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REPLY TO ATTN OF: RW-23

SUBJECT: Issues, Issue Resolution Strategy, and Design Information for the SCP

TO: S. Mann, CRP
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Over the past four months, a number of meetings have been held among HQ and the Project Offices to discuss questions relating to the format and content of the SCP (Chapters 6, 7, and 8) and the SCP Conceptual Design Report (CDR). These meetings covered the topics of SCP preparation issues related to repository design (November 4-5, 1985, Irvine), waste package strategy (December 3, 1985, Richland), issue resolution strategy and performance allocation (January 13-14, 1986, Denver), and NNWSI repository design presentation and issues resolution strategy (February 11-13, 1986, Albuquerque). As a result of these meetings, there is a need to clarify the appropriate scope, content, and format of the SCP and the SCP-CDR in a number of areas. Enclosure 1 provides such clarification in the following areas:

1. Use of the common issue resolution strategy
2. Scope, content, and use of "issues" for site characterization
3. Effect of issues on format and content of SCP and SCP-CDR
4. Q-list for SCP-CDR and SCP
5. Role of SCP Chapter 6 and the SCP-CDR
6. Retrievability and retrieval in the SCP and SCP-CDR
7. Waste types and receipt rates for repository design
8. Seismic design for the SCP and SCP-CDR
9. Reversal of underground ventilation for SCP design

The guidance contained in Enclosure 1 should be used in the preparation of all SCPs.

In a related matter, a number of revisions are needed to the "Annotated Outline (AO) for SCPs "(baseline document OGR/B-5) to make the terminology in the AO consistent with the terminology in the "Generic Requirements for a Mined Geologic Disposal System" (baseline document OGR/B-2). The proposed revisions are provided in Enclosure 2.

The proposed changes to the AOs for the SCP and the SCP-CDR that are described in Enclosures 1 and 2 are provided for information at this time. We plan to process these revisions through the baseline change control procedure in the near future.

Ralph Stein

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Attachment

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ENCLOSURE 1

GUIDANCE CONCERNING ISSUES, ISSUE RESOLUTION STRATEGY, AND DESIGN INFORMATION FOR THE SITE CHARACTERIZATION PLAN

MARCH 21, 1986

Table of Contents for Enclosure 1

1. Use of the Common Issue Resolution Strategy

Issues will be used as a basis for planning site characterization activities. Since the issues will be derived from the applicable regulations and other system requirements that apply to a mined geologic disposal system, resolution of the issues represents the work that needs to be done to meet those regulations and requirements.

A common approach to the resolution of issues was developed at the January 13-14, 1986 SCP meeting in Denver. This approach is presented in an Issue Resolution Strategy (IRS) diagram (see Attachment A). The logic of the IRS will be used to develop the plans for resolving all site-characterization-related issues. This logic will apply to characterization, design, and performance issues (see item 2 below), and will include both postclosure and preclosure concerns.

Performance allocation is an integral part of the IRS and will be used for all site-characterization-related issues (including postclosure and preclosure issues). The approach to performance allocation that will be followed by all Projects is described in the guidance contained in Attachment B. Examples of how the process will be applied to preclosure design issues are provided in Attachment C.

2. Scope, Content, and Use of "Issues" for Site Characterization

Issues will be the basis for planning and reporting the results of site characterization activities. An issues hierarchy will be used to provide a comprehensive identification of all questions or issues that need to be addressed by the site characterization program. The issues hierarchy will be developed in such a way that specific issues that are not in the issues hierarchy, but which are relevant to the program and could be raised, will be covered in a general way by one or more issues that are in the issues hierarchy. All work to be done during site characterization will thus be responsive in some way to issues in the issues hierarchy.

The issues hierarchy for BWIP, NNWSI, and SRP will be similar to the maximum extent practicable. The issues hierarchy presented in Attachment D will be used by all Project Offices except in cases where differences are required for site-specific, technical reasons. In any case, each issue hierarchy will consist of four key issues (adopted from the Mission Plan) which, in turn, will each contain a number of issues. Furthermore, the issues will be comprised of three types (characterization, design, and performance) in a manner similar to the NNWSI issues hierarchy. For each issue, there will be a number of information needs identified; they represent the necessary and sufficient information that is required in order for the issue to be resolved. The information needs will be developed to suit site-specific needs.

The SCP will identify the complete issues hierarchy; however, not all issues require information from site characterization activities. The SCP will provide plans for resolution of only those issues whose resolution requires information from site characterization activities.

The issues in the issues hierarchy will be used as "organizing principles" for the preparation of all technical program planning and reporting documents, to the maximum extent practicable. This means that the format of these documents should reflect the issues being addressed. (See item 3 for how issues affect the format and content of the SCP and the SCP-CDR.)

3. Effect of Issues on Format and Content of SCP and SCP-CDR

The use of the issues hierarchy as organizing principles for site characterization has implications for the format and content of the SCP and the SCP Conceptual Design Report (CDR) as follows:

SCP Sect. 8.2: Section 8.2 will list all issues of the issues hierarchy and provide the rationale of how the issues were developed, including those that are non-site-characterization issues. (However, as noted below, plans for non-characterization issues will not be addressed in the SCP.) It will describe the generic approach to issue resolution and include the IRS diagram. (Section 8.2 will also provide the information requested by the SCP Annotated Outline for Section 8.2).

No changes are needed to the Annotated Outline (AO) for Section 8.2.

SCP Sect. 8.3: Section 8.3 will present, issue-by-issue, the specific application of the IRS (including performance allocation) to each site-characterization issue. The presentation will include, or reference the source of, the basis and rationale utilized for establishing the performance goals and indications of confidence presented in the SCP.

Section 8.3 will provide the information requested by the SCP AO for Section 8.3, however, the format of Section 8.3 will be revised to reflect each of the issues from the issues hierarchy, in a manner similar to that indicated in Attachment E.

SCP Chap. 6: Chapter 6 will be limited to presenting the status on information related to repository design. The information presented in Chapter 6 will provide the basis for developing the strategy, performance allocation, and plans to be presented in Chapter 8; however, this Chapter 8 information will not be included in Chapter 6. Chapter 6 will use extensive references to the SCP-CDR to reduce the volume of Chapter 6.

Sections 6.1 and 6.2 will not be affected by the use of issues as organizing principles.

The format and content of Section 6.3 will remain as indicated in the AO. Sufficient information will be presented in this section so that, at a minimum, a summary of the requested information is provided. As necessary, reference to supplemental information elsewhere can be made.

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No changes are needed to the AO for Section 6.3.

Section 6.4 will present a summary of the status for each repository design issue requiring information from site characterization on an issue-by-issue basis. For each issue, a subsection of section 6.4 will summarize the analysis that has been completed relevant to the resolution

of the issue, the data used in the analysis, the results of the analysis, and an interpretation of the results relative to resolution of the issue. The most significant and difficult aspects of issue resolution will be highlighted. The plans for issue resolution contained in Chapter 8 will be referenced.

The above information is provided as clarification to the content of Section 6.4. Revisions to Section 6.4 of the SCP-AO are not considered necessary.

SCP Chap. 7

Chapter 7 will be limited to presenting the status on information related to waste package design. The information presented in Chapter 7 will provide the basis for developing the strategy, allocation, and plans to be presented in Chapter 8, however, this Chapter 8 information will not be included in Chapter 7.

Sections 7.1, 7.2, 7.3, and 7.4 will not be affected by the use of issues as SCP organizing principles.

In the same manner as Section 6.4, Section 7.5 will present a summary of the status of each waste package design issue requiring information from site characterization on an issue-by-issue basis. For each issue, a subsection of Section 7.5 will summarize the analysis that has been completed relevant to the resolution of the issue, the data used in the analysis, the results of the analysis, and an interpretation of the results relative to resolution of the issue. The most significant and difficult aspects of issue resolution will be highlighted. The plans for issue resolution contained in Chapter 8 will be referenced.

The above information is provided as clarification to the content of Section 7.5. Revisions to Section 7.5 of the SCP-AO are not considered necessary.

In a memorandum dated January 17, 1986, DOE-HQ identified key elements that would be addressed in a "waste package post-emplacement compliance strategy document" to be prepared by each Project Office. The key elements identified in the DOE-HQ memo will need to be presented at various locations in the SCP. Attachment F indicates what locations in the SCP are to be used for each element.

SCP-CDR:

The SCP-CDR will primarily present the status of information related to repository design (Chapters 1-7), in the same manner as Chapter 6 of the SCP, but Chapter 8 of the SCP-CDR will also provide some information on plans for future work.

Chapter 8 will present the status of each repository design issue on an issue-by-issue basis. For each issue, a section of Chapter 8 will summarize the analysis that has been completed relevant to the resolution of the issue, the data

used in the analysis, the results of the analysis, and the interpretation of the results relative to the resolution of the issue. The most significant and difficult aspects of issue resolution will be highlighted. There will also be a summary of the plans made for additional work toward issue resolution, with reference to Chapter 8 of the SCP (or a Repository Design Plan) for further information. Although the emphasis in the SCP-CDR will be on information concerned with site-characterization related issues, Chapter 8 of the SCP-CDR will also address non-site-characterization related issues to the extent that the design associated with such issues has been addressed in Chapters 1 through 7 of the SCP-CDR.

It is proposed that the AO for Chapter 8 of the SCP-CDR be replaced with the following:

"Chapter 8
DESIGN ISSUES
(75 to 100 pages)

This chapter will present the status of information for repository design issues, including those issues that do and do not require information from site characterization. For each issue, the chapter will present or summarize the analysis that has been completed relevant to the resolution of the issues, the data used in the analysis, the results of the analysis, and an interpretation of the results relative to resolution of the issue. Other sections of the SCP-CDR will be referenced, as appropriate, for information that relates to each issue. A brief overview of the plans for issue resolution will be provided; further information about plans will be referenced to Chapter 8 of the site characterization plan for issues requiring information from site characterization, and to another document for issues not requiring information from site characterization."

Chapters 1 through 5 of the AO for the SCP-CDR will not be affected by the use of issues as organizing principles.

The format and scope of Chapters 6 and 7 of the SCP-CDR, as indicated in the AO, will not be affected by the use of issues as organizing principles. Sufficient information will be presented in these chapters so that, at a minimum, a summary of the requested information is provided. As necessary, cross-referencing can be made among Chapter 6, 7, and 8 of the SCP-CDR to minimize redundancy.

4. Q-List for SCP-CDR and SCP

DOE/HQ has examined this issue in light of discussions held with the projects as well as the recent SCP schedule meeting deliberations and Feb. 11-13 meeting in Albuquerque. The following guidance shall be implemented by all projects:

SCP-CDR: The SCP-CDR will provide a list of the systems, structures, and components that are considered to be important to safety as well as a list of the engineered and natural barriers which are important to waste isolation. These lists will be included in Section 4.6 along with the rationale used to formulate them. The lists will include items associated with the repository, the exploratory shaft facility, and waste package for completeness. They will also identify which of the items require information from or otherwise influence the site characterization program. The SCP-CDR and SCP Q-list guidance position paper (scheduled to be issued in March by DOE-HQ) will provide the approach to be utilized in developing these lists. To clarify the above requirements, the following changes to the relevant sections of the SCP-CDR annotated outline are proposed (added text is underlined, deleted text is placed in brackets):

"2.7 CLASSIFICATION OF SYSTEMS, STRUCTURES, AND COMPONENTS
(2 to 5 pages of text, 1 to 2 tables)

This section will summarize the DOE's method of classifying repository systems, structures, components, and excavations according to their importance to safety or [and] waste isolation. It will define the different classes, describe and reference the procedures used, and summarize the QA elements of the procedure.

4.6 SYSTEMS, STRUCTURES AND COMPONENTS IMPORTANT TO SAFETY OR WASTE ISOLATION
(4 to 8 [2 to 4] pages of text; 4 to 8 [2 to 4] tables)

This section will present a preliminary list of the repository systems, structures and components that were identified as important to safety and a list of engineered and natural barriers important to waste isolation. These lists will include repository, ESF, and waste package, and will identify which items need to be considered for the site characterization program. A rationale for these lists will also be provided.

7.4 SYSTEMS, STRUCTURES AND COMPONENTS IMPORTANT TO SAFETY OR WASTE ISOLATION
(4 to 8 [2 to 4] pages of text; 4 to 8 [2 to 4] tables)

This section will discuss the analyses that were made to identify those repository systems, structures, and components that are important to safety or waste isolation. Where a rigorous analytical identification has not been made, the methods and criteria that will be used will be described, and preliminary identifications will be based on engineering judgment. For this

preliminary safety [hazards] analysis, the potential safety concerns [hazards] inherent in the repository system (e.g. [i.e.] rock falls) will be identified and their effects evaluated. This preliminary analysis will identify potential problem areas requiring a more detailed analysis, including the methods for performing such analyses. The status of the design described in the SCP-CDR, relative to the amount of safety analysis performed, shall be clearly explained for each system, component or structure on the list."

SCP Chap. 6: SCP Chapter 6 will reference the information presented in the SCP-CDR and will reproduce the lists including only those items that need to be considered for site characterization. Items associated with the repository, the exploratory shaft facility, and the waste package will be included in this list. The status of the safety analysis work for each item on the list will be provided, and briefly related to the maturity of the design described in subsequent sections. The items included in the list will be linked to the related plans in Sections 8.3 and 8.4. To clarify this requirement, it is proposed that Sections 6.1.4 and 6.1.5 of AO be revised to read:

"6.1.4 STRUCTURES, SYSTEMS, AND COMPONENTS IMPORTANT TO SAFETY

Reference will be made to the information presented in Sections 2.7, 4.6, and 7.4 of the SCP-CDR. The list of structures, system, and components important to safety pertaining only to those items that need to be considered for the site characterization will be reproduced here. Status of the safety analyses work for each item on the list will be provided. Applicable items in the list will be linked to the appropriate test plans in Section 8.3 with suitable reference.

[This section will identify which structures, systems, and components of the repository that have been preliminarily determined to be important to safety and will provide the basis for such determinations. Plans for performing failure modes and effects analyses that lead to more complete identification of structures, systems, and components important to safety will be referenced.]

6.1.5 ITEMS [BARRIERS] IMPORTANT TO WASTE ISOLATION

Reference will be made to the information presented in Sections 2.7, 4.6, and 7.4 of the SCP-CDR. This list of items important to waste isolation pertaining only to those items that need to be considered for the site characterization will be reproduced here. Status of the safety analyses work for each item on the list will be provided. Applicable items in the list will be linked to the appropriate test plans in Section 8.3 with suitable reference.

[This section will provide a description of the repository barriers, such as tunnel backfill and repository and borehole seals, necessary to meet the waste containment and isolation requirements of 10 CFR 60. Numerical values for the performance requirements of the engineered barrier system components and the rationale for their selection will be provided to the extent available.]"

SCP Chap. 7: SCP Chapter 7 will reference the information presented in SCP-CDR and SCP Chapter 6.1.4 and 6.1.5 which include items pertaining to the waste package. To clarify this requirement, the following sentence shall be added at the end of section 7.2 of the SCP AO:

"Reference will be made to the information presented in Sections 6.1.4 and 6.1.5 of SCP Chapter 6 that include waste package items important to safety or waste isolation pertaining to the waste package."

SCP Chap. 8: Section 8.6: Section 8.6 should provide the list of items important to safety or waste isolation and describe the quality assurance procedures that will be applied to activities associated with those items. Section 8.6 of the existing SCP-AO calls for this type of information in subsections 8.6.4.2 and 8.6.4.3, but it is not clear how the information presented in 8.6.4.3 is different from that requested in 8.6.4.2. To clarify the information requested in these two subsections and to simplify the presentation, Sections 8.6.4.2 and 8.6.4.3 will be combined into Section 8.6.4.2, and Section 8.6.4.3 will be deleted as follows:

Section 8.6.4.2 Quality Assurance During Site Characterization

"This section will describe the items and activities, including the design of the repository and waste package, important to safety and waste isolation to be controlled by the QA program. A list (Q-list) of these items and activities, and the rationale for why they are on the Q-list, will be provided. The graded QA approach for items and activities commensurate with their importance to safety or waste isolation will also be described.

[8.6.4.3 Quality Assurance Applied to Repository and Waste Package Design]

[This section will describe the approach to quality assurance applied to the design of the repository and the waste package. This section will describe how the A Q criteria III (Design Criteria) will be implemented in the design process.]

Section 8.3: Section 8.3 of the SCP should be developed taking into consideration the lists of items important to safety or waste isolation provided in Sections 8.6.4.2 and 8.6.4.3 of the SCP. However, it is not necessary to provide explicit reference to the same. Therefore, no changes are required to the AO.

Section 8.4: Section 8.4 of the SCP discusses the planned site preparation activities for surface facilities and subsurface excavations for site characterization with particular reference to the exploratory shaft facility. This section should make reference to Chapter 6 and Section 8.6.4.2 of the SCP and to relevant sections of the SCP-CDR for the list of items pertaining to the ESF that are important to safety or waste isolation. To clarify this requirement, the following sentence shall be added at the end of section 8.4 to the AO:

"Reference will be made to the information presented in Sections 2.7, 4.6, and 7.4 of the SCP-CDR and in Sections 6.1.4, 6.1.5 and 8.6.4.2 of the SCP that include discussion on items important to safety or waste isolation pertaining to the exploratory shaft facility."

5. Role of SCP Chapter 6 and the SCP-CDR

Chapter 6 of the SCP, in accordance with the Annotated Outline for SCPs, basically provides the repository design data base and requirements, describes the current design concepts, and discusses the design information needs. The information provided in Chapter 6 will meet the requirements of NWPA (Section 113(b)(1)(C) and 10 CFR 60 (60.11(a)(6)(ii)) regarding repository design, and it will also provide the information requested in Chapter 6 of NRC Regulatory Guide 4.17, as discussed with the NRC on April 18, 1985.

The DOE Annotated Outline for the SCP-CDR, issued in May 1985, states that the SCP-CDR will be the primary basis for preparation of Chapter 6 of the SCP, the SCP-CDR will be a stand-alone reference document for the SCP, and the SCP-CDR will meet the intent of NRC's proposed Generic Technical Position on Design Information Needs in the SCP.

Thus, the SCP-CDR will provide the basis for preparing Chapter 6 of the SCP, will provide most of the details concerning the design, and will be a stand-alone document. The SCP-CDR will be issued at the same time as (or before) the SCP. The bulk of SCP Chapter 6 will be reduced by suitably referencing the SCP-CDR.

DOE-HQ's requirements, as discussed at the February 26-28, 1986, Advanced Conceptual Design planning meeting, for the SCP-CDR Review/Acceptance Process are as follows:

1. During the preparation of the SCP-CDR, DOE-HQ will participate in the Project's internal design reviews at least once, and provide written feedback to the Projects from the review.

2. At the time of the Chapter Review of SCP Chapter 6, a copy of the CDR will be provided to the reviewers.

3. Formal review of the draft SCP-CDR will be performed by HQ concurrently with formal Project reviews. Approximately four weeks should be set aside for the HQ review of the CDR, in accordance with the OGR Systems Engineering Management Plan (OGR/B-7).

4. The final SCP-CDR will require OGR acceptance after satisfactory resolution of HQ comments on the draft CDR. Approximately two weeks should be allowed for an acceptance review. HQ acceptance of the SCP-CDR must precede HQ concurrence on SCP Chapter 6. Assembled SCP review can occur no earlier than the formal review of the draft SCP-CDR mentioned above.

6. Retrievability and Retrieval in the SCP and the SCP-CDR

DOE-HQ has developed, in conjunction with the Project Offices, the "Department of Energy Position on Retrievability and Retrieval for a Geologic Repository" dated December 6, 1985. This position paper is planned to be baselined and incorporated as Appendix D of the Generic Requirements (GR) document in March 1986.

Statements in Chapter 6 of the SCP and in the SCP-CDR regarding retrievability and retrieval will be fully consistent with the DOE position paper on this topic. DOE-HQ is developing an Annotated Outline to be used by the Projects for preparing their strategy paper for demonstrating compliance with the DOE position. DOE-HQ will transmit this draft Annotated Outline to the Projects in March. The Projects will ensure that the SCP and the SCP-CDR will reflect the position paper philosophy on retrieval issues (e.g., proof-of-principle testing) and that the statements made are compatible with their strategy paper.

For achieving consistency with the retrieval position paper, the following changes in the Annotated Outline for the SCP-CDR sections 3.2, 3.4, 4.5, and 6.3 shall be made:

3.2 WASTE RETRIEVAL
(4 to 6 pages of text; 1 to 2 flow diagrams)

The narrative will discuss the DOE's philosophy on , and approach toward, waste retrievability.[and] It will describe the [approach toward and] current concepts for the retrieval of any or all of the wastes emplaced in the repository and the transportation of retrieved waste from underground to the repository surface facilities [,transport to the surface facilities, and shipment off the site]. Flow sheets will be consistent with the "DOE Position on Retrievability and Retrieval for a Geologic Repository" [DOE position on waste retrievability] (as stated in DOE's Generic Requirements for a Mined Geologic Disposal System, Appendix D). The principal steps involved in retrieval will be shown in a block flow diagram. Equipment and methods for retrieval needing development will be identified so as to ensure that the technology is reasonably available at the time of license application.

3.4 VENTILATION

(7 to 12 [5 to 10] pages of text; 4 to 6 flow diagrams)

This section will describe the underground ventilation systems that are currently envisioned--one for the underground development and the other for waste emplacement. The narrative for each system will describe the complete ventilation system, from the surface through the intake shafts; the underground operation; and the exhaust shafts, fans, filters, and stack. It will also discuss the operating conditions (pressure, volume, ambient conditions, etc.) and system pressure interactions to the extent known, and will identify equipment needing development.

Impacts, if any, on the ventilation system as the result of the requirements imposed upon it for the retrieval of any or all of the emplaced waste(s) along with plans for meeting such demands will be described.

The narrative will be supported by illustrations, including air-flow logic diagrams that indicate operating conditions (pressure, air flow) at strategic locations and principal equipment.

4.5 NORMAL REPOSITORY OPERATIONS
(10 to 15 pages of text; 4 to 8 drawings)

The narrative will describe the operations that will be required to receive and emplace a waste package underground. It will address the development sequence of the waste-emplacement rooms (based on waste receipts), the preparation of the emplacement holes, packing installation (site-specific), transfer operations at the shaft station, transport to the emplacement hole, and emplacement-hole closure. A description of waste removal for performance confirmation purposes [retrieval operations under normal conditions] will also be provided. [to the level of detail provided for emplacement.]

The drawings to be provided for waste emplacement and removal for performance confirmation purposes [retrieval] will include a schematic diagram of the steps involved in these operations; an isometric drawing of the waste transporter; and a drawing of the waste-emplacement rooms that shows the location, spacing, and size emplacement holes.

For mining, the narrative will identify and describe the proposed mining techniques, including the major equipment needed for each technique, the expected rate of advance, maintenance requirements, and the flexibility of the mining method. Also discussed will be muck handling from the face of the rock to the muck-handling facility, with a listing of equipment requirements. Schematic drawings of the mining and muck-handling operations will be included.

Other construction activities to be addressed in this section will include the installation of utilities and ventilation structures and equipment. The utilities outside the shaft pillar will be addressed only to the extent of identifying the utilities, both temporary and permanent, that will be provided in various areas of the facility.

For the ventilation and cooling design, the narrative will include (1) the functions; (2) the design philosophy, explaining how the mine-development air system is separated from the emplacement ventilation system; (3) the differential pressure that will exist between the two systems at various strategic locations underground (4) air temperatures at all underground locations; (5) both temporary and permanent stoppings, as well as their use; and (6) methods of changing a room from the mining ventilation system to the emplacement ventilation system.

6.3.1 Expected Conditions

The narrative will discuss the predicted repository environment (rock temperature, rock conditions, air temperature, backfill condition if used, etc.) as a function of time for the waste-retrievability period. Worst-case situations [extremes] will be identified and discussed. The parameters of interest will [should] also be displayed [in graphical form.] as graphs to the extent practicable.

This discussion will also include a review of abnormal items or events which can reasonably be expected to occur during retrieval [repository] operations. These items could include malfunction or retrieval mechanisms, breached container or stuck waste packages [canister], repair of access ground support, salt creep and corresponding container [canister] movements, ventilation system failure, sudden water inflow, etc.

6.3.2 Demonstration of Retrieval Equipment and Methods

This section will present preliminary plans for the proof-of-principle demonstration of retrieval concepts, methods, and non-standard [including] equipment requiring development. [Retrieval of quantities of waste larger than demonstration quantities (i.e., partial retrieval) will be discussed.] This section should also contain a discussion of how the expected adverse conditions discussed in Section 6.3.1 will be accommodated by the planned sequencing of equipment and operating procedures. For the specific case of salt creep and potential waste container [canister] movement, the measures which will be used to ensure the ability to locate containers will be addressed. [address what measures will be used to ensure the ability to locate canisters.] Also, the future plans for prototypical equipment development to be carried out after License Application and before the license to receive and possess waste if granted by the NRC will be briefly described.

6.3.3 Full Retrieval

The discussion of the design approach to accommodate full [repository] retrieval will include the following:

- The extent to which full retrieval capability should be [is] designed into the repository.
- The design criteria and concepts to be incorporated to ensure maintenance of retrieval capability.
- Principal underground problems expected.
- Site data needs to focus better on the item above.
- [R & D programs and needs.]
- Identified constraints on repository design.
- [Expected worst-case conditions and scenarios for retrieval.]

7. Waste Types and Receipt Rates for Repository Design

The repository design requirements and descriptions presented in the SCP will be fully consistent with the June 1985 Mission Plan. This means that the facilities described in Chapter 6 need to allow for the inclusion of both commercial and defense high-level waste in the repository that is accepted according to the annual receipt rates provided in the Mission Plan. For purposes of repository design, it should be assumed that defense high-level waste will be emplaced with an equivalence of one-half metric ton of uranium per canister. (It is not necessary that every detail of the design be consistent with acceptance of these additional wastes, but, as a minimum, those features that could affect the plans for site characterization described in Chapter 8, e.g., underground layout, need to be accommodated.)

With respect to other waste types associated with the repository, the following assumptions will be made. The SCP conceptual design will be based on disposing spent fuel, associated spent fuel hardware, and defense high-level waste (including West Valley commercial high-level waste) only. Spent fuel hardware will be packaged for disposal to satisfy the requirements of 10 CFR 60.113 and 10 CFR 60.135. All other on-site-generated waste (low-level and TRU) will be processed, packaged, and shipped off-site in accordance with applicable transportation regulations for disposal.

The above guidance is being incorporated into the revisions of OGR's Generic Requirements for an MGDS (OGR/B-2), to be available shortly.

8. Seismic Design for the SCP and SCP-CDR

DOE has prepared a generic annotated outline for a "Rationale for Seismic/Tectonic Investigations for Licensing a Nuclear Waste Repository" that is intended to be used by each Project Office as guidance on how to determine the significance of seismic/tectonic events at their individual sites. It is planned that each Project will either incorporate the intent of the outline directly in the SCP or develop a site-specific position paper that will be referenced by the SCP. The purpose of the generic outline is to provide a program-wide approach to seismic design; one that is comprehensive and appropriately conservative without placing unnecessarily severe constraints at sites with relatively high potential for seismic activity.

Based on the December 3-4, 1985 meeting with the NRC staff, minor modifications to the outline are being completed. The changes that were made are generally editorial in nature. The revised outline, including additional NRC comments on proposed definitions, will be provided for Project review in about one month. The outline represents a program-wide approach with which each Project SCP should be consistent.

The seismic design discussions in Chapter 6 of the SCP will be consistent with the generic annotated outline. As further guidance toward providing consistency on this topic among SCPs, the following approach to seismic design considerations is recommended for purposes of SCP preparation. Each Project is likely to have a preliminary seismic design level (such as an acceleration level) that they are using for conceptual design. Until site-specific seismotectonic positions are fully developed, the preliminary seismic design level should not be associated with either a specific probability of occurrence or a specific seismologic deterministic assumption. It should simply be characterized as an engineering judgment based on site knowledge that will be assessed against final seismic criteria approved by the NRC as part of the licensing process for the repository. The strategy for issues resolution is likely to consider such topics as: a) the procedures to be used in developing the seismic design parameters; b) engineering design measures; and c) recognition and integration of uncertainties. For sites with relatively high seismic hazard, the final approach to demonstrating compliance (with NRC) may include such steps as: 1) event scenario identification and probabilistic/deterministic evaluation; 2) failure mode analysis of structures, systems, and components important to safety; 3) consequence analysis of failure scenarios; and 4) comparison to NRC preclosure release limits and seismic design standards. Each Project can expand/adjust the above approach to fit site-specific design conditions and can discuss this approach as they feel appropriate in the SCP.

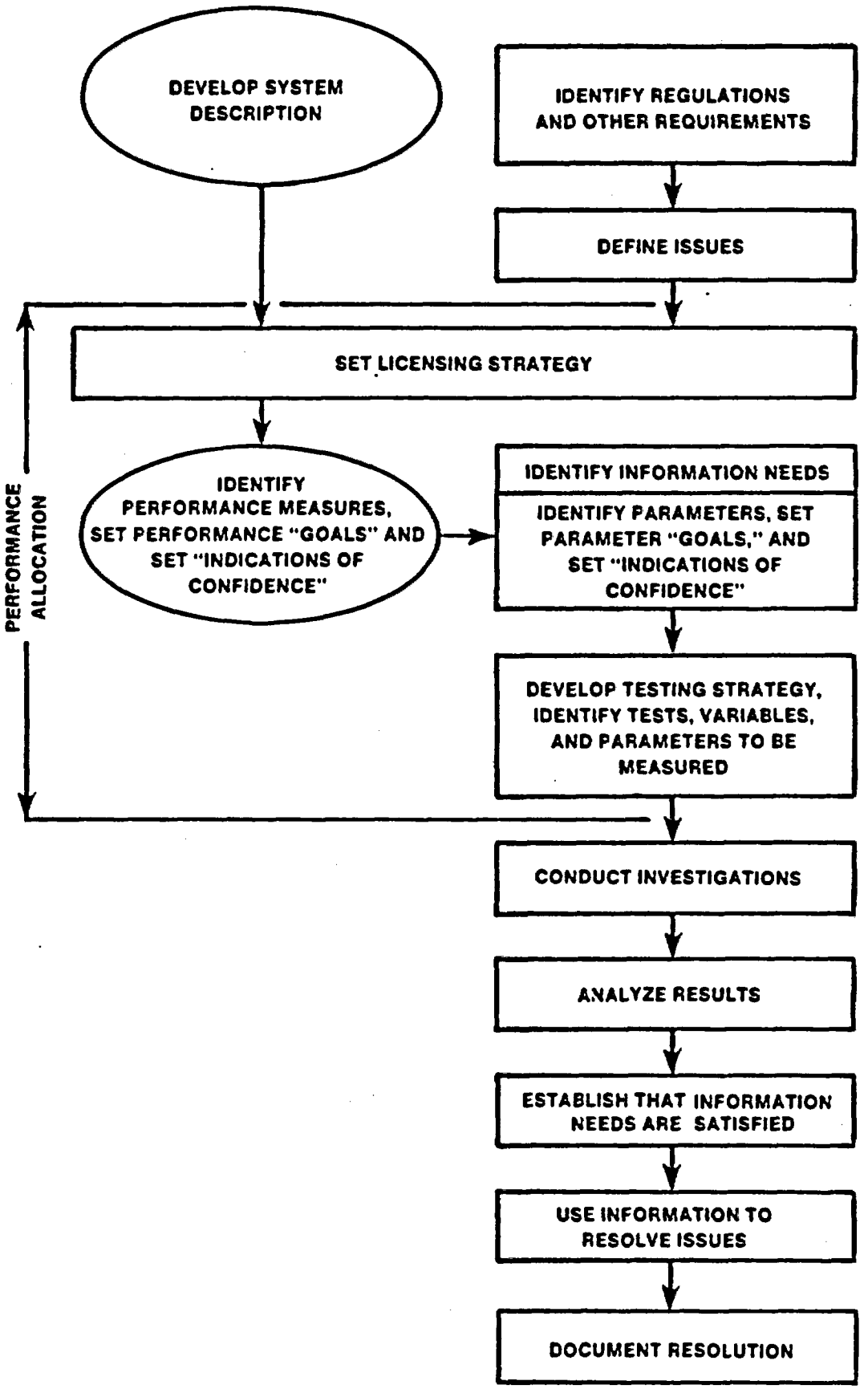
9. Reversal of Underground Ventilation for SCP Design

The requirement that design of the repository be conducted in accordance with the provisions of MSHA Standards and California State Mine and Tunnel Regulations is imposed upon the OCRWM program by the DOE Order 5480.4. Per the Federal standard 30 CFR 57.21-20(6), prompt reversibility of the primary underground ventilation systems airflow direction is required for every mine that has been classified as being gassy. Federal standards do not contain this requirement for mines classified as being non-gassy. The California State Regulations go much further, however, in that they require the ventilation system to permit quick reversal of airflow direction at every mine irrespective of whether it is classified as a gassy operation or not. This requirement is expressed in Section 7099 of Article 31 of the California State Mine Safety Orders, as well as in Section 8437 of Article 12 of the California State Tunnel Safety Orders.

Each Project will evaluate whether reversibility is technically appropriate for site-specific conditions and designs, and to base the SCP conceptual Design on the results of this evaluation. Chapter 6 of the SCP should be written accordingly. If reversibility is not technically appropriate, Headquarters will apply for a variance, based on a detailed technical justification to be developed and submitted by the Projects early in the Advanced Conceptual Design phase.

Attachment A to Enclosure 1

Common issue resolution strategy



Common issue resolution strategy.

Attachment B to Enclosure 1

Guidance for carrying out performance allocation

Attachment B

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DRAFT
(Version of 1/13/86)

GUIDANCE FOR CARRYING OUT PERFORMANCE ALLOCATION

This draft of guidance is intended to be used with viewgraphs supplied with previous oral presentations. The figures and tables called for in the text are additional material that supplants some of those viewgraphs.

DRAFT

GUIDANCE FOR CARRYING OUT PERFORMANCE ALLOCATION

Section 1

Introduction

The NRC and the DOE have agreed to carry out a process called "performance allocation" as a method for guiding the testing programs at potential repository sites. Because the written agreement describes the process only in general terms, this guidance is intended to translate that agreement into specific procedures that each repository project can follow.

The performance allocation for a repository system will specify the following:

1. For each of the four postclosure performance objectives in 10 CFR 60
    a. The barriers (i.e., the subsystems and components, or elements) that the project expects to rely on in licensing.
    b. Any barriers that the project expects to use as secondary or redundant barriers or to hold in reserve.
    c. A level of performance (a "performance goal") that the project expects to achieve for each barrier.
    d. An "indication of confidence" that the project expects to achieve for each performance goal.
2. For each of the quantities to be measured in the testing program
    a. A performance goal.
    b. An indication of the confidence the project expects to achieve for the goal by means of testing.

The "quantities to be measured in the testing program" include two kinds of quantities: those whose measurement is intended to demonstrate compliance with the four performance objectives and those whose measurement is intended to demonstrate the presence or absence of the favorable and potentially adverse conditions (the "nonnumerical criteria") listed in 10 CFR 60.

The performance goals required for the four performance objectives (item 1 in the above list) need to be set only for the barriers that a project expects to use in licensing; they need not be set for any potential barriers that the project does not intend to use in showing that its site meets the licensing criteria. The goals for testing (item 2 in the above list) are to be chosen in such a way that they, if met, will ensure that the goals for the four performance objectives will be met; they must also ensure that the presence or absence of the favorable and potentially adverse conditions can be firmly established. In making both kinds of goals it is important to keep in mind that the DOE will be permitted to change the goals without permission from other agencies. They are not criteria that must be met for licensing.

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The indication of confidence called for in the above list expresses, generally speaking, how well the project thinks it needs to meet the associated performance goal. It may be a statistically meaningful confidence level or confidence interval; it should, in fact, be statistically meaningful whenever such an indication is feasible. More often, however, it will not be statistically rigorous, and it will not even be stated in terms of statistical parameters. When no rigorous or semiquantitative statement is possible, it may be set by expert judgment. It may be stated as "high," "medium," or "low," provided that some effort is made to explain what these terms mean.

Before the goals and confidence levels can be set, certain parts of the project's licensing strategy must be decided on. The decision of what barriers to rely on must be made with due attention to the project's overall strategy for preparing an acceptable license application. For this reason, the approach to performance allocation contained in this guidance begins with these parts of licensing strategy. It is important to remember, however, that performance allocation is only a part of licensing strategy; it is not the same thing. The purpose of performance allocation is to guide testing; the framework for expressing performance allocation is specifically stated in terms of changeable goals and indications of confidence. Licensing strategy, on the other hand, has the larger purpose of guiding a project's demonstration of compliance with all the NRC regulatory criteria, which are set by other agencies and require "reasonable assurance" rather than flexibly defined indications of confidence.

The approach to be used for performance allocation consists of a series of steps. As explained in this guidance, nine steps are needed to provide the required information for the four performance objectives and the tests that support the goals assigned to them. Only six steps are needed to provide the required information for the tests that support the goals assigned for studying the nonnumerical criteria. The explanations of these steps are presented in the two sections that follow this introduction: one section for the performance objectives and their tests and one section for the nonnumerical criteria and their tests.

Section 2

Performance allocation for performance objectives

This section explains in sequence the nine steps that produce a performance allocation for the four performance objectives. A simple way to visualize these steps is Figure 1, which lists the steps as the headings of nine columns. The performance-allocation process may be thought of as simply filling in the nine columns.

As Figure 1 shows, the first three steps are part of licensing strategy; they are the decisions on barriers, which must precede the assignment of performance goals and indications of confidence. The remaining six steps are the performance allocation proper.

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Step 1: Performance objectives

In this column of the performance-allocation chart the project lists the four performance objectives. For simplicity in the rest of this guidance these objectives are called

1. Containment time.

2. Release rate from EBS.

3. Ground-water travel time.

4. EPA standards.

It is important to realize that objective 4 will contain three subobjectives covering the requirements for ground-water protection, individual protection, and releases to the accessible environment.

Step 2: System elements

In this step the project lists, for each performance objective listed in step 1, the barriers--the subsystems and components, or "system elements"--that are available to be relied on for meeting the performance objective. These elements are taken from the complete list that the project's system-requirements document presents as a hierarchical framework. The containment-time objective will be met by relying on the elements within the waste package; the release-rate objective, by relying on those elements plus the other elements within the EBS boundary; the travel-time objective, by relying on the elements between the disturbed zone and the accessible environment; and the EPA-standards objective, by relying on elements in the entire postclosure waste-disposal system.

In step 2 no selections are made from these available elements. They are simply listed for selection in step 3.

Step 3: License approach

Step 3 defines the license approach for each performance objective: it consists of the decisions on the system elements and the processes the project expects to use in showing compliance with the performance objectives. The license approach has three parts.

Part 1. For each performance objective the project selects from the list in step 2 the subsystems and components it expects to rely on in licensing. The project may specify some of these elements as redundant, or secondary, barriers; it may designate some of the elements as barriers to be held in reserve.

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Part 2. For each of the elements selected in part 1, the project specifies the functions that it expects the element to perform in meeting the performance objective. The project then specifies all the processes that will occur in the element and that could be taken into account in deciding whether the element will satisfactorily perform the expected functions.

Part 3. From the processes specified in part 2, the project selects the processes that it expects to rely on in licensing.

Simple example. Suppose that, for meeting the travel-time objective, a project has decided to rely on all the hydrogeologic units between the disturbed zone and the accessible environment. Part 1 of step 3 lists all those units. Part 2 might list, for each of those units, the function "barrier to water movement toward the accessible environment" and the process "ground-water flow." Part 3 would then list only the process "ground-water flow."

More complex example. Suppose that, for meeting the EPA-standards objective, a project has listed in step 2 all the engineered barriers, natural barriers, and institutional barriers that the system-requirements framework includes. In part 1 of step 3 the project might choose to rely on some of the engineered barriers, some of the natural barriers, and all of the institutional barriers. Table 1 shows an example of how the choice might be made. For each of the elements chosen (and designated by the word "yes" in Table 1), the project lists the functions that the element may perform and the processes that occur in it; Table 2 shows examples for a few of the elements chosen in Table 1. Then the project chooses, from the list of possible processes, the processes that the project intends to take into account in licensing. Table 2 shows examples of these choices.

The choices to be made in step 3 are highly important because they set up the remainder of performance allocation and of the overall licensing strategy. Although these choices can be changed as site characterization proceeds, they should be made as carefully as possible; they should reflect the project's most rigorous thinking about the licensing strategy it intends to pursue. If some of the available barriers can reasonably be omitted from the license approach, the testing program and the licensing strategy may be significantly simplified. But it would be unwise to omit, at this early stage, any barriers that are likely to be needed eventually; site characterization will last so long that its testing program can be easily revised after it is well under way.

For the EPA-standards performance objective, it is important that the choices reflect the project's intentions not only for meeting the regulations under expected conditions, but also for meeting them under the unexpected, disruptive conditions that may occur in the future. The project must therefore think ahead to the scenario analysis that it will do as part of licensing. It will not, of course, be possible for a project to do that analysis as part of performance allocation. But a prudent approach to step 3

will require the project to decide what barriers it is likely to rely on for compliance under both expected and unexpected conditions. Further thought about disruptive events must enter the performance allocation for the nonnumerical criteria in 10 CFR 60; the third section of this guidance explains the process by which that thought is embodied in performance allocation.

At least one further criterion for choosing elements is important: the allocators must be careful not to omit any elements that could adversely affect the performance of a barrier. When a project decides not to include a barrier in its licensing approach, it must be sure that the omission will not mask a potential difficulty in meeting the performance objective.

The basis for making the choices in step 3 will probably be the studies reported in the environmental assessments and other bounding and sensitivity studies that the projects have already made. Additional studies will undoubtedly be necessary as revisions to the the performance allocation are made, but the schedule for producing the first edition of the site-characterization plans probably will not allow many new studies.

Step 4: Performance measures

With the completion of step 3, the licensing-strategy part of performance allocation is in place, and the allocation can move toward assigning goals and indications of confidence. In step 4 the project decides the terms in which it will express the performance goals it will choose in later steps. In other words, it picks "performance measures."

For each of the functions listed in step 3, the project must choose a performance measure--a physical quantity that indicates the level to which a function is performed. This physical quantity may be a measurable quantity or a dependent variable. For example, the function chosen in the "simple example" for step 3 is "barrier to water movement toward the accessible environment"; an obvious performance measure for this function is ground-water travel time. Such an performance measure is a dependent variable, because ground-water travel time is not directly measurable. It may, of course, be expressed in an equation whose parameters are directly measurable; those parameters are important in later steps of performance allocation.

The project does not select values for performance measures in step 4. It simply selects the quantities to which it will later assign values.

Step 5: Performance goals and confidence

In step 5 the project states a value for each performance measure selected in step 4. This value is the goal whose achievement the project expects to demonstrate through the testing program and through analytic studies that use the results of testing. The project also states, for each goal, an indication of confidence. It states this indication in quantitative terms, if possible, or in qualitative terms, if not. However the indication is stated, the project should make the statement on the most defensible basis it can produce.

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Achieving reasonable assurance in licensing is a primary criterion for picking the values assigned as performance goals. A project should pick goals that it thinks will produce a satisfactory license application if they are achieved.

In setting the goals, the project should also try to achieve a reasonable redundancy among the barriers it chose in step 3. It should, however, limit the redundancy to what it thinks is necessary for showing reasonable assurance in the licensing process. Unnecessary redundancy increases the difficulty of getting a license, simply because it would require more testing and analysis than a properly designed licensing strategy would require.

The goals should be as simple as possible, and they should be as simple to evaluate as possible. They should, for example, be chosen in such a way that a reasonable testing program can show whether they have been achieved. There is little usefulness in a goal that no test can measure with confidence or in the time available for site characterization. Further consideration of whether the goals are reasonable will occur in a later step of performance allocation, when they are compared with the expectations for proposed tests, but step 5 is best done with some looking ahead to what real experiments can do.

The goals will probably be stated, at least in the early versions of performance allocation, in terms of bounds on performance measures. If X is a performance measure, for example, its goal is likely to be stated in a form like

X is greater than (some number)

where the "(some number)" is a value that the project thinks will contribute strongly to meeting the performance objective to which the performance measure is attached. One reason that bounding values are likely to be appropriate is that step 5, like step 3, will probably be based on available studies, which are largely bounding analyses. Another reason is that, in providing for unexpected disruptive events, a project will, at this early stage, have little ability to do detailed scenario studies; the project may, however, be able to decide that a barrier will protect against particular potential disruptions if its performance is better than some conservatively chosen bound.

Deciding on a meaningful way to establish indications of confidence will require careful thinking. No single way will be appropriate for all the performance goals. The indications can be based on quantitative or qualitative analysis. They may simply reflect a consensus of professional judgment. They may be based on a conservative bounding analysis intended to ensure that the goals will satisfactorily demonstrate that the performance objectives will be met. Whenever it is possible to base the indications on statistical evaluations, a project should attempt to do so, using well-defined confidence intervals or confidence levels and standard statistical parameters.

A performance goal for a given barrier may take different forms depending on the confidence that the project desires to achieve for it. If, for example, the performance measure for a particular geohydrologic unit is travel time T, a project might choose to set goals and indications of confidence like the following:

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T greater than 1,000 years with very high confidence.
T greater than 5,000 years with high confidence.
T greater than 10,000 years with medium confidence.

Such an allocation might be appropriate for a project that wishes to rely primarily on ground-water travel for isolation during the first 5000 years after closure and only partially on ground-water travel at later times.

As mentioned in the introduction to this guidance, qualitative indications of confidence, like those used in this example, must be explained. Ground-water travel time, because it is a derived quantity rather than a directly measured quantity, will be difficult to associate with a statistically rigorous level of confidence. A project might, in this example, choose to use as its indication of confidence the times associated with different percentiles on a cumulative frequency distribution of travel times. It might, for example, choose to associate the term "very high confidence" with the 5th percentile of the distribution--to require, in other words, that 95 percent of the ground-water travel times be greater than 1000 years. It might associate "high confidence" with the 20th percentile and "medium confidence" with the 50th percentile. In making such a choice, the project will not, of course, be using the word "confidence" in the sense that standard statistical textbooks use it. But allocations like these can serve to communicate the project's intentions about the importance of ground-water travel time to the NRC and, in later steps of performance allocation, to the testers who will measure it.

Figure 1 shows, in the column for step 5, separate columns for the two products of the step: a statement of a goal for each performance measure listed in step 4 and a statement of desired confidence (labeled "C_D") for each goal.

Step 6: Parameter needs

Most of the performance measures treated in steps 4 and 5 will not be directly measurable quantities. They can be expressed by an equation like

$$\text{Performance measure} = f(P_1, P_2, \ldots, P_n)$$

where the P_i are parameters. In step 6 the project translates each performance measure into the parameters on which it depends. To do so, the project lists three things: the physical parameters, the ranges that it expects those parameters to take, and an indication of the desired confidence with which each parameter must be known. Figure 1 shows, in the column for step 6, a separate column for each of these three products of the step. The ranges must be chosen in such a way that they will produce a satisfactory value for the performance measure--a value that meets the goal established in step 5. The indications of confidence must be chosen so that meeting them will produce the confidence desired for the performance goal. The choice of ranges and indications of confidence may be based on professional judgment, sensitivity analyses, or statistical analyses.

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Example. One of the parameters in the expression for ground-water travel time is effective porosity. If a project has assigned a performance goal to ground-water travel time (as in the example given above for step 5), it may in step 6 assign a goal for the measurement of effective porosity. It might, for example, decide that the performance goal is likely to be met if the effective porosity of a rock unit listed in step 3 is greater than 0.1. The goal for measurements of effective porosity might then be stated as

Mean effective porosity greater than 0.1

with an accompanying indication of confidence. The indication of confidence in this example might be a quantitative statistical statement, but it would probably be qualitative, because effective porosity is not a directly measurable property. Another way that the indication might be stated is in terms of the variance of the distribution of the measured values. Such an indication might be appropriate for effective porosity; a project might find that the value that will produce a satisfactory license application lies well within the range of porosities known to exist at the site. A useful indication of confidence to be gained through testing could then be simply a statement that the variance of measured porosities must be smaller than a certain value.

Achieving high confidence for some parameters may require only a low precision of measurement. If the goal for a parameter that appears in step 6 lies far below the range of values that exist at the site, a measurement technique that produces a wide variance in measured values may be entirely adequate for showing that the goal has been met.

Step 7: Test definitions

Step 7 is carried out primarily by the experimenters who will plan and carry out the tests. The experimenters provide, for each parameter listed in step 6, a description of the test or series of tests that will measure the parameter. The description defines the test by specifying the locations from which samples, if any, will be taken, the numbers of separate measurements to be made, the scale of the measurements, and other details of the test. The test definition also explains the relationship between the parameters actually measured in the test and the parameters listed in in step 6. Such an explanation is necessary because some parameters in step 6 cannot actually be measured; effective porosity, for example, is often derived from direct measurements of bulk porosity and residual saturation.

From all this information the experimenters produce two major pieces of information for listing in step 7: the names of the actually measured parameters and the precision and accuracy with which they can be measured. Figure 1 shows, in the column for step 7, a separate column for each of these two products of the step.

Step 8: Evaluation of test plans

Step 8 is a cooperative task for the allocators of performance and the experimenters who carry out the testing. Together they look at the parameter needs listed in step 6 and the test definitions listed in step 7. By comparing the two listings, they decide, for each parameter, whether the tests

will be able to meet the needs established in step 6--whether, in other words, the tests will achieve the confidence established as necessary in step 6. They also decide whether the tests, by establishing the parameters as required, will produce the desired confidence listed in step 5 for the performance goals--whether, in other words, the results of the tests defined in step 7 can be combined to show that the goals established in step 5 have been met. If these comparisons and decisions show that the planned tests are indeed capable of providing the confidence required in step 6 and of meeting the goals listed in step 5, the project may decide that its test program is adequate for its needs.

If the tests do not appear adequate for meeting the requirements of steps 5 land 6, the process of performance allocation becomes iterative. The project might decide to reallocate its performance goals and indications of confidence in step 5; it might well choose to do so if, for example, step 8 has shown that the goals in step 6 are simply unrealistic and not attainable by a reasonable test program. On the other hand, the project might decide to revise its test program--to plan new, more elaborate tests or to delete tests that are not needed for meeting the goals established in step 5. The project might choose to revise both the goals and the test plans. Whichever of these revisions the project undertakes, the performance allocation must go back one or more steps and then proceed forward through the process again, revisiting step 8 when the revisions to the earlier steps have been done.

Figure 1, in the two separate columns within the column for step 8, shows schematically that, the step produces two kinds of evaluations of the tests: statements of the goals whose achievement the tests can demonstrate and of the indications of confidence the tests can achieve ("C_A"). For the final set of tests, these goals and indications of confidence will match or exceed those listed in step 5.

Step 8 is the principal tool by which a project decides on the final form of its test program. After the discussions and studies that contribute to step 8 have been finished, the project will have a defensible test program that can be expected to support an adequate license application.

Step 9: Test integration

Step 9 is a final check to remove redundancy from the test program. After the performance allocation for all the performance objectives and nonnumerical criteria has been done, the list of steps in 6 and 7 will probably contain duplications of parameters and tests. A single parameter may appear, for example, in the expressions for more than one performance measure; it might appear in the needs for more than one performance objectives. Usually one for a given parameter test or one series of tests will be adequate for meeting all the needs established in step 6; usually one of the several needs for a single parameter will be more restrictive than the others. In step 9, therefore, the project looks through the lists of tests and eliminates the tests that are superseded or duplicated by others.

Section 3

Performance allocation for nonnumerical criteria

This section explains in sequence the six steps that produce a performance allocation for the nonnumerical criteria in 10 CFR 60. A simple way to visualize these steps is Figure 2, which lists the steps as the headings of six columns. The performance-allocation process may be thought of as simply filling in the six columns. Most of the steps in the sequence are similar to steps in the performance allocation for performance objectives, described in the second section of this guidance; this section therefore assumes that the reader is familiar with the second section.

Step 1: Criteria

In this column of the performance-allocation chart the project lists the nonnumerical criteria in 10 CFR 60.122 (b) and (c). The listing, like the listing in 10 CFR 60, will have two major divisions: favorable conditions and potentially adverse conditions. The list may also include an item for the sealing criteria in 10 CFR 60.134.

Step 2: License rationale

Step 2 requires planning that is analogous to the licensing-strategy steps in the performance allocation for performance objectives; the project decides how it expects its license application to deal with the presence and absence of favorable and unfavorable conditions. In making these decisions, the project will be guided by the requirements in 10 CFR 60.122(a) for dealing with the conditions.

The project may decide not to claim the presence of a favorable condition; it would then need to make no further planning dealing specifically with that condition. If it decides to claim the presence of a favorable condition (i. e., to use that condition in its planning for showing compliance with the numerical performance objectives), it states that intention in step 2 along with an indication of how its planning for the performance objectives has included the condition.

If a project expects to claim the presence of a potentially adverse condition, it must be sure that the plans expressed in steps 2 through 5 of the allocation for performance objectives take into account the effects of the condition. In step 2 the project states how those plans account for those effects. The project also states its plans for showing compliance with the instructions of 10 CFR 60.122(a)(2).

Step 3: Goals and confidence

In step 3 the project lists, for each of the criteria listed in step 1, a goal or goals that it thinks its testing program should demonstrate in order for the project to carry out the planning described in step 2. In other

words, step 3 describes a goal that the project thinks will enable it to deal satisfactorily with the criterion in its license application. The project also lists an indication of the confidence that it expects to achieve for the goal.

If a project expects to claim the presence of a favorable condition, it lists a goal that, if met, will provide satisfactory assurance that the condition is present. If, for example, a project expects to claim the favorable condition for emplacement at depths greater than 300 meters, it might set a goal of 350 meters between its repository emplacement horizon and the ground surface. It might set its indication of confidence as "high," explaining that it will have achieved high confidence if, for example, at least five borehole measurements of the overburden thickness have been made and none of the measurements is less than 350 meters. For any of the favorable conditions the project may list no goal at all if it expects to make no claim that the favorable condition exists at the site.

The project lists some form of goal and indication of confidence for each of the potentially adverse conditions. If these plans require any testing, the project lists the goal and indication of confidence that it expects from the testing. If the project expects to claim the absence of a potentially adverse condition, it lists in step 3 a numerical goal for testing--a goal that will show that the condition is absent; it also lists an indication of the confidence that it expects to achieve for that numerical goal.

Some of the goals established in step 3 may actually be stated in terms of parameter values like those in step 6 of the performance allocation for performance objectives. The goals will usually be more useful guides for testing when they are expressed in such terms. Because, however, of the way in which the nonnumerical criteria are stated, some of the goals for testing may be difficult to express in terms of parameters. For example, the absence of potentially adverse condition 15--evidence of igneous activity--probably cannot be reduced to measurements of parameters that appear in equations for radionuclide transport; the goal for showing that this condition is absent will probably have to be in terms of something like the ages of igneous features near the site.

Step 4: Test definitions

This step is completely analogous to step 7 in the performance allocation for performance objectives. The persons who plan and carry out the tests for each nonnumerical criterion define the tests that are to be carried out. They state the quantities to be measured and the precision and accuracy they expect to achieve for the measurements.

Step 5: Evaluation of test plans

Step 5 is analogous to step 8 of the allocation for performance objectives. By comparing steps 3 and 4, the project decides whether its testing program is adequate for dealing with the nonnumerical criteria. It then may revise the testing program or the plans for dealing with the criteria in the same iterative fashion prescribed for the performance objectives.

Step 6: Test integration

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Like step 9 in the allocation for performance objectives, this step removes redundancy in the test program. The step requires an examination of both the test program for performance objectives and the test program for nonnumerical criteria; if some tests appear in both programs, the redundancy is eliminated in this step.

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Table 1

Example: PERFORMANCE OBJECTIVE 4: Releases to the Accessible Environment

	(Step 2) System Elements that Could be Relied On	(Step 3, Part 1) System Elements Chosen For Licensing Approach
1.	Engineered barriers	Yes
	Waste package	Yes
	Container	Yes
	Waste Form	Yes
	Repository engr. barriers	No
	Backfill	
	Shaft and borehole seals	Yes
2.	Natural barriers	Yes
	Disturbed zone	No
	Units above repository	
	Units below repository	
	Far field	Yes
	Units above repository	Yes
	Units below repository	Yes
3.	Institutional barriers	Yes

Table 2

Example: PERFORMANCE OBJECTIVE 4: Releases to the accessible environment

(Step 3, Part 1)	(Step 3, Part 2)		(Step 3, Part 3)
System Elements Chosen For Licensing Approach	Function	Processes	Processes Chosen For Licensing Approa
2. Natural Barriers			
Far Field			
Units above repository	• control water influx • limit release of volatiles	• ground-water flow • isothermal vapor transport	Yes No
Units below repository	• limit release of aqueous species	• ground-water flow • radionuclide retardation	Yes No

PARTS OF LICENSING STRATEGY → PERFORMANCE ALLOCATION

STEP 1. Regulations: Postclosure Performance Objectives	STEP 2. System Elements	STEP 3. License Approach	STEP 4. Performance Measures	STEP 5. Performance Goals and Confidence		STEP 6. Parameter Needs			STEP 7. Test Definitions		STEP 8. Test Evaluation		STEP 9. Test Integration
				Goal	C_D	P	ΔP	C_D	$\underline{X}$	Prec.& Acc.	Perf. Goal	C_A	
1. Containment Time													
2. Release Rates													
3. Groundwater Travel Time													
4. Releases to Accessible Environment													

FIGURE 1

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PARTS OF LICENSING STRATEGY → PERFORMANCE ALLOCATION

STEP 1.	STEP 2.	STEP 3.			STEP 4.		STEP 5.		STEP 6.
Regulations: Favorable and Adverse Conditions	License Rationale	Goals on the Conditions			Test Definitions		Test Evaluation		Test Integration
		Goal	C_D OR	Processes					
		P	ΔP	C_D	$\underline{X}$	Prec.& Acc.	Goal	C_A	

FIGURE 2

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Attachment C to Enclosure 1

Examples of performance allocation applied to preclosure design issues

ISSUE RESOLUTION - STEP 1

RETRIEVABILITY EXAMPLE

Sandia National Laboratories

PRECLOSURE PERFORMANCE ISSUE 4.9

WILL THE DESIGN OF THE REPOSITORY PRESERVE THE OPTION OF WASTE RETRIEVAL?

Attachment C

OCRWM OGR

THE MGDS HAS MANY ELEMENTS

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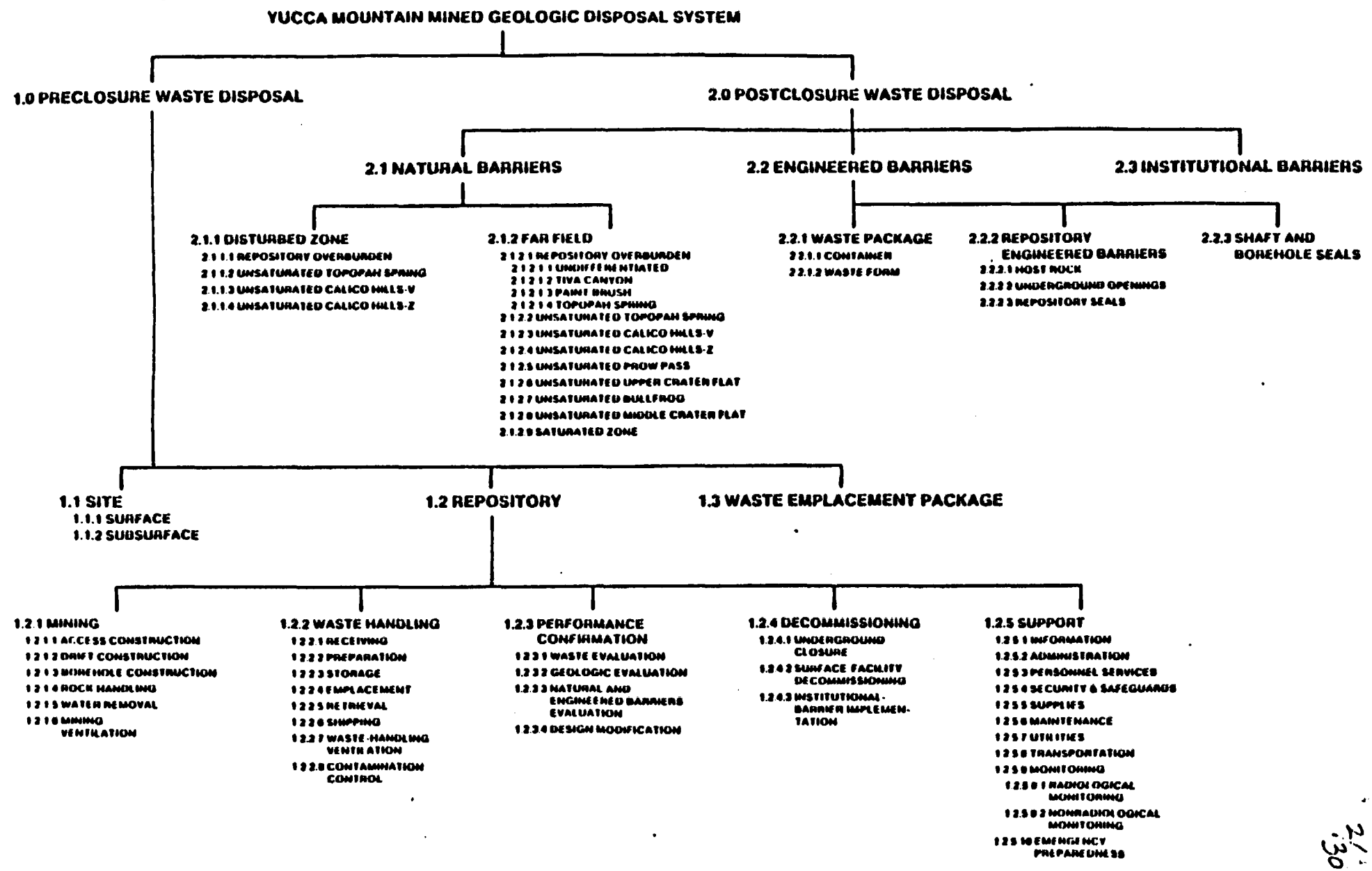

1.0 PRECLOSURE WASTE DISPOSAL

1.2 REPOSITORY

1.2.1 MINING

1.2.1.1 ACCESS CONSTRUCTION

1.2.1.2 DRIFT CONSTRUCTION

1.2.1.3 BOREHOLE CONSTRUCTION

1.2.2 WASTE HANDLING

1.2.2.4 EMPLACEMENT

1.2.2.5 RETRIEVAL

1.2.2.7 WASTE HANDLING VENTILATION

1.2.5 SUPPORT

1.2.5.9 MONITORING

1.3 WASTE EMPLACEMENT PACKAGE

STEP 2		STEP 3
	SYSTEM ELEMENTS	FUNCTIONS
1.2.1.1	ACCESS CONSTRUCTION	PROVIDE ACCESS TO BOREHOLES
1.2.1.2	DRIFT CONSTRUCTION	
1.2.1.3	BOREHOLE CONSTRUCTION	PROVIDE ACCESS TO WASTE PACKAGES
1.2.2.4	EMPLACEMENT	
1.2.2.5	RETRIEVAL	
1.2.2.6	WASTE HANDLING VENTILATION	REMOVE WASTE PACKAGES
1.2.5.9	MONITORING	
1.3	WASTE EMPLACEMENT PACKAGE	ESTABLISH REASONABLE SCHEDULE FOR WASTE RETRIEVAL

STEP 3

FUNCTION

PROVIDE ACCESS TO BOREHOLES

STEP 3

PROCESSES

* DESIGN THE ACCESS AND DRIFTS TO BE USABLE THROUGHOUT THE RETRIEVABILITY PERIOD
* DEVELOP ROCK SUPPORT CONCEPTS WHICH ENSURE MAINTAINABILITY
* PERFORM DRIFT AND ACCESS MAINTENANCE
* MONITOR ROCK MOVEMENT
* DESIGN FOR A SPECIFIC ENVIRONMENT
* MONITOR TO EVALUATE THE ENVIRONMENT
* MODIFY ENVIRONMENT (AS NECESSARY)

STEP 3	STEP 4
PROCESSES	PERFORMANCE MEASURES
FUNCTION: PROVIDE ACCESS TO BOREHOLES	
* DESIGN THE ACCESS AND DRIFTS TO BE USABLE THROUGHOUT THE RETRIEVABILITY PERIOD	* TIME DURING WHICH THE DRIFTS AND ACCESS WILL REMAIN USABLE
* DEVELOP ROCK SUPPORT CONCEPTS WHICH ENSURE MAINTAINABILITY	* MINIMIZE THE AMOUNT OF ROCKFALL * MINIMIZE THE AMOUNT OF REQUIRED MAINTENANCE
* PERFORM DRIFT AND ACCESS MAINTENANCE	* AMOUNT OF ROCKFALL
* MONITOR ROCK MOVEMENT	* ABILITY TO MEASURE ROCK MOVEMENT
* DESIGN FOR A SPECIFIC ENVIRONMENT	* ACCESS DRIFT FLOOR TEMPERATURE * AIR QUALITY
* MONITOR TO EVALUATE THE ENVIRONMENT	* ABILITY TO MONITOR TEMPERATURE AND AIR QUALITY
* MODIFY ENVIRONMENT (AS NECESSARY)	* VENTILATION AIR FLOW AND TEMPERATURE * TIME REQUIRED TO MODIFY THE ENVIRONMENT

STEP 4

PERFORMANCE MEASURES

STEP 5

PERFORMANCE GOALS AND CONFIDENCE

FUNCTION: PROVIDE ACCESS TO BOREHOLES	GOAL	CONFIDENCE
* TIME DURING WHICH THE DRIFTS AND ACCESS WILL REMAIN USABLE	* T >84 YEARS	HIGH
* MINIMIZE THE AMOUNT OF ROCKFALL	* TBD	
* MINIMIZE THE AMOUNT OF REQUIRED MAINTENANCE	* T >6 MONTHS	MED
* AMOUNT OF ROCKFALL	* TBD	
* ABILITY TO MEASURE ROCK MOVEMENT	* TBD	
* ACCESS DRIFT FLOOR TEMPERATURE	* 50 DEG. C at 50 YEARS	LOW
* AIR QUALITY	* AIR QUALITY STANDARDS	HIGH
* ABILITY TO MONITOR TEMPERATURE AND AIR QUALITY	* 1 DEG. C, TBD	MED
* VENTILATION AIR FLOW AND TEMPERATURE	* TBD, TBD	
* TIME REQUIRED TO MODIFY THE ENVIRONMENT	* T<6 WEEKS (UNPROTECTED)	MED

IR STEP 6 - PARAMETERS NEEDED FOR PERFORMANCE MEASURES

ISSUE 4.9 - RETRIEVABILITY

FUNCTION: PROVIDE ACCESS TO BOREHOLES

STEP 4	STEP 6		
PERFORMANCE MEASURES	PARAMETERS	RANGE	CONFIDENCE
TIME DURING WHICH DRIFTS AND ACCESS REMAIN USABLE	UG RESPONSE TO THERMAL AND EXCAVATION LOADS	STRENGTH/STRESS >1.5	HIGH
	UG RESPONSE TO DESIGN EARTHQUAKE	SEE SEISMIC POSITION PAPER	HIGH
	IN SITU STRESS AND TEMP. THERMAL PROPERTIES MECHANICAL PROPERTIES (Matrix, joints, rockmass)	RANGE AND MEAN VALUES GIVEN IN RIB (CH 2 & 6)	MEDIUM
	UG RESPONSE TO MATERIAL VARIABILITY	CRITERIA FOR SUPPORT SYSTEM SELECTION, TBD	MEDIUM
DESIGN FOR SPECIFIC ENVIRONMENT	UG TEMPERATURES AFTER WASTE EMPLACEMENT THERMAL CONDUCTIVITY	$K_t = 1.8 \pm 30\%$	MEDIUM
	REPOSITORY HEAT LOAD	<_ _ KW/acre	HIGH

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STEP 3 FUNCTION	STEP 3 PROCESSES
PROVIDE ACCESS TO WASTE PACKAGE	* DESIGN WASTE EMPLACEMENT ENVELOPE TO ALLOW ACCESS TO THE WASTE PACKAGE THROUGHOUT THE RETRIEVABILITY PERIOD
	* VERIFY THE CONDITION OF THE EMPLACEMENT ENVELOPE AND WASTE PACKAGE PRIOR TO REMOVAL
REMOVE WASTE PACKAGES	* BOREHOLE PREPARATION
	* WASTE PACKAGE REMOVAL
	* TRANSPORT THE WASTE TO THE SURFACE
	* UNLOAD WASTE AT THE SURFACE FACILITIES

STEP 3 PROCESSES	STEP 4 PERFORMANCE MEASURES
FUNCTION: PROVIDE ACCESS TO WASTE PACKAGE	
* DESIGN WASTE EMPLACEMENT ENVELOPE TO ALLOW ACCESS TO THE WASTE PACKAGE THROUGHOUT THE RETRIEVABILITY PERIOD	* BOREHOLE LINER STRESS * BOREHOLE LINER CORROSION * BOREHOLE LINER DEFLECTION * BOREHOLE LINER LIFETIME
* VERIFY THE CONDITION OF THE EMPLACEMENT ENVELOPE AND WASTE PACKAGE PRIOR TO REMOVAL	* ABILITY TO INSPECT THE CONDITION OF THE LINER * ABILITY TO INSPECT THE CONDITION OF THE WASTE PACKAGE
FUNCTION: REMOVE WASTE PACKAGES	
* BOREHOLE PREPARATION	* ABILITY TO PERFORM THE TASKS REQUIRED FOR BOREHOLE PREPARATION FOR NORMAL AND OFF-NORMAL CONDITIONS
* WASTE PACKAGE REMOVAL	* ABILITY TO PERFORM THE TASKS REQUIRED FOR WASTE PACKAGE REMOVAL FOR NORMAL AND OFF-NORMAL CONDITIONS USING THE STANDARD OR BACK-UP EQUIPMENT
* TRANSPORT THE WASTE TO THE SURFACE	* ABILITY TO PERFORM THE TASKS REQUIRED FOR TRANSPORTING THE WASTE FOR NORMAL AND OFF-NORMAL CONDITIONS
* UNLOAD WASTE AT THE SURFACE FACILITIES	* ABILITY TO PERFORM THE TASKS REQUIRED FOR UNLOADING THE WASTE FOR NORMAL AND OFF-NORMAL CONDITIONS

STEP 4	STEP 5	
PERFORMANCE MEASURES	PERFORMANCE GOALS AND CONFIDENCE	
FUNCTION: PROVIDE ACCESS TO WASTE PACKAGE	GOAL	CONFIDENCE
* BOREHOLE LINER STRESS	* STRESS < 20 Ksi	HIGH
* BOREHOLE LINER CORROSION	* CORROSION RATE < 20 mpy	MED
* BOREHOLE LINER DEFLECTION	* DEFLECTION < 3 INCHES	HIGH
* BOREHOLE LINER LIFETIME	* LIFETIME < 84 YEARS	HIGH
* ABILITY TO INSPECT THE CONDITION OF THE LINER	* TBD	
* ABILITY TO INSPECT THE CONDITION OF THE WASTE PACKAGE	* TBD	
FUNCTION: REMOVE WASTE PACKAGES		
* ABILITY TO PERFORM THE TASKS REQUIRED FOR BOREHOLE PREPARATION FOR NORMAL AND OFF-NORMAL CONDITIONS	* DEMONSTRATE THE ABILITY TO CONSISTENTLY PERFORM THE FUNCTION	HIGH
* ABILITY TO PERFORM THE TASKS REQUIRED FOR WASTE PACKAGE REMOVAL FOR NORMAL AND OFF-NORMAL CONDITIONS USING THE STANDARD OR BACK-UP EQUIPMENT	* DEMONSTRATE THE ABILITY TO CONSISTENTLY PERFORM THE FUNCTION	HIGH
* ABILITY TO PERFORM THE TASKS REQUIRED FOR TRANSPORTING THE WASTE FOR NORMAL AND OFF-NORMAL CONDITIONS	* DEMONSTRATE THE ABILITY TO CONSISTENTLY PERFORM THE FUNCTION	HIGH
* ABILITY TO PERFORM THE TASKS REQUIRED FOR UNLOADING THE WASTE FOR NORMAL AND OFF-NORMAL CONDITIONS	* DEMONSTRATE THE ABILITY TO CONSISTENTLY PERFORM THE FUNCTION	HIGH

STEP 3

FUNCTION

ESTABLISH REASONABLE SCHEDULE FOR WASTE RETRIEVAL

STEP 3

PROCESSES

* ESTIMATE THE TIME REQUIRED FOR THE ENTIRE RETRIEVAL PROCESS INCLUDING:

  a) RE-ESTABLISHING ACCESS TO THE BOREHOLES

  b) ENVIRONMENT MODIFICATION

  c) WASTE EMPLACEMENT ENVELOPE/WASTE PACKAGE CONDITION VERIFICATION

  d) WASTE PACKAGE REMOVAL

  e) DELIVERY OF THE WASTE PACKAGE TO THE SURFACE FACILITIES

STEP 3	STEP 4
PROCESSES	PERFORMANCE MEASURES
FUNCTION: ESTABLISH REASONABLE SCHEDULE FOR WASTE RETRIEVAL	
* ESTIMATE THE TIME REQUIRED FOR THE ENTIRE RETRIEVAL PROCESS INCLUDING:	* TIME REQUIRED TO PERFORM THE RETRIEVAL PROCESS
a) RE-ESTABLISHING ACCESS TO THE BOREHOLES	
b) ENVIRONMENT MODIFICATION	
c) WASTE EMPLACEMENT ENVELOPE/WASTE PACKAGE CONDITION VERIFICATION	
d) WASTE PACKAGE REMOVAL	
e) DELIVERY OF THE WASTE PACKAGE TO THE SURFACE FACILITIES	

STEP 4	STEP 5	
PERFORMANCE MEASURES	PERFORMANCE GOALS AND CONFIDENCE	
	GOAL	CONFIDENCE
FUNCTION: ESTABLISH REASONABLE SCHEDULE FOR WASTE RETRIEVAL		
* TIME REQUIRED TO PERFORM THE RETRIEVAL PROCESS	* APPROXIMATELY 84 YEARS	MED

OBSERVATIONS ABOUT ISSUE 4.9

- SUBSTANTIAL ADDITIONAL WORK REMAINS TO BE DONE ON PARAMETERS NEEDED

- ISSUE RESOLUTION APPROACH IS USABLE FOR GEOTECHNICAL AND EQUIPMENT PROGRAMS

SEALING EXAMPLE

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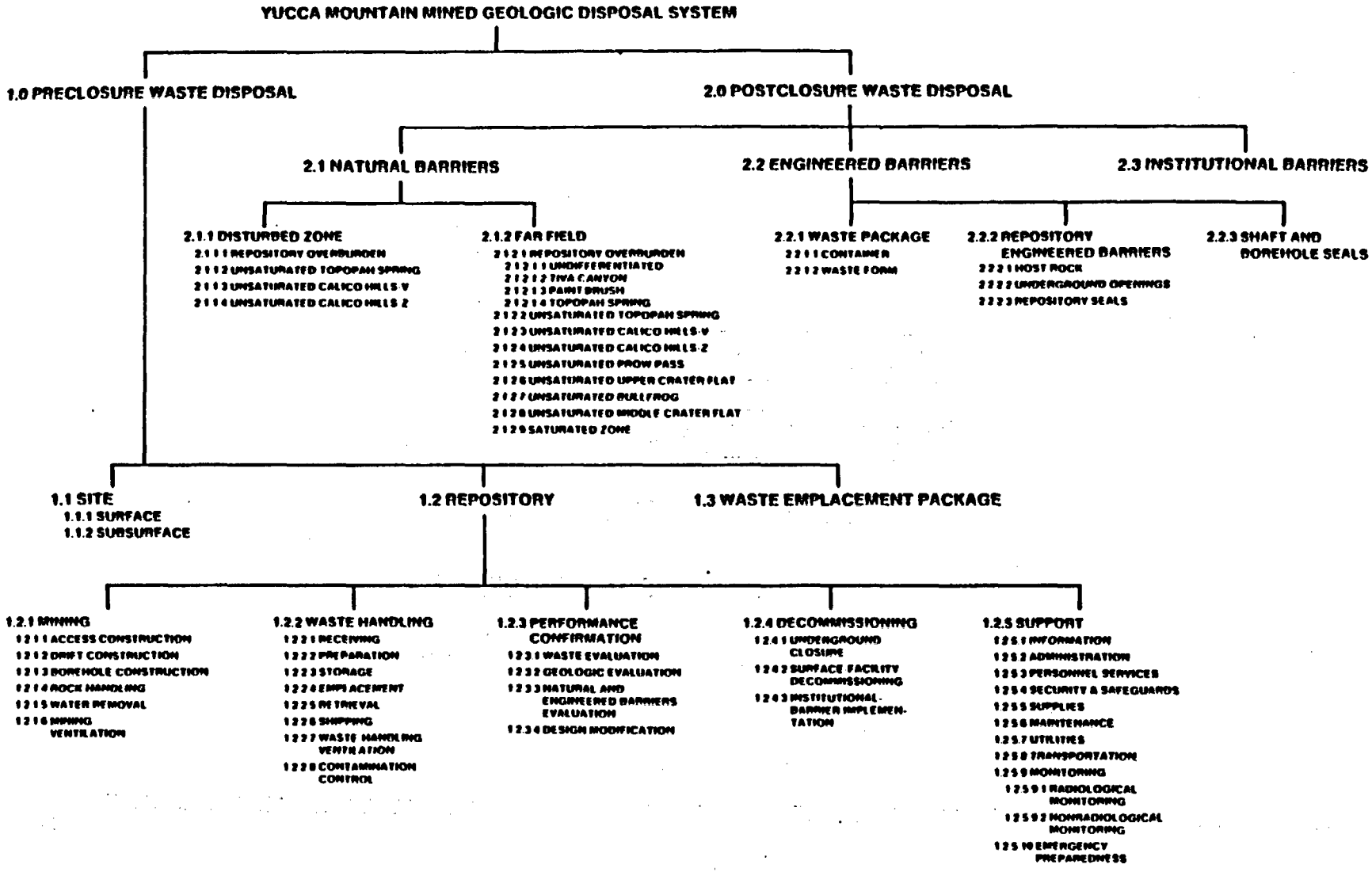
DESIGN ISSUE 1.11

WHAT ARE THE CHARACTERISTICS AND CONFIGURATIONS OF SEALS FOR SHAFTS, DRIFTS, AND BOREHOLES THAT WILL NOT COMPROMISE CONTAINMENT AND ISOLATION?


YUCCA MOUNTAIN MINED GEOLOGIC DISPOSAL SYSTEM
1.0 PRECLOSURE WASTE DISPOSAL
2.0 POSTCLOSURE WASTE DISPOSAL
2.1 NATURAL BARRIERS
2.2 ENGINEERED BARRIERS
2.3 INSTITUTIONAL BARRIERS
2.1.1 DISTURBED ZONE
2.1.1.1 REPOSITORY OVERBURDEN
2.1.1.2 UNSATURATED TOPOPAH SPRING
2.1.1.3 UNSATURATED CALICO HILLS V
2.1.1.4 UNSATURATED CALICO HILLS Z
2.1.2 FAR FIELD
2.1.2.1 REPOSITORY OVERBURDEN
2.1.2.1.1 UNDIFFERENTIATED
2.1.2.1.2 TIVA CANYON
2.1.2.1.3 PAINT BRUSH
2.1.2.1.4 TOPOPAH SPRING
2.1.2.2 UNSATURATED TOPOPAH SPRING
2.1.2.3 UNSATURATED CALICO HILLS V
2.1.2.4 UNSATURATED CALICO HILLS Z
2.1.2.5 UNSATURATED PROW PASS
2.1.2.6 UNSATURATED UPPER CRATER FLAT
2.1.2.7 UNSATURATED BULLFROG
2.1.2.8 UNSATURATED MIDDLE CRATER FLAT
2.1.2.9 SATURATED ZONE
2.2.1 WASTE PACKAGE
2.2.1.1 CONTAINER
2.2.1.2 WASTE FORM
2.2.2 REPOSITORY ENGINEERED BARRIERS
2.2.2.1 HOST ROCK
2.2.2.2 UNDERGROUND OPENINGS
2.2.2.3 REPOSITORY SEALS
2.2.3 SHAFT AND BOREHOLE SEALS
1.1 SITE
1.1.1 SURFACE
1.1.2 SUBSURFACE
1.2 REPOSITORY
1.3 WASTE EMPLACEMENT PACKAGE
1.2.1 MINING
1.2.1.1 ACCESS CONSTRUCTION
1.2.1.2 DRIFT CONSTRUCTION
1.2.1.3 BOREHOLE CONSTRUCTION
1.2.1.4 ROCK HANDLING
1.2.1.5 WATER REMOVAL
1.2.1.6 MINING VENTILATION
1.2.2 WASTE HANDLING
1.2.2.1 RECEIVING
1.2.2.2 PREPARATION
1.2.2.3 STORAGE
1.2.2.4 EMPLACEMENT
1.2.2.5 RETRIEVAL
1.2.2.6 SHIPPING
1.2.2.7 WASTE HANDLING VENTILATION
1.2.2.8 CONTAMINATION CONTROL
1.2.3 PERFORMANCE CONFIRMATION
1.2.3.1 WASTE EVALUATION
1.2.3.2 GEOLOGIC EVALUATION
1.2.3.3 NATURAL AND ENGINEERED BARRIERS EVALUATION
1.2.3.4 DESIGN MODIFICATION
1.2.4 DECOMMISSIONING
1.2.4.1 UNDERGROUND CLOSURE
1.2.4.2 SURFACE FACILITY DECOMMISSIONING
1.2.4.3 INSTITUTIONAL-BARRIER IMPLEMENTATION
1.2.5 SUPPORT
1.2.5.1 INFORMATION
1.2.5.2 ADMINISTRATION
1.2.5.3 PERSONNEL SERVICES
1.2.5.4 SECURITY & SAFEGUARDS
1.2.5.5 SUPPLIES
1.2.5.6 MAINTENANCE
1.2.5.7 UTILITIES
1.2.5.8 TRANSPORTATION
1.2.5.9 MONITORING
1.2.5.9.1 RADIOLOGICAL MONITORING
1.2.5.9.2 NONRADIOLOGICAL MONITORING
1.2.5.10 EMERGENCY PREPAREDNESS

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SEALING EXAMPLE

2.0 POSTCLOSURE WASTE DISPOSAL

2.2 ENGINEERED BARRIERS

2.2.2 REPOSITORY ENGINEERED BARRIERS

2.2.2.3 REPOSITORY SEALS

2.2.3 SHAFT AND BOREHOLE SEALS

SEALING EXAMPLE

2.2.2.3 REPOSITORY SEALS

DRIFT/FAULT SEALS

WASTE EMPLACEMENT HOLE - FAULT SEALS

2.2.3 SHAFT AND BOREHOLE SEALS

SHAFT SEALS

EXPLORATORY SHAFT

ESCAPE SHAFT (ES-2)

MEN AND MATERIALS SHAFT

EMPLACEMENT EXHAUST SHAFT

RAMP SEALS

WASTE EMPLACEMENT RAMP

TUFF HANDLING RAMP

BOREHOLE SEALS

(WHICH ONES? - SEE FOLLOWING VIEWGRAPH)

2.2.3 SHAFT AND BOREHOLE SEALS, CONT.

BOREHOLE SEALS

CATEGORY A -

USW H-5	UE-25A#4	UE-25WT#4	UE-25WT#14
USW G-4	UE-25A#5	USW WT-1	UE-25WT#15
UE-25A#6	UE-25A#7	UE-25WT#5	UE-25WT#13
USW H-4	UE-25B#1	UE-25C#1	
USW WT-2	UE-25A#1	UE-25P#1	

CATEGORY B -

USW H-3
USW G-3
USW GU-3
USW UZ-1
USW G-1
USW H-1
UE-25WT#18

SEALING EXAMPLE - SHAFT SEAL COMPONENTS

2.2.3 SHAFT AND BOREHOLE SEALS

SHAFT SEALS

EXPLORATORY SHAFT SEAL

SURFACE BARRIER

SHAFT COVER

SHAFT COLLAR CORE

ANCHOR-TO-BEDROCK PLUG/SEAL

LOWER SHAFT

SHAFT FILL

SETTLEMENT PLUG

REPOSITORY STATION PLUG/SEAL

OCRWM OGR

IR STEP 3 - DEVELOP IR APPROACH - FUNCTIONS

ISSUE 1.11 - SEALS

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STEP 2		STEP 3
SYSTEM	ELEMENTS	FUNCTION
2.2.3.1	SHAFT (AND RAMP) SEALS	REDUCE AMOUNT OF WATER THAT CAN REACH WASTE DISPOSAL ROOMS
		REDUCE AMOUNT OF WATERBORNE RADIONUCLIDES THAT CAN REACH AND FLOW THROUGH SHAFT BELOW WASTE STORAGE LEVEL
		REDUCE AMOUNT OF AIRBORNE RADIONUCLIDES THAT COULD PREFERENTIALLY EXIT FROM REPOSITORY VIA SHAFTS
		REDUCE POTENTIAL FOR HUMAN INTRUSION INTO REPOSITORY
		ADEQUATELY WARN FUTURE POPULATION OF HAZARD

OCRWM NNWSI PROJECT

IR STEP 3 - DEVELOP IR APPROACH - PROCESS

ISSUE 1.11 SEALS

Sandia National Laboratories

STEP 2		STEP 3
SYSTEM ELEMENTS	FUNCTION	PROCESS
2.2.3.1 SHAFT (AND RAMP) SEALS	REDUCE AMOUNT OF WATER THAT CAN REACH WASTE DISPOSAL ROOMS	WATER FLOW PAST MULTIPLE BARRIERS (ANCHOR-TO-BEDROCK SEAL, SHAFT FILL, REPOSITORY STATION SEAL) IN SHAFT SEALS
	REDUCE AMOUNT OF WATER-BORNE RADIONUCLIDES THAT CAN FLOW THROUGH SHAFT BELOW WASTE STORAGE LEVEL	FLOW INTO SHAFT AT REPOSITORY LEVEL FOR ES ONLY, FLOW INTO CALICO HILLS CONCENTRATED BY SHAFT
	REDUCE AIRBORNE RADIO-NUCLIDES PREFERENTIALLY EXITING REPOSITORY VIA SHAFTS	PRESSURE DIFFERENCES DUE TO CONVECTIVE AIR MOVEMENT RESULTING FROM REPOSITORY THERMAL GRADIENTS

IR STEP 4 - DEFINE PERFORMANCE MEASURE

IR STEP 5 - DEFINE PERFORMANCE GOALS AND CONFIDENCE

ISSUE 1.11 SEALING

STEP 3	STEP 4	STEP 5	
		PERFORMANCE GOALS AND CONFIDENCE	
PROCESS	PERFORMANCE MEASURE	GOAL	C_D
WATER FLOW PAST MULTIPLE BARRIERS IN SHAFT SEALS	QUANTITY OF WATER ALLOWED TO FLOW INTO REPOSITORY LEVEL FROM ALL SHAFTS AND RAMPS	106.000 M^3/YR EACH OF FOUR SHAFTS IS ALLOWED 25.000 M^3/YR EACH OF TWO RAMPS IS ALLOWED 3.000 M^3/YR	MEDIUM

OCRWM Nevada Nuclear Waste Storage Investigations PROJECT

IR STEP 6 - DERIVE SITE OR DESIGN PARAMETERS

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ISSUE 1.11 SEALING

STEP 3	STEP 6		
PROCESS	PARAMETERS	RANGE	CONFIDENCE
DETER OR LIMIT WATER FLOW PAST MULTIPLE BARRIERS IN SHAFT SEALS	FOR THE SHAFT SEALS, PARAMETERS, THEIR RANGE, AND THE REQUIRED LEVELS OF CONFIDENCE CAN BE DETERMINED ONLY AFTER CONSIDERING THE COMPONENTS THAT MAKE UP THE SEAL		

NOTE: SEE THE FOLLOWING VIEWGRAPHS - FOR A DISCUSSION OF HOW TO APPLY THE STRATEGY TO COMPONENTS THAT MAKE UP THE SHAFT SEALS

SEALING EXAMPLE - SHAFT SEAL COMPONENTS

2.2.3 SHAFT AND BOREHOLE SEALS

SHAFT SEALS

EXPLORATORY SHAFT SEAL

SURFACE BARRIER

SHAFT COVER

SHAFT COLLAR CORE

ANCHOR-TO-BEDROCK PLUG/SEAL

LOWER SHAFT

SHAFT FILL

SETTLEMENT PLUG

REPOSITORY STATION PLUG/SEAL

DETAILED EXAMPLE OF PROCESSES APPLICABLE TO ES SEAL COMPONENTS

STEP 2		STEP 3
SYSTEM ELEMENTS	FUNCTION	PROCESS
2.2.3.1.1 SHAFT SEALS		
EXPLORATORY SHAFT SEAL	REDUCE AMOUNT OF WATER THAT CAN REACH WASTE DISPOSAL ROOMS	WATER FLOW PAST MULTIPLE BARRIERS
SURFACE COVER	"	DIVERT SURFACE WATER FLOW
COLLAR CORE	"	INHIBIT WATER FLOW FROM SURFACE TO BEDROCK
ANCHOR-TO-BEDROCK PLUG/SEAL	"	LIMIT QUANTITY OF SURFACE WATER ENTERING SHAFT AT BEDROCK INTERFACE
LOWER SHAFT FILL	"	LIMIT QUANTITY OF SURFACE AND SUBSURFACE WATER REACHING BASE OF SHAFT
SHAFT STATION PLUG/SEAL	"	LIMIT QUANTITY OF WATER ENTERING REPOSITORY LEVEL FROM SHAFT
2.1.2.2 UNSATURATED TOPOPAH SPRING TUFF AT BASE OF SHAFT	"	DRAINAGE THROUGH BASE OF SHAFT

PERFORMANCE MEASURES AND GOALS FOR ES SEAL COMPONENTS

STEP 2	STEP 3	STEP 4	STEP 5	
			PERFORMANCE GOALS AND CONFIDENCE	
SYSTEM ELEMENTS	PROCESS	PERFORMANCE MEASURE	GOAL	C_D
EXPLORATORY SHAFT SEAL	WATER FLOW PAST MULTIPLE BARRIERS:			
SURFACE COVER	DIVERT SURFACE WATER	QUANTITY OF H_2O PASSING COMPONENT	NO GOAL ESTAB.	NA
COLLAR CORE	INHIBIT FLOW TO BEDROCK	"	NO GOAL ESTAB.	NA
ANCHOR-TO-BEDROCK PLUG/SEAL	LIMIT FLOW IN SHAFT AT BEDROCK	"	25,000 M^3/YR	MEDIUM
LOWER SHAFT FILL	LIMIT FLOW TO BASE OF SHAFT	"	25,000 M^3/YR	LOW
SHAFT STATION PLUG/SEAL	LIMIT WATER ENTERING REPOSITORY LEVEL	"	25,000 M^3/YR	MEDIUM
UNSATURATED T.S. TUFF @ SHAFT BASE	DRAINAGE THROUGH BASE OF SHAFT	DRAINAGE CAPACITY	150 M^3/YR	MEDIUM

OCRWM — Nevada Nuclear Waste Storage Investigations PROJECT

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PARAMETERS, GOALS, AND INDICATIONS OF CONFIDENCE FOR MEETING ES SEAL PERFORMANCE GOALS

STEP 2	STEP 4		STEP 6	
TEM ELEMENTS	PERFORMANCE MEASURE	PARAMETERS	RANGE	CONFIDENCE
ORATORY SHAFT				
RFACE COVER	QUANTITY OF WATER PASSING COMPONENT	TBD		
LLAR CORE	"	TBD		
CHOR-TO-DROCK PLUG/AL	"	PERMEABILITY OF SEAL	$<10^{-5}$ CM/SEC	MEDIUM
		EXTENT AND PERMEABILITY OF DAMAGE ZONE	$K_{EFF}<10^{2}\cdot K_{SAT}$ FOR 1 RADIUS	HIGH
		TIVA CANYON PERMEABILITY	REF INFO BASE (CH 3)	MEDIUM
		IN-SITU STRESS	>1 MPA	50%
WER SHAFT LL	"	FILL PERMEABILITY	<10 CM/SEC	MEDIUM
		LINER PERMEABILITY	TBD	TBD
		EXTENT AND PERMEABILITY OF DAMAGE ZONE	$K_{EFF}<10^{2}\cdot K_{SAT}$ FOR 1 RADIUS	MEDIUM
		IN-SITU STRESS	>2 MPA	LOW
AFT STATION UG/SEAL	"	PLUG PERMEABILITY	$<10^{-4}$ CM/SEC	MEDIUM
		T.S. PERMEABILITY	REF INFO BASE (CH 3)	MEDIUM
		EXTENT AND PERMEABILITY OF DAMAGE ZONE	$K_{EFF}<10^{2}\cdot K_{SAT}$ FOR 1 RADIUS	MEDIUM
		IN-SITU STRESS	2 MPA<5<12 MPA	LOW
TURATED T.S. @ SHAFT BASE	DRAINAGE CAPACITY	T.S. PERMEABILITY	$K_{SAT}>2\times10^{-6}$CM/SEC	LOW
		LINER PERMEABILITY	WITHIN 2 ORDERS OF MAG.	LOW
		SHAFT DESIGN PARAMETERS (RADIUS, LINER THICKNESS, ETC.)	NA	NA

OBSERVATIONS ABOUT ISSUE 1.11

- ESTABLISHMENT OF DETAILED PROCESS AND MEANINGFUL PARAMETERS REQUIRED BREAKDOWN OF SYSTEM ELEMENTS TO SEAL COMPONENT LEVEL

- TOTAL WATER FLOW INTO REPOSITORY VIA SHAFTS AND RAMPS REPRESENTS INTERFACE BETWEEN SEALING PROGRAM AND POSTCLOSURE PERFORMANCE ISSUE 1.16 THAT ADDRESSES RADIONUCLIDE RELEASES TO THE ACCESSIBLE ENVIRONMENT

Attachment D to Enclosure 1

Issues hierarchy

Attachment D

ISSUES HIERARCHY

Key Issue 1: Will the geologic repository at the site, including multiple natural and engineered barriers, isolate the radioactive waste from the accessible environment after closure in accordance with the requirements set forth in 10 CFR Part 60 and 40 CFR Part 191?

Characterization Issues

Issue 1.1: What are the present and expected characteristics of the geohydrologic setting that must be known to determine compatibility with containment and isolation?

Issue 1.2: What are the present and expected geochemical characteristics that must be known to determine compatibility with containment and isolation?

Issue 1.3: What are the present and expected characteristics of the host rock and surrounding units that must be known to determine compatibility with containment and isolation?

Issue 1.4: What are the future climatic conditions that must be known to determine if radionuclide releases will be greater than those allowed by regulations?

Issue 1.5: What are the future erosional processes and rates that must be known to determine if releases are likely to be greater than those allowed by regulations?

Issue 1.6: What characteristics of rock dissolution within the geologic setting must be known to determine if radionuclide releases are likely to be greater than those allowed by regulations?

Issue 1.7: What characteristics of future tectonic processes or events must be known to determine if radionuclide releases are likely to be greater than those allowed by regulations?

Issue 1.8: What are the natural resources at or near the site that could cause human interference activities that could lead to radionuclide releases greater than those allowed by regulations?

Design Issues

Issue 1.9: What are the characteristics and configuration of the waste package that must be known to show that interactions with the emplacement environment do not compromise the function of the waste packages, the performance of the underground facility, or the geologic setting?

Issue 1.10: What characteristics and configurations of the underground facility contribute to containment and isolation?

Issue 1.11: What are the characteristics and configurations of seals for shafts, drifts, and boreholes that will not compromise containment and isolation?

Performance Issues

Issue 1.12: What are the magnitudes and the extent of the effects of the repository on site characteristics?

Issue 1.13 Will the waste package provide substantially complete containment for at least 300-1000 years?

Issue 1.14: Will the engineered barrier system meet the performance objective for radionuclide release rates?

Issue 1.15: Is the pre-waste-emplacement ground-water travel time at least 1000 years along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment?

Issue 1.16: Will the projected range of radionuclide releases to the accessible environment meet the system performance objective?

Issue 1.17: What are the effects of favorable and potentially adverse conditions on repository performance?

Issue 1.18: Can the higher level findings that are required by 10 CFR Part 960 for the postclosure technical guidelines be made?

Key Issue 2: Will projected radiological exposures of the general public and repository workers, and releases of radioactive materials to restricted and unrestricted areas during repository operation and closure at the site meet applicable safety requirements set forth in 10 CFR Part 20, 10 CFR Part 60, and 40 CFR Part 191?

Characterization Issues

Issue 2.1: What information on population density and distribution in the vicinity of the site is necessary to determine compliance with preclosure radiological safety requirements?

Issue 2.2: What information on the status of land ownership and surface and subsurface rights to land and minerals in the vicinity of the site is necessary to determine compliance with preclosure radiological safety requirements?

Issue 2.3: What are the prevailing meteorological conditions that must be known to determine compliance with preclosure radiological safety requirements?

Issue 2.4: What are the characteristics of offsite installations and operations that must be known to determine compliance with preclosure radiological safety requirements?

Issue 2.5: Will the waste packages maintain containment during handling, emplacement, and retrieval?

Issue 2.6: What features and operating procedures of the geologic repository ensure radiological protection of the environment, the public and the workers?

Performance Issues

Issue 2.7: Will the radiation exposures and levels in, and releases of radioactive materials to, restricted and unrestricted areas be less than the allowable limits?

Issue 2.8: Can the higher level findings that are required by 10 CFR Part 960 for the preclosure technical guidelines related to radiological safety be made?

Key Issue 3: Can the repository and its support facilities be sited, constructed, operated, closed, and decommissioned so that the quality of the environment will be protected and waste-transportation operations can be conducted without causing unacceptable risks to public health or safety?

Characterization Issues

Issue 3.1: What are the present and projected environmental conditions considered sufficient to assess environmental impacts?

Issue 3.2: What are the present and projected social and economic conditions considered sufficient to assess social and economic impacts?

Issue 3.3: What are the present and projected transportation conditions considered sufficient to assess transportation impacts?

Design Issues

Issue 3.4: What are the characteristics of the site, proposed facilities, and operating procedures and activities considered sufficient to assess environmental impacts and risks to the public health and safety?

Issue 3.5: What are the characteristics of the site, proposed facilities, and operating procedures and activities considered sufficient to assess social and economic impacts to the affected area?

Issue 3.6: What are the characteristics of the site, proposed facilities, and operating procedures and activities considered sufficient to assess transportation impacts to the affected area?

Performance Issues

Issue 3.7: What are the projected environmental impacts and what mitigation activities will be employed to avoid or reduce these impacts?

Issue 3.8: What are the projected social and economic impacts and what mitigation activities will be employed to avoid or reduce these impacts?

Issue 3.9: What are the projected transportation-related impacts and what mitigation activities will be employed to avoid or reduce these impacts?

Issue 3.10: What are the projected significant environmental impacts and risks to public health and safety that cannot be mitigated or otherwise avoided?

Issue 3.11: Can the higher level findings that are required by 10 CFR Part 960 for the preclosure technical guidelines related to environmental quality and public health and safety be made?

Key Issue 4: Will repository construction, operation (including retrieval), closure, and decommissioning be feasible at the site on the basis of reasonably available technology and will the associated costs be reasonable?

Characterization Issues

Issue 4.1: What are the surface characteristics and conditions that must be known to determine if construction, operation, closure, and decommissioning of the repository are feasible?

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?

Issue 4.3: What are the hydrologic characteristics and conditions that must be known to determine if construction, operation, closure and decommissioning of a repository are feasible?

Issue 4.4: What are the expected tectonic phenomena and igneous activity that must be known to determine if repository construction, operation, closure, and decommissioning are feasible?

Design Issues

Issue 4.5: Can the waste packages be produced with reasonably available technology?

Issue 4.6: Will the design and operating procedures of the repository ensure non-radiological health and safety?

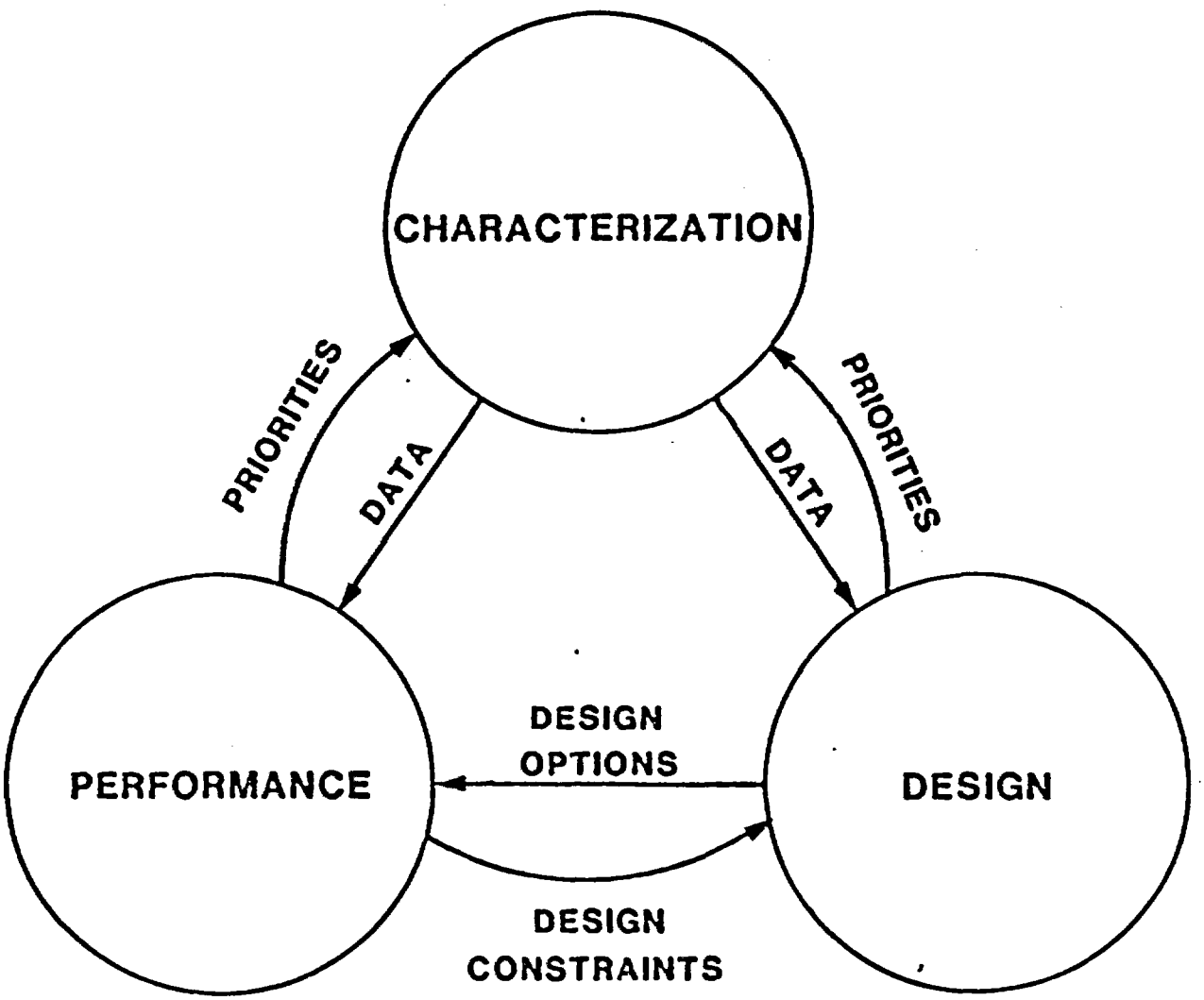
Issue 4.7: Can the repository be constructed, operated, closed, and decommissioned with reasonably available technology?

Issue 4.8: Will the repository system be cost-effective?

Performance Issues

Issue 4.9: Will the design of the repository system preserve the option of waste retrieval?

Issue 4.10: Can the higher level findings that are required by 10 CFR 960 for the preclosure technical guidelines related to ease and cost of siting, construction, operation and closure be made?


CHARACTERIZATION
PRIORITIES
DATA
DATA
PRIORITIES
PERFORMANCE
DESIGN OPTIONS
DESIGN
DESIGN CONSTRAINTS

Attachment E to Enclosure 1

Revised outline for SCP Section 8.3

Attachment E

REVISED OUTLINE FOR SCP SECTION 8.3

8.3 PLANNED TESTS, ANALYSES, AND STUDIES

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8.3.1.1 Overview

8.3.1.2 Geohydrology (Post Closure) (Issue 1.1)

8.3.1.3 Geochemistry (Post Closure) (Issue 1.2)

8.3.1.4 Rock Characteristics (Post Closure) (Issue 1.3)

8.3.1.5 Climatic Conditions (Post Closure) (Issue 1.4)

8.3.1.6 Erosion (Post Closure) (Issue 1.5)

8.3.1.7 Dissolution (Post Closure) (Issue 1.6)

8.3.1.8 Tectonics (Post Closure) (Issue 1.7)

8.3.1.9 Human Interference (Post Closure) (Issue 1.8)

8.3.1.10 Surface Characteristics (Preclosure) (Issue 4.1)

8.3.1.11 Rock Characteristics (Preclosure) (Issue 4.2)

8.3.1.12 Hydrology (Preclosure) (Issue 4.3)

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8.3.2 Repository Program

8.3.2.1 Overview

8.3.2.2 Host Rock Environment

8.3.2.3 Coupled Tests

8.3.2.4 Design Tests and Activities

8.3.2.5 Repository Modeling

8.3.2.5.1 Basic Approach to Modeling in the Repository Program

8.3.2.5.2 Aspects of Repository Program Requiring Modeling

8.3.2.5.3 Modeling Tools Currently Proposed for the Repository Program

8.3.2.6 Considerations for Configuration of the Underground Facilities (Post Closure) (Issue 1.10)

8.3.2.7 Radiological Health and Safety (Preclosure) (Issue 2.6)

8.3.2.8 Non-radiological Health and Safety (Preclosure) (Issue 4.6)

8.3.2.9 Technical Feasibility (Preclosure) (Issue 4.7)

8.3.3 Seal System Program

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8.3.3.2 Seal System Environment

8.3.3.3 Seal System Components and Interaction Testing

8.3.3.4 Seal System Design Optimization

8.3.3.5 Seal System Modeling

8.3.3.6 Seal Characteristics and Configurations (Post Closure) (Issue 1.11)

8.3.4 Waste Package Program

8.3.4.1 Overview

8.3.4.1.1 Waste Package Environment

8.3.4.1.2 Waste Package Components and Interaction Testing

8.3.4.1.3 Waste Package Design Development

8.3.4.1.4 Waste Package Modeling

8.3.4.2 Concerns for Waste Package Characteristics (Post Closure) (Issue 1.9)

8.3.4.3 Containment of Radionuclides (Preclosure) (Issue 2.5)

8.3.4.4 Reasonably Available Technology for Waste Package Development (Preclosure) (Issue 4.5)

8.3.5 Performance Assessment Program Plan

8.3.5.1 Strategy for Preclosure Performance Assessment

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8.3.5.3 Design for Waste Retrieval (Preclosure) (Issue 4.9)

8.3.5.4 Strategy for Postclosure Performance Assessment

8.3.5.5 Plans for Assessing Engineered Barrier Subsystem and Component Performance (Post Closure) (Issues 1.12, 1.13, 1.14)

8.3.5.6 Plans for Assessing Seal System Performance

8.3.5.7 Plans for Assessing the Contribution of Site Characteristics to Site Subsystem Performance (Preclosure) (Issue 1.15)

8.3.5.8 Plans for Assessing System Performance (Preclosure) (Issues 1.16, 1.17)

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8.3.5.10 Substantially Completed Analytical Techniques

8.3.5.10.1 Analytical Techniques

8.3.5.10.2 Data Required

8.3.5.10.3 Plans for Verification and Validation

8.3.5.11 Analytical Techniques Requiring Significant Development

8.3.5.11.1 Analytical Techniques

8.3.5.11.2 Data Required

8.3.5.11.3 Plans for Verification and Validation

Attachment F to Enclosure 1

Correlation of key elements of waste package strategy to sections in the SCP

Elements of a Waste Package Post-Emplacement Compliance Strategy	Related SCP Section
1. Identification of Regulatory Requirements	7.2
a. Applicable Regulatory Definitions and Interpretations (10 CFR 60.2)	
b. Applicable Performance Objectives (10 CFR 60.113)	
c. Required Release Rate Analyses (10 CFR 60.21)	
2. Description of Emplacement Environment	7.1
3. Identification of Credible Scenarios	8.3
a. Baseline conditions for anticipated processes and events	
b. Conditions for unanticipated processes and events analyses	
c. Determination of credible anticipated/unanticipated events to be included in design process	
4. General Approach to Compliance Demonstration Strategy	8.3
a. Substantially Complete Containment Period Strategy	
b. Controlled Release in Postcontainment Period Strategy	
5. Performance allocation to subsystems.	8.3
a. Performance goals	
b. Level of confidence	
6. Comparative Evaluation of Alternatives (10CFR60.21(C)(ii)(D))	8.3
7. Summary of Plan to Implement Strategy	8.3
a. Issues that require resolution	
b. Activities (to implement strategy and resolve issues)	
c. Summary schedule	

Enclosure 2

Proposed Revisions to the Annotated Outline for Site Characterization Plans (OGR/B-5) for Consistency with the Generic Requirements for a Mined Geologic Disposal System (OGR/B-2)

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FOREWORD

The Nuclear Waste Policy Act of ~~1982~~ (NWPA) requires that site characterization plans (SCPs) be submitted to the Nuclear Regulatory Commission (NRC), affected States and Indian tribes, and the general public for review and comment prior to the sinking of shafts at a candidate repository site. The SCP is also required by the NRC licensing procedures for the disposal of high-level waste contained in 10 CFR 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories." The NRC has additionally provided guidance to the DOE for the preparation of SCPs in the form of Regulatory Guide 4.17 (R.G.4.17, "Standard Format and Content of Site Characterization Plans for High-Level-Waste Geologic Repositories," Proposed Revision 1 dated September 1984).

The Annotated Outline (AO) which follows provides the DOE's standard format and guidance for the preparation of SCPs. It has been developed primarily for the use of the DOE and its contractors to aid in the preparation of SCPs to a common format. Although the AO differs to some extent with R.G. 4.17, it is considered to be consistent to the maximum extent practicable with the intent of the regulatory guide and the philosophy contained therein. There are some format differences between the AO and R.G. 4.17; however, there are very few content differences. These format changes include such things as combining discussions for clarity and ease of reference, moving discussions to sections believed to be more appropriate, and making format revisions, such as in Chapters 4, 6, and 8. The format and content changes are clearly indicated in a correlation of the AO with R.G. 4.17, which has been prepared and is included as Attachment A.

Chapters 1 through 7 form Part A of the SCP (~~Description of Site, Waste Package, and Conceptual Design of a Repository~~) and Chapter 8 forms Part B (Site Characterization Program) which is consistent with the terminology in R.G. 4.17. Provisions for an unnumbered introduction, which is to contain important background information, is also included.

Description of Mined Geologic Disposal System

INTRODUCTION TO ANNOTATED OUTLINE

The Nuclear Waste Policy Act of 1982 (NWPA) requires the preparation of a site characterization plan (SCP)[1] prior to the initiation of shaft construction at any candidate repository site (Sec. 113(b). The SCP is also required by the Nuclear Regulatory Commission (NRC) licensing procedures for the disposal of high-level waste as contained in 10 CFR Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories." As part of the prelicensing procedures, the Department of Energy (DOE) is required to submit an SCP to the NRC and the States for a particular geologic repository operations area prior to sinking shafts. The basic purpose of the SCP is simple: to provide a mechanism for identifying and delimiting the specific issues[2] at a proposed repository site[3] and to identify the plans to obtain data for resolving those issues at an early time in order to avoid delays in the licensing process. As reflected in the logic sequence and organization of this Annotated Outline (AO) of Site Characterization Plans for High-Level-Waste Geologic Repositories, the SCP will accomplish the following objectives:

- Establish what is known about a site from site exploration activities completed to date
- Describe the issues that the DOE has identified at a site in light of the results of investigations to date
- Describe the detailed plans to obtain data to be used to resolve the issues identified.

[1] As defined in 10 CFR Part 60, site characterization 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 Part 60. Site characterization includes borings, surface excavations, excavation of exploratory shafts, limited subsurface lateral excavations and borings and in-site testing at depth needed to determine the suitability of the site for a geologic repository. It does not include preliminary borings and geophysical testing needed to decide whether site characterization will be undertaken.

[2] Issues are defined as questions that must be answered or resolved to complete licensing assessments of a site and design suitability in terms of 10 CFR 60 and 10 CFR 960. The role of issues in the Site Characterization Program are described in Chapter 8 of the AO.

[3] Site and other terms appearing in this Introduction have the meanings set forth in § 60.2 of 10 CFR Part 60, as amplified by those definitions in Generic Requirements for a Mined Geologic Disposal System (OGR/B-2) which differentiate between pre- and post closure requirements.

Objective of Site Characterization

Site characterization will include exploration and research, both in the laboratory and in the field, to establish the geologic conditions at a site and the ranges of parameters that characterize the site. The objective of site characterization is to collect pertinent geological and other site characteristic information that will be needed for site selection and ultimately for a license application (i.e., sufficient information about a site to support a finding, prior to construction, of reasonable assurance that there is no unreasonable risk to public health and safety).

Objectives of Site Characterization Plan

The purpose of the SCP is to provide a document in which the DOE:

- Describes the site, design of a repository and engineered barriers, appropriate to the site, waste packages, emplacement environment, and performance analysis in sufficient detail so that the planned site characterization program may be understood.

- Identifies the uncertainties and limitations on site- and design-related information developed during site screening, including issues that need further investigation or for which additional assurance is needed.

- Describes the detailed programs for additional work, including performance confirmation, to (1) resolve outstanding issues, (2) reduce uncertainties in the data, and (3) make site suitability findings relative to DOE siting guidelines, 10 CFR 960.

The SCP will provide a vehicle for early NRC, State, Indian tribal, and public input on the DOE's data-gathering and development work so as to avoid postponing issues to the point where modifications would involve major delays or disruptions in the program. Early review of the DOE's site characterization plans as presented in the SCP will provide an opportunity for the NRC to evaluate whether the DOE's proposed program is likely to generate data suitable to support a license application.

Following commencement of shaft sinking, the DOE will report to the NRC Director of the Office of Nuclear Material Safety and Safeguards (NMSS) at least semiannually on the results of site characterization studies, including any new information that might affect the design assumptions concerning waste form and ~~packaging~~ and the planned repository itself. Such semiannual reporting will also include the identification of new issues, plans for additional studies to resolve these issues, the elimination of planned studies no longer necessary, and the identification of decision points reached and modifications to schedules, where appropriate.

Purpose, Applicability, and Use of this Annotated Outline (AO)

The purpose of this AO is to indicate the types of information that the DOE intends to include in the SCP in accordance with 10 CFR Part 60 and to establish a uniform format for presenting the information. Use of this format will help ensure the completeness of the information provided, will assist the NRC staff and others in locating the information, and will aid in shortening the time needed for the review process.

Any information collection requirements mentioned in this AO are exempt from the Paperwork Reduction Act (44 U.S.C. 3518(c)(1)), as stated in NRC Reg. Guide 4.17.

The AO is divided into an introductory chapter and two parts:

1. Part A provides guidance on the types of information needed to describe the site and the design (including the waste package and its emplacement environment) of a repository, appropriate to the site. There is no threshold amount of data to be accumulated during the preliminary site exploration activities required prior to the submittal of an SCP. Rather, Part A provides guidance on how to submit information that is currently available.

nd engineered barriers

2. Part B provides guidance on the presentation of the site characterization program, on the identification of information needs and unresolved issues, and on the plans to resolve these issues during site characterization.

The DOE will prepare Part B with the expectation that the NRC will look for answers to the following questions:

- Have the important information needs and unresolved issues been identified?
- Does the SCP specifically address these information needs and present program plans to obtain the needed information?
- Are the methods of testing and analysis proposed for the planned site characterization program appropriate?
- Have alternative methods of testing and analysis been identified and evaluated, and has an adequate basis been provided for the selection of the methods to be used?
- Will the data to be collected and the reliability of the collection methods and analysis be of adequate quality to support site selection and a future license application?
- Have the testing plans been based on the performance requirements for the ~~repository system~~ components, and are the tests adequate to enable evaluation of whether or not the ~~repository system~~ components will perform as required?

MGDS

MGDS

It is expected that the SCP will be principally evaluated by the NRC according to the completeness of Part B, its most critical part.

In developing Part B of the SCP, the DOE will focus attention on those aspects of siting, development of ~~waste packaging~~ engineered barriers, and the design of a repository appropriate to the site that may require the most effort in the site characterization program. While the SCP must be complete in developing the issues of site characterization, it is important -- particularly in initial planning phases -- that those issues considered critical or most important to site selection and licensing be identified and given highest priority in the SCPs.

The DOE intends that Part B will contain information about the planned tests at a level of detail sufficient to enable determination of whether adequate information for site selection and licensing will be produced. This information will include definitive descriptions of the parameters to be controlled and measured in planned tests, or analyses that show how the tests adequately bound the range of potential limiting conditions that are important to performance of the aspect of the repository being investigated. The word "definitive" is intended to: (1) connote explicit descriptions of test procedures, suitable for prelicensing consultation between DOE and NRC; and (2) recognize the maturation processes of a phased approach to testing which reflects and responds to the results of ongoing system performance assessments.

The DOE recognizes that the quality of data is virtually determined by the specific data-gathering methods and procedures that are used. In addition to questioning the relevancy and completeness of data supplied in the license application, the licensing process must explicitly address the question of whether or not the data are of adequate quality so that licensing determinations can be made with reasonable confidence. It is important, therefore, that specific methods to be used in data gathering and in the site characterization program be the subject of the prelicensing consultation between the DOE and the NRC.

The DOE program of site characterization will be a phased process. The depth of information provided may be determined considering the need for flexibility to account for the exploratory, developing nature of the investigations. Plans included in the SCP 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). However, for testing currently being conducted or planned as the first stage of future investigations, definitive plans must be documented. As the DOE completes plans for later phases of site characterization, additional information will be provided to the NRC via semi-annual reporting or referenced in such reporting and provided through other mechanisms provided for under the Procedural Agreement between the NRC and the DOE entitled "Identifying Guiding Principles for Interface During Site Investigation and Site Characterization."

In any event, all site characterization plans for gathering the necessary information to conduct evaluations of site suitability and design acceptability that will accompany the license application, as well as the 10 CFR 960 site selection, will be addressed fully in the SCP for each site.

Identification of Agents and Contractors

The DOE project management organization will be identified, and the DOE technical projects and tasks will be described. Prime agents or contractors for site investigations, design, ~~waste form and packaging~~ research and development, and performance analysis will also be identified. The division of responsibility and lines of communication among these various parties will be delineated.

waste package

Supplemental Information

Detailed supplemental information not explicitly identified in this AO may be provided in appendices to the SCP. Examples include the following:

- Technical information in support of design features
- Reports furnished by consultants
- Summaries of how appropriate NRC regulations and guides were addressed
- Portfolios of maps.

In cases where only representative data (e.g., selected geophysical data from selected borehole logs) are submitted, the original raw data will be accessible either at the site or other appropriate locations and will be readily available to the NRC. Representative data will be of sufficient quality and quantity to permit an understanding of the nature and extent of the data actually available.

Style and Composition

The AO has been prepared to minimize duplication of information. Similar or identical information may be requested in various sections of the AO because it is appropriate to more than one portion of the SCP. In such cases, the information will be presented in the principal section and referenced appropriately in the other applicable sections.

The SCP will be prepared according to a DOE style guide in the following manner:

- Information will be presented clearly and concisely
- Claims of adequacy of designs or design methods will be supported with technical bases
- Units of measurement (both fundamental and derived) be given in the International System of Units (SI). If common industrial usage is in other units and the use of SI would be confusing, give the measurement in accepted units with SI units in parentheses
- The SCP will be completely consistent with the numbering system and headings of the AO

INTRODUCTION

This introduction will provide an overall description of the background, purpose, and organization of the Site Characterization Plan (SCP). The plan consists of two parts. Part A, Chapters 1 through 7, will establish what is known about the candidate area, site, and design. Part B, Chapter 8, will present the site characterization plans and activities which describe the additional exploration and research needed for characterization and to address the issues.

Overview

This section will provide background to the purpose of the SCP by summarizing the process by which geologic repositories will be developed by the Department and by relating the SCP to that process. The key elements of the Nuclear Waste Policy Act (NWPA) and 10 CFR 60 that set forth the process will be summarized. The role of the siting guidelines in the process will be described. The Environmental Assessment for the site will be referenced, and its relationship to the SCP will be discussed. This section will also describe the purpose of the SCP.

It will be pointed out that the Department will conduct site characterization activities in a manner that minimizes any significant adverse environmental impacts pursuant to Section 113(a) of the NWPA.

The general basis for planning for a ~~repository~~ Mined geologic disposal system will be described. Reference will be made to (1) the Mission Plan and its overall bases for the program, (2) the siting guidelines and their role in the site characterization process, (3) the Generic Requirements for Mined Geologic Disposal System, and (4) applicable regulations.

The emphasis on spent fuel as a waste form and the inclusion of solidified high-level waste will be discussed as it may relate to site characterization.

The strategy for inclusion of defense waste and transuranic waste will be acknowledged, but it will necessarily be covered in future reporting. Similarly, the disposal of spent fuel hardware from disassembly of the fuels will be discussed in future reporting because it has little impact on the plans for site characterization or ~~repository~~ MGDS design.

History of Site Investigations

This section will describe geographic setting and location of the site. The "candidate area", the "site", and any other terms relating to location that are used in the SCP will be defined. This section will also summarize and reference, as appropriate, the history of (basis for) site investigations which were conducted prior to passage of the Nuclear Waste Policy Act (NWPA).

The Nuclear Waste Policy Act

This section will briefly discuss the broad programmatic requirements of the NWPA as they apply to the SCP.

Purpose of the Act

This section will briefly summarize the purpose of the NWPA.

Siting Guidelines

This section will briefly discuss the following items:

- The requirements of the NWPA for preparation of siting guidelines
- The definition of the NWPA for "site characterization"
- The distinction the NWPA draws (Section 112) between those guidelines requiring site characterization as a prerequisite for application, and those guidelines not requiring site characterization
- The findings required by the guidelines.

The purpose of this discussion is to present the basis for the discussion below of the requirements for the SCP to provide plans to obtain information for supporting higher level findings.

Environmental Assessments

This section will briefly discuss the requirements of the NWPA for preparation of the Environmental Assessments.

Site Characterization Plan

This section will discuss the following topics:

- The NWPA requirements for preparation of the SCP
- 10 CFR 60 requirements for preparation of the SCP
- NRC guidance for the format and content of the SCP contained in Regulatory Guide 4.17
- The purpose and objectives of the SCP
- The fact that the SCP is to present the plan for conducting site characterization activities required to identify the geologic conditions of the candidate site and to prepare the basis for developing conceptual ~~repository~~ MGDS designs
- The fact that the SCP will provide plans for conducting activities to collect information that support 1) preparation of the license application, and 2) making higher level findings required by the siting guidelines for those guidelines requiring site characterization.

PART A

~~DESCRIPTION OF SITE, WASTE PACKAGE, AND REPOSITORY DESIGN~~

DESCRIPTION OF MINED GEOLOGIC DISPOSAL SYSTEM

Chapter 1 - GEOLOGY

This chapter will provide a description of the geology of the candidate area and site. This information is needed to understand the relationship between the design of ~~a repository~~ an MGDS appropriate to the specific site and the rationale for the proposed site characterization program. This chapter will also describe field and laboratory activities conducted in support of geologic studies as well as geologic data acquired from the literature. Sources of geologic information will be referenced at the end of this chapter.

1.0 INTRODUCTION

This section will introduce the site geology to indicate the role in the site characterization program of the material covered in the chapter. This section will cover in a brief introductory fashion:

- Summary remarks about how the presently available information has been obtained and plans for obtaining additional information,
- Summary remarks about how the information will be used.
- Discussions about the quality of present data and the sophistication of models which will use the data.

1.1 GEOMORPHOLOGY

The physiography, geomorphic units, and geomorphic processes for the candidate area and site will be described.

1.1.1 Physiography

The physiographic provinces in which the candidate area and site are located will be described, including areal relationships to surrounding provinces, distinguishing characteristics, and major active processes modifying the present-day topography of the provinces. This information will be provided by means of topographic maps of the candidate area and site, using appropriate scales and contour intervals to support other studies associated with this site. When available, representative ground-level photographs, vertical and oblique aerial photographs, and satellite imagery will be included.

1.1.2 Geomorphic Units

This section will describe the common land forms in the candidate area and the landforms at the site. Each geomorphic unit will be described giving its name, areal extent, distinguishing characteristics, and other pertinent information defined by factors such as relief and landform morphology. All units will be shown on a topographic map.

In this chapter, the mechanical, thermal, and thermomechanical properties of the rock units and the expected mechanical boundary conditions that are the basis for the design of the ~~geologic repository~~ will be presented. Each discussion will include a brief summary of generic information from similar rock units and projects and site-specific information,* if available. The information will be in sufficient detail to (1) permit an understanding of the geomechanical basis of the proposed design of a repository appropriate to the site (Chapter 6) and (2) support the discussion of design issues in Part B. The discussions will include values or ranges of values for the design parameters used in the design and will provide the rationale for selecting these preliminary values.

MGDS

2.0 INTRODUCTION

This section will introduce the site Geoengineering to indicate the role in the site characterization program of the material covered in the chapter. This section will include in a brief introductory fashion:

- Summary remarks about how the presently available information has been obtained and plans for obtaining additional information
- Summary remarks about how the information will be used
- Discussions about conceptual models that are based upon or are supported by the information contained in the chapter
- Discussions about the quality of present data and the sophistication of models which will use the data.

2.1 MECHANICAL PROPERTIES OF ROCK UNITS - INTACT ROCK

The scope of the section, background, equipment and procedures, limitations and uncertainties in data, and definitions (where needed) will be stated.

2.1.1 Mechanical Properties of Other Rocks

Mechanical properties of rocks from locations other than the site will be presented, as appropriate.

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*Site-specific information means information gained from tests done in, or samples taken from, limited borings, surface outcrops, near-surface test facilities, pre-existing tunnels or mines, etc., near the site proposed for characterization. It does not imply that a shaft has been sunk.

2.1.2 Mechanical Properties of Rocks at the Site

This section will present the mechanical properties as determined by laboratory tests on samples of the potential host rock and of other rock units an MGDS important for the design of ~~a repository~~ appropriate to the site. Data on elastic and inelastic behavior, compressive and tensile strength, and the effects of heating and fluid pressure are presented. Geologic borehole logs, geologic cross sections, or photographs accumulated during preliminary site exploration activities will be provided, as appropriate, to show where the tests were conducted or samples taken. Anisotropic properties will be addressed or isotropic approximations justified.

2.2 MECHANICAL PROPERTIES OF ROCK UNITS - DISCONTINUITIES

The scope of the section, background, equipment and procedures, limitations and uncertainties in data, and definitions (where needed) will be stated.

2.2.1 Mechanical Properties of Discontinuities in Other Rocks

Mechanical properties of discontinuities in rocks from locations other than the site will be presented, as appropriate.

2.2.2 Mechanical Properties of Discontinuities in Rocks at the Site

The mechanical properties and physical characteristics of discontinuities (fractures, joints, bedding planes, inclusions, voids) present in the rock units will be described. Site-specific data as well as available generic data from similar rock units and environments will be provided. The discussion will include the coefficient of friction, the compressibility of fractures and filling materials, and the effect of heating and changes of pore pressure on the mechanical properties of the joints, fractures, bedding planes, and other discontinuities.

2.3 MECHANICAL PROPERTIES OF ROCK UNITS - LARGE SCALE

The scope of the section, background, equipment and procedures, limitations and uncertainties in data, and definitions (where needed).

2.3.1 Mechanical Properties of Other Rocks

Strength, deformability, and creep data (where appropriate) for rocks from locations other than the site will be presented, as appropriate.

2.3.2 Mechanical Properties of the Rocks at the Site

The results of any large-scale laboratory and field tests, such as plate-bearing test, block test, chamber test, flat jack test, Goodman jack test, or convergence test will be presented. Large-scale here means tests of sufficient size to take into account the discontinuities, such as fractures, joints, and inhomogeneities of the media. Non-standard tests will be discussed in detail including procedures, equipment, instrumentation, data reduction, and uncertainties.

2.6 EXISTING STRESS REGIME

The scope of the section, background, equipment and procedures, limitations and uncertainties in data, and definitions (where needed) will be presented.

2.6.1 Stress Regime in Region of the Site

Information will be presented from direct measurement and other observations concerning the regional stress field.

2.6.2 Stress Regime at the Site

The stress field data specific to the site and the assumptions used to infer stress from field observations will be provided. The expected direction and magnitude of the principal stresses as a function of depth will be discussed. The data presented here will be referenced in Section 1.3 and will provide the basis for discussions relating stress field to tectonics contained therein.

2.7 SPECIAL GEOENGINEERING PROPERTIES

This section will describe any special thermal, mechanical, thermomechanical coupled properties, or other properties of the rock units that were considered in developing the design of ~~a repository~~ appropriate to an MGDS the site (e.g., brine migration, thermal decrepitation, thermal dewatering). Available site-specific data as well as generic data from similar rock units will be provided.

2.8 EXCAVATION CHARACTERISTICS OF ROCK MASS

The scope of the section and background information will be provided.

2.8.1 Excavation Characteristics of Similar Rocks

Excavations under rock conditions similar to the rock conditions at the site will be discussed, including various techniques such as controlled blasting and mechanical excavation. The discussion will address the monitoring and analysis of the excavations.

2.8.2 Excavation Characteristics of Rock at the Site

Excavations in rock at or near the site will be discussed, including excavation methods and procedures, monitoring techniques, and analysis.

2.8.3 Changes in Geoengineering Properties Due to Excavation

The potential changes in geoengineering properties that might be produced by the various excavation techniques will be evaluated. Appropriate methods for avoiding or mitigating such damages will be discussed. The impact of these considerations on ~~repository~~ MGDS design will be summarized.

4.2 GEOCHEMICAL EFFECTS OF WASTE EMPLACEMENT

This section will discuss the geochemical effects of waste emplacement on the host rock. Discussions of the interactions within the engineered barriers system will be presented in Chapter 6 ~~(backfill and seals)~~ (repository engineered barriers and shaft and borehole seals) and Chapter 7 (waste package).

4.2.1 Anticipated Thermal Conditions Resulting from Waste Emplacement

This section discusses the expected thermal conditions resulting from waste emplacement and how these conditions will vary with time.

4.2.2 Hydrothermal Alteration Due to the Thermal Pulse

This section will discuss the waste-induced hydrothermal alteration of minerals in the host rock and surrounding units.

4.2.3 Changes in Water Chemistry Due to the Thermal Pulse

This section will discuss the thermal influence of the repository on the chemical composition of waters in the host rock and surrounding units along possible flow paths.

4.2.4 Effects of the Thermal Pulse on Radionuclide Migration

This section will discuss the effects of the thermal pulse on the mineralogy and water composition in the host rock. This discussion will focus on how these changes affect radionuclide migration.

4.3 NATURAL ANALOGS AND RELATED FIELD TESTS

This section will describe studies being performed to obtain data relative to radionuclide transport, hydrothermal alteration, and engineered barrier performance. Studies may include both natural analogs and relevant field tests. The significance of these studies to performance assessment model evaluation will be discussed.

4.3.1 Natural Analogs

This section will identify and describe naturally occurring processes analogous to those expected in the natural and engineered barrier systems.

4.3.2 Related Field Tests

This section will describe field tests to provide information relevant to radionuclide migration in the host rock and surrounding units.

4.4 GEOCHEMICAL STABILITY

This section will identify the human and natural factors that could potentially affect the geochemical stability of the host rock and surrounding units. For both situations, the importance of potential effects will be evaluated.

Chapter 6 - CONCEPTUAL DESIGN OF A ~~REPOSITORY~~ MINED GEOLOGIC DISPOSAL SYSTEM

6.0 INTRODUCTION

The objective of this section will be to state the purpose of Chapter 6 and to provide an overview of the current ~~repository~~ mined geologic disposal system (MGDS) concepts as they relate to the Site Characterization Program. Chapter 6 will provide the requirements and reference the media-specific design data base, describe the current design concepts, and discuss design information needs. The discussion of design information needs will address the topics listed in Chapter 6 of Reg. Guide 4.17.

The introduction will specify that design information will provide:

- The basis for the design
- Information detailed enough to permit an evaluation of whether the kinds and amounts of tests and analyses to be performed during site characterization will be adequate
- Sufficient ~~repository~~ MGDS design information that an assessment can be made on whether the suitability of the site will be compromised by the facilities that will be constructed for site characterization.

The introduction will reference other chapters of the SCP which provide:

- Discussions of site characterization activities that utilize the information contained in the chapter
- Discussion of performance assessment models that are based upon or supported by the information contained in the chapter
- Discussion about the accuracy and uncertainties of present performance assessment design data.

6.1 DESIGN BASIS

6.1.1 ~~Repository~~ MGDS Design Requirements

This section will present the technical requirements and assumptions established as a basis and rationale for ~~repository~~ MGDS design. Site constraints that affect the design or the approach to the design will be discussed. Project Functional Design Criteria will be summarized and will include site functional requirements and criteria from laws or regulations, natural phenomena, safety or waste isolation considerations, and other design criteria imposed by repository operations. The design basis imposed by safety considerations will require the preliminary identification and classification of buildings, structures, excavations, systems, and components important to safety or waste isolation.

6.1.2 Reference Design Data Base

A summary of the geological and geotechnical data used for ~~repository~~ (MGDS) design will be presented in this section. The objectives will be to develop a data base of site characteristics and data important to the design of the MGDS (NSE) ~~facility.~~ (DELETE) The source of the data will be discussed (i.e., whether the data is derived from in-situ tests, references, etc.). Appropriate sections of Chapters 1-5 will be referenced as needed. A description of the site characteristics needed to perform the design analysis will be provided.

Specific consideration will be given to rock strength, rock discontinuities, in-situ stress, thermal properties, the hydrologic regime, stratigraphy, and seismic motion. Uncertainties in these site characteristics will be quantified to the extent possible. A reasonable expected range for each characteristic will be established, either through quantitative analysis or using engineering judgment, as appropriate. Discussions of the methods used to establish these ranges will be included.

6.1.3 Analytical Tools for Geotechnical Design

This section will present the analytical tools used in establishing and analyzing the geotechnical design.

The description of the computer codes being used will include author, ownership, and code name; a description of analysis that the code performs; and design areas for which the code is used. References will be made to Chapter 8, discussions of performance assessment, as required.

6.1.4 Structures, Systems, and Components Important to Safety

This section will identify which structures, systems, and components of the ~~repository~~ MGDS that have been preliminarily determined to be important to safety and will provide the basis for such determinations. Plans for performing failure modes and effects analyses that lead to more complete identification of structures, systems, and components important to safety will be referenced.

6.1.5 Engineered Barriers Important to Waste Isolation

This section will provide a description of the ~~repository~~ engineered barriers, such as ~~tunnel backfill~~ and ~~repository~~ shaft and borehole seals, necessary to meet the waste containment and isolation requirements of 10 CFR 60. Numerical values for the performance requirements of the engineered barrier system components and the rationale for their selection will be provided to the extent available.

~~repository~~ engineered barriers

6.2 CURRENT ~~REPOSITORY~~ REPOSITORY AND ENGINEERED BARRIERS DESIGN DESCRIPTION

This section will describe the current ~~repository~~ repository and engineered barriers design concepts. Design information will reflect current design concepts being considered for the site. The design description will reference design documents or portions of the documents that are consistent with the reference concepts. Design concepts known to be outdated will not be presented for the sake of including greater detail in the SCP.

The description of design concepts will focus on design features that are influenced by site characteristics. Details of the design will be included in the SCP, where they are important to planning site-characterization. It will be noted that design development and the site testing program are interactive, and that design detail will progress during the site characterization program.

Major alternative design concepts currently being considered in the design process will be described, along with a discussion of how the alternatives allow for parametric uncertainty and subsystem component tradeoffs.

Where uncertainties in site or other SCP-related design parameters are currently identified, plans for bounding design parameters and for performing preliminary sensitivity analyses will be discussed or referenced as appropriate. These plans will indicate how parametric changes on system or component performance will be assessed.

6.2.1 Background

This section will summarize the background and history of ~~repository~~ MGDS design for the site and will explain how the design has evolved to its current status.

6.2.2 Overall Facility Design

The information provided on ~~repository~~ MGDS design in this section will include a description of the design concept along with the general arrangement drawings of the repository as a whole. The description and drawings will show how the ~~surface, subsurface,~~ and shafts and/or ramps are integrated with the site. The general arrangements shall include the location of site characterization boreholes and the Exploratory Shaft Facility (ESF).

6.2.3 Repository Operations

This section will describe the current ~~surface and subsurface~~ mining waste transport, emplacement, and retrieval concepts. The current emplacement and retrieval descriptions will account for "normal" and "anticipated" failure conditions. The results will be provided or the plans will be referenced for performing accident analyses. In addition to the operational accident analysis, other problems will be included which could prevent the emplacement holes or waste ~~canister~~ package from functioning as anticipated (e.g., emplacement hole failure, ~~canister~~ container failure, stuck ~~canister~~ container).

6.2.4 Design of Surface Facilities

This section will describe and provide drawings of the most recent concepts for surface facility layout. These drawings will illustrate the major surface facility arrangements, including shafts/ramps, buildings, structures, major utility corridors, material, and extensive storage area(s). This section will also provide current drawing(s) of the existing surface features and terrain, and a general layout of structures and facilities within the site area(s) such as buildings, wells, roads, drainages, utilities, etc. Sources of water for construction and operation will also be identified.

6.2.4.1 Foundation Considerations

This section will discuss the properties of surface materials and foundation soil or rock considered in the design of structural foundations for the above surface facilities. Expected or known soil and rock conditions, and the depth to and quality of foundation soil or rock will be described. Any known or inferred foundation problems will be discussed.

6.2.4.2 Flood Protection

This section will describe the consequences of all types of flooding that could occur at the candidate area and site, and the methods by which the surface and underground facilities will be protected from surface flooding.

6.2.5 Shaft and Ramp Design

This section will describe the functions of the shafts/ramps and will provide or reference drawings which show the location and general arrangement of shafts and ramps. Alternative design, construction, and lining concepts under consideration will be described in this section.

6.2.6 Subsurface Design

This section will describe the general layout and design of underground openings. Drawings will be provided or referenced to show the relationship of shafts, ramps, drifts, ES facilities, and known or inferred geologic discontinuities. Sketches or drawings will be provided with a narrative description of all underground excavations, including their functions and general arrangement.

6.2.6.1 Excavation, ~~Development, and Ground Support~~ and Rock Handling

Excavation, shaft sinking, and muck removal methods currently being considered will be described. The ground support design and shaft lining design with installation methods will also be described.

6.2.6.2 Ground-water Control

Proposed methods for controlling ground-water inflow that may be encountered during construction and operation will be described. Methods for dealing with high pressure water sources, if encountered, will be discussed. In addition, the pumping system concept which will handle water inflow from the subsurface to the surface will be described.

6.2.6.3 Ventilation

Air flow logic diagrams, with estimated air quantities and velocities for the development and emplacement ventilation systems, will be described.

6.2.7 ~~Backfill of Underground Opening~~ Repository Engineered Barriers

Describe the need for ~~backfill and decommissioning seals~~ repository engineered barriers in the ~~repository~~ waste disposal postclosure design. If backfill or seals are required, preliminary materials,

specifications, the functions, handling, and emplacement concepts will be provided.

6.2.8 Shaft and Borehole Seals

6.2.8.1 Shaft Seal Characteristics

A conceptual description of shaft seals will identify components (e.g., backfill, seals, cutoffs, rock treatment) for shaft seals for each of the repository shafts that will be sealed and will indicate their tentative locations.

For each component of the shaft seals, this section will describe key features, types of seal materials, seal materials properties (mechanical, chemical, hydrologic), backfill material properties, and properties of the rock and ground water surrounding the shafts that are relevant to shaft seal design, if such information is available.

Shaft seal design will be addressed in reference to shaft sinking method, shaft lining, and any treatment of the rock for stability and ground-water control necessary for repository construction and operation. The uncertainties (quantitatively, where possible) in the site characteristics affecting design (in particular, those of the rock immediately surrounding the shafts) and in the material properties for sealing materials will be identified.

6.2.8.2 Shaft Seal Emplacement

The construction method and the general construction sequence will be described for each component of the shaft seals proposed.

6.2.8.3 Borehole Seal Characteristics

The approximate number and location of the boreholes that require sealing will be listed. Any boreholes drilled by others prior to site characterization will be identified.

Borehole seal design will be addressed with consideration of borehole casings and other materials placed in the borehole, and any damage of the rock surrounding the borehole during drilling and subsequent use of the borehole (e.g., hydrofracturing). The expected range of parameters and associated uncertainties (quantitatively, where possible) in the site characteristics affecting borehole seal design and in the material properties for sealing materials will be identified.

For each of the various types of borehole seals that are important to MGDS ~~repository~~ performance, this section will describe key features, types of seal materials, seal material properties, and properties of the rock and ground water surrounding the boreholes that are relevant to borehole seal design. If such information is not yet available, plans will be referenced for its development.

6.2.8.4 Borehole Seal Emplacement

This section will describe the methods for borehole seal placement, including the sequence of sealing each borehole type and the timing of sealing relative to repository construction, operation, and closure.

6.3 ASSESSMENT OF DESIGN INFORMATION NEEDS

6.3.1 Introduction

This section will explain the relationship between the repository design described in Section 6.2 of this outline and the elements listed in Chapter 6 of Regulatory Guide 4.17 (Proposed Revision 1, September 1984). The design regulations will identify the design information required for licensing and, consequently, the data requirements on the site characterization program. The data requirements will be evaluated including the sensitivity of data accuracy and the effect of uncertainty on the design. These data requirements supported by the evaluation of the sensitivity and uncertainty will partially determine the in-situ testing plans.

6.3.2 Design of Underground Openings

This section will reference the general layout and design of proposed subsurface openings, and will show their relationship to proposed plans for in-situ testing at depth and to known or inferred geologic and hydrologic conditions of the site. Proposed locations of shafts will be related to the proposed plan for in-situ testing at depth and to known or inferred subsurface conditions. Shaft stability based on inferred subsurface rock stresses and ground-water conditions and their relationship to the proposed test shaft(s) will be discussed. Test considerations for ground-water conditions, thermal output, the natural and thermally induced stress regime, rock creep where applicable, and the need for ventilation will be included in the discussion. Factors such as space requirements for emplacement of the waste, layout requirements for separation and control of excavation, and waste emplacement operations, ventilation requirements, and worker safety considerations will be related to the test requirements.

6.3.3 Backfill*

Section 6.2.7 will be referenced for the proposed characteristics and functions of the backfill material handling and emplacement. The mechanical properties of the proposed backfill that are critical for the site and design will be provided. This section will discuss the relationship between the mechanical properties of the proposed backfill and the expected conditions at the site (e.g., temperature, moisture, stress, radiation). The geochemical characteristics of the backfill materials will be described, as well as anticipated chemical interactions among the waste package, backfill, ground-water, and host rock under assumed waste emplacement conditions. The measured or inferred material and site parameters used to estimate those reactions will be identified. Any effect of the backfill on retrieval procedures will be described as well as any effects of radiation on the backfill or its interactions. (The geochemical discussion here will be in sufficient detail to describe the geochemical role of the backfill at the site. The full descriptions of the geochemical investigations on the waste

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* The term "backfill in not defined in OGR/B-2 or in 10 CFR 60. The term "backfill" here is intended to mean the same as "backfill materials" where it appears as part of the definition of Repository Engineered Barriers in OGR/B-2 page 2.2.2-1."

container, packing
form, ~~package,~~ rock, and ground-water interactions will be provided in Chapter 4 - GEOCHEMISTRY, in Chapter 7 - WASTE PACKAGE, or in Chapter 8 - SITE CHARACTERIZATION PROGRAM.)

6.3.4 Strength of Rock Mass

This section describes the testing requirements necessary to supplement or confirm preliminary design values used for the mechanical properties of the rock, including elastic and inelastic behavior of the rock mass, the thermomechanical behavior of the rock mass, and the mechanical behavior of rock discontinuities (e.g., joints, shear zones). A description of how these requirements were determined is included, as well as a description of effects of radiation on these properties. (The rock mechanics information will be presented here in sufficient detail to describe the relationship of the rock properties to the design. The full description of the rock mechanics background will be presented in Chapter 2 - GEOENGINEERING). This section will also describe how these values for the mechanical and thermomechanical behavior of the rock were used in developing the design of a repository. MGDS Plans for confirming the results of model studies used in developing the design of a repository appropriate to the site will be presented in Chapter 8.

6.3.5 Sealing of Shafts, Boreholes, and Underground Openings

This section will reference the design of proposed treatment of the disturbed section of rock around openings and excavated surfaces, the proposed design measures to control ground-water movement into the facility, and the available laboratory and field data. The geochemical characteristics of the seal material will be described, as well as the anticipated chemical interactions among the seal materials, ground water, host rock and backfill materia under assumed emplacement conditions. It will also describe methods for confirming inferred site conditions on which the selection of the treatment measures was based. The proposed design for the sealing of boreholes and shafts will be referenced, as well as available laboratory and field data and methods for confirming inferred site conditions on which the design was based.

6.3.6 Construction

This section will describe construction techniques being considered for potential repository development at the site as well as any known or inferred site conditions requiring specialized construction techniques. It will also describe how the construction of exploratory workings at the site will not compromise the integrity of the site.

The methods under consideration for breaking and removing rock during construction will be described. The potential for the construction to cause additional fracturing will be assessed, and any special action taken to minimize propogation of additional fractures that could be potential pathways considering the inferred rock conditions will be noted. This section will also describe how the planned excavation techniques match the expected site characteristics and rock mass properties. (The full description of excavation investigations will be given in Chapter 2 - GEOENGINEERING). Temporary or permanent rock reinforcement and rock support structures proposed will be described, and the compatibility with rock mass properties will be discussed. In addition, this section will discuss or reference methods planned to control, collect, and dispose of ground-water during excavation and their compatibility with the data obtained from exploratory investigations.

6.3.7 Design of Surface Facilities

This section will describe tests to confirm properties of surface materials and foundation soil or rock considered in the design of structural foundations for surface facilities, including known or inferred foundation problems. It will also discuss or reference the sources of water for construction and operation of the proposed facilities.

6.3.8 ~~Repository System~~ MGDS Component Performance Requirements

Preliminary numerical values for the performance goals and design criteria for the ~~repository systems~~ MGDS will be provided to assure that the ~~repository~~ MGDS as a whole meets the overall regulatory requirements. As the design evolves, these goals will be subdivided to the component level and will evolve into system and component requirements.

Early assignment of numerical goals for systems and components cannot be accomplished witha high degree of accuracy.

The general nature of the design and performance assessment will establish what ~~site~~ natural barrier data need to be obtained. The specific analytic tools used in the design process and performance assessment will establish the accuracy requirements on the data collection and analysis systems. Tentative values for acceptable ranges of ~~site~~ natural barrier properties can be established using an assumed design. If the measured ~~site~~ data falls within the initially assumed values only modest design changes are required. If the measured ~~site~~ values fall outside the initially assumed values more extensive design changes may be required to continue to meet the overall repository performance requirements.

6.4 SUMMARY OF DESIGN ISSUES AND DATA NEEDS

This section will provide a summary of design issues and related data needs, and will be cross-referenced to appropriate sections of Chapter 6.3 and Chapter 8.

REFERENCES

A list of all pertinent references will be provided.

evolve into system and component requirements. A quantitative description of design constraints used in developing the design (e.g., maximum heat loads, maximum temperatures, maximum radiation levels) and references to appropriate documentation which supports the constraints will be included.

7.3 DESIGN DESCRIPTIONS

This section will introduce the subject of waste package designs. Reference designs and alternative designs will be included.

7.3.1 Reference Design

Current reference waste package designs considered appropriate for the emplacement environment will be described, including candidate waste forms and barrier materials. To the extent information is available, this section will include the following:

- A description of the reference designs in narrative form and illustrative sketches of the waste package design for each waste type
- A narrative description of waste package component materials, waste package material properties and chemical compositions, and the range of expected variations
- A description of the ways in which the spectrum of spent fuel waste types will be accommodated within the waste package concept (e.g., what provisions will be made to accommodate intact fuel assemblies and consolidated rods; how rods consolidated at reactors will be accommodated; how short-cooled or high-burnup spent fuel will be accommodated)
- A quantitative description of important waste package parameters such as overall dimensions, wall thickness, heat loads (expected values and range), number of assemblies (of various types), and radiation levels (expected values and range)
- A description of waste package component fabrication and assembly processes and their potential impact on performance.

7.3.2 Alternative Designs

This section will describe the waste package designs that will continue to be considered as alternatives to the reference design. Alternative design concepts will be presented in a level of detail adequate to allow identification of site data needed to support development of those designs. A description of the factors arising from the characterization program which could lead to selection of an alternative over the reference design concept will be provided. Alternatives that have been considered and dropped from further consideration will be included by way of reference to appropriate design concept selection reports.

7.4 RESEARCH AND DEVELOPMENT STATUS - WASTE PACKAGE DESIGN AND GEOCHEMICAL INTERACTIONS

This section will summarize the available results of tests and analyses related to waste package performance. The status or results of the following waste package test activities will be described as applicable:

- Tests aimed at characterizing the waste package environment
- Tests of appropriate waste package components such as waste forms, containers, metal barriers, and packing materials (DELETE)
- Component interaction tests, including waste barrier and waste barrier rock interaction tests (package)
- Tests to evaluate processes which might be active in the waste package environment and might affect a component's ability to perform its assigned functions
- Tests to determine releases of matrix and/or radionuclide species from the waste form under anticipated waste package environmental conditions (e.g., temperature, oxidation state).

The role of predictive models in the design of the waste package will be addressed briefly. The availability and interrelationship of individual component models will be discussed. Quantitative estimates of the performance of each component with respect to its assigned function and preliminary estimates of the performance of the waste package as a whole will be included. Analytical results related to demonstration of reasonable assurance of compliance with regulatory requirements will be presented. Results of available sensitivity studies of performance related to expected variation in parameters will also be provided. As available, analysis of failure modes and effects will be provided or referenced.

7.5 SUMMARY

This section will link the data and analyses presented in Part A - Chapter 7 to Part B of the Site Characterization Plan. It will include the following material:

- Synopsis of the significant results with respect to performance of the waste package reference design
- Discussion of the major design issues and related information needs. Refer to appropriate Chapter 8 subsections for plans to obtain the necessary information.

REFERENCES

A list of all pertinent references will be provided.

Chapter 8 - SITE CHARACTERIZATION PROGRAM

8.0 INTRODUCTION

This section will provide a brief introduction to Part B, Site Characterization Program, of the Site Characterization Plan (Chapter 8). The section will discuss the purpose, significance, content, and organization of Chapter 8. In addition, it will discuss the relationship of Chapter 8 to Part A, Description of ~~Site, Waste Package, and Repository Design~~ (Chapters 1 through 7). Finally, it will discuss the relationship of Chapter 8 to separate program documents which will present plans for conducting site investigations, including environmental studies and socioeconomic studies.

lined
Geologic
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System

Purpose of Chapter 8

This chapter will present the rationale behind the proposed site characterization program and will describe in detail the program of exploration and testing to be conducted during site characterization. The description of the site characterization program at the named sites will include:

- Issues to be resolved and information to be acquired during site characterization
- Tests and experiments to be performed
- Schedule, sequence, and duration of testing and data analyses
- Extent of planned excavation and in-situ at-depth testing
- Elements of the design of a ~~repository~~ MGDS appropriate to the site relevant to data acquisition, analyses, and scheduling
- Key milestones against which the progress of site characterization can be measured
- Provisions to control or mitigate any adverse safety-related impacts from site characterization activities that are important to safety or that are important to waste isolation
- The quality assurance methods to be used in data acquisition and analysis
- Decision points at which the direction of the site characterization program might be changed if warranted by the results obtained.

In addition, this section will stress the significance of Chapter 8 in providing the link and focus between data that has already been obtained for a site and has been presented in Chapters 1 through 7, and data that will be acquired during site characterization.

Relationship of Chapter 8 to Chapters 1 through 7

This section will discuss the relationship between Part B, Chapter 8, Site Characterization Program and Part A, Chapters 1 through 7, Description of ~~Site, Waste Package, and Repository~~ Mined Geologic Disposal System Design.

Part A, Chapters 1 through 7 will present a synthesis of all relevant information concerning site characterization and repository and waste package design that will be available at the time the SCP is written. In addition these chapters will briefly describe how the information in the chapter and the information to be obtained will be used.

The depth of information provided will consider the need for flexibility to account for the exploratory, developing nature of the investigations. The initial investigation steps may need to be completed before a full program can be developed. The relative importance of various aspects of the program will change as investigations proceed. A phased approach to testing is necessary. Flexibility is required not only to make fine adjustments in the investigations on a particular subsystem or technical program area, but also to make major shifts in the overall program based on the results of ongoing system performance assessments. The relative priorities among the investigations of the subsystems will change as data are gathered, analyzed, and evaluated. Thus, plans may be better defined and more detailed for early phases of site characterization, and less detailed for later phases.

Part B, Chapter 8 will provide the rationale behind the proposed site characterization program and will describe in detail the program of exploration and testing to be conducted during site characterization. The level of detail will be sufficient to determine whether adequate information for licensing will be produced.

Organization of Chapter 8

This section will present the overall organization of Chapter 8 and a summary of the contents of the chapter.

Wherever appropriate, the discussion will refer to and summarize separate supporting documents which present detailed test plans. These plans will include such plans as Exploratory Shaft Test Plans and Performance Assessment Plans.

Relationship of Chapter 8 to Other Plans

This section will describe the relationship of Chapter 8 to plans to obtain other information required by 10 CFR 960. The scope of the discussions of the plans in Chapter 8 will be limited to activities undertaken to establish the geologic conditions of a candidate site relevant to the location of a ~~repository~~ MGDS, and activities that are important to containment and isolation of the waste and the safe construction, operation, and closure of the repository.

Other site investigation activities which will establish the preclosure radiological safety, environmental, transportation, and socioeconomic characteristics of the site will be conducted concurrently with the site

8.2 ISSUES TO BE RESOLVED AND INFORMATION REQUIRED DURING SITE CHARACTERIZATION

This section will discuss the origin of issues, the relationship of issues to the program, and the manner by which the program deals with issue resolution.

8.2.1 Issues to be Resolved

This section will present issues related to siting and design of a ~~geologic repository operations area and waste package~~ MGDS that are to be resolved using information obtained during site characterization. Issues will be defined in the SCP as questions that must be answered or resolved to complete licensing assessments of a site and design suitability in terms of 10 CFR 60 and 10 CFR 960. Issues can be expressed in many different ways, in different categories. The Department of Energy has developed a formal issues hierarchy, which is a comprehensive set of issues that will be used to correlate and address other issues that may be raised.

8.2.1.1 Mission Plan Issues

The Mission Plan issues will be presented in this section. These are the higher-level issues that must be addressed to complete licensing assessments of site and design suitability. The Mission Plan issues encompass the requirements of the siting guidelines (10 CFR 960). Issues addressed in the SCP are limited to those encompassed by the definition of Site Characterization in the Nuclear Waste Policy Act.

8.2.1.2 Site-Specific Issues

This section will present site-specific MGDS issues that are related to siting and design of a ~~geologic repository operations area and waste package~~ MGDS that are to be resolved during site characterization. These issues will be generally encompassed by the Mission Plan issues, but may be formulated from a different perspective and organized differently. A correlation between each of these "site-specific" issue sets and the Mission Plan issues will be presented. As needed, a correlation of information needs among issues will be provided. The issues identified by the NRC in the Issue-Oriented Site Technical Position for the site will be addressed in this section.

Table 1 presents an example matrix correlation of Mission Plan issues and 10 CFR 960. Correlation of issues with 10 CFR 60, and other appropriate correlations such as those indicated in the notes to Table 1, will be provided. Additional correlation to information needs may be included. Correlation tables such as this will be referenced by Subsections 8.2.1.1 and 8.2.1.2.

8.2.2 Approach to Issue Resolution

This section will illustrate the manner by which information needs are used to answer the questions posed by the issues. The use of performance assessment, as applicable, in the resolution of issues will be described. Reference will be made to Section 8.3.4, as appropriate. This section will also present specific plans for issue resolution. A description of an issue-tracking system will be presented.

TABLE 1. EXAMPLE TABLE FOR SECTION 8.2

MISSION PLAN ISSUES	10 CFR 960	SITE SPECIFIC ISSUES/INFORMATION NEEDS
Key Issue I - Postclosure Isolation	960.4(a) Postclosure System Guidelines	
1.1 Geohydrology (In 1.1.1, etc.)	960.4-2-1	Geohydrology Fav/Pot Adv cond
1.2 Geochemistry	960.4-2-2	Geochemistry
1.3 Waste Package	--	
1.4 Erosion	960.4-2-5	Erosion
1.5 Paleoclimatology	960.4-2-4	Climate
1.6 Rock Dissolution	960.4-2-6	Dissolution
1.7 Tectonics	960.4-2-7	Tectonics
1.8 Human Interference	960.4-2-8.1	Human Interference
1.9 Compatibility of Construction w/Contain and Isolate	960.4-2-3	Rock Characteristics
2.2 Meteorology	960.5-2-3	Meteorology
4.1 Waste Package and Costs	--	
4.2 Surface Characteristics	960.5-2-8	Surface Characteristics
4.3 Flexibility of Repos Horizon	960.5-1-9	Rock Characteristics
4.4 Hydrology and Ease of Const.	960.5-2-10	Hydrology
4.5 Tectonics and Construction	960.5.1.11	Tectonics
4.6 Cost Effectiveness Safety and Repos. Construction	960.5.1.3(c)	Pre Cl. System. Guideline

nplacement

Notes

Table could be expanded to include:

- Tests
- References to data needs
- Design interfaces
- ISTPs
- State Issues
- System Requirement Tree
- DSCA Issues

This section will also describe testing for purposes other than site characterization, to the extent that such testing influences the selection and conduct of tests for site characterization. The performance confirmation program test required in 10 CFR 60 Subpart F will be addressed in Chapter 8 in this regard, with particular attention to the test that will be initiated during site characterization.

8.3.1 Site Program

This section will describe the planned site characterization studies, tests, and analyses required to characterize the geologic, hydrologic, geochemical, and climatological systems and resource potential of a candidate area and site to meet Federal standards, guidelines, and requirements for licensing a ~~geologic nuclear repository~~ mined geologic disposal system.

Discussions in Subsections 8.3.1.2 through 8.3.1.6 of the planned studies and tests will explain:

- Why the test, study, or analysis is planned and what data or information will be obtained
- How the results will be used to help resolve specific information needs
- What methods, techniques, and data analysis will be used.
- Limitations and uncertainties of test methods and data analysis
- Representativeness, precision, and accuracy of proposed test methods and data analysis,
- Significant options or alternative test methods and data analyses to those proposed.

In addition, discussion of in-situ tests will include:

- A description of tests that could use radioactive materials
- A description of tests that might affect the capability of the site to isolate waste
- A summary of instrumentation and monitoring.
- A summary of how significant environmental impacts, if any, resulting from site characerization activities are minimized or mitigated.

8.3.1.1 Overview

This section will state the purpose of Section 8.3.1 and provide an overview of the site program. The overview will summarize the overall objectives and approach of the site program. The interrelationships and sequencing of the primary activities of the program will be described.

8.3.1.2 Geology

This section will present the studies and tests to characterize the geomorphologic, stratigraphic, mineralogic and petrologic, and tectonic systems of the candidate area. Past drilling and mining will be addressed.

8.3.1.3 Hydrology

This section will present the studies and tests to characterize the surface and subsurface hydrologic systems of the candidate area.

8.3.1.4 Geochemistry

This section will present the studies and tests to characterize the far-field and near-field geochemical systems of the candidate area.

8.3.1.5 Climatology

This section will present the studies and tests to characterize the meteorology and paleoclimatology of the candidate area.

8.3.1.6 Resource Potential

This section will assess the economic mineral and fossil fuel potential and the ground-water resources of the candidate area.

8.3.2 Repository* Program

This section will summarize the repository* test program and provide an overview of the research and development and engineering activities required to ensure that the ~~repository~~* is capable of satisfying applicable performance objectives. Current design bases and concepts are presented in Chapter 6 - CONCEPTUAL DESIGN OF A ~~REPOSITORY~~.

MGDS

* Mined Geologic Disposal System *

Discussions in Subsections 8.3.2.2 through 8.3.2.5 of the planned studies and tests will explain:

- Why the test, study, or analysis is planned and what data or information will be obtained
- How the results will be used to help resolve specific information needs
- What methods, techniques, and data analysis will be used,
- Limitations and uncertainties of test methods and data analysis
- Representativeness, precision, and accuracy of proposed test methods and data analysis,
- Significant options or alternative test methods and data analyses to those proposed.

* The term "repository" refers to the MBS (OGR/B-4) meaning whereas the term "MGDS" refers to the GRMGDS (OGR/B-2) meaning.

In addition, discussion of in-situ tests will include:

- A description of tests that might use radioactive materials
- A description of tests that might affect the capability of the site to isolate waste
- A summary of instrumentation and monitoring.

8.3.2.1 Overview

This section will state the purpose of Section 8.3.2 and provide an overview of the repository program. The overview will summarize the overall objectives and approach of the repository program. The interrelationships and sequencing of the primary activities of the program will be described.

8.3.2.2 Verification or Measurement of Host Rock Environment

This section will identify and describe the site characterization program tests and analyses which will define the geologic/geotechnical environment of the host rock for three conditions:

- Pre waste emplacement
- Post subsurface excavation (i.e., reflecting rock stress as a result of rock excavation)
- Post waste emplacement.

The objective of these tests will be the measurement of those geologic/geotechnical properties necessary to model the ~~repository~~ GDS design.

8.3.2.3 Coupled Interaction Tests

Thermal-hydrological-mechanical-geochemical interaction tests will be described in this section.

The test plans will either provide for direct testing of the coupled behavior or demonstrate that tests of the coupled behavior is unnecessary. The need for coupled tests will be based on site-specific conditions. The following guidance will be useful in deciding when direct testing of coupled behavior may not be required:

1. The component of the natural system (far-field geology) for which performance credit is taken is characterized adequately for evaluation of overall repository performance.
2. In evaluating waste disposal postclosure ~~overall repository~~ performance, no credit is taken for the near-field host rock that cannot be characterized adequately.
3. Components of the engineered barriers system such as the waste package are designed with adequate conservatism with respect to the coupled thermal conditions that will be encountered. Examples of conservatism in design include limiting the host rock thermal loading and thickening waste package container walls.

4. The tests that support the design of the engineered barriers system are carried out under a much wider range of conditions than the anticipated ~~repository~~ MGDS conditions. This means that the design of the tests takes into account conditions above and beyond the full range of coupled thermal behavior that is expected to be encountered.

The test plans will specify the scale and the duration of the planned tests and will describe how this scale and duration will be adequate to assess compliance with 10 CFR Part 60.

8.3.2.4 Design Optimization Activities and Tests

The design optimization studies and activities which require site characterization data will be described. Typical topics which may be discussed include the refinement of design data needed to resolve design alternatives, decisions, construction feasibility issues, and design performance verification for such activities as rock excavation and mining techniques, waste package emplacement, and retrieval issues.

8.3.2.5 ~~Repository~~ MGDS Modeling

This section will identify and describe planned ~~repository~~ MGDS design model and code development, utilization, verification, and validation activities which require site characterization data. Potential subjects include MGDS ~~repository~~ component and subsystem models, and their use to conduct performance, safety, and design optimization analyses. Reference will be made to Subsection 8.3.5.1, as appropriate.

8.3.3 Seal* System Program

This section will summarize the seal system test program and provide an overview of the research and development activities required to ensure that the repository seals and backfill ~~system~~ is capable of satisfying applicable design and performance objectives. The current design bases and concepts are presented in Chapter 6 - CONCEPTUAL DESIGN OF A ~~REPOSITORY~~ Mined Geologic Disposal System.

Discussions in Subsections 8.3.3.2 through 8.3.3.5 of the planned studies and tests will explain:

- Why the test, study or analysis is planned and what data and information will be obtained
- How the results will be used to help resolve specific information needs
- What methods, techniques, and data analysis will be used.
- Limitations and uncertainties of test methods and data analysis
- Representativeness, precision, and accuracy of proposed test methods and data analysis,
- Significant options or alternative test methods and data analyses to those proposed.

* The term "seal system" here refers to seals which are part of both Repository Engineered Barriers and Shaft and Borehole Seals sub parts of MGDS Waste Disposal Postclosure sub-system in OGR/B-2.

This section will discuss plans with regard to in-situ testing of . . . The discussion of in-situ tests will include:

- A description of tests that might use radioactive materials
- A description of tests that might affect the capability of the ~~site~~ natural barriers to isolate waste
- A summary of instrumentation and monitoring.

If no such tests are planned, Chapter 8 will explain why these tests are unnecessary in order to provide sufficient data for licensing. If the final decision on such tests will depend on results of preceding tests, the SCP will describe the logical steps which lead to the decision.

8.3.3.1 Overview

This section will state the purpose of Section 8.3.3 and provide an overview of the seals program. The overview will summarize the overall objectives and approach of the seals program. The interrelationships and sequencing of the primary activities of the program will be described.

8.3.3.2 Seal System Environment

This section will identify and describe the tests and analyses needed to establish the repository seal and backfill environments. The objective of these tests is to define the physical and chemical characteristics (e.g., ground-water chemistry, flow transport behavior) that influence the design and performance of the repository seals.

8.3.3.3 Seal System Components and Interaction Tests

This section will identify and describe planned seal system component tests, including component-environment interaction testing. Repository backfill tests and studies will also be identified and described in this section.

8.3.3.4 Seal System Design Optimization

This section will identify and describe seal system design optimization activities that will require site characterization data. Potential subjects include studies and tests to assist in design concept selection, development of design requirements, and studies to translate design requirements into specific design descriptions. Development tests to demonstrate feasibility of fabrication processes and to help verify the designs will be described.

8.3.3.5 Seal System Modeling

This section will describe planned modeling and code development studies associated with seal system development, utilization, verification, and validation, for those tests and studies requiring data from site characterization. Potential subjects include development of seal component and subsystem models, the use of these models to conduct performance, safety, and optimization analyses, and tests planned to help assess the validity of these models. Reference will be made to Subsection 8.3.5.2.2, as appropriate.

8.3.4 Waste Package Program

This section will summarize the waste package test program and provide an overview of the research and development, and engineering activities required to ensure that the waste packages are capable of satisfying applicable design and performance objectives. The current design basis and concepts are presented in Chapter 7 - WASTE PACKAGE.

Discussions in Subsections 8.3.4.2 through 8.3.4.5 of the planned studies and tests will explain:

- Why the test, study, or analysis is planned and what data or information will be obtained
- How the results will be used to help resolve specific information needs
- What methods, techniques, and data analysis will be used,
- Limitations and uncertainties of test methods and data analysis
- Representativeness, precision, and accuracy of proposed test methods and data analysis,
- Significant options or alternative test methods and data analyses to those proposed.

This section will discuss plans with regard to in-situ testing of waste packages. The discussion of in-situ tests will include:

- A description of tests that might use radioactive materials
- A description of tests that might affect the capability of the ~~site~~ natural barriers to isolate waste
- A summary of instrumentation and monitoring.

If no such tests are planned, Chapter 8 will explain why these tests are unnecessary in order to provide sufficient data for licensing. If the final decision on such tests will depend on results of preceding tests, the SCP will describe the logical steps which lead to the decision.

8.3.4.1 Overview

This section will state the purpose of Section 8.3.4 and provide an overview of the waste package program. The overview will summarize the overall objectives and approach of the waste package program. The interrelationships and sequencing of the primary activities of the program will be described.

8.3.4.2 Waste Package Environment

This section will identify and describe the tests and analyses needed to establish the waste package emplacement environment. The objective of these

tests is to define the physical and chemical characteristics (e.g., ground-water chemistry, flow and transport behavior) which influence the performance of the waste package.

8.3.4.3 Waste Package Components and Interaction Testing

This section will identify and describe planned waste package component tests, including component-environment interaction testing. Potential characterization or testing activities might include waste form, ~~canister,~~ container, packing material, and waste-barrier-rock interactions.

DELETE

8.3.4.4 Waste Package Design Development

This section will identify and describe planned waste package design development activities. Potential subjects include engineering studies to assist in design concept selection and alternate design definition, development of design requirements, waste package studies to translate design requirements into specific design descriptions, and development tests to demonstrate feasibility, including fabrication processes, and to help verify the designs.

8.3.4.5 Waste Package Modeling

This section will identify and describe planned areas of study associated with waste package model development, utilization, and verification and validation. Potential subjects include development of waste package component and subsystem models; the use of these models to conduct performance, safety, optimization, and economic analyses; and tests planned to help assess the validity of these models. Reference will be made to Subsection 8.3.5.2.1, as appropriate.

8.3.5 Performance Assessment Program Plan

This section will summarize the performance assessment strategy described in the Performance Assessment Plan and describe the licensing assessment strategy, as appropriate. Performance assessment is the process of quantitatively evaluating component, subsystem, and system behavior relating to containment and isolation of radioactive wastes to support the development of a high-level waste repository and to determine compliance with applicable regulations.

Performance assessment is one part of licensing assessment strategy. Licensing assessment also includes semi-quantitative and qualitative assessments that will address the non-numerical requirements and criteria and will provide input to quantitative assessments.

The performance assessment program provides plans for:

- Preclosure safety assessment (10 CFR 20)
- Engineered barrier performance assessment *
- Shaft/ramp seals and borehole seals performance assessments *

* It is recognized that seals are included as sub parts of Engineered Barriers in OGR/B-2.

Natural barriers

- ~~Site~~ performance assessment

- Demonstration of compliance with the EPA standard (40 CFR 191) and NRC preclosure and postclosure performance objectives and criteria (10 CFR 60).

8.3.5.1 Strategy for Preclosure Performance Assessment

This section will describe the safety analyses that will be performed during each phase of repository design. It describes an iterative approach in which the level of detail and the techniques will be governed by the complexity and detail available at each iteration. These safety analyses will follow the design through each major phase. Performance assessments during the design stages will focus on identification and qualitative descriptions of radiological safety hazards. Detailed design phases will rely on quantitative techniques. To the extent possible, standard codes and other safety-analysis methods will be used. Topics to be discussed include:

- System criteria
- System description
- Characterization of events, conditions, and accidents
- Characterization of normal operations hazards
- Selection and characterization of accident scenarios
- Preclosure performance assessment, including consequence analysis and sensitivity studies
- Recommendation of preventive and mitigative measures
- Preclosure performance assessment schedule and interfaces, including preliminary safety analysis, design support, upgraded design, safety assessment, and preclosure license application input.

8.3.5.2 Strategy for Postclosure Performance Assessment

This section will discuss the strategy for assessing the long-term behavior of the ~~repository~~ waste disposal postclosure system and its major subsystems. The approach will be to describe the performance goals* for the system and subsystems and provide the plans for meeting these goals with reasonable assurance. These assessments will be performed on the overall ~~repository~~ waste disposal postclosure system and the following three subsystems:

- The engineered barriers
- The shaft/ramp seals and borehole seals
- ~~The site.~~ The natural barriers.

* Preliminary performance goals will be provided in the SCP.

8.3.5.2.1 Plans for Assigning and Assessing Engineered Barrier Subsystem and Component Performance Goals

This section will describe elements of the approach which include:

- Describing the role of performance assessment in defining the data and information needs and reviewing tests to ensure adequacy of data and information
- Setting tentative performance/design goals for individual components in the reference design
- Developing site and design specific scenarios (processes and events) which need to be accounted for in assessing the performance of the engineered barriers system components. (Data will include ~~repository~~ design material data and site specific information) MGDS
- Developing a conceptual model of the engineered barrier subsystem
- Developing numerical codes based on the conceptual models
- Conducting performance assessments including sensitivity and uncertainty analyses using reference codes and data to determine if design goals are met
- Reallocating performance/design goals as necessary, and/or recommending design changes and/or additional tests to reduce uncertainties where necessary
- Making decisions on final design and evaluating the contribution of the individual components to the overall performance of that design
- Recommending confirmatory tests and monitoring as required.

8.3.5.2.2 Plans for Assigning and Assessing Seal Systems Performance Goals

This section will describe elements of the approach which include:

- Defining data and information needs and reviewing tests to ensure adequacy of data and information
- Setting tentative performance goals for the seals

- Developing site-and seal-specific scenarios (processes and events) which need to be included in assessments of seal performance. (Data will include seal design and materials information and site specific information)

- Developing a conceptual model of the seal systems

- Developing numerical codes based on the conceptual models

- Conducting performance assessments, including sensitivity and uncertainty analyses to determine if seal design goals are met

- Reallocating performance design goals and/or recommending design changes and/or additional testing to reduce uncertainties where necessary

- Making decisions on final seal system design and determining their performance for the license application

- Recommending confirmatory tests and monitoring as required.

8.3.5.2.3 Plans for Assessing the Contribution of ~~Site~~ Natural Barrier Characteristics to ~~Site~~ Subsystem Performance

This section will discuss the elements used in assessing the performance of individual site characteristics in ~~site~~ natural barrier subsystem performance. These elements include:

- Developing ~~site~~ natual barrier subsystem performance goals that will support the higher level findings of compliance required by Appendix IV of 10 CFR 960, for those siting guidelines requiring site chracterization.

- Establishing a baseline set of conditions for each of the site regulatory criteria specified in 10 CFR 60

- Defining scenarios for ~~site~~ natural barrier subsystem performance, including both expected and disruptive events

- Describing the role of performance assessment in the data and information needs and reviewing tests to ensure the adequacy of data and information for performance assessments

- Developing a conceptual model of the ~~site~~ natural barrier subsystem

- Developing numerical codes based on the conceptual models

- Conducting performance assessment sensitivity studies, and uncertainty analyses of the system based upon the ~~site~~ natural barrie and engineered system conceptual models, and making preliminary determination of the reliability of the performance assessment

- Making final determination of site suitability.

8.3.5.2.4 Plans for Assessing System Performance

- Establishing a description of the waste disposal postclosure system for performance assessments
- Describing the role of performance assessment in defining the data and information needs
- Establishing individual radionuclide release limits as the system performance goals based on 40 CFR 191
- Developing system release scenarios for expected and disruptive events
- Developing a conceptual model for the overall system
- Developing a system code or codes based on the conceptual model
- Conducting performance assessments and sensitivity and uncertainty analyses to determine if the system goals are met
- Recommending design changes and/or additional testing to reduce or accommodate uncertainties where necessary.

8.3.5.3 Plans for Demonstrating Compliance with EPA Standards, NRC Preclosure and Postclosure Performance Objectives, and DOE Siting Guidelines

This section will explain, using text and schematic diagrams, how the tools described in Subsections 8.3.5.1 through 8.3.5.3 will be used to demonstrate compliance with EPA standards, NRC performance objectives for the release rate and lifetime of the waste package, operational safety and retrievability objectives, and DOE siting guidelines.

8.3.5.4 Substantially Completed Analytical Techniques

This section will present, in the text and in a matrix chart, a description of those performance assessment techniques, including simplifying assumptions, limitations, and boundary conditions, for which development work is substantially completed, with particular emphasis on identification of the types and quality of data needed and on the plans for documentation, verification, and validation of performance assessments during or after site characterization. In the description, specific sections from other documents, such as user manuals and code documentations, may be incorporated by reference provided these documents are either publicly available or, if proprietary, are readily available to the NRC.

8.3.5.5 Analytical Techniques Requiring Significant Development

This section will present, in the text and in a matrix chart, a description of those analytical techniques that are expected to be important for evaluating the performance of the site but that still require significant additional developmental work at the time the SCP is prepared. Site-specific and generic models and computer codes will be included. The programs formulated for undertaking the developmental work during site characterization will be described, including plans for documentation, verification, and validation of models and codes.

8.6.4.1 Quality Assurance During Site Exploration

This section will describe and reference the quality assurance procedures that were applied to data gathering and other activities during site exploration. Descriptions of these procedures will be presented, such as peer reviews of published and unpublished data, and documents and references to standard data gathering techniques.

8.6.4.2 Quality Assurance During Site Characterization

This section will describe the items and activities important to safety or waste isolation to be controlled by the QA program and the basis for their selection. The graded QA approach for items and activities commensurate with their importance to safety and/or waste isolation will also be described.

8.6.4.3 Quality Assurance Applied to Repository and Waste Package Design

This section will describe the approach to quality assurance applied to the design of the repository and the waste package. This section will describe how the QA criteria III (Design Criteria) will be implemented in the design process.

8.6.5 Administrative QA Procedures

References to administrative QA procedures which will implement the site characterization QA program will be provided in this section.

8.6.6 Quality Assurance Plans and Procedures for Specific Program Areas

This section will outline the quality assurance procedures to be applied during site characterization. Since two of the 18 criteria of Appendix B have been previously covered, the remaining sixteen criteria will be discussed in this section. These include: design control; procurement document control; instructions, procedures, and drawings; document control; control of purchased materials, equipment, and services; identification and control of materials, parts, and components; control of processes; inspection; test and experiment control; control of measuring and test equipment; handling, storage, and shipping; inspection, test, and operating status; nonconformances; corrective action; quality assurance records; and audits. Reference will be made to detailed descriptions of the QA procedures that will be used in specific program technical areas. Although all test plans and procedures will not be completed at the time of submittal of the SCP, those that are completed will be referenced and available for QA review.

8.7 DECONTAMINATION AND DECOMMISSIONING

This section will provide plans for decontamination and decommissioning of the candidate site and for the mitigation of any significant adverse environmental impacts caused by site characterization activities if the site is determined to be unsuitable for a license application for a ~~repository~~ MGDS.

ATTACHMENT A

CORRELATION OF REGULATORY GUIDE 4.17

WITH THE ANNOTATED OUTLINE

The Annotated Outline for Site Characterization Plans (AO) was prepared by the DOE with the intent of addressing all of the material contained in NRC Regulatory Guide 4.17: "Standard Format and Content of Site Characterization Plans for High-Level-Waste Geologic Repositories" (Proposed Revision 1 dated September 1984). This attachment correlates the information requested in each section of Regulatory Guide 4.17 with corresponding sections of the AO where that information has been addressed.

The format of Regulatory Guide 4.17 and the format of the AO are essentially the same. The AO presents background material referred to as "Introduction to the Annotated Outline" which is similar to the "Introduction" of Regulatory Guide 4.17. This background material provides general information about site characterization and the SCP, and does not represent any specific section that will be written in the SCP. In this background material presented in the AO, the text of Regulatory Guide 4.17 is generally used verbatim; notable exceptions are listed in Table 1.

The AO calls for an introductory chapter in the SCP referred to as "Introduction," which provides a description of the purpose and scope of the SCP, relevant program history, requirements of the Nuclear Waste Policy Act for the program, and the organization of the SCP. This introductory chapter, while not requested by Regulatory Guide 4.17, is considered important material to include in the SCP.

For Chapters 1 through 8, there is a one-to-one correspondence between Regulatory Guide 4.17 and the AO. Tables 2 through 9 provide a correlation of Regulatory Guide 4.17 with the AO for the contents of Chapters 1 through 8, respectively. In the left hand column, a list of the section and subsection titles for each chapter in Regulatory Guide 4.17 is presented. In the middle column, the section or subsection of the AO that addresses the information requested in the Regulatory Guide section or subsection is indicated. In the right hand column, an explanation and rationale for differences between Regulatory Guide 4.17 and the AO is provided. For some sections or subsections of Regulatory Guide 4.17, the requested information is provided in more than one section or subsection of the AO. In such cases, individual topics are listed in the left hand column and the location in the AO where the topics are addressed is indicated in the middle column.

The AO uses the nomenclature and system structure from "Generic Requirements for a Mined Geologic Disposal System" (OGR/B-2) and Office of Geologic Repositories Work Breakdown Structure and Dictionary-Development and Evaluation Plase" (OGR/B-4). In some cases the nomenclature and or its meaning will differ in detail from Regulatory Guide 4.17. Consult OGR/B-2 and/or OGR/B-4 for the intended definition.

Table 7

Correlation of Chapter 6 of Regulatory Guide 4.17 with the Annotated Outline

Section of Regulatory Guide 4.17	Analogous Section of Annotated Outline for SCP	Explanation and Rationale for Differences Between Regulatory Guide 4.17 and the Annotated Outline
6. CONCEPTUAL DESIGN OF A REPOSITORY	6. CONCEPTUAL DESIGN OF A REPOSITORY (MINED GEOLOGIC DISPOSAL SYSTEM)	Same. MGDS subsituted for REPOSITORY to clarify meaning in accordance with OGR/B-2.
	6.0 Introduction	This section has been added to provide a general discussion of the information contained in the chapter and to explain the role of that information in the site characterization program.
	6.1 Design Basis	The organization of R.G. 4.17 did not easily allow for presentation of all the relevant design information, nor did it allow easiest presentation of a logical design description. An approach has been used in the AO which provides all of the information requested by R.G. 4.17 in a single section of Chapter 6 and the additional information necessary to present design information. To accomplish this two sections, 6.1 Design Basis, and 6.2 Current Repository Design Description have been added to provide the assumptions and rationale for the design basis and to describe the current design status. The requirements of Sections 6.1 through 6.7 of R.G. 4.17 are included as subsections of Section 6.3 in the Annotated Outline, as indicated below. The information presented in Sections 6.1 and 6.2 will be referenced as appropriate in Section 6.3
MGDS	6.1.1 Repository Design Requirements	
	6.1.2 Reference Design Data Base	
	6.1.3 Analytical Tools for Geotechnical Design	
	6.1.4 Structures, Systems, and Components Important to Safety	
Engineered and Natural	6.1.5 Barriers Important to Waste Isolation	
MGDS	6.2 Current Repository Design Description	
	6.2.1 Background	
	6.2.2 Overall Facility Design	
	6.2.3 Repository Operations	
	6.2.4 Design of Surface Facilities	
	6.2.5 Shaft and Ramp Design	
	6.2.6 Subsurface Design	
	6.2.7 ~~Backfill of Underground~~ Repository Engineered Barriers Opening	
	6.2.8 Shaft and Borehole Seals	

Editorial conventions used in Section titles of the AO:

1. titles that are underlined (e.g., 1.1.1 Physiography) indicate that the title in the AO is changed from that in R.G. 4.17 or that the title is of a Section not specifically requested by R.G. 4.17.
2. titles in brackets (e.g., [1.1 Geomorphology]) indicate that the information requested by R.G. 4.17 is relocated to the bracketed Section in the AO.

Table 7 (continued)

Correlation of Chapter 6 of Regulatory Guide 4.17 with the Annotated Outline

Section of Regulatory Guide 4.17	Analogous Section of Annotated Outline for SCP	Explanation and Rationale for Differences Between Regulatory Guide 4.17 and the Annotated Outline
	6.3 Assessment of Design Information Needs	
	6.3.1 Introduction	This section has been added in order to provide a general discussion of the contents of the section.
6.1 Design of Underground Openings	6.3.2 Design of Underground Openings	Same.
6.2 Backfill	6.3.3 Backfill	Same.
6.3 Strength of Rock Mass	6.3.4 Strength of Rock Mass	Same.
6.4 Sealing of Shafts, Boreholes, and Underground Openings	6.3.5 Sealing of Shafts, Boreholes, and Underground Openings	Same.
6.5 Construction	6.3.6 Construction	Same.
6.6 Design of Surface Facilities	6.3.7 Design of Surface Facilities	Same.
6.7 Repository System Component Performance Requirements	MGDS 6.3.8 ~~Repository System~~ Component Performance Requirements	Same.
	6.4 Summary of Design Issues and Data Needs	This section has been added to summarize design issues and data needs, and to provide a link between Chapter 6 and the plans presented in Chapter 8.

Editorial conventions used in Section titles of the AO:

1. titles that are underlined (e.g., 1.1.1 Physiography) indicate that the title in the AO is changed from that in R.G. 4.17 or that the title is of a Section not specifically requested by R.G. 4.17.
2. titles in brackets (e.g., [1.1 Geomorphology]) indicate that the information requested by R.G. 4.17 is relocated to the bracketed Section in the AO.