationale for Selected Study

- Constraints
- Alternate Tests and Analysis Methods
- Rationale for Selected Tests and Analyses

III. Description of Tests and Analyses

- General Approach
- Methods Summary
- Tolerance, Accuracy, Precision Required
- Range of Expected Results
- Required Equipment
- Data Reduction and Analysis of the Results

IV. Application of Results

- Use of Results in Performance Assessment

- Use of Results in Design

- Use in Making Direct Findings Against Regulations

V. Schedule and Milestones

- Duration
- Sequence
- Iterations
- Interrelation of Tests
- Decision Points

Project - Specific Examples

- **Present Format, Content, and Level of Detail Considered Appropriate by Individual Projects**
  - BWIP: Uniform Corrosion Tests
  - NNWSI: Thermal Properties Tests and Analyses
  - SRP: Mine - By Test

BASALT WASTE ISOLATION PROJECT
SITE CHARACTERIZATION PLAN
SECTIONS 8.3.1-8.3.4
LEVEL OF DETAIL

Attachment 5

PS84-2012-1

CONTENTS

- "UNIFORM CORROSION TESTS" DESCRIPTION
- OVERVIEW OF SECTION 8.3.4 STRUCTURE
- DETAILED "GENERIC" TABLE OF CONTENTS FOR SECTION 8.3.1-8.3.4

FS84-2047-2

SECTION 8.3.4 - WASTE PACKAGE PROGRAM

8.3.4.1 OVERVIEW

8.3.4.2 WASTE PACKAGE ENVIRONMENT

8.3.4.3 WASTE PACKAGE COMPONENTS AND INTERACTION TESTING

8.3.4.4 WASTE PACKAGE DESIGN DEVELOPMENT

8.3.4.5 WASTE PACKAGE MODELING

AREAS OF STUDY:

- WASTE FORMS: INFORMATION AND MATERIALS
- **CONTAINER MATERIALS TESTING**
- PACKING MATERIALS TESTING
- WASTE/BARRIER/ROCK INTERACTIONS TESTING
- WASTE PACKAGE PERFORMANCE TESTING

SECTION 8.3.4.3.2 - CONTAINER MATERIALS TESTING

8.3.4.3.2.1 APPROACH AND RATIONALE

8.3.4.3.2.2 DETERMINE CONTAINER MATERIALS CORROSION BEHAVIOR

8.3.4.3.2.3 DETERMINE CONTAINER MATERIALS RESISTANCE TO CRACK GROWTH

- UNIFORM CORROSION TESTS
- PITTING CORROSION TESTING

EXAMPLE: UNIFORM CORROSION TESTS

- PURPOSE AND OBJECTIVE
- APPROACH
  - CONSTRAINTS
  - OPTIONS
- DESCRIPTION OF TEST
- APPLICATION OF RESULTS
- SCHEDULE

EXAMPLE: UNIFORM CORROSION TESTS

- EXTRACTED FROM CURRENT DRAFT OF SECTION 8.3.4
- REORGANIZED MATERIAL FROM SECTION 8.3.4 TO PROVIDE TYPICAL EXAMPLE OF DETAIL

- SOME DEVIATIONS WILL BE NECESSARY
- OTHER TEST DESCRIPTIONS MIGHT HAVE ADDITIONAL INFORMATION, OR LESS, DEPENDING ON INDIVIDUAL CASE
- PORTIONS OF THE EXAMPLE MIGHT ACTUALLY BE DESCRIBED IN A "HIGHER" SECTION OF THE TEXT

8.3.4 WASTE PACKAGE PROGRAM

8.3.4.1 OVERVIEW

8.3.4.x (PROGRAM ACTIVITY)

- 8.3.4.x.y (AREA OF STUDY)
  - 8.3.4.x.y.1 APPROACH AND RATIONALE
  - 8.3.4.x.y.2 FIRST WORK REQUIREMENT
    - 8.3.4.x.y.2.1 RATIONALE FOR SELECTED TESTS AND STUDIES
    - 8.3.4.x.y.2.2 TEST AND STUDIES
      - 8.3.4.x.y.2.2.1 FIRST TEST OR STUDY
        - 8.3.4.x.y.2.2.1.1 PURPOSE AND OBJECTIVES
        - 8.3.4.x.y.2.2.1.2 CONSTRAINTS AND OPTIONS
        - 8.3.4.x.y.2.2.1.3 DESCRIPTION OF TEST/STUDY AND ANALYSES
    - 8.3.4.x.y.2.3 APPLICATION OF RESULTS
    - 8.3.4.x.y.2.4 ANALYTICAL TECHNIQUES
    - 8.3.4.x.y.2.5 FACILITIES AND EQUIPMENT
    - 8.3.4.x.y.2.6 SCHEDULE

PS84-2042-11

8.3.1 SITE PROGRAM

8.3.1.1 OVERVIEW
8.3.1.x (PROGRAM ACTIVITY)
- 8.3.1.x.1 SUMMARY
  - 8.3.1.x.y (AREA OF STUDY)
    - 8.3.1.x.y.1 APPROACH AND RATIONALE
    - 8.3.1.x.y.2 FIRST WORK REQUIREMENT
      - 8.3.1.x.y.2.1 RATIONALE FOR SELECTED TESTS AND STUDIES
      - 8.3.1.x.y.2.2 REQUIREMENTS
      - 8.3.1.x.y.2.3 TESTS AND STUDIES
        - 8.3.1.x.y.2.3.1 FIRST TEST OR STUDY
          - 8.3.1.x.y.2.3.1.1 PURPOSE AND OBJECTIVES
          - 8.3.1.x.y.2.3.1.2 DESCRIPTION OF TEST/STUDY AND ANALYSES
      - 8.3.1.x.y.2.4 APPLICATION OF RESULTS
      - 8.3.1.x.y.2.5 ANALYTICAL TECHNIQUES*
      - 8.3.1.x.y.2.6 FACILITIES AND EQUIPMENT*
      - 8.3.1.x.y.2.7 SCHEDULE

*AS APPROPRIATE

PS84-2042-12

8.3.2 REPOSITORY PROGRAM

8.3.2.1 OVERVIEW

8.3.2.x (PROGRAM ACTIVITY)

- 8.3.2.x.y (AREA OF STUDY) APPROACH AND RATIONALE .
  - 8.3.2.x.y.1 FIRST WORK REQUIREMENT
  - 8.3.2.x.y.1.1 RATIONALE FOR SELECTED TESTS AND STUDIES
  - 8.3.2.x.y.1.2 CONSTRAINTS AND OPTIONS
  - 8.3.2.x.y.1.3 TESTS AND STUDIES
    - 8.3.2.x.y.1.3.1 FIRST TEST OR STUDY
      - 8.3.2.x.y.1.3.1.1 PURPOSE AND OBJECTIVES
      - 8.3.2.x.y.1.3.1.2 DESCRIPTION OF TEST/STUDY AND ANALYSES*

*INCLUDES SCHEDULE, ANALYTICAL TECHNIQUES, AND FACILITIES AND EQUIPMENT

8.3.3 SEAL SYSTEM PROGRAM

8.3.3.1 OVERVIEW

8.3.3.x (AREA OF STUDY)

- 8.3.3.x.1 APPROACH AND RATIONALE
- 8.3.3.x.2 FIRST WORK REQUIREMENT
  - 8.3.3.x.2.1 RATIONALE FOR SELECTED TESTS AND STUDIES
  - 8.3.3.x.2.2 REQUIREMENTS
  - 8.3.3.x.2.3 CONSTRAINTS
  - 8.3.3.x.2.4 OPTIONS
  - 8.3.3.x.2.5 TESTS AND STUDIES
    - 8.3.3.x.2.5.1 FIRST TEST OR STUDY
      - 8.3.3.x.2.5.1.1 PURPOSE AND OBJECTIVES
      - 8.3.3.x.2.5.1.2 DESCRIPTION OF TEST/STUDY AND ANALYSES
  - 8.3.3.x.2.6 APPLICATION OF RESULTS
  - 8.3.3.x.2.7 ANALYTICAL TECHNIQUES
  - 8.3.3.x.2.8 FACILITIES AND EQUIPMENT
  - 8.3.3.x.2.9 SCHEDULE

RECAP

- "UNIFORM CORROSION TESTS" PROVIDES AN EXAMPLE OF DETAIL IN BWIP SCP SECTIONS 8.3.1-8.3.4
- OTHER CASES MIGHT HAVE MORE OR LESS DETAIL, AS APPROPRIATE FOR SCP ISSUANCE
- ELEMENTS WITHIN SECTIONS 8.3.1-8.3.4 GENERALLY CONSIST OF:
  - PROGRAM ACTIVITIES
  - AREAS OF STUDY
  - WORK REQUIREMENTS
  - TESTS AND STUDIES

  INCLUDING:
  - PURPOSE AND OBJECTIVES
  - APPROACH, CONSTRAINTS, OPTIONS
  - TEST AND STUDY DESCRIPTIONS
  - APPLICATION OF RESULTS
  - SCHEDULES

CHAPTER 8 - SITE CHARACTERIZATION PROGRAM

- 8.0 INTRODUCTION
- 8.1 RATIONALE FOR THE PLANNED SITE CHARACTERIZATION PROGRAM
- 8.2 ISSUES TO BE RESOLVED AND INFORMATION REQUIRED DURING SITE CHARACTERIZATION
- 8.3 PLANNED TESTS, ANALYSES, AND STUDIES
  - 8.3.1 SITE PROGRAM
  - 8.3.2 REPOSITORY PROGRAM
  - 8.3.3 SEAL SYSTEM PROGRAM
  - **8.3.4 WASTE PACKAGE PROGRAM**
  - 8.3.5 PERFORMANCE ASSESSMENT PROGRAM
- 8.4 PLANNED SITE PREPARATION ACTIVITIES
- 8.5 MILESTONES, DECISION POINTS, AND SCHEDULE
- 8.6 QUALITY ASSURANCE PROGRAM
- 8.7 DECONTAMINATION AND DECOMMISSIONING

P584-2047-3

ISSUES HIERARCHY

ISSUES HIERARCHY STRUCTURE

KEY ISSUES: MISSION PLAN KEY ISSUES

ISSUES: THE LIST OF QUESTIONS THAT MUST BE ANSWERED IN ORDER FOR THE KEY ISSUE TO BE RESOLVED

INFORMATION NEEDS: THE SET OF INFORMATION THAT IS REQUIRED IN ORDER FOR THE ISSUE TO BE RESOLVED

BASIC PREMISE: IF CONTROLLING LAWS AND REGULATIONS ARE ACCURATELY REFLECTED IN THE ISSUES HIERARCHY, THEN RESOLUTION OF THE ISSUES AND KEY ISSUES WILL COVER ALL REQUIREMENTS FOR REPOSITORY SITING, CONSTRUCTION, OPERATION, CLOSURE AND DECOMMISSIONING

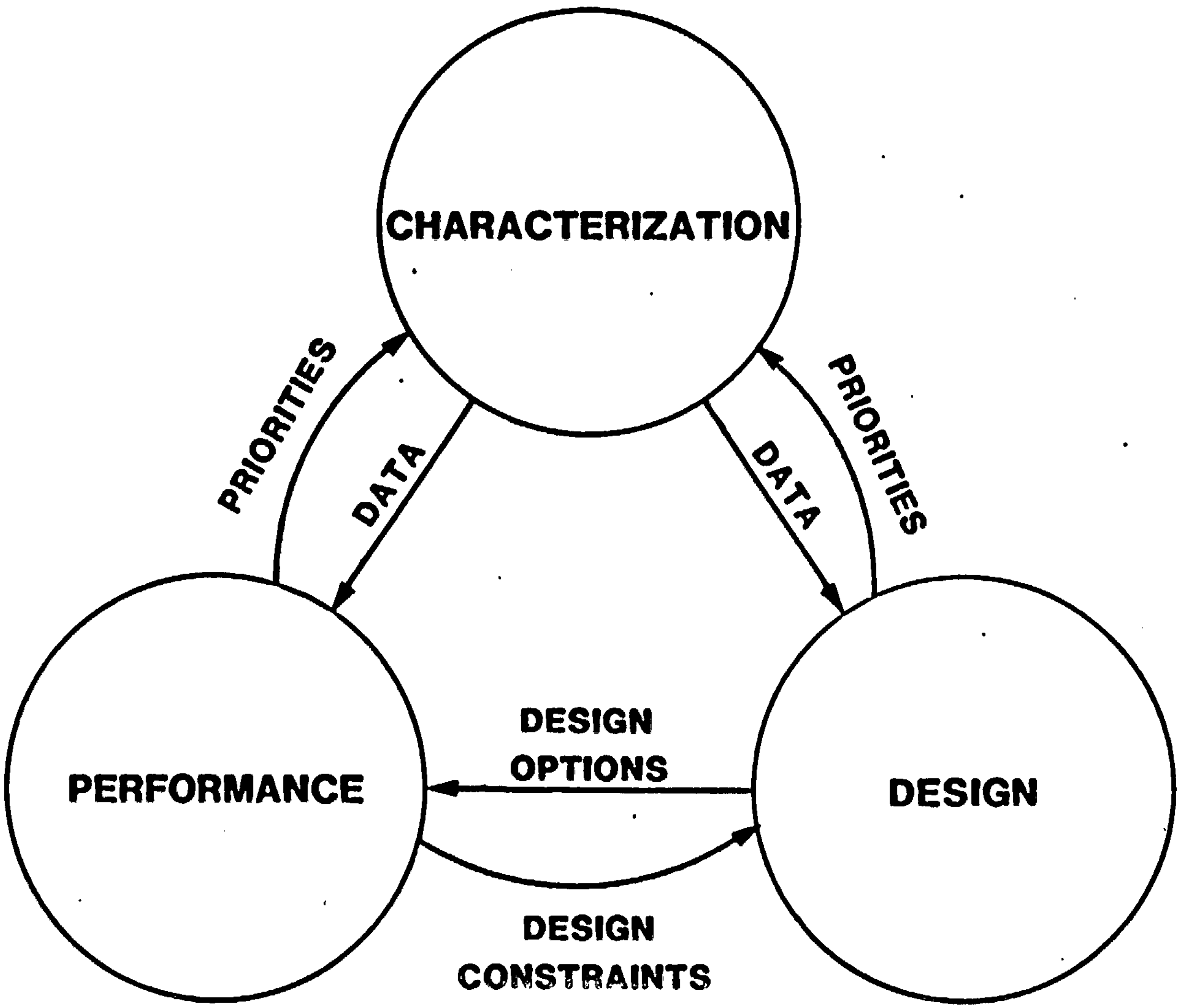
Attachment 6

ISSUE CATEGORIES

HELP TO ESTABLISH THE INTERNAL LOGIC WITHIN EACH KEY ISSUE

CHARACTERIZATION ISSUES:	THE SITE CHARACTERISTICS AND CONDITIONS THAT AFFECT REPOSITORY DESIGN, PERFORMANCE, AND ENVIRONMENTAL IMPACTS
DESIGN ISSUES:	DESIGN ELEMENTS OF THE ENTIRE GEOLOGIC REPOSITORY SYSTEM THAT ARE ESSENTIAL FOR DETERMINATION OF COMPLIANCE WITH REGULATORY REQUIREMENTS
PERFORMANCE ISSUES:	ANALYSES NECESSARY TO ASSESS THE SUITABILITY OF THE SITE AND ENGINEERED SYSTEMS AS A LICENSABLE GEOLOGIC REPOSITORY

RELATIONSHIPS AMONG THREE TYPES OF NNWSI ISSUES



U.S. DEPARTMENT OF ENERGY

OCRWM

OGR

Nevada Nuclear Waste Storage Investigations PROJECT

YUCCA MOUNTAIN

ISSUES & INFORMATION NEEDS

This is 8.2

KEY ISSUE I

- COMPLIANCE WITH ISOLATION REQUIREMENTS OF 10CFR60 AND 40CFR191

ISSUES

- 1.1 CHARACTERISTICS OF GEOHYDROLOGIC SETTING NECESSARY TO SHOW COMPLIANCE
- 1.2 GEOCHEMICAL CHARACTERISTICS
- 1.3 ROCK CHARACTERISTICS
- 1.4 CLIMATE

INFORMATION NEEDS

- 1.1.1 HYDROGEOLOGY
- 1.1.2 REGIONAL HYDROLOGY
- 1.1.3 SITE HYDROLOGIC CHARACTERISTICS
- 1.1.4 MODELS OF FLOW IN UNSATURATED ZONE
- 1.1.5 MODELS OF FLOW IN SATURATED ZONE
- 1.1.6 FLOW PATHS, FLUXES, VELOCITIES IN UNSATURATED ZONE
- 1.1.7 FLOW PATHS, FLUXES, VELOCITIES IN SATURATED ZONE

DATA/PARAMETERS

- THICKNESS OF HYDROGEOLOGIC UNITS
- LATERAL EXTENT OF HYDROGEOLOGIC UNITS
- POROSITY OF HYDROGEOLOGIC UNITS

KEY ISSUES	ISSUES	INFORMATION NEEDS	INVESTIGATIONS
1. KEY ISSUE 1			
	1.1 ISSUE		
		1.1.1 INFORMATION NEED i) WHY INFORMATION NEED EXISTS - REFERENCE TO PERFORMANCE ALLOCATION ii) TECHNICAL BASIS FOR ADDRESSING INFORMATION NEED - RESOLUTION STRATEGY/ANALYSIS FOR INFORMATION NEED iii) PLANNED TESTS/STUDIES /INVESTIGATIONS/ANALYSES	
			1.1.1.1 INVESTIGATION 1) PURPOSE/OBJECTIVE OF INVESTIGATION 2) APPROACH TO INVESTIGATION 3) DESCRIPTION OF TESTS/STUDIES /ANALYSES • TEST 1 • TEST 2 • Etc... 4) WHERE RESULTS ARE USED (INFORMATION NEEDS) 5) DURATION AND PRODUCTS
			1.1.1.2 INVESTIGATION 1)-5) similar to above
			1.1.1.3 INVESTIGATION 1)-5) similar to above
		iv) WHERE THE INFORMATION IS USED IN ISSUE RESOLUTION v) SCHEDULE- INFORMATION NEED RESOLUTION SCHEDULE PRODUCTS MILESTONES- IN RESOLUTION OF INFORMATION NEEDS	
		1.1.2 INFORMATION NEED i) similar to above	
	1.2 ISSUE similar to above		
	1.3 ISSUE similar to above		
2. KEY ISSUE 2 similar to above			
3. KEY ISSUE 3 similar to above			
4. KEY ISSUE 4 similar to above			

INFORMATION NEED DESCRIPTION

o STATEMENT OF INFORMATION NEED

I. WHY THE NEED EXISTS

- o TO ADDRESS DOE GUIDELINES AND NRC AND EPA REGULATIONS

II. TECHNICAL BASIS FOR ADDRESSING THE INFORMATION NEED

- o INTRODUCTORY PARAGRAPH: REFERENCE APPROPRIATE DATA CHAPTERS

A. PARAMETERS

- o LIST AND BRIEF DESCRIPTION OF PARAMETERS OBTAINED FROM THIS INFORMATION NEED
- o REQUIRED PARAMETERS THAT ARE SUPPLIED FROM OTHER INFORMATION NEEDS

INFORMATION NEED DESCRIPTION (CONT'D)

B. LOGIC

- o EXPLANATION OF TIES AMONG PARAMETERS
- o DEMONSTRATION THAT THE PARAMETERS ARE NECESSARY, AND ARE CONSIDERED SUFFICIENT AT THIS TIME, TO SATISFY THE INFORMATION NEED
- o JUSTIFICATION AND PRELIMINARY PRIORITIZATION THROUGH PERFORMANCE ALLOCATION AND PROFESSIONAL JUDGEMENT

III. PLANNED INVESTIGATIONS

- o PLANNED INVESTIGATIONS AND TESTS/ANALYSES NECESSARY TO ESTABLISH OR BOUND THE VALUES OF THE PREVIOUSLY DEFINED PARAMETERS (DETAILS TO FOLLOWS)

INFORMATION NEED DESCRIPTION (CONT'D)

IV. WHERE THE INFORMATION WILL BE USED

- HOW THE RESULTS FROM THIS INFORMATION NEED WILL BE USED TO HELP SATISFY THIS ISSUE AND OTHER ISSUES AND INFORMATION NEEDS

V. SCHEDULES AND MILESTONES

- SCHEDULE AND MILESTONES FOR RESOLVING THE INFORMATION NEED
- PRODUCTS (LEVEL I AND II REPORTS) WHICH WILL RESULT FROM THE INVESTIGATIONS, WITH PROPOSED TITLES, DATES, AND MILESTONE NUMBERS

INVESTIGATION DESCRIPTIONS

I. PURPOSE AND OBJECTIVES

- o HOW THE INVESTIGATION WILL BE USED TO RESOLVE THE INFORMATION NEED
- o JUSTIFICATION FOR, AND INITIAL PRIORITIZATION OF, THE INVESTIGATION (REFERENCE PERFORMANCE ALLOCATION DISCUSSIONS AT A HIGHER LEVEL, AND INITIAL PRIORITIZATION STUDIES, IF AVAILABLE)

II. STRATEGY

- o LIST OF SPECIFIC TESTS AND ANALYSES UNDER THIS INVESTIGATION, AND THE PARAMETERS ADDRESSED BY EACH
- o DESCRIPTION OF THE SEQUENCE OF CONDUCTING THESE TESTS AND ANALYSES
- o RATIONALE AND JUSTIFICATION FOR THE SEQUENCE OF TESTS AND ANALYSES, INDICATING THAT OTHER LESS APPROPRIATE METHODS WERE CONSIDERED
- o LIMITS AND CONSTRAINTS ON THE TESTS AND ANALYSES

III. DESCRIPTION OF TESTS AND ANALYSES

o FOR EACH TYPE OF TEST/ANALYSIS (AS APPROPRIATE):

FOR TESTS:

- SCOPE AND OBJECTIVE
- LOCATION OF SAMPLING AND TESTING, EXPECTED CONDITIONS, AND NUMBER OF TESTS PLANNED
- IDENTIFICATION OF THE PROCEDURES FOR CONDUCTING THE TEST AND STATEMENT OF HOW THEY WILL BE USED
- LEVEL OF QUALITY ASSURANCE
- RANGE OF EXPECTED RESULTS OR OUTPUT
- LIST OF EQUIPMENT USED TO CONDUCT EACH TEST DESCRIBED
- BRIEF DESCRIPTION OF TECHNIQUES TO BE USED FOR DATA REDUCTION
- REPRESENTATIVENESS OF TEST

7) limitations and uncertainties of test methods and data analysis

INVESTIGATION DESCRIPTIONS (CONT'D)

FOR ANALYSIS:

- DATA REQUIREMENTS OF EACH ANALYSIS DESCRIBED
- METHODS OF ANALYSIS
- EXPECTED OUTPUT OF THE ANALYSIS
- REPRESENTATIVENESS OF THE ANALYTICAL APPROACH

IV. APPLICATION OF RESULTS

(SPECIAL APPLICATIONS THAT ARE NOT DISCUSSED UNDER "WHERE THE INFORMATION WILL BE USED" AT THE INFORMATION NEED LEVEL WILL BE DESCRIBED IN THIS SECTION)

- o WHERE THE RESULTS FROM THE INVESTIGATION WILL BE USED FOR THE SUPPORT OF OTHER AREAS OF STUDY, FOR USE IN PERFORMANCE ASSESSMENT, AND FOR USE IN DESIGN

INVESTIGATION DESCRIPTIONS (CONT'D)

V. SCHEDULE AND MILESTONES

- o DURATIONS OF AND INTERRELATIONSHIPS AMONG PRINCIPAL TESTS AND ANALYSES
- o THE KEY MILESTONES ASSOCIATED WITH THE TESTS AND ANALYSES
- o TIMING OF THIS INVESTIGATION RELATIVE TO OTHER INVESTIGATIONS, TESTS, AND ANALYSES TO SHOW THE LOGICAL SEQUENCE OF ACTIVITIES TO RESOLVE THE INFORMATION NEED

VOLUME REDUCTION STRATEGY

- PUT INFORMATION AT HIGHEST POSSIBLE LEVELS IN THE STRUCTURE; AVOID REDUNDANCIES AT LOWER LEVELS

- FOR STANDARD TESTS/ANALYSES, REFERENCE PUBLISHED METHODS AND PROCEDURES FOR TEST DESCRIPTION DETAILS; NON-STANDARD TESTS, OR UNUSUAL APPLICATIONS, WILL REQUIRE DETAILED WRITE-UPS IN SCP

- TABULATE AS MUCH INFORMATION AS POSSIBLE. THIS COULD INCLUDE, FOR EACH TEST DESCRIPTION (ITEM III):

  - LOCATION, NUMBER OF TESTS AND SAMPLES, EXPECTED CONDITIONS
  - QA LEVEL
  - RANGE OF EXPECTED RESULTS
  - EQUIPMENT USED
  - PUBLISHED TECHNICAL PROCEDURES USED

- MAKE USE OF PRIORITIZATION STUDIES. DON'T PROVIDE DETAILED DESCRIPTIONS FOR LOW PRIORITY OR UNNECESSARY INVESTIGATIONS, TESTS, OR ANALYSES

PRIORITIZATION STRATEGY

- ESTABLISH PERFORMANCE GOALS FOR SUBSYSTEMS AND COMPONENTS OF THE MGDS SYSTEM BASED ON PERFORMANCE OBJECTIVES

- COMPILE "SHOPPING LIST" OF PARAMETERS, INVESTIGATIONS, TESTS, AND ANALYSES

  - PARTICIPANT WORKSHOPS TO ESTABLISH LISTS
  - PROJECT REVIEW TO FILL GAPS, ELIMINATE REDUNDANCIES

- PRIORITIZE PARAMETERS, INVESTIGATIONS, TESTS, AND ANALYSES

  - BASED ON PERFORMANCE GOALS
  - USING SENSITIVITY ANALYSES
  - USING PROFESSIONAL JUDGEMENT
  - BASED ON PERFORMANCE ASSESSMENT AND DESIGN NEEDS
  - PROJECT WORKSHOPS

EXAMPLE OF TEST DESCRIPTION

FOR

SCP SECTION 8.3

SALT REPOSITORY PROJECT

DOE/NRC MEETING

OCTOBER 29, 1985

Attachment 7

CONTENT OF THIS PRESENTATION

ISSUE HIERARCHY AND PERFORMANCE ALLOCATION

TEST PLAN STRUCTURE

SUMMARY OF SCP SECTION 8.3

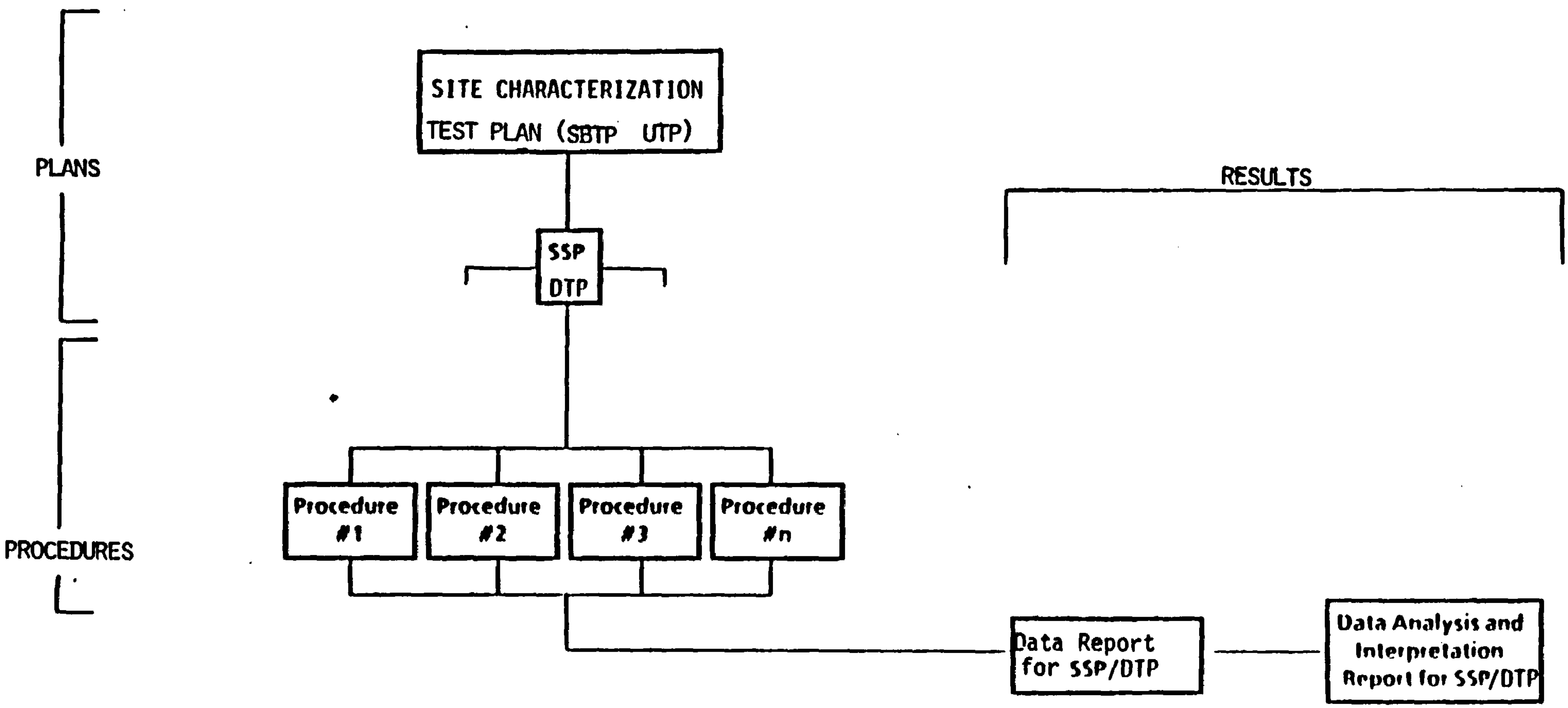
EXAMPLE OF TEST-GOAL LOGIC

OUTLINE OF TEST DESCRIPTION (MINE BY TEST)

EXAMPLE OF SCP TEST DESCRIPTION (MINE BY TEST)

RWK: OCTOBER, 1985

TEST PLAN STRUCTURE



RWK: OCTOBER, 1985

SRP ISSUE HIERARCHY LOGIC

PERFORMANCE OBJECTIVES

↓

KEY ISSUES

↓

ISSUES

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INFO/DATA NEEDS

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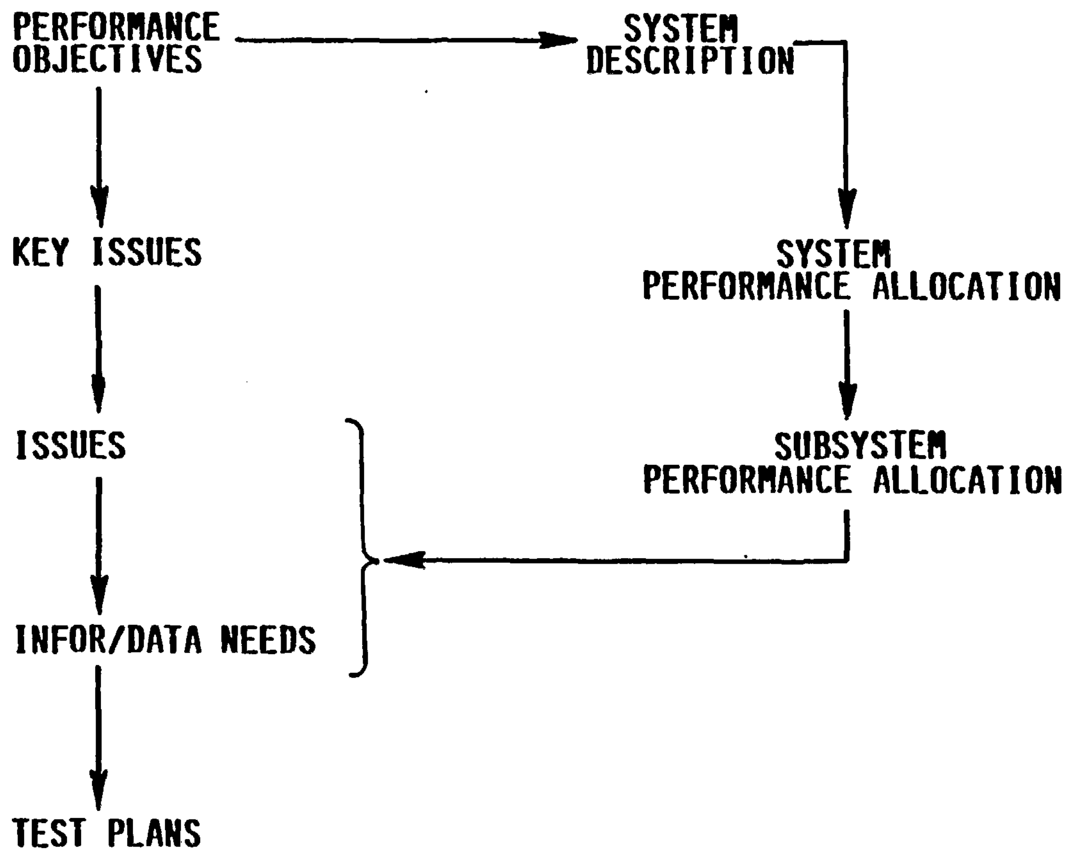
TEST PLANS

RWK: OCTOBER, 1985

SCP ISSUE HIERARCHY AND PERFORMANCE ALLOCATION



RWK: OCTOBER, 1985

SITE STUDY PLANS (SURFACE BASED TEST PLAN)

ENGINEERING DESIGN BOREHOLES

STRATIGRAPHIC BOREHOLES

TEST/MONITORING WELLS

SURFACE GEOLOGIC MAPPING

SHALLOW HYDRO NESTS

DEEP HYDRO NESTS

SEISMIC REFLECTION SURVEY

POTENTIAL-FIELD SURVEYS (GEOPHYSICS)

MICROEARTHQUAKE MONITORING

SURFACE HYDROLOGY

ROCK LABORATORY TESTING

GEOCHEMICAL INVESTIGATIONS

METEOROLOGY/CLIMATOLOGY

FOUNDATION BOREHOLES

TOPOGRAPHIC MAPPING

SOIL LABORATORY TESTING

RWK: OCTOBER, 1985

<u>DETAILED TEST PLANS (UNDERGROUND TEST PLAN)</u>

DATA ACQUISITION PLAN

SHAFT TESTING/MONITORING PLAN

MINE-BY TEST PLAN

ROOM HEATER TEST PLAN

BRINE MIGRATION TEST PLAN

AT-DEPTH TESTING/MONITORING PLAN

WASTE PACKAGE HEATER TEST PLAN

ROOM BACKFILL TEST PLAN

ROOM SEAL TEST PLAN

UNDERGROUND BOREHOLE SEAL TEST PLAN

MINING ENVIRONMENT MONITORING PLAN

<u>SCP SECTION 8.3</u>

8.3 PLANNED TESTS, ANALYSES, AND STUDIES

- SYSTEM AND SUBSYSTEM ALLOCATION

EXAMPLES: GW TRAVEL TIME
RADIONUCLID RELEASE RATE
WP LIFETIME

RWK: OCTOBER, 1985

SCP SECTION 8.3 (CONT'D)

8.3.1 SITE PROGRAM (8.3.2,3,4 SIMILAR)

- LOWER LEVEL ALLOCATION

  EXAMPLES: CHARACTER OF CONSTRUCTION ZONE
  WASTE FORM SOLUIBILITY
  WASTE PACKAGE CORROSION

- TEST RESULTS

  EXAMPLES: IN SITU STRESS
  WF MATRIX PROPERTIES
  WP MATERIALS PROPERTIES

- RELATE TO HIGHER ISSUES/ALLOCATIONS

RWK: OCTOBER , 1985

SCP SECTION 8.3 (CONT'D)

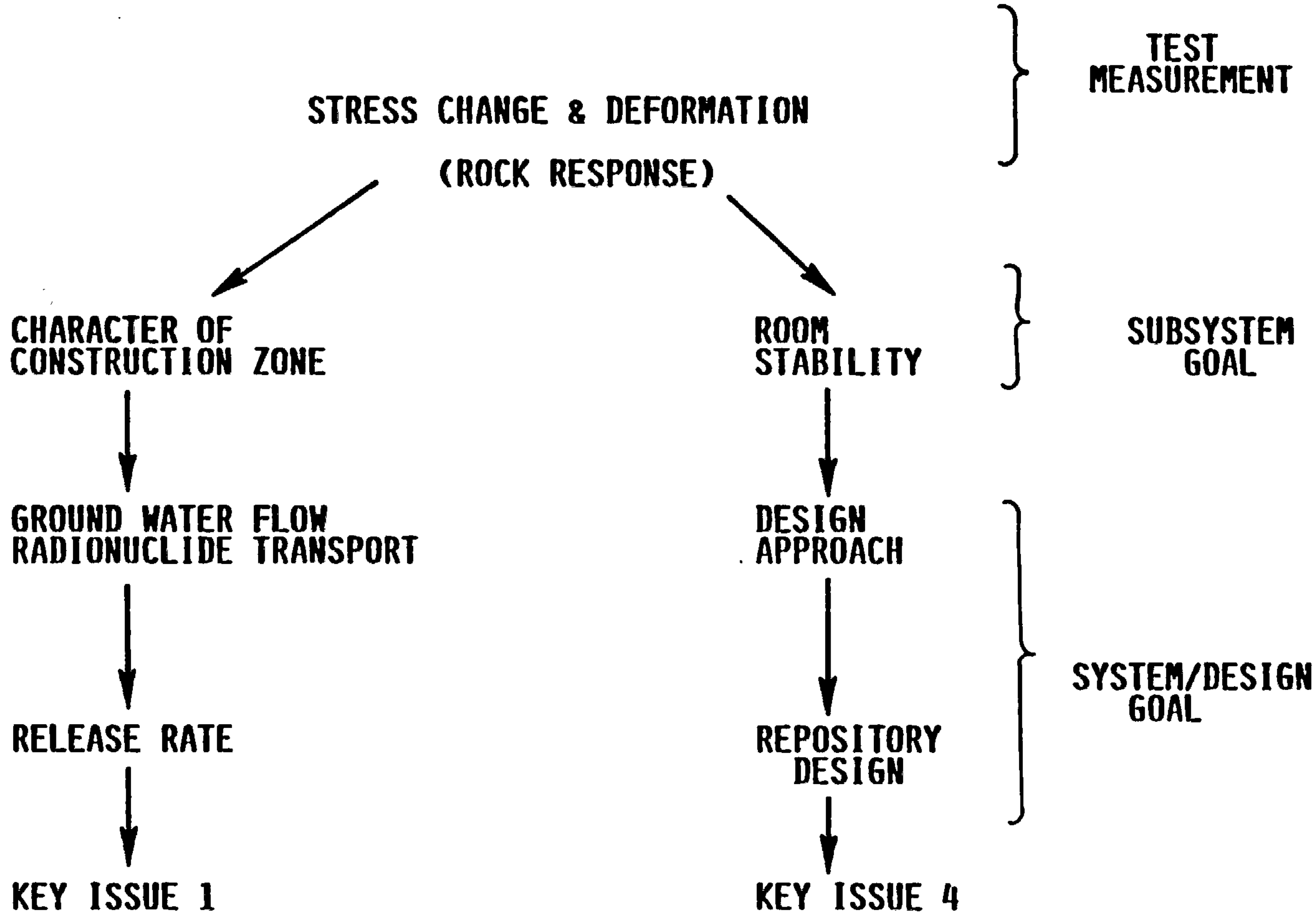
8.3.5 PERFORMANCE ASSESSMENT PROGRAM

- PERFORMANCE ANALYSIS METHODOLOGIES

DETAILED TEST PLANS (UNDERGROUND TEST PLAN)

- DATA ACQUISITION PLAN
- SHAFT TESTING/MONITORING PLAN
- ● MINE-BY TEST PLAN — CHOSEN EXAMPLE
- ROOM HEATER TEST PLAN
- BRINE MIGRATION TEST PLAN
- AT-DEPTH TESTING/MONITORING PLAN
- WASTE PACKAGE HEATER TEST PLAN
- ROOM BACKFILL TEST PLAN
- ROOM SEAL TEST PLAN
- UNDERGROUND BOREHOLE SEAL TEST PLAN
- MINING ENVIRONMENT MONITORING PLAN

EXAMPLE OF TEST-GOAL LOGIC (MINE BY TEST)



RWK: OCTOBER, 1985

TEST DESCRIPTION (MINE-BY TEST)

I. PURPOSE AND OBJECTIVES

ROCK RESPONSE

II. RATIONALE FOR THE TEST

DEMONSTRATE ROOM CHARACTERISTICS

III. DESCRIPTION OF THE TEST

LAYOUT, EQUIPMENT, AND TECHNIQUES

IV. APPLICATION OF RESULTS

MODEL VALIDATION

KEY ISSUE 1

KEY ISSUE 4

V. SCHEDULE AND MILESTONES

RWK: OCTOBER, 1985