Encls to
11-15-82 memo
to Stello

REVIEW PLAN

FOR

SITE CHARACTERIZATION REPORTS

DIVISION OF WASTE MANAGEMENT
U. S. NUCLEAR REGULATORY COMMISSION

Revised November 1982

CONTENTS

INTRODUCTION

This review plan is developed for use by NRC staff and NRC contractors and consultants who will be involved in the SCR review. The plan provides a set of procedures to prepare for SCR receipt and review, which includes working with DOE to assure that the SCR is of adequate scope and quality and to identify and resolve questions of site characterization plans and approaches. It will be applied to each site for which DOE intends to submit an SCR. The plan is designed to provide the basic organization and approach used in SCR reviews. It is not intended to be a rigid set of procedures; some details in the plan may be altered as necessary to reflect unique project-specific conditions and the overall evolution of the repository program. This plan was initially prepared in the Spring of 1982. This revised edition incorporates changes based on NRC experience in making detailed preparations for SCR receipt.

The effective implementation of this review plan depends heavily on obtaining up-to-date, site specific information prior to receipt of the SCR. This will derive from a variety of activities that both precede and are concurrent with each SCR review. These include, to the extent practicable, continuing interactions between NRC and DOE - site visits, topical and programmatic discussions, and other technical interchanges. Interactions will also be needed with other involved parties, such as State agencies, the U.S. Geological Survey, etc.

BACKGROUND

Site Characterization (SC)

"Site characterization," as defined in 10 CFR 60, at 46 FR 13980, means the program of exploration and research, both in the laboratory and in the field, undertaken to establish the geologic conditions and the ranges of those parameters of a particular site relevant to the procedures under 10CFR60. Site characterization includes borings, lateral excavations and borings, and in situ testing at depth needed to determine the suitability of the site for a geologic repository and the adequacy of the proposed repository design, but does not include preliminary borings and geophysical testing needed to decide whether site characterization should be undertaken.

The objectives of site characterization (SC) are:

1. To collect pertinent geological and other site characteristic information so that the construction authorization application will be complete enough to enable NRC to do the evaluation and make the findings required by 10 CFR 60.31: namely, a meaningful analysis of (a) the suitability of the site to isolate radionuclides and (b) the adequacy of the repository design to site conditions.

2. To collect necessary data from alternative sites and media to permit the NRC to make a National Environmental Policy Act (NEPA) finding on the preferred site proposed in DOE's license application for construction authorization.

Site Characterization Report (SCR)

On February 25, 1981, the Nuclear Regulatory Commission (NRC) promulgated the licensing procedures for the disposal of high-level waste in 10 CFR 60 -- "Disposal of High-Level Radioactive Waste in Geologic Repositories" (46 FR 13971). As part of the pre-licensing procedures set forth in the final rule, the Department of Energy (DOE) is required to submit a Site Characterization Report (SCR) to the NRC as early as possible after commencement of planning for a particular geologic repository operations area and prior to starting site characterization.

The basic purpose of the SCR is clear: to provide a mechanism for identifying problems at a proposed repository site and the plans for resolving them at an early time in order to avoid delays in the licensing process.

It is anticipated that each SCR will be an extensive document covering the many technical and institutional aspects of characterizing a high-level waste repository. Types of information to be provided in the SCR and a uniform format for presenting the information are detailed in

the NRC "Standard Format and Content of Site Characterization Reports for High-Level Waste Geologic Repositories" (Regulatory Guide 4.17, July, 1982).

The SCR, in accordance with the Standard Format and Content, should accomplish the following:

1. Establish what is known about a site from site screening, selection and exploration activities completed to date,

2. Describe the issues* that DOE has identified at a site in light of the results of investigations to date, and

3. Describe the detailed plans of work for data acquisition and analysis to meet information needs for issues.

Site Characterization Analysis (SCA)

General Nature of the SCA

The Director of NMSS will prepare a draft SCA after receipt of the SCR and, following a public comment period on the draft SCA, the Director will prepare a final SCA which takes into account comments received and any additional information acquired during the comment period. Included in the final SCA will be either an opinion by the Director that he has no objection to DOE's SC program, if such an opinion is appropriate, or specific objections of the Director to DOE's proceeding with SC at the proposed site.

The SCA represents the beginning of a process of reviewing the DOE program at each site and will focus on major issues and associated licensing information needs. The SCA is advisory in nature; it conveys NRC comments and advice on the thrust of DOE's plans for site characterization. Details occuring later in the DOE program will be followed through DOE's semiannual reports on the progress of site characterization.

The SCA is intended to be a concise analysis, approximately 50 pages in length, emphasizing open items for continued follow-up discussion. The SCA will not provide coverage of all items presented in the SCR; for a complete understanding of the SCR, readers will need to refer to the SCR and supporting materials submitted by DOE. Technical positions, preliminary and supporting analyses, NRC contractor reports and related materials will be provided as appendices to the SCA.

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* An issue, as used in the context of the NRC SCR reviews, is a question that must be answered or resolved to complete licensing assessments of site and design suitability in terms of 10 CFR 60 performance objectives and requirements and to make NEPA findings.

General Approach to SCA Development

This review plan indicates how NRC will review each SCR and develop a Site Characterization Analysis (SCA) from the Office of the Director of NMSS.

Because of the short turnaround time from receipt of the SCR to issuance of the draft SCA, the draft SCA will be issued approximately 4 months after SCR receipt and prior to public comments on the SCR or the SCA. Elapsed time between receipt of the SCR and publication of the final SCA is expected to be 9 months, depending in part on the extent of the public comments and the availability of information and data prior to SCR receipt, NRC emphasis will be placed on "advance work" prior to receipt of the SCR. This advance work will consist of activities such as: developing technical background material; reviewing available site data; and establishing and maintaining contact with DOE technical staff, State agencies, and other individuals and organizations who are likely to be involved in the preparation/review of the SCA. Continuing interaction with DOE and other interested parties is essential to NRC's development of a sound and effective SCA in the short time that will be available.

Upon receipt, the SCR will be given a brief acceptance review by the NRC staff to determine whether it contains the information identified in the Standard Format and Content of Site Characterization Reports for High-Level-Waste Geologic Repositories. If it is not adequate for review it will be returned with comments on the basis for such action. Once the SCR is accepted, the NRC shall cause to be published in the Federal Register a notice that the SCR has been received and shall make the SCR available at the Public Document Room (PDR). NRC will also transmit copies of the Federal Register notice to the Governor and the legislature of the State and to the chief executive of the municipality (or county or Tribal organization as appropriate) in which a site to be characterized is located and the Governors of any contiguous States.

The NRC staff will critically review the SCR and then prepare a draft SCA. The draft SCA will include consideration of all pre-SCR consultations with DOE, States, the USGS and other organizations. The draft SCA will be published for public comment (the comment period shall not be less than 90 days). All public comments will be available at the

PDR) and transmitted to Governors and chief executives as noted above. The NRC will prepare written responses to State, Indian tribal and local government comments, and shall make these responses available at the PDR. The final SCA will incorporate public comments received by the NRC.

The NRC analysis of the SCR has two main objectives:

1. To review DOE's identification of issues and site characterization program. Specifically, does the SCR adequately:

a. establish what is known about a site from site screening, selection and exploration activities completed to date,

b. describe the issues that DOE has identified at a site in light of the results of investigations to date, and

c. describe the detailed plans of work for data acquistion and analysis to meet information needs for issues.

2. To examine information on the process by which the site was selected for detailed site characterization to determine whether there are any obvious, major problems with the site. This is to ensure that "the DOE will be able to develop a slate of candidate sites that are among the best that can reasonably be found and from which DOE will select its preferred site for construction authorization" (10CFR60, 46 FR 13973 February 25, 1981).

Since the DOE program of site characterization will need to be a phased process, NRC expects that the SC plan may be better defined and more detailed for early phases of site characterization (e.g., testing in the exploratory shaft) and less detailed for later phases (e.g., testing in an underground facility with two shafts). As DOE finalizes the plan for later phases of site characterization, additional details can be submitted to NRC in periodic updates to the SCR, as provided for in 10 CFR 60.

The NRC review must encompass the plan for all site characterization activities for gathering information needed (1) to conduct the full 10 CFR Part 60 evaluation of site suitability and acceptability of design and (2) to make required NEPA findings. Although the levels of detail in the SC plan may vary among issues, the NRC review team must ensure that DOE has a plan to adequately address all issues; the SCA will contain a summary of all NRC concerns, comments and open items.

GENERAL APPROACH TO REVIEW AND ANALYSIS

This section of the review plan describes the conditions and procedures which will govern the review of each SCR.

Site Selection

Type of Material for Review

Descriptive material, largely taken from earlier site selection documents. Many documents may be referenced in the SCR; some may be submitted as attachments to the SCR, others may be on file at DOE field offices. As specified in 10 CFR 60, the information will deal with (a) criteria used in selection, (b) method of selection, (c) identification and location of alternative sites in the same and other media, and (d) the decision process by which the site was chosen for characterization.

Nature of Analysis

Generally, the purpose of this review is to ensure that DOE has a workable mechanism for ensuring that the screening process will ultimately result in a "slate of candidate sites that are among the best that can reasonably be found" (46 FR 13973). The objective of this screening effort is not to find the "best" site but to assure there is a slate of sites that are among the best.

a) Determine reasonableness of site selection method and decision process, focusing on how the candidate area was selected and on the site-specific factors considered in selecting a specific site within a candidate area.
b) Examine selection criteria for validity and completeness.
c) Determine whether there are any obvious, major problems with the site proposed for characterization.
d) Examine descriptions of other sites and media for validity as alternatives.

Site Characterization Program

Type of Material for Review

(a) Site conditions: (1) reports which describe existing properties of the site, (2) reports on the interpretation of the geologic history of the site, (3) data summaries such as representative core logs and borehole test results, and (4) scientific literature relevant to

understanding properties or processes which may impact the site. Other data will be available in advance from DOE at the specific site.

(b) Pre-conceptual repository design: design criteria, functional description, conceptual drawings.

(c) Waste form and package: design concepts, alternatives.

(d) Identification and discussion of plans for resolution of issues in siting, design, waste form and performance assessment.

(e) Site characterization program. Description of tests to be conducted underground, at surface and in laboratory: objective, selected method and technique, application, alternative methods/techniques. Design of underground test facility: design criteria, drawings, specification. Schedule of activities with milestones, decision points, outputs (reports).

(f) Description of the quality assurance (QA) program for SC at the selected site, supported (perhaps) by QA reports and documents from other sites.

Nature of Analysis

(a) Review data and information from investigations to date and evaluate the interpretations by DOE. How was it collected and what is its quality and its relevence to site issues? How are data to be interpreted?

(b) Evaluate each issue: (i) identification; (ii) importance to site, (iii) degree of resolution; (iv) information specific needs for resolution; and (v) SC investigations needed to develop information for resolution. Analyze data in SCR and at site to determine whether all relevant issues are recognized and developed.

(c) Determine whether proposed investigations to address outstanding issues are properly conceived. Determine whether appropriate tests, test methods and investigative strategies are proposed. Evaluate appropriateness and reasonableness of program schedule, mileposts and plans. Judge applicability and suitability of QA program,

determine acceptability of activities to be covered under QA; determine suitability of QA procedures.

(d) Examine validity of design criteria and functional description, and adequacy of design. Analyze integration and compatability of exploratory shaft and underground test facility with repository.

(e) Check DOE's modeling (if available) of groundwater flow/radionuclide migration. Establish the importance of site-specific variables through sensitivity studies and preliminary modeling based on existing, limited data.

Comments

Through site visits and meetings with DOE, in order to review site data and informally consult on plans, NRC and its contractors should be reasonably familiar with much of this material. The review and analysis will require assistance from outside contractors and consultants with guidance provided by NRC on (1) method and completeness of review, (2) form of output, and (3) timing of review activities.

All personnel involved in SCR review should note that there may be several site reviews and other staff activities going on in parallel (see the WMHT HLW plan). Since there will likely be constraints on time available for SCR reviews, care must be given to determining priorities of issues, levels of detail of analyses, schedules for issue resolution, and other aspects of each SCR review.

SITE CHARACTERIZATION ANALYSIS PRODUCTS

The NRC analysis of each SCR will include the development of the following separate and distinct products:

Site Characterization Analysis (SCR)

The SCA will be a critique of the SCR, focusing on major concerns and comments on the basic thrust and strategy of the DOE program, especially those plans now on the critical path for licensing. The SCA is used to check the completeness and adequacy of the issues presented by DOE in the SCR and is the basis for developing the basic units (Site Issue Analyses) in the NRC review. The SCA will be published as a NUREG. It will be brief (50 page text), contain various summary tables, and be supported by numerous appendices and site issue analyses as described below (see Figure 1 for the outline of the draft SCA). The SCA will not be a complete summary or restatement of the SCR; the reader must refer to the SCR for details.

Included in the final site characterization analysis will be an opinion by the Director, NMSS, on DOE's SC program. In the opinion the Director will state that he has no objection to the DOE's site characterization program, if such an opinion is appropriate, or specific objections to DOE's proceeding with characterization of the named site.

SCA Appendices

Appendices will be prepared by NRC staff to support selected aspects of analyses in the SCA text. The appendices will be a part of the SCA and be contained in the NUREG document. The major appendices are:

Tabulation/Evaluation of Site Characterization Issues - A comprehensive and systematic identification of all concerns and open issues at the site. This will include a comparison and cross reference between NRC and DOE issues.

Sensitivity Analyses - Preliminary studies of elements in performance assessment of the site, incorporating selected hydrogeologic parameters and simplifying assumptions (See Figure 2). This will include an evaluation of performance assessment at a broad level of detail using simple models commensurate with current levels of uncertainty in the controlling parameters. These analyses will be performed to (1) help determine what are the important issues in terms of system performance and (2) help integrate the activities of various reviewers examining individual elements of system performance, since the importance of any single element cannot be determined in isolation. The analyses incorporated into the SCA will be precursors to more detailed and complete performance

assessments NRC will do in licensing reviews. The focue at this stage in the DOE program (i.e., prior to beginning detailed site characterization activities) will be on the uncertainties in the parameters. The rackout of issues described in the appendix above will be developed by rigorously considering the assessments that will have to be done in licensing.

Detailed Technical Analyses - Detailed, site-specific data and analyses which provide supporting information for selected, major site issues as addressed in the SCA. Typical information may include hydrostratigraphy and geologic controls, environmental conditions for the waste form and metallic waste package component, stability of openings, retrievability systems and other subjects as appropriate to each site.

Description of Site and SCR - Maps of the site and table of contents of the SCR.

Site Issue Analyses (SIAs)

An analysis of all site-specific issues (at least in some level of detail) will be prepared by NRC staff. (See Figure 3 for complete outline of each SIA). Each analysis will be brief (2 pages), with technical backup attachments developed by NRC staff/NRC contractors as necessary. The SIAs will be sent to the Public Document Room but will not be included in the SCA NUREG document. Each SIA will include: a summary of the issue and an evaluation of DOE plans for investigations and tests to aquire information to resolve the issue.

References

Selected, key technical reports of NRC contractors will be included as references to the SCA. This will include the general results of major technical assistance efforts of a several year period addressing selected, major issues and identifying the basic elements of an acceptable SC program to allow addressing these issues in licensing. These reports will focus on chief technical issues, such as those in geochemistry and hydrology, which are new, unconventional and unique to a high-level waste repository.

FIGURE 1

OUTLINE OF SCA

		NO. OF PAGES
EXECUTIVE SUMMARY		3
DIRECTOR'S OPINION		6
CHAPTER 1.	INTRODUCTION - DESCRIPTION OF LICENSING AND SITE CHARACTERIZATION PROCESS	3
CHAPTER 2.	DESCRIPTION OF SITE AND CONCEPTUAL DESIGN	4
CHAPTER 3.	SITE SELECTION PROCESS	4
CHAPTER 4.	GROUNDWATER FLOW	6
CHAPTER 5.	GEOLOGIC STABILITY	4
CHAPTER 6.	GEOCHEMICAL RETARDATION	4
CHAPTER 7.	DESIGN OF FACILITIES	6
CHAPTER 8.	WASTE PACKAGE	4
CHAPTER 9.	INSTITUTIONAL AND ENVIRONMENTAL FACTORS	4
CHAPTER 10.	QUALITY ASSURANCE PROGRAM	3
CHAPTER 11.	PERFORMANCE ASSESSMENT	6
CHAPTER 12.	SUMMARY OF NRC CONCERNS/COMMENTS/OPEN ITEMS	5
APPENDICES		100+
o	DETAILED SYSTEMATIC TABULATION/EVALUATION OF SCR ISSUES	
o	SITE UNCERTAINTY AND SENSITIVITY ANALYSIS	
o	OTHER SELECTED DETAILED TEAM EVALUATIONS	
o	10 CFR 60	

FIGURE 2

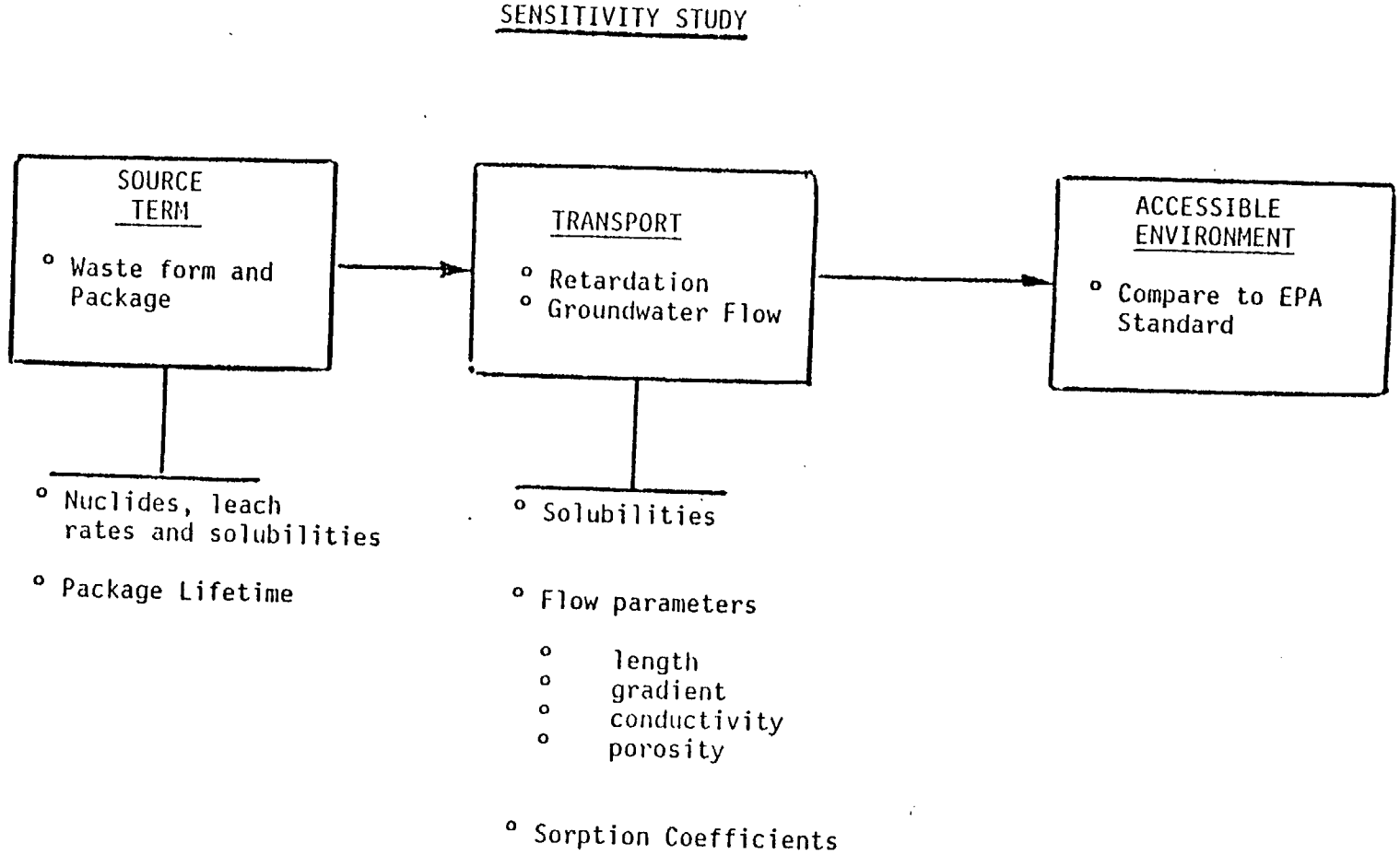

SENSITIVITY STUDY
SOURCE TERM
° Waste form and Package
TRANSPORT
° Retardation
° Groundwater Flow
ACCESSIBLE ENVIRONMENT
° Compare to EPA Standard
° Nuclides, leach rates and solubilities
° Package Lifetime
° Solubilities
° Flow parameters
° length
° gradient
° conductivity
° porosity
° Sorption Coefficients

FIGURE 3

SITE ISSUE ANALYSIS

(1) Name of the site:

(2) Statement of the issue (in form of a qestion):

(3) Importance of the issue to repository performance:

(4) Portions of 10 CFR 60 that are directly connected to the issue:

(5) Summary of the present state of knowledge, with analysis of uncertainties:

(6) Summary of the additional information needed to resolve the issue by the time of construction authorization application:

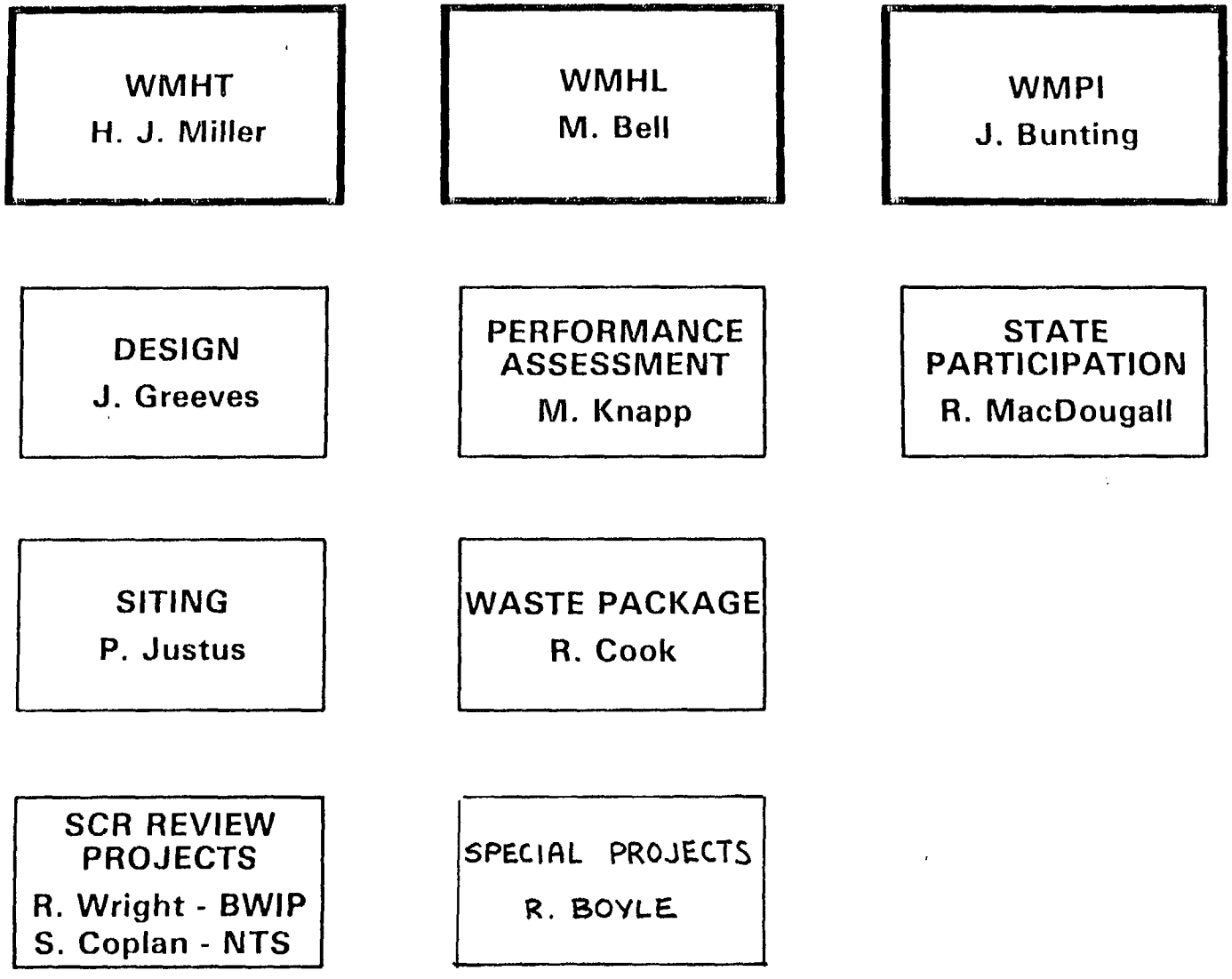
(7) Summary of the planned approaches to testing, tests, test methods and investigations, and data analyses and assessments to provide the information needs of (6):

(8) Analysis of (7) as to completeness, practicality and likelihood of success:

References: On a separate page list all references used in the analysis.

FIGURE 4

NRC HLW Licensing Program



REVIEW PROCEDURE

Introduction

In preparation for the SCR review, the review team is named and a Project Manager (PM) is selected. Most of these individuals are members of the NRC's High-Level Waste Technical Development Branch (WMHT) and the High-Level Waste Licensing Management Branch (WMHL).

For review purposes, the content of the SCR is considered to be embraced within seven review topics. Each member of the review team is assigned to one or more topic review groups (see Figure 4). These are:

1. Groundwater Flow
2. Waste Form/Waste Package
3. Retardation
4. Repository Design
5. Geologic Stability
6. Institutional Concerns
7. Performance Assessment and Integration

In a further breakdown of SCR content, each review topic is divided into a group of site issues, which are the basic units for the SCR review and analysis. A site issue is a question about a site or design that is critical to determination of site suitability and adequacy of repository design at the construction authorization stage. All site issues will be linked to performance objectives and requirements of 10 CFR 60; they will not be merely a function of degree of controversy.

Among all the site issues at a particular location, the more important ones identified during the SCR review process will be thoroughly discussed in the SCA.

The responsibility of directing and executing the review and analysis of site issues within each topic review group rests with a group coordinator,i.e., a designated senior member of the topic review group or section leader. Because of the extensive interrelationship among issues -- the fact that the data required to resolve many of them are exactly the

same -- there will be a need for operating as teams according to the topics described above. Group coordinators have the responsibility of assisting the project manager in: (a) assuring rapid dissemination of relevent information to all group members and assuring that all members are current on each others activities; (b) assuring coordination among specific activities of group members through frequent meetings, phone conferences, etc.; and (c) assuring coordination of reports from group members.

The responsibility of WMHT and WMHL line managment (section leaders and branch chiefs) for assuring the technical adequacy of evaluations remains unchanged. Their review of products - in addition to reviews performed by group coordinators and the PM - provides the mechanism for the line managers to discharge their responsibilities. In most cases, the section leaders will be the group coordinators.

The review and analysis of specific site issues will be carried out by a designated issue reviewer, i.e., a review group member who is an NRC staff member, an NRC contractor or an NRC consultant - as determined by the group coordinator and PM. For uniformity of presentation and efficiency of SCA preparation, the site issue analysis will be presented on a Site Issue Analysis form (see Figure 3 in the previous section of this review plan). The completed form may be accompanied by one or more pages of supporting material prepared by issue reviewers.

As part of the advance work before receipt of the SCR, a preparatory SCA (consisting of mockups and preliminary outlines of the SCA and supporting materials) will be developed utilizing information already in hand. The development will be analogous to the process indicated for preparation of the draft SCA.

Steps in SCR Review and Analysis

The SCR analysis involves four main activities:

1.0 Organization of Pre-SCR Review Activities
2.0 Development of Preparatory SCA
3.0 Preparation of Draft SCA
4.0 Preparation of Final SCA

The general sequence of major steps for each of the four main activities is described in the following narrative. Figures 5 thru 9 show in more detail the organization of the review team and the milestones and approximate schedule for each review activity. Note that many products will be produced and reviewed in parallel; for example, preparation of the SCA and the site issue analyses will both begin prior to SCR receipt and continue throughout the SCR review sequence (see Figure 9).

The activities described herein are mainly those to be undertaken by the NRC, its contractors and consultants. These activities depend heavily on an active exchange of information between DOE, NRC and various contractors. The interactions with DOE include site visits, topical discussions and programmatic discussions, all representing a thorough technical interchange to facilitate the review process. In addition, discussions on matters related to the site investigations are expected to be held with a wide range of non-DOE groups, such as the U.S. Geological Survey, U.S. Bureau of Mines, U.S. Army Corps of Engineers, state groups, citizen organizations, and the National Academy of Sciences. These activities are essential parts of this review plan, even though they are, of necessity, somewhat ad hoc in nature and cannot be specifically defined or enumerated. In fact, it is only because of these activities that it will be possible to complete a review of the SCR and prepare an SCA rapidly.

1.0 Organization of Pre-SCR Review Activities

1.1 Topic review group convenes with project manager to (a) systematically prepare a comprehensive list of site issues to be handled by the group, (b) assign each site issue to issue reviewers and (c) establish priority among the issues. Site issues will be identified mainly from trip reports, project reviews performed by staff and others and other documents already in hand. At an early time a systematic and comprehensive review of site issues will be tabulated and categorized for tracking purposes.

1.2 An inventory of documents and other data that pertain to each site issue is prepared by group members designated by the group coordinator or PM.

1.3 Group coordinator or PM (a) sets priorities among assigned site issues, (b) designates responsibilities for review, and (c) establishes priorities and schedules.

1.4 PM, in consultation with all involved section leaders and group coordinators, integrates all site issue review schedules from 1.3(c) into an overall project review schedule that (a) sets priorities among all site issues, (b) determines level of effort for SCR review of each site issue, and (c) identifies issue reviewers.

2.0 Development of Preparatory SCA

2.1 Each designated issue reviewer prepares a Site Issue Analysis (draft #1, see Figure 8) and delivers same to the group coordinator. Since this draft will be prepared prior to SCR receipt, it will be a partial, preliminary analysis based on information obtained from previous site visits, workshops with DOE staff and other sources. This draft will cover only items (1) thru (6) on the SIA form (Figure 3). Items (7) and (8), a summary and evaluation of DOE's plans for SC, will be preapred after SCR receipt.

2.2 Each topic review group prepares appendices for the SCA and an annotated outline or "mockup" of portions of the SCA text for which it is responsible.

2.3 Each group coordinator, with assistance from designated issue reviewers (a) edits Site Issue Analyses, draft SCA appendices, and outlines of portions of the SCA text for clarity and completeness and (b) transmits these to PM.

2.4 With input from 2.3 above, PM develops a preparatory SCA.

2.5 Preparatory SCA is reviewed by NRC management.

2.6 PM, with assistance from the group coordinators, revises preparatory SCA and completes plans for SCR receipt.

3.0 Preparation of Draft SCA

[Note: Throughout preparation of the DSCA, at least up through Step 3.4, NRC staff will have discussions with DOE, NRC consultants, States and other groups largely for clarification of questions on information contained in the SCR. These communications will be on an informal, "rapid-turnaround, not-to-interfere-with-schedule" basis.]

3.1 Upon receipt of the SCR, each group coordinator (a) provides each site issue reviewer with relevant portions of the SCR and (b) identifies portions of the SCR review for which each reviewer is responsible. These assignments should be the same as those for the preparatory SCA as modified under step 2.6.

3.2 For each site issue, the issue reviewer prepares Draft #2 of each Site Issue Analysis (i.e., Draft #1 plus items (7) and (8) on DOE's plans for SC), based on the SCR, workshops, and other available information, and delivers same to the group coordinator.

3.3 Each group coordinator, with assistance from selected group members, (a) edits the Site Issue Analyses for technical adequacy, clarity, consistency and relevance to review topic, (b) prepares assigned portions of the SCA text, with analysis of issues and (c) delivers all materials to PM.

3.4 PM (a) integrates SCA chapters into Draft #1 and (b) assembles all Site Issue Analyses.

[Notes: (1) Based on early experience in review, issue reviewers may prepare designated sections of SCA for integration by PM; group coordinators have primary responsibility for managing this effort. (2) In Drafts #1 and #2, the DSCA chapters are treated separately. Beginning with Draft #3, the DSCA is treated as a single document.]

3.5 SCA Draft #1 chapters are reviewed in parallel by other interface groups, section leaders, and WMHT and WMHL branch chiefs (for selected review to assure problems are identified early) and deliver revised chapters to PM for integration into SCR Draft #2 (see Figure 7).

[Note: This parallel review process will be repeated as necessary. The same parallel review will be used in preparing the SIAs (see Figure 8).]

3.6 SCA Draft #2 is reviewed (revised into Draft #3) by DWM.

[Review at the Division level will be selective.]

3.7 SCA Draft # 3 is reviewed (revised) by NMSS, ELD, RES, and other NRC offices as appropriate.

[Review by other NRC offices will be selective.]

3.8 Following internal NRC review, SCR Draft #3 is discussed with selected other outside groups for general review.

3.9 NRC staff finalizes SCA Draft #3 for publication.

3.10 Draft SCA is published and all Site Issue Analyses are provided for public review in Public Document Room. (16 weeks after SCR receipt)

4.0 Preparation of Final SCA

4.1 During 90 days public comment period, each comment, as received, is assigned by PM to a topic reviewer.

4.2 Designated topic reviewer (a) prepares a draft response to the comment, (b) prepares any needed change in draft SCA and (c) delivers both to the PM.

4.3 All comments are evaluated, and proposed changes in the draft SCA are discussed with NRC management.

4.4 PM develops final SCA. (14 weeks after DSCA issued)

4.5 Designated review team members prepare document covering the response to public comments.

4.6 Commission is briefed on documents in 4.4 and 4.5.

4.7 Final SCA is reviewed (revised) by WMHT and WMHL.

4.8 Final SCA is reviewed (revised) by WM.

4.9 Final SCA is reviewed (revised) by WMSS.

4.10 Simultaneously with 4.9, SCA is discussed with the Commission.

4.11 Final SCA is published. (20 weeks after DSCA issued)

FIGURE 5

SITE CHARACTERIZATION REVIEW PROCESS

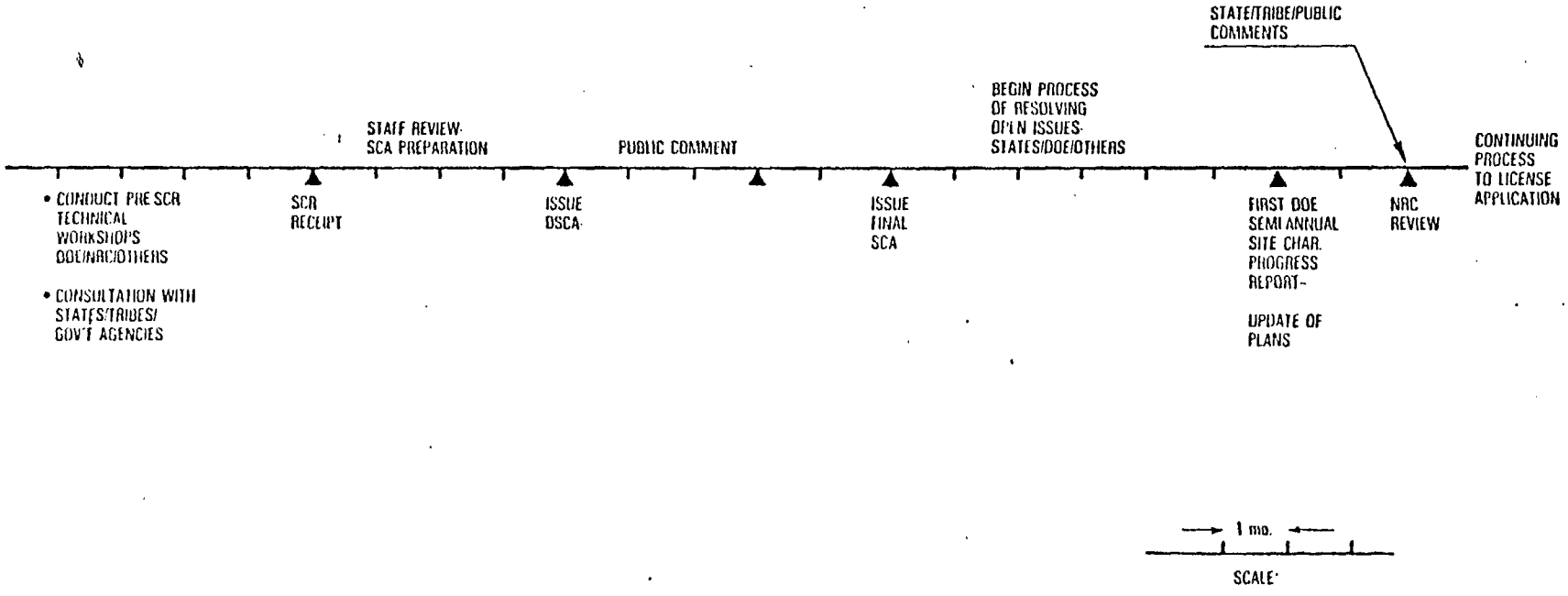
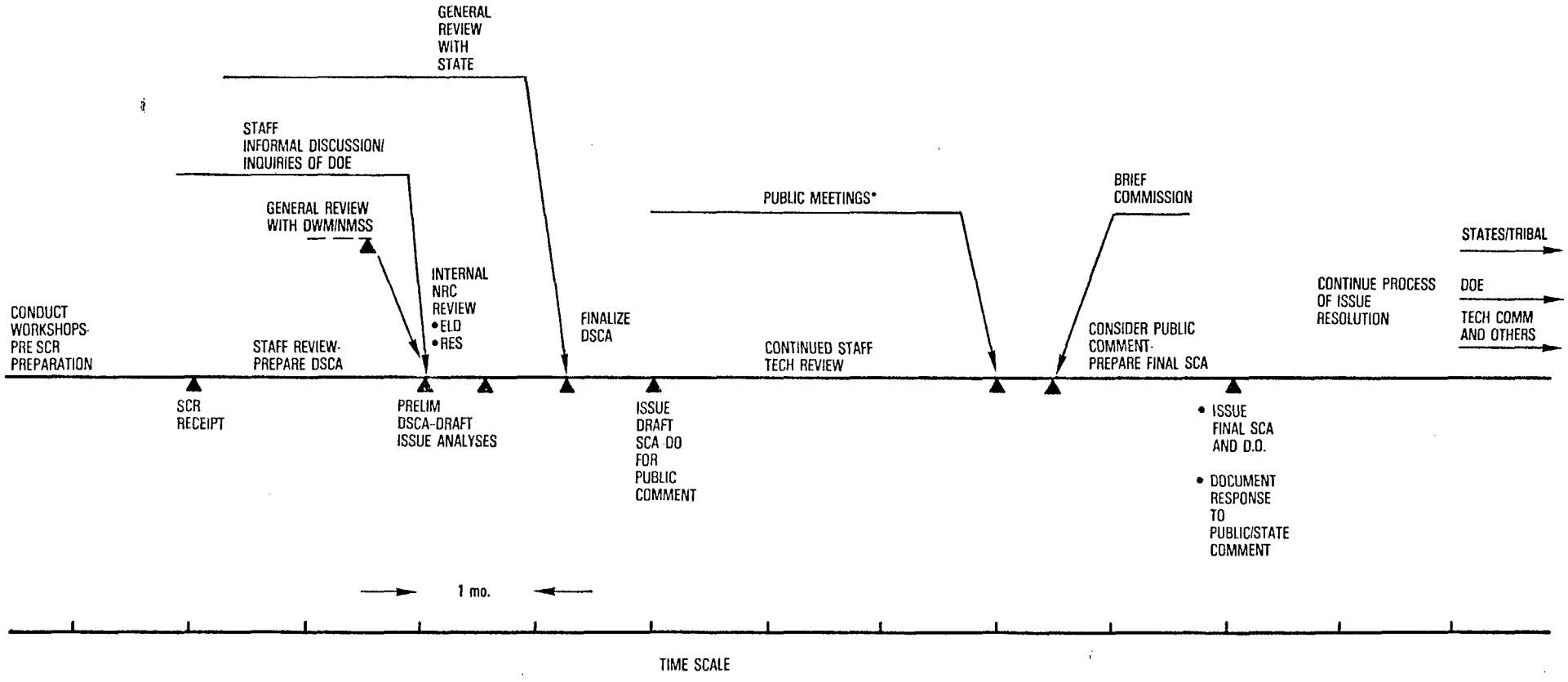


FIGURE 6

OVERALL SITE CHARACTERIZATION ANALYSIS SEQUENCE



* Not required by rule.
May be coordinated with public meetings by the State and DOE.
Timing may also differ in some cases.

FIGURE 7

DSCA DOCUMENT DEVELOPMENT AND REVIEW-GENERAL SEQUENCE

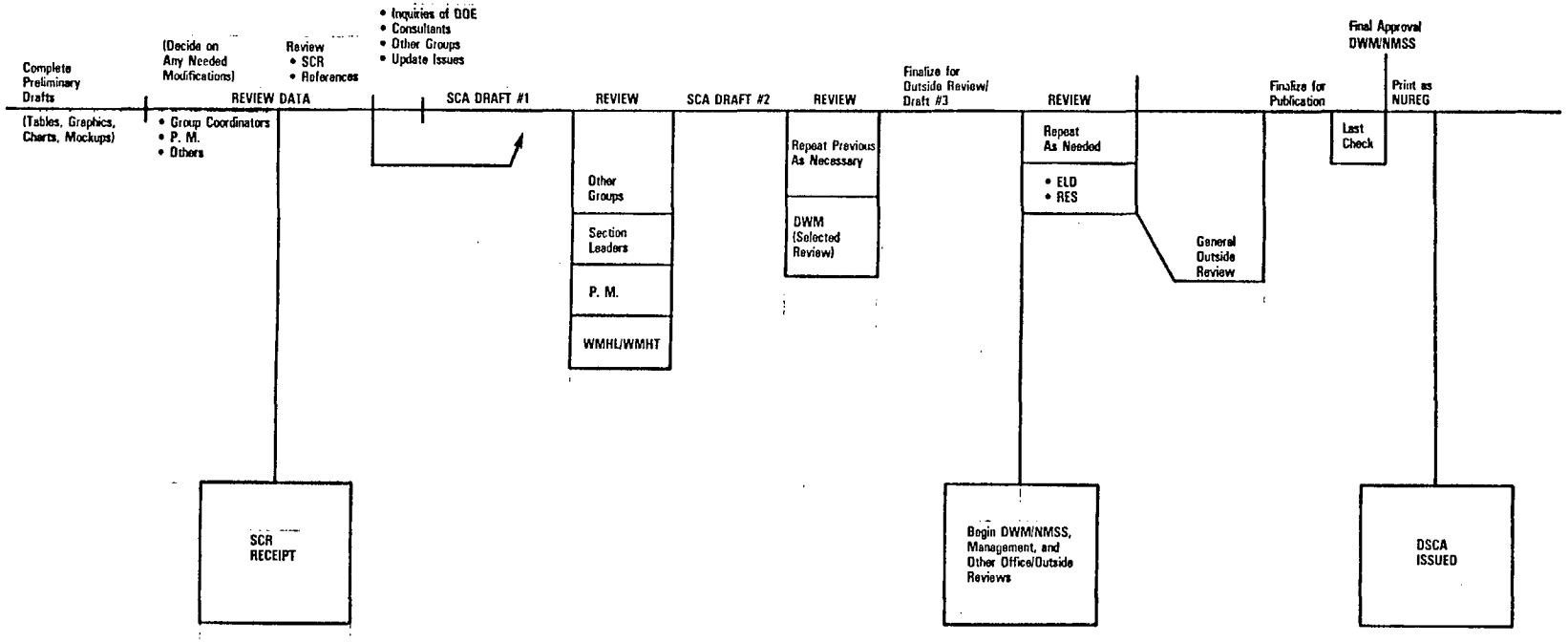


FIGURE 8

SIA DOCUMENT DEVELOPMENT AND REVIEW - GENERAL SEQUENCE

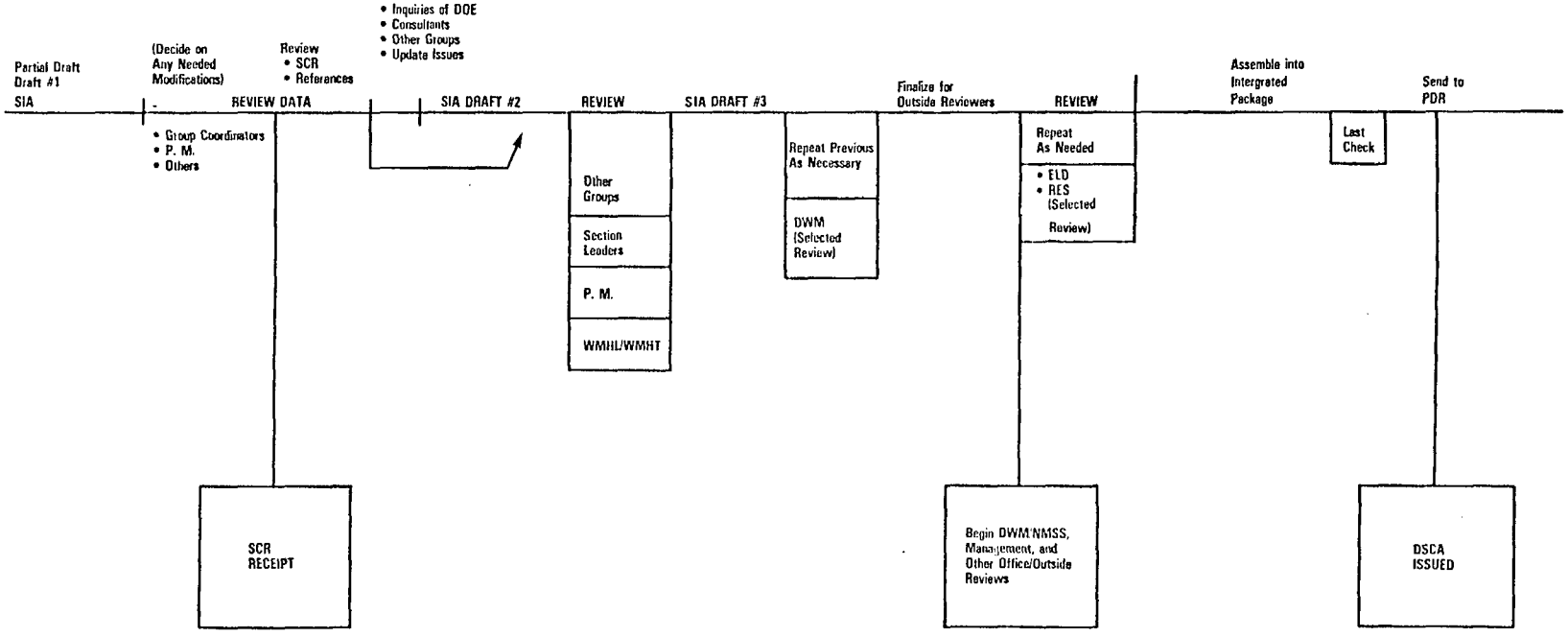
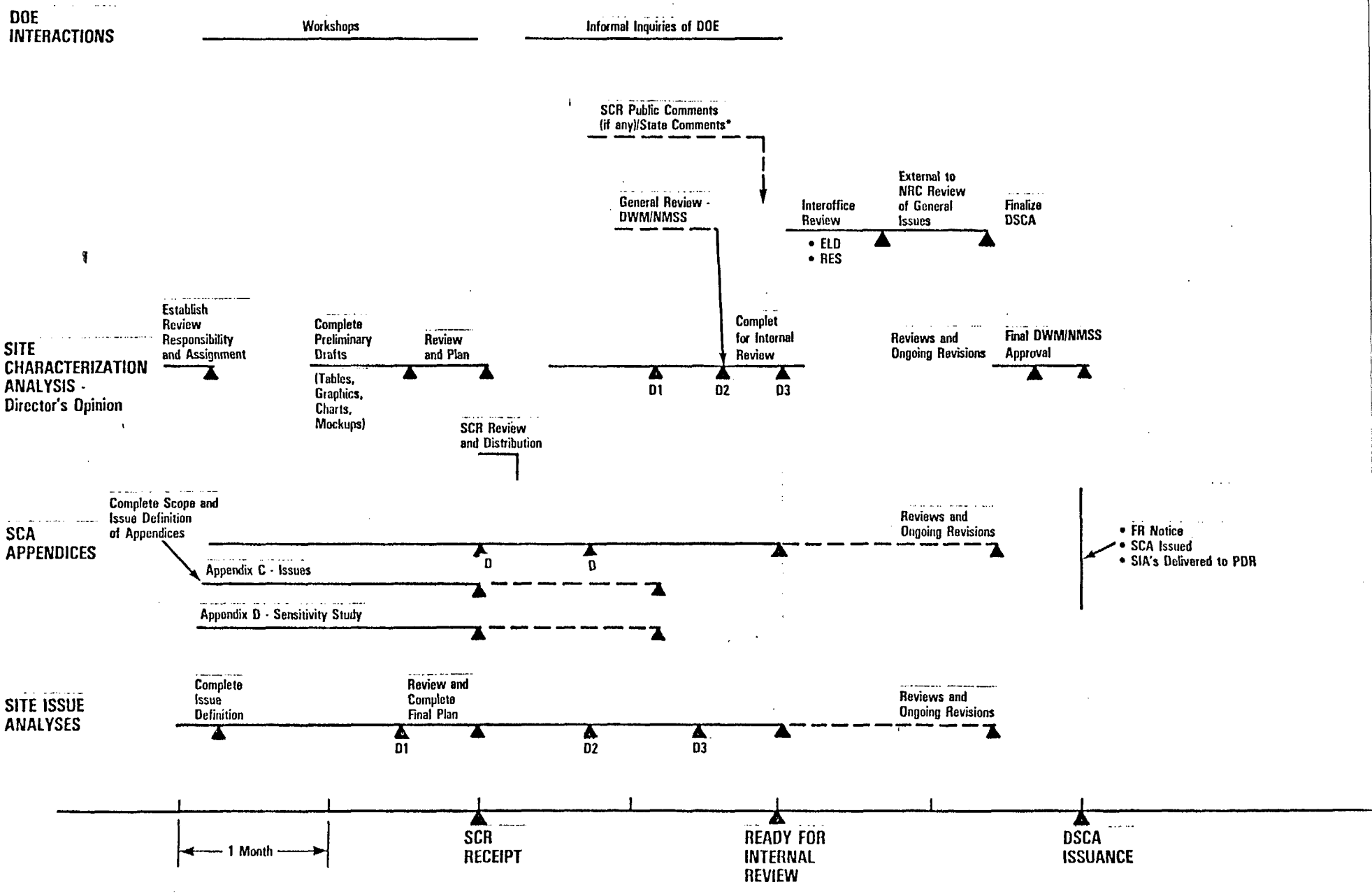


FIGURE 9

SCA PRODUCTS - INTERGRATED SEQUENCE AND SCHEDULE**



* Public commentson on DOE'S SCR will be considered to the extent practicable. Arrangements for interfaces with states will be determined on a case by case basis

** The interior milestones shown are approximatly located with the time scale at the bottom of the figure

BWIP ISSUES

IDENTIFIED BY NRC

November 15, 1982

1.0 Groundwater Flow

o 1.1 What are the groundwater flow paths, discharges (flux), velocities, and travel times under present conditions (disturbed zone, farfield and Pasco Basin)?

- o 1.1.1 What is the three-dimensional distribution of hydrogeologic parameters (including vertical and horizontal hydraulic conductivity, effective porosity, double porosity, dispersivity, and hydraulic head) within the sytem (disturbed zone, farfield and Pasco Basin)?
  - o 1.1.1.1 What are the distributions of measured hydrogeologic parameters of each unit tested?
  - o 1.1.1.2 Whare are the distribution of <u>interpolated</u> hydrogeologic parameters of each unit?
- o 1.1.2 What are the groundwate recharge and discharge locations,
  mechanisms, and amounts for the Pasco Basin?
- o 1.1.3 What are the boundary conditions used for the flow systems being analyzed?

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o Issues for SIA development

- 1.1.4 How and to what extent is groundwater flow affected by structural heterogeneities?

- 1.1.5 How and to what extent is groundwater flow affected by stratigraphic and lithologic heterogeneities?

- 1.1.6 What is the hydrochemistry of the groundwater systems of the Pasco Basin?

- 1.1.7 What are the hydrostratigraphic units within the disturbed zone and Pasco Basin?

    - 1.1.7.1 How is the choice of units supported by geologic data (including core data)?

    - 1.1.7.2 How is the choice of units supported by geophysical data?

    - 1.1.7.3 How is the choice of units supported by hydrogeologic data (including hydraulic head distribution)?

    - 1.1.7.4 How is the choice of units supported by hydrochemical and temperature and temperature data?

    - 1.1.7.5 What is the relationship between the hydrostratigraphic units and the units tested for hydrogeologic parameters?

- 1.1.7.6 What is the relationship between the hydrostratigraphic units and the units used in groundwater modeling?

- 1.2 What are the types, probabilities, and nature of natural changes that would affect groundwater flow?

  - 1.2.1 What are the types, probabilities, and nature of catastrophic Colubmia River flooding changes that would affect groundwater flow?

  - 1.2.2 What are the types probabilities, and nature of glaciation changes that would affect groundwater flow?

  - 1.2.3 What are the types, probabilities, and nature of precipitation/evapotranspiration changes that would affect groundwater flow?

  - 1.2.4 What are the types, probabilities, and nature of structural and tectonic stress changes that would affect groundwater flow?

- 1.3 What are the types, probabilities, and nature of human-induced changes (excepting repository-induced changes) that would affect groundwater flow?

  - 1.3.1 How does the value of water resources in the Pasco

Basin compare with the values in other surrounding areas of similar size, and what is the potential for future use?

- 1.3.2 What are the types, probabilities, and nature of water resource development (drilling) changes that would affect groundwater flow?

- 1.3.3 What are the types, probabilities, and nature of groundwater withdrawals and recharge changes that would affect groundwater flow?

- 1.3.4 What are the types, probabilities, and nature of changes from dam construction on the Columbia River that would affect groundwater flow?

- 1.4 What are the expected effects overtime on groundwater flow paths, velocities, dispersivities, discharges, and travel times resulting from repository-induced changes (including underground facility construction, dewatering and long-term stability, borehole/shaft seal failure, thermomechanical, thermal buoyancy, and thermal alteration of fracture filling minerals)?

- 1.5 What are the expected effects over time on groundwater flow paths, velocities, dispersivities, discharges, and travel times resulting from human-induced changes excepting repository-induced changes (including water resource exploration, groundwater withdrawals and recharges, dam

construction on the Columbia River, and human induced structure and tectonic changes)?

- 1.6 What are the expected effects over time on groundwater flow paths, velocities, dispersivities, discharges, and travel times resulting from natural changes (including catastrophic Columbia River flooding, glaciation, precipitation/evapotranspiration, structure and tectonic stress)?

2.0 Waste Form/Waste Package

- 2.1 What are the possible mechanisms by which water will penetrate packing materials around containers?

- 2.2 To what extent over time will groundwater flow, temp. or other effects change the ability of packing materials to control flow through those materials? What chemical and physical changes are possible? What are the chemical and physical properties?

- 2.3 What are the hydrothermal conditions with time at the surfaces of the waste form and containers and within packing materials which influence property changes and radionuclide release?

- 2.4 What are the possible mechanical failure modes for the container?

- 2.5 What are the chemical and physical property changes in container materials and what are the properties?

- 2.6 What are the mechanical loads on containers vs. time? How do the packing materials affect the loading?

- 2.7 What are the possible corrosion failure modes for the container?

- 2.8 What is the effect of packing materials on the corrosion mechanisms for the container?

- 2.9 How do Eh, pH and PO_2 change with time in the vicinity of the container and in the packaging?

- 2.10 What is the radiolytic generation of hydrogen, oxygen and other species due to gamma radiation in the vicinity of the container?

- 2.11 What is the dependence of the oxygen removal rate from packing materials upon temperature, pressure, radiolysis, packing materials physical characteristics, groundwater flow rates and composition and time?

- 2.12 How do microbes effect conditions affecting corrosion modes?

- 2.13 What is the solubility of radionuclides vs. time in the vicinity of the waste form and packing materials? How are radionuclides released from the waste form?

- 2.14 How does the waste form change its physical and chemical properties with time from initial manufacture to 10,000 years? and what are these properties?

- 2.15 What is the effect of water residence time on release of radionuclides from the waste form?

- 2.16 What are the ranges of residence times of a unit volume of water in contact with a unit area waste form and when do the residence times occur? For spent fuel how do hulls change the effective residence time?

- 2.17 How do the packing (spent fuel hulls if applicable), canister, and container materials and/or their alteration products interact with waste form to cause its alteration and/or effect release radionuclides?

- 2.18 How does the Eh, pH and AO_2 change with time in the vicinity of the surface of the waste form? (Relates to 2.9)

- 2.19 What is the production of particles and colloids (by or near the waste form) which can hold or transport radionuclides or effect waste form degradation vs. time?

- 2.20 For spent fuel what are the failure mechanisms for hulls and what is their failure rate?

- 2.21 What are the transport and retardation processes and how do they effect the flux of radionuclides with time in packing materials?

- 2.22 How do the species which incorporate radionuclides change with time in the waste package? (This includes particles, colloids and solubles.)

- 2.23 Can actinides be concentrated to increase heating in the packing materials or create a potential for criticality?

- 2.24 What effect do microbes have on the conditions affecting transport? (Relates to 2.12)

- 2.25 How do radionuclides migrate through failed contaienrs and how does this change with time? (Relates to 2.5)

- 2.26 What are the convective flows in the waste package vs. time? (Relates to 2.1)

- 2.27 Does alpha radiation in the waste packing materials affect chemistry and hence transport and species identification?

- 2.28 What are the conditions which affect criticality?

3.0 Retardation

- 3.1 What is the expected solubility of released radionclides in the near-field (excluding the waste package) and the far-field through time?

  - 3.1.1 How does precipitation/co-precipitation affect radionuclide migration from the vicinity of the outermost packing material/rock/backfill interfaces to the accessible environment through time?

  - 3.1.2 How does speciation affect radionuclide solubility?

  - 3.1.3 How do colloids affect radionuclide solubility/concentration?

- 3.2 What is the expected retardation of released radionuclides in the near-field (excluding the waste package) and the far-field through time?

  - 3.2.1 How do chemical changes in the outermost packing material influence radionuclide migration from the vicinity of the outermost packing material/rock/backfill interfaces through time?

  - 3.2.2 How does backfill mineralogy influence radionuclide migration through time?

  - 3.2.3 How does the nearfield mineralogy influence radionuclide migration through time?

3.2.4 How does the farfield mineralogy influence radionuclide migration through time?

3.2.5 How does sorption in the near-field (excluding the waste package) and far-field affect radionuclide migration through time?

3.2.6 How does solubility/concentration of radionuclides in the near-field (excluding the waste package) and the far-field affect radionuclide migration through time?

3.2.7 How do colloids/particulates affect radionuclide migration/retardation in the near-field (excluding the waste package) and the far-field through time?

- o 3.3 How is the migration behavior (including solubility and retardation) of radionuclides being validated/verified?
- o 3.4 How are the geochemical data that have been and will be gathered be shown to be appropriate for use in anticipated performance assessment methods?
- o 3.5 What is the mineralogy/petrology/chemistry of the backfill prior to emplacement?
- o 3.6 What is the mineralogy/petrology/chemistry of the nearfield/farfield host rock prior to waste emplacement?

- 3.7 What is the mineralogy/petrology/chemistry of secondary minerals of the nearfield/farfield host rock prior to waste emplacement?

- 3.8 What are the geochemical conditions expected under anticipated and unanticipated repository scenarios at the outer waste package interface with the host rock/backfill, in the near-field and in the far-field, through time?

  3.8.1 What are the geochemical conditions (e.g., groundwater, species, conc. Eh, ph, and others as appropriate) anticipated in the backfill through time?

  3.8.2 What are the geochemical conditions (e.g., groundwater, species, conc., Eh, pH and others as appropriate) anticipated in the nearfield rock (distrubed zone) environment through time?

  3.8.3 What are the geochemical conditions (e.g., groundwater, species, conc., Eh, pH and others as appropriate) anticipated in the farfield rock environment through time?

- 3.9 What are the geochemical reactions (including thermaochemical reactions) expected under anticipated and unanticipated repository scenarios from the outer waste package interfaces with the host rock/backfill, through the near-field and the far-field, through time?

3.9.1 What are the geochemical reactions anticipated in the backfill through time?

3.9.2 What are the geochemical reactions anticipated in the nearfield rock/fracture-filling materials (disturbed zone) environment through time?

3.9.3 What are the geochemical reactions anticipated in the farfield rock/fracture filling-materials environment through time?

3.9.4 What are the geochemical reactions anticipated in seals within the nearfield and farfield environment through time?

3.9.5 What are the geochemical reactions anticipated in the groundwater within the nearfield and farfield environment through time?

3.9.6 What are the effects of gamma and alpha radiolysis products on backfill, nearfield and farfield host rock relevant to assessment of radionuclide retardation?

3.9.7 How fast does the Eh (in the disturbed zone) return to "ambient" conditions after repository sealing?

4.0 Design of Facility

4.1 Are the repository design criteria and the functional description (prior to decommissioning) shown to be complete and accurate with respect to the performance objectives?

4.1.1 How do the design criteria and conceptual design address releases of radioactive materials to unrestricted areas within the limits specified in Part 20?

o 4.1.2 How do the design criteria and conceptual design accommodate the retrievability option?

4.2 Can stability of the repository be maintained in the presence of coupled in-situ, excavation induced and thermal stress during construction and operation of the repository?

4.2.1 How is the conceptual design shown by analysis to accommodate in-situ stresses, and mechanical and thermal effects due to construction of the repository and waste emplacement?

o 4.2.2 What are the in situ stress conditions and how do stress conditions vary with time and temperature?

o 4.2.3 What are the rock mass strength properties and how do they vary with time and temperature?

o 4.2.4 What are the rock mass deformation characteristics and how do they vary with time and temperature?

4.3 How can isolation capability of the underground facility be maintained in the presence of coupled in situ, excavation induced, and thermal stresses?

o 4.3.1 How does construction modify the groundwater flow characteristics in and around the underground facility?

o 4.3.1.1 What will be the rate of groundwater inflow into the repository?

4.3.1.2 How will the head distribution vary after construction?

4.3.2 How do thermal loads modify the flow characteristics in and around the underground facility?

o 4.3.3 What are the physical conditions (e.g., temperature pressure, stress etc) anticipated in and around the underground facility through time?

4.4 What is the maximum expected radionuclide release rate from the engineered system and is this rate in compliance with NRC technical criteria?

4.4.1 What is the release rate from the waste form with time?

4.4.2 What is the release rate from the waste package with time?

4.4.3 What is the release rate from the engineered barrier system with time?

o 4.4.3.1 What are the physical conditions (e.g., temperature, pressure, stress, permeability, etc) anticipated in the backfill through time?

4.5 Can repository shafts and exploratory boreholes be constructed and sealed adequately?

o 4.5.1 How is repository performance expected to be affected by construction of the Exploratory Shaft?

o 4.5.2 How is repository performance expected to be affected by repository shafts?

4.5.3 How is repository performance expected to be affected by exploratory boreholes?

5.0 Geologic Stability

o 5.1 What are the structural heterogeneities in the Pasco Basin under present conditions?

5.1.1 What is the significance of the aeromagnetic anomalies that define intact blocks in the Cold Creek Syncline?

5.1.1.1 What is the significance of the N-96 and N-84 anomalies?

5.1.2 What is the probability and nature of undetected faulting in the controlled area?

5.1.2.1 East-west faulting?

5.1.2.2 North-west trending faulting?

5.2 What are the stratigraphic heterogeneities of the Pasco Basin under present conditions?

o 5.2.1 What is the lateral continuity and variation in thickness of the Umtanum Flow and Middle Sentinel Bluffs Flow?

5.3 What are the probabilities and nature of natural changes that would affect repository performance?

o 5.3.1. What is the probability of earthquake activity in or near the Pasco Basin affecting repository performance?

5.3.1.1 What is the seismic hazard and risk to surface and subsurface facilities including micro-earthquakes and earthquake swarms within the controlled zone?

- 5.3.2 What is the nature and probability of renewed volcanism in or near the Pasco Basin affecting repository performance?

  5.3.2.1 Flood basalt?

  5.3.2.2 Air fall tephra?

  5.3.2.3 Ash flows?

  5.3.2.4 Flooding with water (damming walula gap)?

- 5.3.3 What is the probability of glaciation in or near the Pasco Basin affecting repository performance?

  5.3.3.1 What is the probability that differential loading caused by glaciation can result in a change in the state of stress?

  5.3.3.2 What is the probability that water loading from ice melt flooding will cause a change in the state of stress?

o 5.3.4 What is the probability and nature of structural deformation in the Pasco Basin that would effect repository performance?

5.3.4.1 What tectonic models are being considered and what are the bounding conditions (geologic constraints)?

5.3.4.2 What is the state of stress at depth and how does it relate to the regional stress field?

5.3.4.3 What is the probability and nature of future faulting in the controlled zone?

5.3.4.3.1 What is the probability of future faulting in the repository shearing the backfill or waste package?

5.4 What are the probabilities and nature of human-induced changes, excluding repository construction, that would affect repository performance?

o 5.4.1 What are the probabilities that groundwater withdrawals would affect repository performance?

5.4.1.1 What is the probability that groundwater withdrawals for irrigation would trigger micro-earthquake or earthquake swarms?

- 5.4.2 What are the probabilities and nature of groundwater recharge that would affect repository performance?

  - 5.4.2.1 What is the probability that fluids injected into the confined aquifer at the 200W area will trigger earthquake swarms in the controlled zone?

  - 5.4.2.2 What is the probability that water impoundments behind possible future dam construction (Ben Franklin dam) will cause micro-earthquakes or earthquake swarms?

  - 5.4.2.3 What is the probability that flooding due to upstream dam failure will cause micro-earthquakes or earthquake swarms?

6.0 Site Screening and Environmental/Institutional

- 6.1 How did DOE select the Pasco Basin from among other candidate areas?

- 6.2 How did DOE select the reference repository location (RRL) from among the other sites in the Pasco Basin?

- 6.3 Are there any obvious environmental concerns that could preclude the reference repository location (RRL) from being

considered as one of the candidate sites in DOE's subsequent application for an authorization to construct a repository?

6.3.1 Will the reference repository location (RRL) at Hanford adversely affect the Rattlesnake Hills Critical Wildlife Habitat in the Cold Creek Critical Wildlife Habitat?

6.3.2 Will constructing and operating a repository adversely affect six species of rare, threatened or unique birds, which have been identified on or near the Hanford Reservation?

6.3.3 Could a repository at Hanford, particularly during construction generate dust which would degrade the air quality?

6.3.4 Will dust affect three species of endangered/threatened plants within the Arid Lands Ecology Reserve?

6.3.5 During construction, water will be needed for drilling and dust control. Given the arid environment of the Pasco Basin, could a repository compete with irrigated agriculture for a limited supply of water?

6.3.6 How will the public react to transportation impacts

since HLW must be transported across the nation to reach a repository at Hanford, Washington?

6.3.7 Will the public accept the RRL site as one of the best sites that can reasonably be found?

7.0 Other

- 7.1 How is the accessible environment defined and where is it located?

- 7.2 How is the disturbed zone defined and where is it located?

- 7.3 What are the most likely performance scenarios?